THE ECONOMICS OF
LAND DEGRADATION

Central Asia
Regional Report

Broadening land management options for improved economic sustainability across Central Asia: A synthesis of national studies

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About the ELD Initiative

The Economics of Land Degradation (ELD) Initiative is an international collaboration that provides a global assessment of the economics of land degradation, and highlights the benefits of sustainable land management. Working with a team of scientists, practitioners, policy-/decision-makers, and all interested stakeholders, the Initiative endeavours to provide a scientifically robust, politically relevant, and socio-economically considerate approach that is economically viable and rewarding. Ensuring the implementation of more sustainable land management is of critical importance considering the vast environmental and socio-economic challenges we are collectively facing – from food, water, and energy security and malnutrition, to climate change, a burgeoning global population, and reduction in biodiversity, ecosystems, and ecosystem services.

Understanding the cost of inaction and benefits of action are important in order for all stakeholders to be able to make sound, informed decisions about the amount and type of investments in land they make. Even though techniques for sustainable land management are known, many barriers remain and the financial and economic aspects are often put forward as primary obstacles. If the full value of land is not understood by all stakeholders, it may not be sustainable managed, leaving future generations with diminished choices and options to secure human and environmental well-being. A better understanding of the economic value of land will also help correct the imbalance that can occur between the financial value of land and its economic value. For instance, land speculation and land grabbing are often separated from the actual economic value that can be obtained from land and its provisioning services. This divergence is likely to widen as land scarcity increases and land becomes increasingly seen as a 'commodity'.

Economic values can provide a common language to help entities decide between alternative land uses, set up new markets related to environmental quality, and reach the goal of land degradation neutrality. It should also be noted that the resulting economic incentives must take place within an enabling environment that includes the removal of cultural, environmental, legal, social, and technical barriers, and also consider the need for equitable distribution of the benefits of land amongst all stakeholders. Though there is a wide variety of possible methods, valuations, and approaches that may be available or appropriate, the ELD Initiative promotes the use of the total economic value, achieved through cost-benefit analyses, as this can provide broad and cohesive understanding of the economics of land degradation. It is a method that is generally accepted by governments and others as a decision-making tool, and applying other tools may require a fundamental change existing systems.

Our Vision

The partners' vision of Economics of Land Degradation (ELD) Initiative is to transform global understanding of the value of land and create awareness of the economic case for sustainable land management that prevents loss of natural capital, secures livelihoods, preserves ecosystem services, combats climate change, and addresses food, energy, and water security, and to create capacity for the utilisation of economic information for sustainable land management.

Mission Statement

The central purpose and role of the ELD Initiative is that through an open inter-disciplinary partnership:

- We work on the basis of a holistic framework built upon a recognized methodology to include the economic benefits of sustainable land management in political decision-making;
- We build a compelling economic case for the benefits derived from sustainable land

management from the local to the global level while applying a multi-level approach;

- We estimate quantitatively the economic benefits derived from adopting sustainable land management practices and compare them to the costs of these practices;
- We develop the capacities of decision-makers and land users through innovative formats to adapt and build their knowledge into national frameworks and action on the ground;
- We stimulate the transformation towards land uses that provide fulfilling and secure livelihoods to all while growing natural capital, enhancing ecosystem services, boosting resilience and combating climate change;
- We increase the awareness of the total value of land with its related ecosystem services;
- We mainstream the full benefits of land in international and national land use strategies and action programmes by proposing effective solutions, tailored to country- or region-specific needs, including policies, and activities to reduce land degradation, mitigate climate change and the loss of biodiversity, and deliver food, energy, and water security worldwide.

Acronyms and abbreviations

BEAF	Advisory Service on Agricultural Research for Development
CACILM	Central Asian Countries Initiative for Land Management
CAMP4CA	World Bank Climate Adaptation & Mitigation program for Central Asia
CAREC	Regional Environmental Centre for Central Asia
ECFS	Eurasian Center for Food Security
ELD	Economics of Land Degradation
GIS	Geographical information system
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
ICARDA	International Center for Agricultural Research in the Dry Areas
ICRAF	World Agroforestry Centre
IRR	Internal rate of return
km	kilometre
m	metre
mm	millimetre
NPP	Net primary productivity
UNCCD	United Nations Convention to Combat Desertification
UNEP	United Nations Environment Programme
USD	United States dollar

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Chapter 6

Executive summary

Land degradation is a pressing concern that reaches across all republics of Central Asia and is increasingly affecting the economy and quality of life in each. The resulting loss of arable land particularly affects the rural poor, who depend directly on what the land can provide for their very survival and livelihoods. The breakup of the Soviet Union led to mass de-collectivisation of agricultural frameworks across Central Asia, with formerly centralised land management regimes dissolved. The reorganisation of boundaries and priorities quickly led to a conversion of natural landscapes and traditional fallows to agricultural and industrial landscapes dominated by monocrops, water mismanagement, and a net rise in livestock that now graze in the same pastures year-round, rather than traditional nomadic pastoralism on seasonal pastures. Induced by the establishment of land management planning that understandably focused on economic growth but lacked long-term, sustainable strategies, the land is now becoming dangerously impoverished under ever-growing demands.

Of the nearly 400 million hectares in the region, two-thirds are drylands with extreme biophysical constraints of arid and continental climates, vulnerable to even the slightest pressures beyond their capacity and which in turn affect local populations significantly. Each country faces unique challenges related to their landscape and agricultural demands, but across the board there are widespread losses of fertile topsoil and nutrients necessary for growth, declining productivity of crops and pastures, losses of biodiversity and habitats, increasing salinisation and deforestation, and increasing weed infestation in rangelands. Estimates are imprecise due to a lack of research to date, but degradation is observed to be extensive, ranging from 4-10 per cent of cropped land, 27-68 per cent of pasture land and 1-8 per cent of forested land, in total representing *40-100 per cent of land degraded in each country.* In Kazakhstan, 48 million hectares of land are now degraded due to land conversions, and in Kyrgyzstan over 30 per cent of all highland pastures are degraded. Tajikistan saw an estimated loss in GDP of 7.8 per cent (USD 5.6 billion) in 2010 as a direct result of land degradation. In Turkmenistan, 70 per cent of all pasture lands are degraded and in Uzbekistan, over half of the irrigated landscapes suffer from salinisation due to improper management.

This is a growing issue in need of addressing, with immediate action at governmental levels to establish long-term sustainable land management strategies for the well-being of their economy and people. Part of these strategies necessarily includes understanding the biophysical aspect – the science – behind land use changes. However, for decision-makers, there is also a need to understand the economic outcomes of land management planning, in order to make choices that optimally reflect the most beneficial scenario both economically and environmentally. It is on this basis that in 2015, the Economics of Land Degradation (ELD) Initiative supported the development of a regional Central Asia study, with case studies in each country in identified ecosystems. National-level researchers from Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan were supported in the undertaking of cost-benefit analyses for current land management scenarios, as well as feasible alternative scenarios that integrated sustainable land management, to determine economically viable choices for sustainable land management planning. Specific ecosystems were selected to cover a range of landscapes across the region, so that the countries could engage in knowledge exchange and sharing of best practices, including high mountain pastures (Kyrgyzstan), foothill pastures (Tajikistan), forests (Kazakhstan), lowland pastures (Turkmenistan), and irrigated agriculture (Uzbekistan).

These analyses moved beyond the market value for crops that normally act as an indicator for land value. They included a range of ecosystem services benefits, from carbon storage and sequestration to nutrient provision and cycling, which fall into four categories as part of an attempt to measure total economic value of land. While not valued directly

in market prices, these values (and the loss of them) do eventually factor into future economic losses or benefits, depending on their maintenance and use. For example, in Kyrgyzstan, there are net benefits when carbon value is considered explicitly, but the current economic incentives for land managers do not encourage this. In Tajikistan, increasing agricultural productivity leads to improved livelihoods, while incurring only minor economic losses from managing pasture lands in a way that prevents emergency situations.

Total economic valuation is becoming increasingly used in international arenas to enhance understandings of the benefits of land and land-based ecosystems. They factor into international agreements and binding UN conventions, and can help countries meet targets such as those outlined in the UN Sustainable Development Goals, ratified in New York in 2015, particularly Goal 15: *Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.*

These cost-benefit analyses also help identify how to share benefits so that land users like farmers and herders who can directly support sustainable land management and thus create economic benefits, can reap rewards that are otherwise distributed throughout the rest of society. For instance, efforts to reduce deforestation can contribute directly to carbon sequestration and thus play a role in mitigating climate change – benefits which do not necessarily accrue directly to farmers, and of which other members of society benefit from. Rewarding sustainable land management practices through the provision of these economic incentives is a powerful tool in establishing sustainable land management, which is sorely needed in light of the severe degradation and subsequent economic and environmental losses faced across the Central Asian republics.

This regional report presents the findings of all five country-level research reports, following the outline of the ELD Initiative's 6+1 step approach. Unique characteristics and findings from each country, alongside shared challenges and concerns uncovered throughout the project are put forward. Finally, the report concludes with a summary of recommendations borne out of the research, and intended to support policy-/decision-makers in developing informed policies for sustainable land management.

Beyond understanding the economic drivers of sustainable land management, these decisions will also need to address the lack of data, research support, and institutional capacity, lack of inter-sectoral coordination and regional cooperation at the political level, as well as the need to empower the ministries responsible for land use management, which currently lack the necessary power and influence. In doing so, the Central Asian republics can root their future in the sustainable productivity of their shared landscapes, stabilise food, water, and energy security, and move towards an enhanced future for the health of their people, economy, and environment.

01 Introduction

Introduction

Independence from the former Soviet Union in 1991 presented the republics of Central Asia, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan, with severe challenges for land management and ensuing economic, social, and environmental crises. Driven by the historic development of irrigation projects, largely unsupportable increases in livestock numbers, and agricultural land conversion, there has been a general detrimental effect on the state and value of the land in the region.

Of the 399.4 million hectares in Central Asia, about two-thirds are drylands with extreme biophysical constraints of arid and continental climates. These have extremely cold winters and hot dry summers, and are well described in the literature[1,2,3,4]. Rangelands dominate the land area, with 8 per cent arable land and 4 per cent forest (*Figure 1*). Land cover reflects rainfall patterns, with 150 mm or less in the southwestern deserts of Turkmenistan and Uzbekistan, increasing up to 400 mm over the northern plains of Kazakhstan, and up to 800 mm in mountainous regions in easterly Kazakhstan, Tajikistan, and Kyrgyzstan, where sparse forests exist.

Although estimates vary and are imprecise, land degradation is claimed to be extensive, ranging from 4-10 per cent of cropped land, 27-68 per cent of pasture land and 1-8 per cent of forested land. In total this represents 40-100 per cent of area degraded across each country[4]. Salinisation of irrigated lands, water and wind soil erosion in rainfed and sloping lands, overgrazing, and vegetation changes in rangelands are considered the main forms of land degradation[2]. Much of the land degradation has human causes; through

FIGURE 1

Land cover map of Central Asia

Source: Celis et al. (2007)[5]

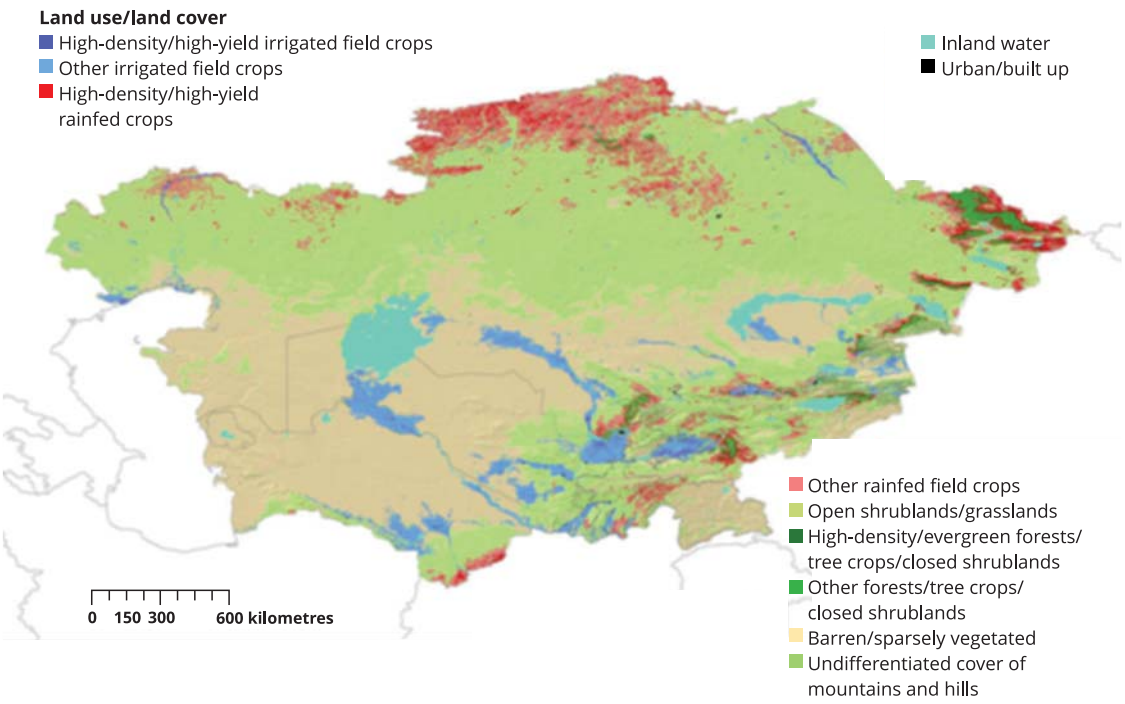


FIGURE 2

Hot spots of land degradation in Central Asia

Source: Mirzabaev et al. (2016)[3]

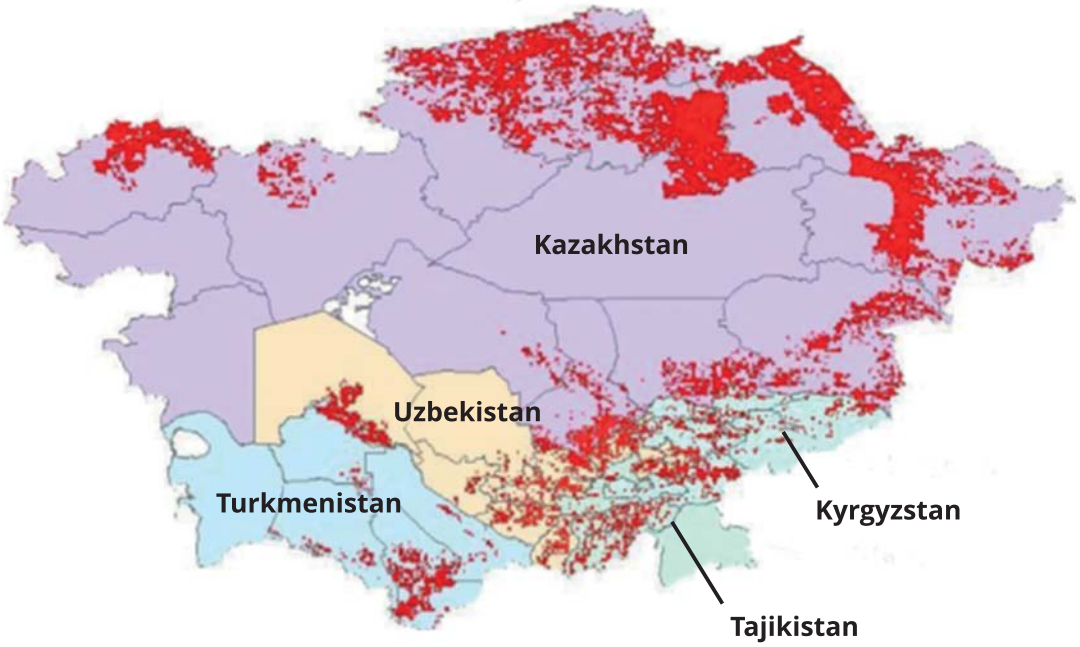
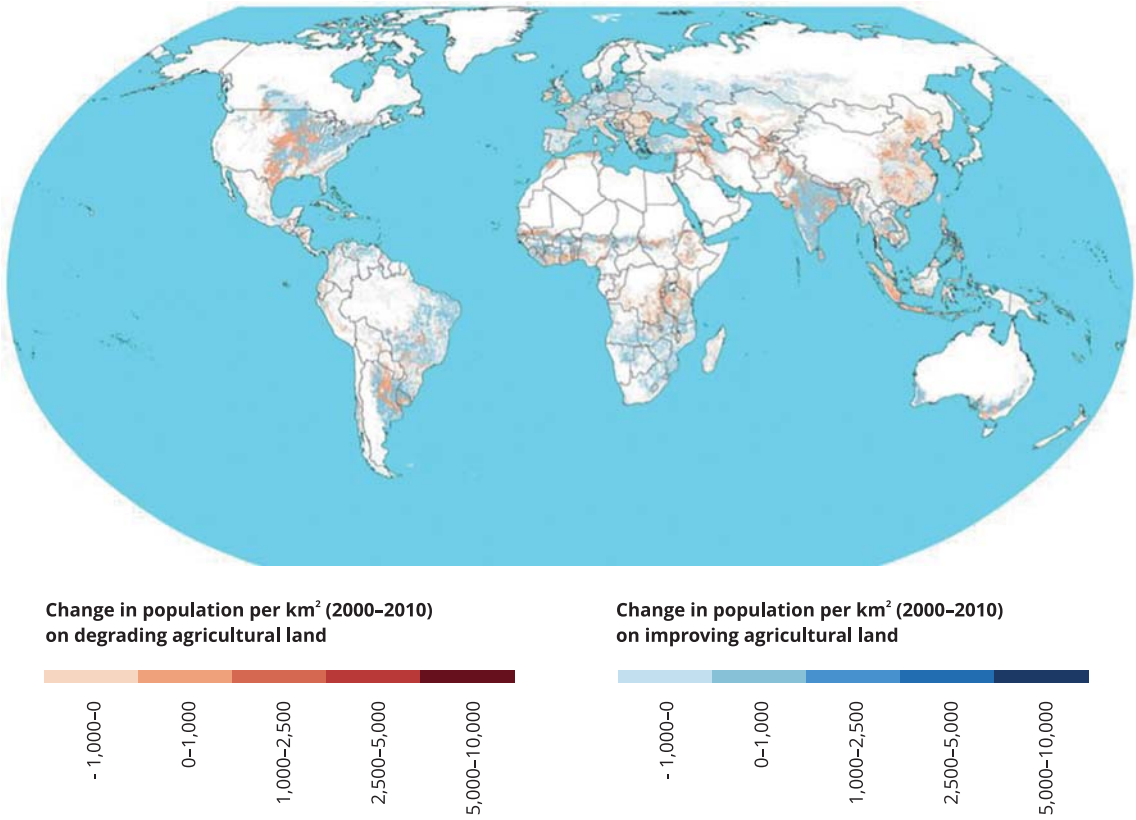


FIGURE 3

Global change in population per km^2 on degrading and improving agricultural land, 2000–2010

Source: Barbier and Hochard (2016)[7]



Range approximate. Degrading max: 9,374, min: -808. Improving max: 8,957, min: -606

Degrading agricultural land consists of agricultural land with negative changes in Net Primary Productivity (NPP), from 1981–2000. Climate-adjusted NPP is measured as change in grams of carbon sequestered per m^3 from 1981–2000 after subtracting respiration losses. Improving agricultural land has non-negative changes in NPP.

unsustainable cropping practices, overgrazing of pastures, expansion of agriculture onto marginal lands, deforestation, and inefficient use of water for irrigation. *Figure 2* shows estimated 'hot spots' of degradation as determined by changes in Normalized Difference Vegetation Index between 1981 and 2003 in the region[3,6]. *Figure 3* shows changes in population density in degrading as well as improving agricultural areas, and it is noticeable that Central Asia displays decreasing population densities in both areas. More worryingly, there are distinct degrading agricultural areas where population densities have increased acutely[7].

These growing rural populations expect better livelihoods, income options, and stable and healthy food supplies. With strenuous circumstances and a failure to meet these demands, there is civil unrest and outward migrations of people seeking relief from the burdens of survival. Securing the land for sustainable long term agriculture and forestry use is therefore high on the political agendas of the region. An extensive overview of the historical perspectives of land use in Central Asia is found in Robinson (2016)[4]; however, several issues remain to be addressed. Employees of former state-run collective farms have had to become farmers yet

lack knowledge, skills, and capital. Governments have failed to maintain and improve agricultural infrastructure and continue with policies and laws that hold back transitioning towards more sustainable land management practices, including price and trade controls. Water resources also continue to be used inefficiently, resulting in serious salinisation problems and associated socioeconomic problems[8].

Sustainable land management technologies for agriculture are well known and include conservation agriculture on irrigated and rainfed cropland, crop diversification, crop rotations, crop breeding for heat, cold, drought, salinity, and pest and disease resistance, integrated water management focusing on efficient rainwater and irrigation water management, integrated tree-crop-livestock, and rangeland management options and livestock production[2]. Pilot testing of these options has been successful in research for development programs and projects such as CACILM – the Central Asian Countries Initiative for Land Management – which started in 2005[9]. However, "the success of efforts by governments, donors, investors and civil society to address sustainable land management will depend on the identification and promotion of feasible and profitable agricultural and land management options that are suited to the different agro-ecological environments and farming systems in Central Asia"[2]. The scaling up and out of sustainable land management options has rarely occurred because of barriers that include knowledge exchange, financial, policy, and institutional constraints.

On this basis, the Economics of Land Degradation Initiative (*www.eld-initiative.org*) undertook five country-level studies, summarised in this regional-level report, that attempts to demonstrate the added benefits of sustainable land management beyond the economics of agricultural production towards other relevant economic activities. Using the methodology developed by the ELD Initiative[10,11,12], the project valued current land use strategies and feasible alternatives in economic terms to promote sustainable land management in line with national development goals and international targets such as the Sustainable Development Goals. This knowledge and information can be an input into decisions made on land use by public and private decision-makers.

This report summarises the findings from each country alongside the '6+1 steps' of the ELD approach, and synthesises country-specific recommendations for policy-/decision-makers in Central Asia on improved land use to create greater economic, social, and environmental benefits.

02 Regional overview

Terrain level trends

In Central Asia, land degradation widely affects rural populations who are the most vulnerable to poverty and unemployment; these communities directly depend on what is provided by the land for their survival. Agriculture remains the main sources of income for the rural population considered in the case studies, including animal husbandry (Kazakhstan, Kyrgyzstan, Turkmenistan, and to a smaller extent Tajikistan and Uzbekistan), forest products (Kyrgyzstan), small-scale agriculture (Kazakhstan, Tajikistan) and fibres (Tajikistan, Uzbekistan). The common denominator amongst the studies is on-going land degradation, the pace of which varies with altitude, type of ecosystem, and land use. Degradation takes different forms (erosion, salinisation, reduced yields, soil nutrient depletion, etc.) with economic consequences varying between countries and land users. It also affects the provision of ecosystem services like fodder or nutrients, which are crucial for local agricultural production and livelihoods. National studies and other reports show that ecosystem services have already been severely depleted in the region.

In **Kazakhstan**, widespread conversions of natural steppe and fallow land to agricultural and industrial use since the 1950s, as well as high pressure on conifer and sauxal forests has led to reduced quality of forestry stock and land productivity, especially in desert areas around settlements and large towns[13]. Over 48 million hectares of land have become degraded, and up to 36 per cent of forests. This has resulted in as much as a 30-60 per cent decrease in soil fertility from wind and water erosion, as well as severe dust storms that have covered up to 9 million hectares some years.

Kyrgyzstan's highland pastures have suffered severe land degradation after practices for pasture rotation implemented under the Soviet Union were abandoned, and because of degrading infrastructure reducing support to migratory pastoralism. Thirty per cent of pastures are already degraded[14] and further increase in (over) exploitation of pasture lands, especially summer pastures, are likely to occur because of increased livestock production.

In **Tajikistan**, reduction of hay production and a rise in privately owned livestock while most pastures remain under state management has contributed to intense pressures on pasture lands[15]. Such increased pressures have resulted in 89 per cent of the summer pastures and 97 per cent of winter pastures suffering from medium to strong erosion as result of overgrazing[16]. A study by Bann *et al.* (2012)[16] in Tajikistan estimated annual losses of revenue from land degradation up to (USD 442 million) or 7.8 per cent of GDP in 2010 (USD 5.6 billion).

In **Turkmenistan**, 70 per cent of all pastures have various level of degradation, while more than 96 per cent irrigated areas of the country are subject to salinisation[17]. More than half of the desert pastures are affected by degradation, greatly reducing their productivity[18].

In **Uzbekistan**, inappropriate irrigation practices, including excessive watering, discharge of drainage water into desert depressions resulted in half of all irrigated areas being salinised (2.2 million hectares in 2007). In hotspots of degradation, the share of salinised lands reaches from 50 up to 100 per cent of all irrigated land.

Alongside numerous other issues that result from increasing land degradation, these national-level issues highlight a pressing need to improve sustainable land management and practices across the region. There are common concerns and demands which overlap, discussed next.

Shared challenges and opportunities

All five Central Asia republics share similar land management challenges as a result of region-wide increases in land degradation. Although there are cultural differences, they are united by a common Soviet heritage and land reforms following the end of the Soviet Union which are still reflected in current day land use and management practices. Contemporary common challenges must thus be seen in the context of the transition from a centrally planned land use and management scheme to a more decentralised, market-oriented system under rapidly changing environmental conditions. Additionally, land use, management, and degradation are also affected by an increasing degree of socio-economic, political, and environmental uncertainty[19]. The ecosystems, which have been the subject of the different

national studies, are spread across all five Central Asian republics. The presented results are thus relevant beyond the respective national focus.

The first challenge is related to **animal husbandry**. For centuries, husbandry in Central Asia has been characterised by seasonal mobility not only over considerable distances and altitudes but also across political borders. This was still common during the socialist era between the administrative units of the Soviet republics[20], even though the introduction of collective farming systems in the 1930s caused sedentarisation of nomads. On state farms, dependence on feed increased especially during winter months. The livestock populations of the Central Asian countries grew during this collective period but, in combination with expanded cultivation, led to rangeland and soil degradation[21]. The breakdown of the Soviet Union finally put an end to cross-border pastoralism and still limits the mobility of livestock between pastures to this day. This restriction of seasonal pastures results in overuse of pasture resources, especially those closer to human settlements, and severe damage for the transitional economies of the Central Asian countries[20]. Conflicts over land use and access to pastures and water also impact them ecologically, economically, socially, and politically.

Apart from livestock, there are further challenges in the fields of **forestry** and **irrigation**. Approximately 22 million people directly or indirectly rely on irrigated agriculture for their livelihoods, which is also part of the shared Soviet history with the Aral Sea being one of the most well-known examples of man-made ecological catastrophes[22]. Salinisation is one of the main forms of soil degradation, variously affecting up to half of the region's irrigated lands[23]. Technical solutions are available to mitigate the impact of salt-induced land degradation with associated economic benefits[8], but need to be complemented by policy level interventions and interstate cooperation in the area of the Aral Sea basin to stop salt-affected soil and water resources from posing an environmental and productivity constraint[22].

Governance and **management of common natural resources** in the region is impaired by a lack of inter-sectoral coordination and regional cooperation at the political level. Furthermore, ministries responsible for land use management are the least powerful and influential ones in each of the five countries. Urgently needed responses to address the issue of land degradation in consideration of the full trans-boundary dimension lack effective institutions and cooperation on national and regional levels. Knowledge exchange, common learning, and cooperation are rarely achieved, and thus boundaries remain amongst people in the countryside and in national policies between countries, as well as amongst different sectors and ministries.

Another common challenge is linked to regional **vulnerability to climate change**. Central Asia has become more vulnerable to climate change because of a dominant focus on monoculture agricultural exports, reinforced by a breakdown of social, economic, and institutional structures following independence[24]. A physical geography dominated by deserts and semi-deserts also increases vulnerability to climate change impacts, with regional projections predicting increasing aridity and thus vulnerability to land degradation. Limited access to energy supplies and high vulnerability to natural disasters further impacts land use and management practices. Chuluun and Ojima (2002)[21] state that the "nomadic land use system and ecosystems of Central Asia have co-adapted and co-evolved for the past several thousand years towards land use efficiency and sustainability. Short-term seasonal movements and long-term migrations have been the main land use strategies for people to deal with climate variability in this region." However, these are now in decline. The close interrelation of land use and vulnerability to climate change provides an opportunity for countries to work on common solutions to address these two issues of global interest – climate change and land degradation – at the same time and shape a profile of the region that makes it more visible in international discussions and processes.

Another common challenge is that in all Central Asian republics, a high share of the **population lives in rural areas** with economic activity closely linked to the agricultural sector. Lioubimtseva and Henebry (2009)[24] have observed growing economic inequality and a shortage of adequate living conditions in these areas compared to urban populations. Whereas some urban areas have shown an increasing quality of life, water, and health, in the most rural areas populations are

still poor, or even with deteriorating situations. As economic, social, and environmental equity is an enduring issue throughout these countries, it is important to ensure natural resources and the related ecosystem services which rural populations relies on are not further deteriorated in favor of short-term economic benefits.

Lioubimtseva and Henebry (2009)[24] also noted a **shortage of data** in regional land cover/land use maps and satellite data records, which is of uneven quality where it exists. Capacity building for scientific personnel as well as political and technical staff is an opportunity to improve circumstances for more informed decision-making, based on existing institutional structures. Collectively, these challenges represent a common ground for countries in the region to work together, increasing the efficiency and impact of action through exchange of relevant research as well as sharing best practices, and establishing transnational understandings.

03 Structural overview

Project partners

The series of five country reports and this regional synthesis report were commissioned by the Advisory Service on Agricultural Research for Development (BEAF) of the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH and the Korea Forest Service through the United Nations Convention to Combat Desertification (UNCCD), in partnership with the ELD Initiative Secretariat. The research was undertaken under the leadership of the CGIAR Research Program on Drylands Systems under the framework of the ELD Initiative and facilitated by the International Center for Agricultural Research in the Dry Areas (ICARDA). In each country, selected national consultants were responsible for data collection and analysis with one technical coordinator (Oleg Guchgeldiyev) with support from an environmental economist (Dr. Emmanuelle Quillérou, ELD Central Asia Scientific Support Consultant & IUT de Quimper, Univ. Brest). Additional financial support was provided by the Korea Forest Service through its links with the UNCDD.

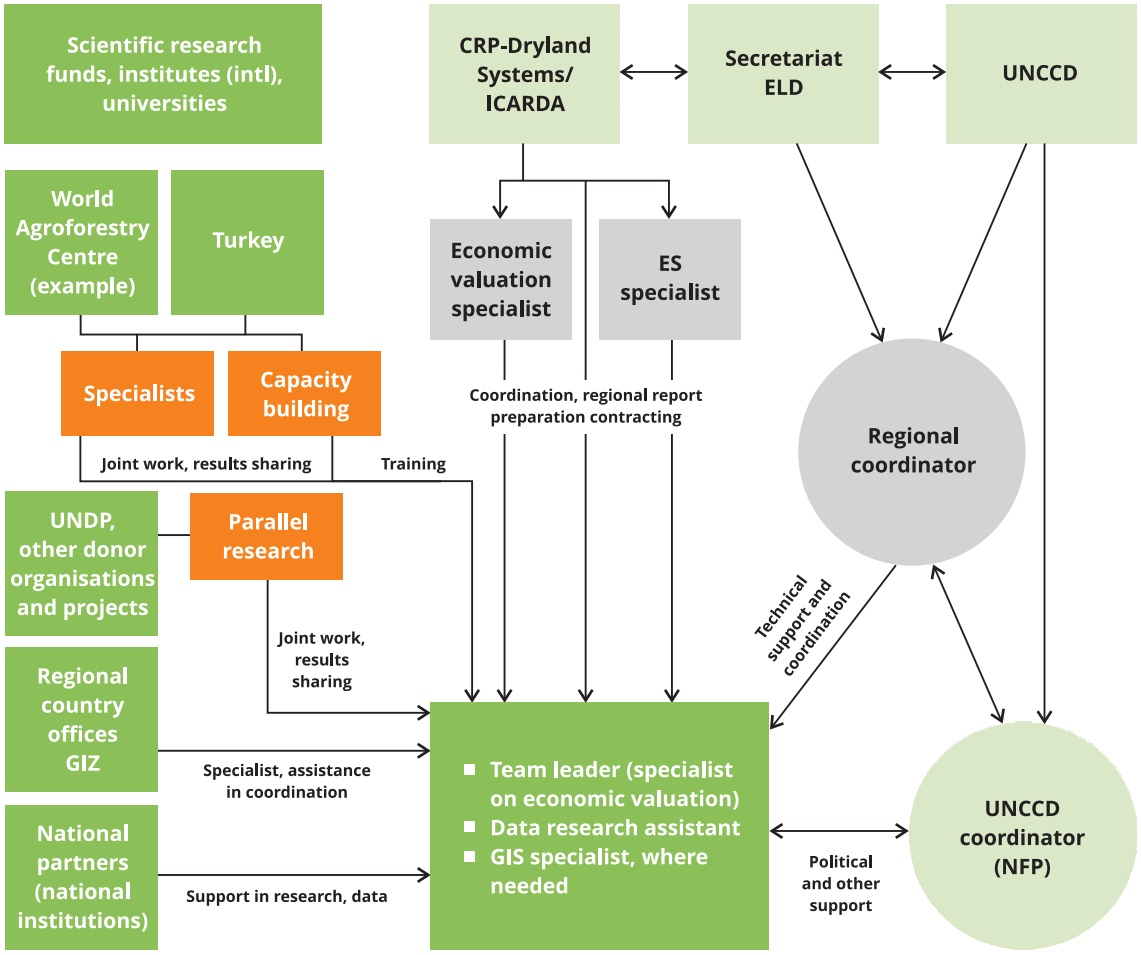
The project has worked in a collaborative way and has striven to combine forces on a scientific as well as an institutional front, through collaborative exchanges and partnership building. Convergence was sought and valued within the CGIAR system thanks to the nature of the Research Program on Drylands Systems that brings together eight CGIAR centres under a common umbrella. This has facilitated an additional study undertaken by a team at the World Agroforestery Centre (ICRAF) in Kazakhstan[25]. Scientific exchanges involved the Michael Succow Foundation, the American University of Central Asia, Uzbekistan Scientific Research Institute of Agricultural Economics, Faculty of Soil Science of Lomonosov Moscow State University (MSU), UNIQUE forestry and land use GmbH, and GIZ's Regional Programme for Sustainable and Climate Sensitive Land Use for Economic Development in Central Asia, amongst others.

The ELD Central Asia project has combined forces with a range of other organisations and initiatives such as the UNCCD Secretariat and the convention's national focal points, the Turkish government, Tajikistan environmental agency, Regional Environmental Centre for Central Asia (CAREC), and regional and national offices of GIZ. In addition to scientific exchanges and institutional partnerships, actors of the project have monitored other complementary initiatives such as research by the Center for Development Research (ZEF), Eurasian Center for Food Security (ECFS) and World Bank e-consultation Eurasia and the World Bank Climate Adaptation & Mitigation program for Central Asia (CAMP4CA).

A simplified representation of the project structure, collaborations, and partnerships is represented in *Figure 4*. Because of these partnerships and convergence of efforts, this report is mainly centred on the five country reports originally commissioned, but includes information from other parallel studies in the region.

FIGURE 4

Structure and partnerships of the ELD Central Asia project



Research approach and methodology

The main objectives of the project are to identify current losses incurred by unsustainable land management in economic terms and propose and analyse economically viable and feasible options for more sustainable use of land resources in Central Asia. The ELD Central Asia project conducted case studies, one in each of the republics: Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan. It is a follow up study with a broader scope than the one commissioned by United Nations Environment Programme (UNEP) in 2012 in Tajikistan[16].

Mirzabaev *et al.* (2016)[3] estimate the annual cost of land degradation in the region due to land use and cover change between 2001 and 2009 to be USD 5.85 billion (*Table 1*) most of which is due to rangeland degradation (USD 4.6 billion), followed by desertification (USD 0.8 billion), deforestation (USD 0.3 billion), and abandonment of croplands (USD 0.1 billion). Their study shows potential for economically justified investment into more sustainable land management with costs of action five times lower than costs of inaction on average in the region (*Table 2*). This research presented here goes beyond Mirzabaev *et al.* (2016)[3] by looking at a broader range of benefits stemming from action and comparing those benefits to both costs of action and costs of inaction.

TABLE 1

Costs of land degradation in Central Asia through land use and cover change only (i.e., without costs of land degradation from lower soil and land productivity within the same land use)

Source: Mirzabaev et al. (2016)[3]

Country	Annual cost of land degradation between 2001 and 2009, due to land use/cover change, in billion USD	Annual cost of land degradation per capita, in USD	GDP in 2009, in billion USD	Cost of land degradation as a share of GDP
Kazakhstan	3.06	1,782	115	3%
Kyrgyzstan	0.55	822	5	11%
Tajikistan	0.50	609	5	10%
Turkmenistan	0.87	1,083	20	4%
Uzbekistan	0.83	237	33	3%
Total	**5.85**	**769**	**178**	**3%**

TABLE 2

Costs of action vs. inaction in Central Asia, in billion USD

Source: Mirzabaev et al. (2016)[3]

	Annual total economic value for cost of land degradation (2009)	Annual provisional cost of land degradation (2009)	Cost of action (6 years)	Cost of action (30 years)	Cost of inaction (6 years)	Cost of inaction (30 years)	Ratio cost of inaction/ action
Kazakhstan	24	11	22	22	102	138	6
Kyrgyzstan	4	2	6	6	22	29	5
Tajikistan	4	2	4	4	17	24	6
Turkmenistan	7	3	10	10	35	48	5
Uzbekistan	7	3	11	11	36	49	5
Central Asia	**47**	**20**	**53**	**53**	**213**	**288**	**6**

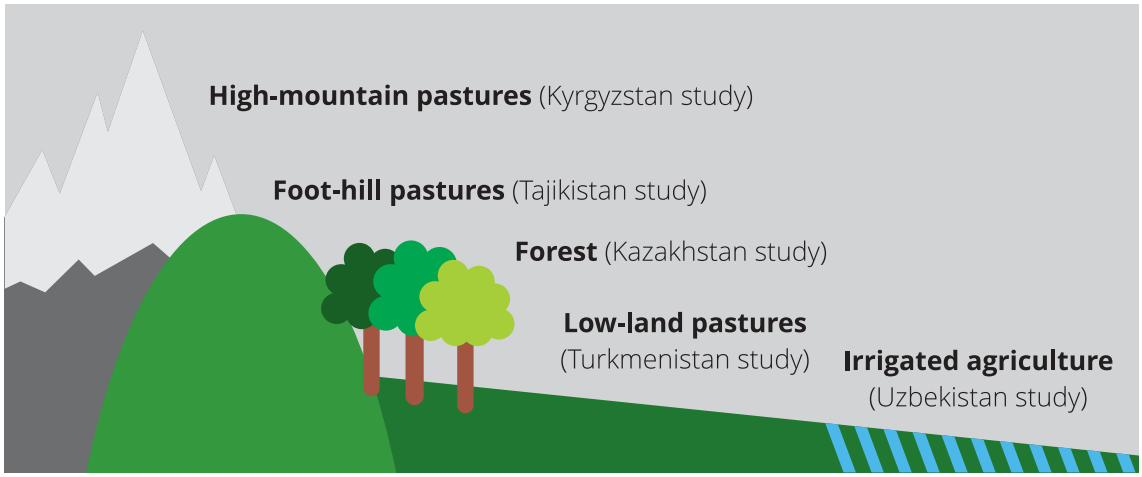
The approach taken for the ELD Central Asia project follows an altitudinal approach (*Figure 5*) proposed and agreed upon with country representatives at an inception meeting, held in Ashgabat on August 2-3, 2014. Specific zones for each country were chosen based on predominance and representativeness of the ecosystems both at the national and regional level (Turkmenistan), the economic importance for the country (Tajikistan, Uzbekistan) and existing or potential land degradation (Kazakhstan, Kyrgyzstan). This approach allowed for results to be applied and compared at national, cross-country, and regional perspectives. The altitudinal approach involved the following ecosystems:

- **Kazakhstan** has the largest forest area in the whole Central Asia region (by size) and represents all types of forests in the region, including Siberian forests in the north of the country. The group of national experts however decided to concentrate on desert forests for their importance in both ecosystem use and anthropogenic pressures, particularly saxaul.
- In **Kyrgyzstan**, migratory grazing was historically the main type of livestock management. However, summer (highland) pastures represent the largest share of pasture land in the country as well as the region. They are more accessible, and as a result are now overgrazed in all seasons, requiring attention to improve their management.
- In **Tajikistan**, the foothills and low mountains represent the largest type of pastures (by size) in the country; moreover, most economic and livelihood activities of the country's population take place there, making it an important area to research.
- In **Turkmenistan**, lowland pastures occupy the most of the territory, traditionally providing services to traditional rural communities. The recent ecosystem valuation study revealed that around 60 per cent of the value of ecosystem services comes from pastures[18].
- **Uzbekistan** has the largest area of irrigated land in the region, and consumes the largest share of available water as a result. Irrigated agriculture contributes between 20 to 30 per cent to countries' GDP, with the largest share of population (around 49 per cent) involved.

Because of the physical layout of the countries, these ecosystems tend to be found more prominently in one country than in the others. However, to discern a clear and complete picture of current land management in the region as well as possible future scenarios for sustainable land management, the five national case studies are pieced together in this report in an attempt to bridge national thinking and enhance regional cooperation to manage natural resources, particularly those that are shared.

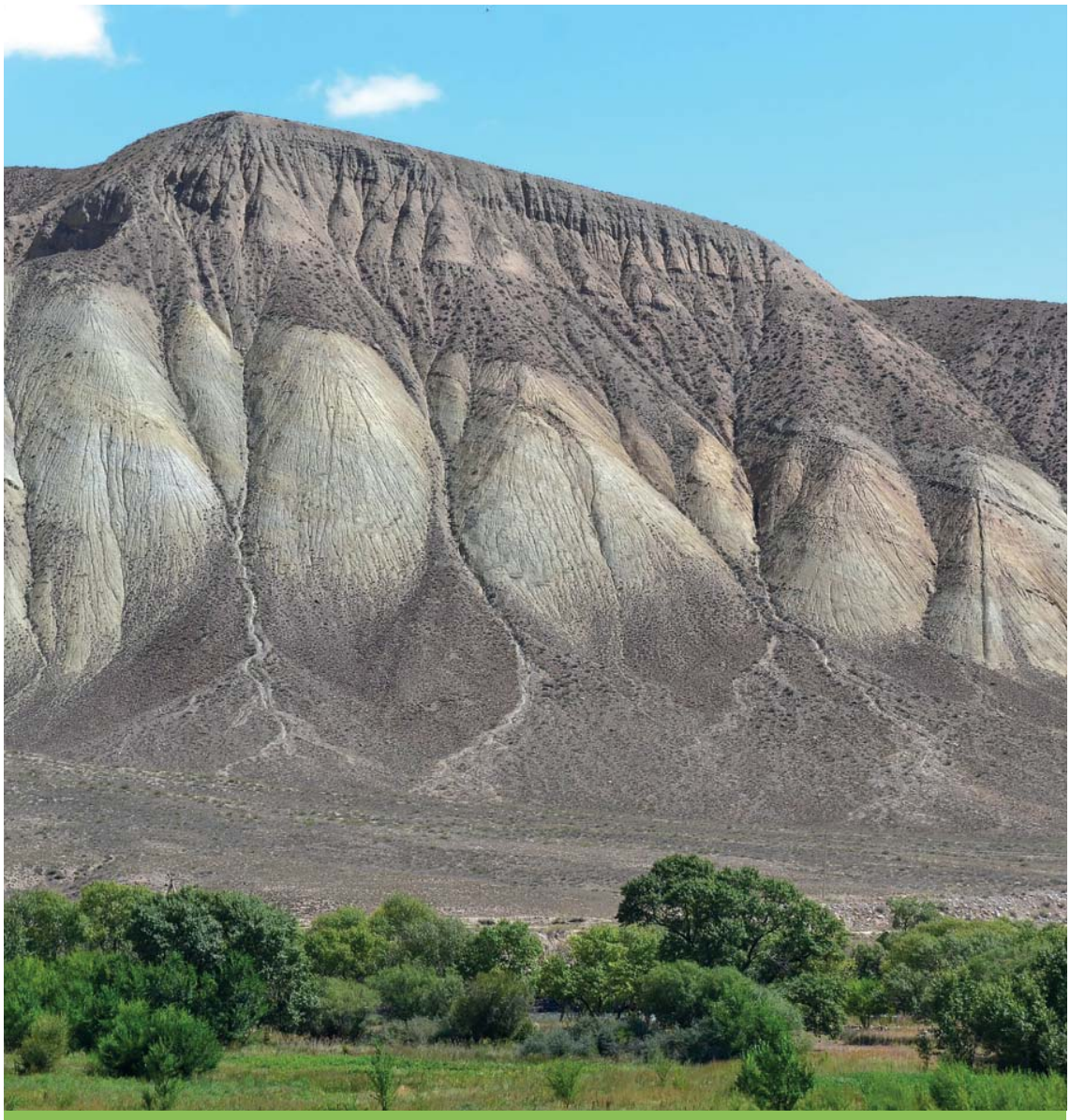
FIGURE 5

Schematic overview of altitudinal gradient for Central Asia case studies (providing the basis of the 'jigsaw' approach)
Source: Ettling et al. (2016)[26]



The ELD Initiative has promoted a 6+1 step approach[10,11,12] that has been used as a common structure to establish each national case study, with adaptations to tailor it to specificities, needs, and conditions. The selection of alternative scenarios (Step 6, *Chapter 4*) was based on the scientifically sound and proven practices implemented in the region for ecosystems, but which lacked a socio-economic justification or background. The selection and validation of alternatives was part of national consultations in all five countries, and based on multi-criteria analysis. This included *general criteria* (applicability, feasibility and replicability), *production criteria* (increase of land productivity, conservation of used or potential ecosystem services, impact on ecosystems), *social criteria* (importance for local communities, support of ecosystem services important inside or outside the community) and *financial aspects* (maintenance/increase of the value of ecosystem services, level of investments). Criteria were selected and assessed for each proposed alternative by stakeholders representing scientific communities, government, and technical specialists.

The economic valuation of ecosystem services was based on existing sources information, field research, and data collection missions of national consultants. A minimum of two field missions to selected sites were performed by national consultants. Where possible, climatic data were added to cost-benefit analyses.



BOX 1

The ELD Initiative's '6+1 step' approach[10,11]

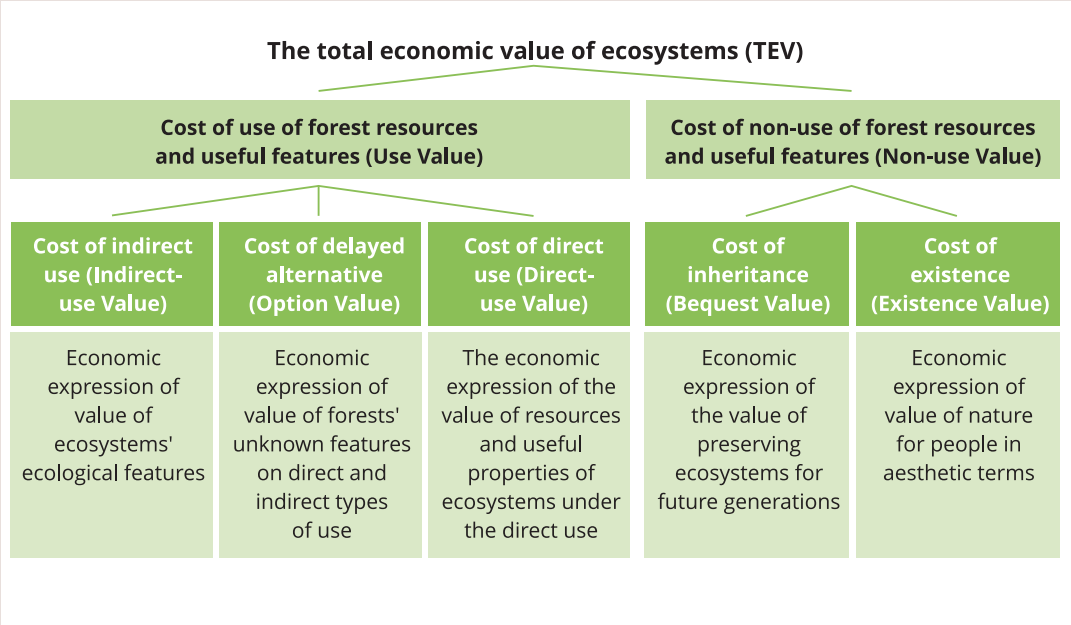
(from ELD Initiative, 2013, pg. 40–41[1])

1. **Inception:** identification of the scope, location, spatial scale, and strategic focus of the study, based on stakeholder consultation.
2. **Geographical characteristics:** establishment of the geographic and ecological boundaries of the study area identified in Step 1, following an assessment of quantity, spatial distribution, and ecological characteristics of land cover types that are categorised into agro-ecological zones and analysed through a Geographical Information System (GIS).
3. **Types of ecosystem services:** For each land cover category identified in Step 2, identification and analysis of stocks and flows of ecosystem services for classification along the four categories of the ecosystem service framework (provisioning, regulating, cultural, and supporting services).
4. **Role of ecosystem services and economic valuation:** i) Identification of the role of ecosystem services in the livelihoods of communities living in each land cover area and in overall economic development in the study zone; ii) estimation of the total economic value of each ecosystem service.
5. **Patterns and pressures:** Identification of land degradation patterns and drivers, pressures on sustainable management of land resources and drivers of adoption of sustainable land management (including determining the role of property rights and legal systems), and their spatial distribution to inform the establishment of global scenarios.
6. **Cost-benefit analysis:** Cost-benefit analysis comparing costs and benefits of an 'action' scenario to that of a 'business-as-usual' scenario to assess whether the proposed land management to net benefits ('Action' scenarios include land management changes that can reduce or remove degradation pressures). Mapping of net benefits can be undertaken for identification of the locations for which land management changes are suitable from an economic perspective. This can help identify 'on-the-ground' actions that are economically desirable.

'+1', Take action: Consider possible implementation of the most economically desirable option(s) and how to best achieve it. This may require adapting the legal, political, and economic contexts to enable the adoption of most economically desirable option(s), and removing existing barriers to adoption.

Figure 6: The basic components of the total economic value of ecosystems

Source: Bayzakov and Toktasynov (2016)[13]



04 Research findings

The following takes information from the national level case studies (Kazakhstan: Bayzakov and Toktasynov 2016[13]; Kyrgyzstan: Sabyrbekov and Abdiev 2016[27]; Tajikistan: Shukarov et al. 2016[15]; Turkmenistan: Murad and Mamedov 2016[18]; Uzbekistan: Nazarkulov and Rustamova 2016[28]) as well as a parallel study by Thevs et al. 2016[25], and brings them together along the 6+1 steps of the ELD Initiative approach.

Setting the scene or inception (ELD approach, Step 1)

This step involves identification of the scope, location, spatial scale, and strategic focus of the study, based on stakeholder consultation. The strategic focus of the case studies is based on the ecosystems identified in the altitudinal approach as most representative of each country. Case study sites were chosen because they presented land degradation problems in selected ecosystems but also showcased feasible alternatives to current land management approaches. The scope of the study has been mostly limited by available human resources, financial resources, and data.

When more than one site was selected, efforts were made to diversify the types of ecosystems or land-based economic activities. For example, the Kyrgyzstan case study has three sites of highland pastures presenting varying degree of agricultural activity and tourism. The study in Turkmenistan includes gypsum desert pastures, clay desert pastures, and sand desert pastures. These exact locations were chosen to ensure a maximum level of representativeness of the diverse problems faced by the overall country. Spatial scale tends to be larger for areas where ecosystems and their associated economic activities are homogeneous. Site selection should be based on stakeholder consultation, however, expert knowledge of the national consultants appointed to conduct the studies was used instead. As an example, in Kyrgyzstan, the main selection criteria were the existence of high-altitude pasture lands, exploitation and reliance of local populations on ecosystem services, data availability, and support from local stakeholders, as well as discussions with Kyrgyzgiprozem, the State Land Use Planning Institute of the Ministry of Agriculture of the Kyrgyz Republic, and available literature[27].

Land use and geographical characteristics of selected ecosystems (ELD approach, Step 2)

This step involved the establishment of geographic and ecological boundaries of the study area identified in Step 1, following an assessment of quantity, spatial distribution, and ecological characteristics of land cover types that are categorised into agro-ecological zones and analysed through GIS. Due to the way the case study sites were selected, geographic and ecological boundaries were easily identified and categorised based on the main land cover types.

Types of ecosystem services (ELD approach, Step 3): Decomposing reality to compose a comprehensive integrated perspective

This step involves identification and analysis of stocks and flows of ecosystem services for classification along the four categories of the ecosystem service framework (provisioning, regulating, cultural, and supporting services). The approach taken for this series of case studies is based on whole ecosystems, as opposed to previously sectoral approaches which considered human activities independently one from the other. The problem with the latter approach is that they are not appropriate for analysing impacts across sectors of wider phenomena such as land degradation and climate change[29]. They also fail to capture trade-offs between different human activities competing for resources from or access

to the same ecosystem. Taking an ecosystem approach can help build comprehensive integrated assessments of ecosystems. These assessments are established for different management and policy options with the view of providing structured, comprehensive, and integrated inputs into decision-making processes[29].

As an example of good sector approaches, the study in Tajikistan by Bann *et al.* (2012)[16] focused on agricultural production, losses from yield shortages, shortages of irrigation, and current abilities to sustainably manage land resources. These are all important aspects for sustainable agricultural production and help achieve objectives such as food sufficiency. However, they did not look at a broader range of ecosystem services, which could represent equally important income sources to local population. The study by Shukarov *et al.* (2016)[15] in Tajikistan builds on this but includes ecosystem services explicitly beyond food production.

Ecosystem services refers to a framework made increasingly popular following the publication of the Millennium Ecosystem Assessment report from 2005[30]. This is a framework that helps classify services provided by ecosystems, mainly to humans, based on four categories (*Table 3*). These categories can be used, as in this series of studies, to structure scientific assessments and ensure they are holistic and inclusive of multiple economic activities. The case studies all included provisioning, regulating, and cultural ecosystem services (*Table 4*) to varying degrees.

TABLE 3

Types of ecosystems services

Source: (ELD Initiative, 2015b, p.29[12] adapted from Turner et al., 2015[31])

Provisioning services	Natural capital combines with built, human, and social capital to produce food, timber, fibre, water, fuel, minerals, building materials and shelter, biodiversity and genetic resources, or other 'provisioning' benefits. For example, grains delivered to people as food requires tools (built capital), farmers (human capital), and farming communities (social capital) to produce.
Regulating services	Natural capital combines with built, human, and social capital to regulate processes such as climatic events with water flow regulation (e.g., for increased flood or drought control, storm protection), pollution control, decrease in soil erosion, nutrient cycling, human disease regulation, water purification, air quality maintenance, pollination, pest control, and climate control with carbon storage and sequestration. For example, storm protection by coastal wetlands requires built infrastructure, people, and communities to be protected. These services are generally not marketed but have clear value to society.
Cultural services	Natural capital combines with built, human, and social capital to produce more material benefits linked to recreation (tourism) and hunting as well as non-material benefits such as spiritual or aesthetic, education, cultural identity, sense of place, or other 'cultural' benefits. For example, production of a recreational benefit requires an attractive natural asset (a mountain), in combination with built infrastructure (road, trail, etc.), human capital (people able to appreciate the mountain experience), and social capital (family, friends, and institutions that make the mountain accessible and safe). Such cultural services would tend to be mostly experienced through tourism or religious practices.
Supporting services	These maintain basic ecosystem processes and functions such as soil formation, primary productivity, biogeochemistry, soil formation, and nutrient cycling. They affect human well-being indirectly by maintaining processes necessary for provisioning, regulating, and cultural services. For example, net primary production is an ecosystem function that supports climate control through carbon sequestration and removal from the atmosphere, which combines with built, human, and social capital to provide climate regulation benefits. Some argue that these supporting 'services' should be defined as ecosystem 'functions', since they have not yet clearly interacted with the other three forms of capital to create benefits in terms of increased human well-being, but rather support or underlie such benefits. Supporting ecosystem services can sometimes be used as proxies for benefits when such benefits cannot be easily measured directly.

TABLE 4

Ecosystem services identified for each case study

Country	**Kazakhstan**		**Kyrgyzstan**		
Ecosystem	**Desert forests**	**River delta**	**Highland pastures (high mountain pastures)**		
Source report	(Bayzakov and Toktasynov, 2016)[13]	(Thevs *et al*., 2016)[25]	(Sabyrbekov and Abdiev, 2016)[27]		
Case study location	**Bakanas state forest**	**Ili delta**	**Chon-Aksuu watershed**	**Kyzyl Unkur municipality**	**Son-Kol Lake highland pastures**
Provisioning					
Pasture and fodder (forage) for livestock	✓ (hay)	✓	✓	✓ (trade-off between number of livestock and quality of the forest area: in addition to the increasing pressure on pastures, the livestock contributes to the forest degradation)	✓
Food (agricultural production)	✓ (melons)		✓ (wheat, barley, fruits and vegetables)		
Fibre (agricultural or forestry production)	✓ (planting stock, poplar plantations)				
Biomass to meet other human activity needs		✓			
Habitat and biomass for wildlife	✓ (hunting wild animals)	✓			
Fish		✓			✓ (poaching)
Water (drinking)			✓	✓	✓
Fuel	✓ (firewood)		✓ (timber used only for firewood and regulated by the local forestry)		
Non-timber forest products (mushrooms, berries, medical herbs…)	✓ (herbs, honey, mushrooms)		✓ (mushrooms)	✓	
Regulating					
Carbon sequestration	✓	✓	✓	✓	✓
Climate regulation (local)		✓			
Water quality regulation		✓			
Water flow regulation (incl. flood control)	✓ (redistribution of rains by forests)	not applicable			
Nutrient cycle regulation for soil fertility (organic matter, nitrogen…)					
Soil quality and erosion regulation (salinisation)	✓ (preventing forest soil erosion and sand movement)				
Generation of oxygen	✓				
Cultural					
Recreational and tourism		✓	✓		✓
Cultural significance and sense of identity		✓ (not valued in economic terms)			✓
Aesthetic value					✓
Educational					✓
Supporting					
Although fundamentally important for land productivity, supporting services have not been considered on their own in all the national studies but rather through the lens of other ecosystem services. It is assumed that good supporting services will lead to higher land productivity (agricultural productivity or for other activities such as wildlife hunting or watching etc.)					

Tajikistan	Turkmenistan		Uzbekistan	
Low mountains (foothill pastures)	**(Lowland) desert pastures**		**Irrigated agriculture**	
(Shukarov *et al*., 2016)[15]	(Nepesov and Mamedov, 2016)[18]		(Nazarkulov and Rustamova, 2016)[28]	
Faizobod region	**Gokdere (gypsum desert pastures)**	**Madau (clay desert pastures)**	**Yerbent village site (sand desert pastures)**	**Buka district**
Provisioning				
✓	✓	✓	✓	✓
✓ (cereals, vegetables, potatoes, fruits, watermelons, meat, milk, honey, eggs)	✓	✓	✓	✓ (plant oil for cooking)
(wool and silkworm products)				✓ (cotton: textile, military needs etc.)
	✓	✓	✓	
✓ (mineral bottled water plant)	✓	✓	✓	
	✓	✓	✓	✓ (cotton stalks as firewood)
Regulating				
	✓	✓	✓	✓
	✓	✓	✓	
	✓	✓	✓	
✓ (landslides and gullies)				
✓				✓ (not valued in economic terms)
✓	✓	✓	✓	not provided by ecosystem but through human action
Cultural				
✓ (hunting wild animals and birds)	✓	✓	✓	✓
	✓ (landscape diversity, spiritual and religious values, knowledge system)			
	✓	✓	✓	
	✓	✓	✓	
Supporting				
Although fundamentally important for land productivity, supporting services have not been considered on their own in all the national studies but rather through the lens of other ecosystem services. It is assumed that good supporting services will lead to higher land productivity (agricultural productivity or for other activities such as wildlife hunting or watching etc.)				

Role of economic services and valuation (ELD approach, Step 4): Identifying and measuring the connection between ecosystems and people

This step involves identification of the role of ecosystem services in the livelihoods of communities living in each land cover area and overall economic development in the study zone as well as estimation of the economic value of each ecosystem service. The ecosystem services identified all play a role in the livelihoods of local communities, with varying degrees of importance depending on the site of interest:

In **Kazakhstan**[13], ecosystem services stemming from Bakanas State forestry in Balkhash district of Almaty region are firewood, hay, herbs, honey, melons, planting stock, poplar plantations, hunting wild animals, and mushrooms, all currently falling under the umbrella of "forest resources and useful properties". These benefit primarily local people and businesses.

Also in Kazakhstan, in the Ili delta[25], major sectors of employment and income sources are livestock herding (main income source except for Kuigan), fishery (commercial in Kuigan, Karoi), and to a small extent agriculture (concentrated in Aral Töbe) and tourism. Herders use pastures in the delta several kilometres away from their villages. There are a few small kitchen gardens for self-consumption in some villages. Tourism, which is family-based and contributes to local incomes, takes place in resorts located remotely in the wetlands and in Karaoysek, These are owned and managed by people from outside the delta region. Major tourism activities are sport fishing, hunting, and bird watching. Provisioning services like food production (livestock, fish, and agriculture) are therefore very important to local populations, while cultural services associated with tourism and recreational activities (fishing, hunting) would be more important to people from outside the delta region (tourism resort managers and visitors).

In **Kyrgyzstan**[27], provision of pasture and pasture related products (fodder) are the most important ecosystem services provided as support for animal husbandry (livestock productions). Animal husbandry is culturally and economically important. Forests and community-based tourism provide some equally important livelihoods to local communities in some selected case study sites.

In **Tajikistan**[15], the dominant activity in the case study area is agriculture at TJS 17.5-20.2 million a year (73-74 per cent of total local income). The proportion of the service sector as part of the total GDP in the case study site has recently increased from 2 to 21 per cent. Provision of food and fibres by agriculture is therefore an ecosystem service that is very important for local communities.

In **Turkmenistan**, pastures provide the green vegetation biomass that is used as food for grazing livestock, which is one of the dominant agricultural practices and a priority for both the government and the people. In 2008, there were 18 million head of cattle alone, who primarily depend on the provision of fodder in pastures.

In **Uzbekistan**[28], more than 80 per cent of the population lives in rural areas, and agriculture on household plots is a main source of employment and income. 65 per cent of the population is employed in agriculture (farmers, field workers, mechanisation workers etc.). Provision of food by land through agriculture is therefore one of the most important ecosystem services in Uzbekistan, including the selected case study location.

Once the ecosystem service has been identified, it is valued in economic terms, using money as a common measuring rod. *Table 5* lists examples of possible valuation methods used to estimate monetary values of ecosystem services in the Ili delta in Kazakhstan[25]. A more complete list of possible valuation methods is detailed in other ELD Initiative reports[10,11]. *Table 6* lists estimated values for selected ecosystem services in the location[25]. *Figure 7* is another way to represent estimates of monetary values for ecosystem services currently provided in each of the three Kyrgyzstan case study sites[27].

TABLE 5

Methods and data source for the assessment of ecosystem service values of the Ili Delta
Source: Thevs et al. (2016)[25]

Ecosystem service	Valuation method	Data source
Provisioning of fodder	Market prices: farm-gate selling prices of animals and milk as animal product	Statistical data, expert and farm interviews, costs of livestock production from Baranowski (2016)[32]
Provisioning of fish	Market prices: selling prices of 60% of the annual fish catch of Lake Balkhash, assuming all 60% grew up in the Ili Delta	Statistical data, literature data, expert and farm interviews (see Piechottka, 2015)[33]
Provisioning of biomass	Market price for harvested reed biomass: farm-gate selling prices	Expert interviews on selling prices and use of biomass. Costs for harvest from Köbbing *et al.* (2015)[34]
Retain carbon in organic matter under submerged reed beds	Carbon price from voluntary market for organic matter exposed if water levels drop	Expert interviews
Water purification	Transfer value from other wetlands	De Groot *et al.* (2012)[35]
Basis for recreation – tourism	Zonal travel cost approach (after *www.ecosystemvaluation.org*)	Interviews with owners and managers of all tourist facilities in the Ili Delta, expert interviews

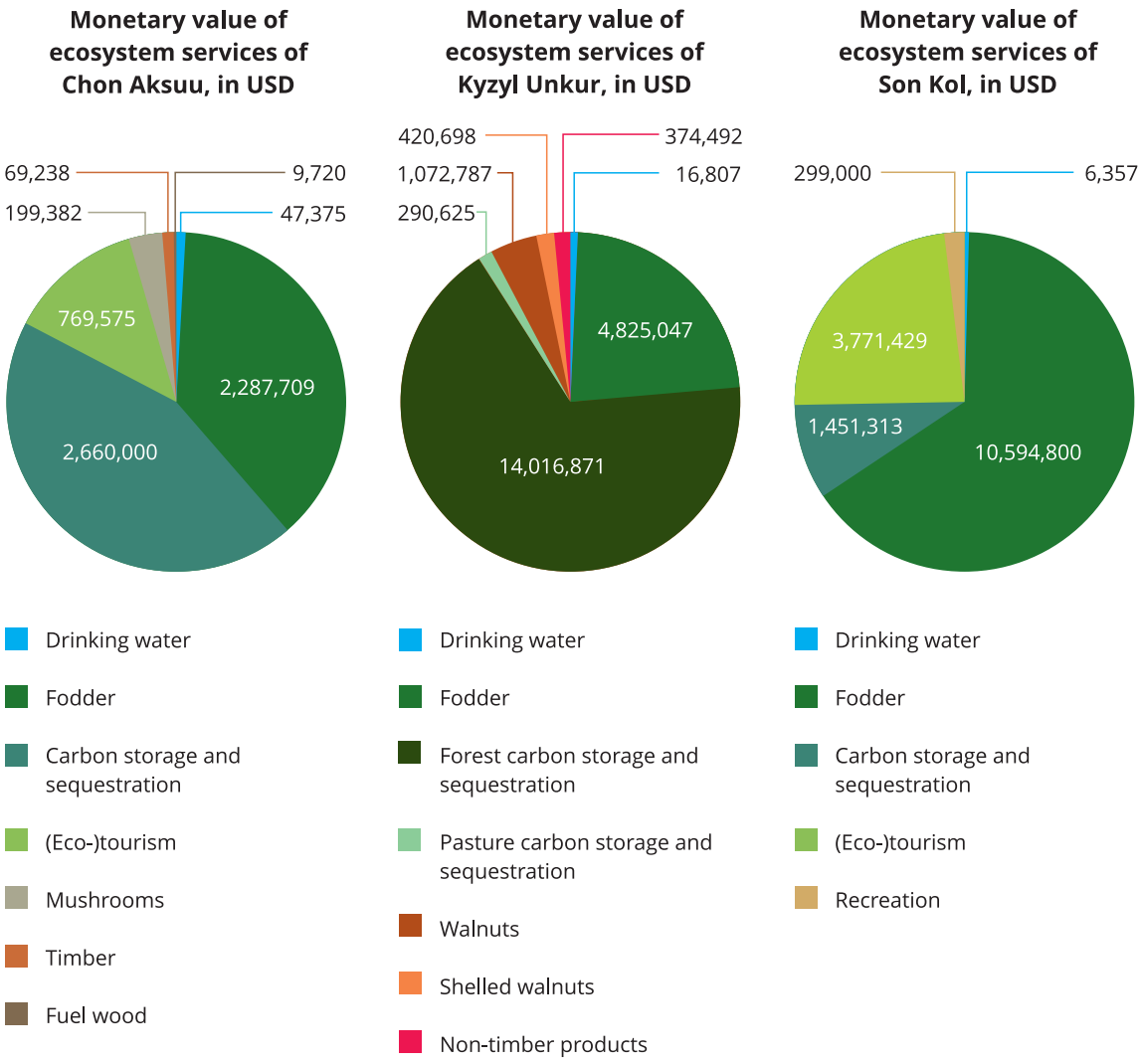
TABLE 6

Livestock numbers included in calculations of the monetary value of ecosystem services in Kazakhstan, in 2014
Source: Thevs et al. (2016)[25]

Livestock	Number sold and consumed	Farm-gate selling price per animal [USD]
Cattle	11,720	753
Horses	3,299	1,345
Sheep	6,893	161
Goats	8,618	67
Milk	1,513,913 litres	1.08

FIGURE 7

Monetary values of ecosystem services provided in study sites of Kyrgyzstan
Source: Sabyrbekov and Abdiev, 2016[27]



Land use patterns and pressures (ELD approach, Step 5): Understanding the reality

This is the fifth step of the ELD approach: land use patterns and pressures. This step involves identification of land degradation patterns and drivers, pressures on sustainable management of land resources and drivers of adoption of sustainable land management (including determining the role of property rights and legal systems), and their spatial distribution to inform the establishment of business as usual and alternative management scenarios. It also involves revision of previous steps if needed, to ensure the assessment is as comprehensive as possible.

The main types of land degradation involved in the case studies are detailed in *Table 7*. In **Kazakhstan** Ili delta, the pressure on ecosystem service provision arises with reduced water availability because of human activities[25]. One of the pressures listed in **Kyrgyzstan** is linked to the fact that land is not used in an optimal way: due

to redrawn boundaries and reliance on proximity and ease of access, some is overused whilst the rest is underused. There are overgrazed pastures with livestock density beyond carrying capacity whilst other pastures are not used because of bad road infrastructure limiting access to them[27]. In **Tajikistan**, pressures induced by soil degradation and in particular water and gully erosion, are more prominent[15].

There are different types of drivers for land degradation in Central Asia. *Figure 8* and *Table 8* show examples of land degradation drivers listed in the national case studies. They can be classified in different ways depending on their nature; some are "natural" in that land would degrade even if there were no human activity on it. This is the case for wind erosion and landslide susceptibility which are linked to the intrinsic properties of soil and land cover. There is also land degradation which is created (or aggravated) by human activity. This is often due to application of "one-size-fits-all" land management techniques and technologies which are not suited to certain areas. Land degradation can be driven, alternatively or in addition to the above, by institutional, economic, or socio-cultural factors (*Table 8*). These are all linked to the incentives local populations have to manage their land in certain ways. The interaction of economic markets, institutions and policy set up can lead to incentives that result in land degradation. It is not always possible to identify the one driver that, when removed, will allow for reduced anthropogenic land degradation and mitigation of natural land degradation.

TABLE 7

Main land degradation problems identified in each case study

Country	**Kazakhstan**		**Kyrgyzstan**			**Tajikistan**	**Turkmenistan**			**Uzbekistan**
Ecosystem	**Desert forests**	**River delta**	**Highland pastures (high mountain pastures)**			**Low mountains (foothill pastures)**	**(Lowland) desert pastures**			**Irrigated agriculture**
Source report	(Bayzakov and Toktasynov, 2016)[13]	(Thevs *et al.*, 2016)[25]	(Sabyrbekov and Abdiev, 2016)[27]			(Shukarov *et al.*, 2016)[15]	(Nepesov and Mamedov, 2016)[18]			(Nazarkulov and Rustamova, 2016)[28]
Case study location	**Bakanas State forest**	**Ili delta**	**Chon-Aksuu watershed**	**Kyzyl Unkur municipality**	**Son-Kol Lake highland pastures**	**Faizobod region**	**Gokdere (gypsum desert pastures)**	**Madau (clay desert pastures)**	**Yerbent village site (sand desert pastures)**	**Buka district**
Main land degradation problems										
Water availability reduction, impacting land cover		✓				✓				
Pasture degradation			high	low but rapidly increasing	high	✓	✓	✓	✓	
Forest degradation	✓		in terms of forest cover and non-timber product provision			contributing to soil erosion				
Pollution			lack of tourism waste management system							
Soil degradation (water and wind erosion, fertility reduction, salinisation, structure) causing decline in (agricultural) land productivity			wind erosion as a consequence of pasture degradation			water erosion and gully erosion (landslides), salinisation				✓
Trade-offs				between number of livestock and quality of the forest area		between food and fodder production				

FIGURE 8

Drivers of land degradation in Kyrgyzstan
Source: Sabyrbekov and Abdiev (2016)[27]

Economic
- individual profit orientation
- market prices

+

Institutional
- weak governance
- poor monitoring and enforcement

→ **Pasture degradation**

+

Sociocultural
- norms and traditions
- population growth
- welfare growth

TABLE 8

Drivers of land degradation in Tajikistan
Source: Shukarov et al. (2016)[15]

Natural factors:	
■ Shortage of arable land	■ Low soil fertility
■ Water scarcity	■ Soil compaction
■ Wind erosion	■ Strong vulnerability to natural disasters
■ Soil stoniness	■ Landslides and mud torrent phenomena
Anthropogenic factors:	
■ Imperfection of technological methods and irrigation technology	■ Reduction of organic matter contents (dehumification) in soil profiles
■ Leaching of fertile soil layers	■ Insufficient recultivation of degraded land
■ Exposure of soil to irrigational erosion	■ Logging of woody and shrubby vegetation
■ Soil salinity and waterlogging	■ Heavy grazing pressure on pastures
■ Soil contamination with chemicals	■ Non-systematic grazing
■ Unsatisfactory functioning of irrigation and drainage networks	■ Increase of weeds and reduction of useful vegetation on pastures
■ Insufficient crop rotation and pasture rotation	■ Deficit of energy resources and energy carriers
	■ Improper practices of land use, etc.

Business as usual and economic implications of current land practices: Accepting the reality

To be able to assess whether current land management could be improved and how, it is important to first understand how everything has been working to date, and outline a scenario based on the current situation and its likely evolution over the next few years. This 'business-as-usual' scenario is the baseline against which any considered change will then be assessed. Under such an approach, any change would have to lead to an improvement seen as desirable from an economic perspective. *Box 2* details examples of 'business-as-usual' scenarios established in the different case study countries.

BOX 2

Examples of 'business-as-usual' scenarios in each country

Kazakhstan forests[13]

Saxaul harvesting and associated land degradation and impacts (e.g., dust storms) have been studied as the business-as-usual scenarios.

Kazakhstan Ili delta[25]

It seems very likely that the runoff into the Ili Delta will decrease, because of increasing agricultural activities and water withdrawal upstream of the delta in Kazakhstan and China[36]. Furthermore, climate change due to glacier melt may result in lower runoffs by the middle of the 21st century[37]. It can be expected that decreased inflow into the delta will lead to lower water levels of the water bodies and groundwater reserves. Periodically submerged areas will likely become non-submerged throughout the year. As a consequence of these changes, the following ecosystem changes can be expected (cf. Ogar, 2003[38]; Thevs *et al.*, 2008[39]):

Some *submerged dense reed turns* into *non-submerged dense reed*. Herders gain land for grazing and haymaking. Spawning space and space for young fish to develop will be reduced.

Some *non-submerged dense reed* will turn into *open reed and shrub vegetation*, which offers less fodder for livestock.

Herders from the upstream part of the delta reported during interviews in 2015 that they already suffer from land degradation, and that part of the livestock was moved to the downstream villages of Jideli, Karoi, and Kuigan, while others had already considered giving up herding.

Along with decreasing water inflow from upstream into the Ili Delta, the following changes in the ecosystem services included into this study can be expected:

Provisioning of fodder will be compromised, because the area from which fodder is provided will likely shrink. Furthermore, the productivity of ecosystems that provide fodder will decrease.

Provisioning of fish will decrease, because spawning space and space for fish to grow up will shrink. On the other hand, the Kazakh National Fishery Research Institute proposes a long term annual upper limit of 8623 tonnes of fish catch from Lake Balkhash.

Provisioning of biomass will decrease because the area of submerged reed will be reduced.

Tourism will be impacted to a minor extent. The large and expensive tourist bases are located at major water bodies, which will carry water even if the inflow drops. However, smaller tourist bases at the delta margins will lose customers when water bodies dry up.

BOX 2 CONTINUED

Kyrgyzstan pastures[27]

In Chon-Aksuu: it is expected under the current management that local population continues to use pastures as main source of income regardless of falling pasture yield. The main ecosystem services in the scenarios are tourism, drinking water, firewood and fodder. Fodder also accounts for sustainable grazing level of 55 per cent where 45 per cent of the yield is left for reproduction purposes.

In Kyzyl Unkur: the land use patterns and practices will probably not change. Here the local population continues to rely on non-timber products and livestock numbers continue to grow. Related to this, the pasture yields fall sharply due to the growing livestock numbers at rate of 3 per cent per year. The value of non-timber products and drinking water continues to grow based on the historical data while carbon estimates are expected to remain constant.

In Son-Kol: all four rayons [administrative units] continue to use pasture in unsustainable manner without planning, investment and increasing the pasture load. As a result of increasing number of livestock and overgrazing the pasture yields fall at rate of 2.5 per cent per year. The tourism and drinking water provision continue to grow.

Tajikistan[15]

Production of food is decreased because of land degradation, with non-fruit bearing trees in degraded areas. Almost half of the pasture land is now animal paths with no vegetative growth, and over-grazing is responsible for the disappearance of tall fodder grass species from the grasslands. This situation contributes to intensive precipitation runoff. All these factors contribute to decrease in pasture yields. According to the Department of Statistics, unused (degraded) land resulting from mismanagement in 2013 decreased by 19 hectares from 2012, which suggests there are already efforts to mitigate or reverse land degradation through improving land management.

Uzbekistan[28]

In the Buka District, a main aspect to consider is the centralised economy of cotton production in Uzbekistan. The lack of domestic markets for cotton does not allow for a determination of its real price. The government focuses on international market prices to argue for the importance of cotton production, but farmers account for it based on producer prices (no market). For example, fibre, as a main product of cotton, is commercialised by quasi-state organisations. For farmers, this means there is a guaranteed outlet and guaranteed price for raw cotton because of this demand. The supply of production factors is also carried out centrally, at lower prices. However, delays of allocation transfers occur, farmers cannot regulate the volume of production themselves, and they are further limited in selecting the patterns of crop rotation. This latter point is very important from the perspective of providing optimum regeneration and stability of soil nutrition patterns as an ecosystem service and as a sustainable land management practice. As a result of the current system, the productive properties of the soil are decreasing, affecting the nutrient availability and negatively impacting the value – and productivity – of land.

Turkmenistan[18]

Degradation with loss of fodder production in desert pasture is the business as usual scenario considered in the Turkmenistan case study.

What can be derived from all of the national case studies is that there is a decline in economic benefits provided by local ecosystems due to ongoing and often increasing land degradation processes. This has already negatively impacted the livelihoods of some local populations, and will worsen in the near future. This necessarily leads researchers to consider possible alternatives that

can reduce land degradation and/or its impact on local populations and communities.

Cost-benefit analysis (ELD approach, Step 6): Defending alternatives, preserving ecosystems

The cost-benefit analysis compares costs and benefits of an 'action' scenario to that of a 'business-as-usual' scenario to assess whether the proposed land management can lead to net benefits. 'Action' scenarios include land management changes that can reduce or remove degradation pressures. This is to ensure that any alternative action proposed will lead to the same net benefits or higher, when compared to business as usual.

Mapping of net benefits for identification of the locations for which land management changes are suitable from an economic perspective. This can help identify 'on-the-ground' actions that are economically desirable. Because of the way this project was built based on representative selected case studies, mapping of net benefits has not yet been undertaken. Although it will be essential to achieving land degradation neutrality and its measurement by each land cover class.

Table 9 lists some of the alternative scenarios which were established to assess whether they are an improvement on the current land management practices from an economic perspective. *Table 10* provides an example of the type of details included in the alternative scenarios, which all include aspects to mitigate land degradation and/or its impact on livelihoods in the case study location. They were established by experts as a starting point to provide information that can be inputted into decision-making consultations and discussions. In some cases, such scenarios have been developed following discussions with local population and governance representatives[27] or with stakeholder representatives[15]. This was not done to preempt any kind of decision, but rather to ensure that the options considered were realistic and politically feasible and thus provide an assessment with some meaning for local stakeholders. Alternative scenarios help explore possible options for change in terms of land management and their economic impact and should be seen as a pre-feasibility approach to inform further discussions.

TABLE 9

Alternative scenarios assessed by cost-benefit analysis in each country

Country	Ecosystem	Source report	Case study location	Alternative 1	Alternative 2	Alternative 3
Kazakhstan	Desert forest	(Bayzakov and Toktasynov, 2016)[13]	Bakanas state forest	Saxaul harvesting	Collection of deadwood	Implementation of integrated ecosystem enhancement measures
	River delta	(Thevs *et al.*, 2016)[25]	Ili delta	Maximum use of ecosystem services	Runoff decrease 20%	
Kyrgyzstan	Highland pastures (high mountain pastures)	(Sabyrbekov and Abdiev, 2016)[27]	Chon-Aksuu	High pasture yields and favourable weather conditions	Moderate pasture yields and unfavourable weather conditions	Runoff decrease 67%
			Kyzyl Unkur	Better pasture management and favourable weather conditions	Moderate pasture yields and tourism development	
			Son-Kol	High pasture yields and favourable weather conditions	Moderate pasture yields and unfavourable weather conditions	
Tajikistan	Low mountains (foothill pastures)	(Shukarov *et al.*, 2016)[15]	Faizobod region	Increased agricultural productivity	Improvement of pasture conditions and prevention of emergency situations	
Turkmenistan	(Lowland) desert pastures	(Nepesov and Mamedov, 2016)[18]	Gokdere (gypsum desert pastures; Madau (clay desert pastures; Yerbent village site (sand desert pastures)	Increased pasture productivity and reduced degradation		

TABLE 10

Example of description of alternative scenarios to improve sustainable land management in Tajikistan

Source: Shukarov et al. (2016), Table 19[15]

Name of project/ alternative	Description of scenario			Ecosystem services, which will be impacted	Economic assessment after the impact
	Goal	Tasks	Specific activities		
Increase agricultural productivity	Increase food production	Effective use of arable land; Increase of soil fertility; Increase of crop profitability	Use of resource- and energy-saving technology (no-till); Establishment of intensive fruit gardens (*cost of garden establishment*)	Food; Soil fertility maintenance; Water management	Received profit from agricultural production; Improved food supply; Increase of export potential from agricultural crop production
Improvement of pasture conditions and preventing emergency situations	Preservation of agro-biodiversity and prevention of pasture overgrazing, recultivation of pastures, prevention of soil outwash	Management and improvement of pasture conditions; Prevention of emergency situations (emergence of landslides and mud torrents); Prevention of siltation of irrigation and drainage networks	Interseeding of perennial herbs and improvement of grass diversity and productivity of pastures (*costs for purchase and planting of seeds*).	Soil; Food; Water; Erosion control	Profits from sale of livestock products; Savings from costs for rehabilitation of consequences from emergency situations; Savings from operation and maintenance of irrigation and drainage networks

What possible actions could be envisaged? What the numbers suggest (ELD approach '+1' step)

This step '+1' corresponds to land users, private sector, and public decision-makers taking action and removing barriers to action depending on their respective role. What the economic indicators obtained in the cost-benefit analysis suggest is that the majority of alternatives considered are economically viable and should be considered for adoption by land users, with support from the private sector and public decision-makers. Even if they have been subject to discussion with various stakeholders, questions remain around how to best operationalise and implement them, who would lose and who would gain from them on an individual basis, etc.

Table 11 summarises the main cost-benefit analysis results from the case studies. The economic indicator is the net present value, computed at a 10 per cent discount rate to make them comparable in time unless specified otherwise. When the net present value is greater than zero, it means that the alternative scenario under consideration is more desirable than 'business-as-usual' from an economic perspective. Although tempting, net present values cannot be compared across scenarios: a higher net present value does not mean the project is better. The indicator can only be used for a yes/no assessment of one option against 'business-as-usual'.

For example, in the **Ili delta in Kazakhstan**[25], the first alternative involves investing in actions that allow maintenance of the Ili river flow (as opposed to the current decrease) thereby sustaining current ecosystems and associated economic benefits. The additional economic value stems from an increase in fodder production (reed factory in Karoi, Zhideli pulp factory, cattle farm designed for 10,000 meat cattle under construction next to Bakanas) and 50 per cent tourism development (fishing, hunting, transport and accommodation infrastructure and services). It is the only economically attractive alternative; the second and third alternatives which both involve reduction in water runoff into the delta were found economically undesirable. This would suggest that any reduction in water flow in the delta would negatively affect ecosystem functioning and in turn negatively impact local activities and livelihoods. However, these alternatives could be considered 'acceptable' losses depending on specific country objectives that may not have been considered by this assessment.

In **Kyrgyzstan**[27], the Chon-Aksuu case study considered a scenario with favourable weather conditions and one with unfavourable ones. Both are economically attractive with a positive net present value. However, this is because the value of carbon storage has been included. If this service is removed from the computations because it is not (yet) associated with real income to local populations, net present value is negative and none of the alternatives appear desirable compared to 'business-as-usual'. This demonstrates the importance of taking a holistic perspective of benefits provided by ecosystems. The net present values are within the same range (USD 9.4 million and 7.8 million) whether weather conditions are favourable or unfavourable, and conclusions are robust when the discount rate changes. The question is now to determine the level of action that could be taken considering these results: what kind of scenario is more likely? How risk averse are stakeholders? Risk-averse stakeholders may want to go for the unfavourable weather condition scenario to be on the safe side. Could carbon payments be envisaged? What form would they take? For current storage? What type of land use? How to estimate carbon stored? Who will centralise funds, where from, and administer them? These are a few questions stakeholders may want to consider and discuss, in order to decide what type of action would be more appropriate.

Also in **Kyrgyzstan**[27] the **Kyzyl Unkur** case study has positive net present values for both alternatives. Like Chon Aksuu, the first alternative is only economically attractive when carbon storage is included. As carbon storage is not currently associated with real money flows, it does not really contribute to the livelihoods of local communities. The question of whether carbon payments could be envisaged is still relevant for this case study. The second scenario is economically attractive: an expansion of the tourism industry helps diversify income sources and mitigate the impact of adverse weather conditions.

The last case study in **Kyrgyzstan**[27] at **Son-Kol**, displays positive net present values for both alternative scenarios under consideration. This would suggest that implementation of improved

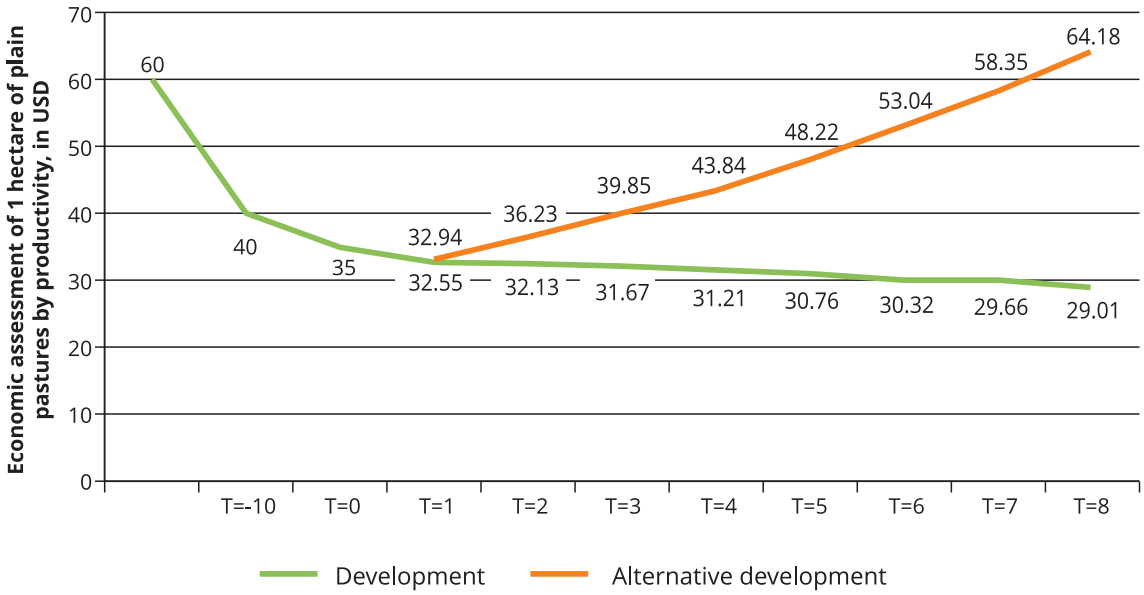
pasture management is worth undertaking from an economic perspective regardless of climatic evolution in the region. The question that remains is how to implement such changes in a manner suited to the local culture (developing incentives for local communities to take action).

In **Tajikistan**[15], the case study in the Faizobod region has positive net present values for both alternative scenarios under consideration. Increased agricultural productivity (first alternative) seems worth undertaking from an economic perspective. Even so, the question remains about how to best promote no-till and intensive fruit garden in the region and make sure it is adopted, should the country choose to go for this course of action. When inter-sowing perennial herbs without destroying turf to improve pasture conditions and recultivating zones of excessive grazing and consequent mud torrents from vegetative cover loss, there is an opportunity to prevent mud flows and landslides. This stresses again the importance of adopting a more inclusive and integrated perspective to assess possible actions which would have been missed by a single-sector approach study. This raises further questions: How could farmers be compensated for pasture productivity losses? Should they?

In **Turkmenistan**[18], economic assessment of plain pastures by productivity has shown increased economic benefits by improving pastures of the sandy deserts by creating pastoral phyto-cenoses all year round, establishing seasonal pastures with planting (mostly in the gypsum deserts and foothill areas), and improving forage productivity of the halophytic pastures of the clay deserts based on local surface water flow from the *takyr* areas (*Figure 9*).

FIGURE 9

Current and projected value of sandy desert pastures in Turkmenistan
Source: Nepesov and Mamedov (2016)[18]



Selected results of cost-benefit analyses

Country	Ecosystem	Source report	Case study location	Net present value of additional net benefits compared to business as usual scenario (in USD, discount rate = 10%)		
				Alternative 1	Alternative 2	Alternative 3
Kazakhstan	River delta	(Thevs et al., 2016)[25]	Ili delta	Maximum use of ecosystem services: **39.7 million**	Runoff decrease 20%: **-18.8 million**	Runoff decrease 67%: **-126.8 million**
Kyrgyzstan	Highland pastures (high mountain pastures)	(Sabyrbekov and Abdiev, 2016)[27]	Chon-Aksuu	High pasture yields and favourable weather conditions: **9.4 million** including carbon storage (ranging between USD 1.8 million for discount rate = 20% and USD 7.3 million for discount rate = 1%) **-6.9 million** once carbon value is excluded	Moderate pasture yields and unfavourable weather conditions: **7.8 million** including carbon storage (ranging between USD 0.9 million for discount rate = 20% and USD 4.4 million for discount rate = 1%) **-8.5 million** once carbon value is excluded	
			Kyzyl Unkur	Better pasture management and favourable weather conditions: **4.1 million** including carbon storage (ranging between USD 1.9 million for discount rate = 20% and USD 8.6 million for discount rate = 1%) **-83.8 million** once carbon value is excluded	Moderate pasture yields and tourism development: **1.6 million** including carbon storage (ranging between USD 0.4 million for discount rate = 20% and USD 4.3 million for discount rate = 1%) **-86.3 million** once carbon value is excluded	
			Son-Kol	High pasture yields and favourable weather conditions: **19,2 million** including carbon storage (ranging between USD 10.4 million for discount rate = 20% and USD 36.1 million for discount rate = 1%)	Moderate pasture yields and unfavourable weather conditions: **12.2 million** including carbon storage (ranging between USD 6.8 million for discount rate = 20% and USD 22.7 million for discount rate = 1%)	

05 Lessons learned

Scientific approach: environmental and economic capacity building in Central Asia

Working with national consultants as on-the-job training on the one hand worked well, but on the other hand, a gap was revealed in the age structure of the regional scientific community, concerning young scientists. To meet this need capacity building should start earlier, e.g., via cooperation with the universities on the regional and international level.

Institutional approach: how to create and continue regional cooperation

Stakeholder consultations were held relatively late during the process which deprived researchers of the opportunities to include their respective views into the initial structure of the national reports. Apart from this disadvantage, it was noted that the participants appreciated the opportunity to discuss the preliminary results, alternatives, and recommendations, which would not have been possible at an earlier stage of the process. The recommendation would be to plan an early round of consultation, followed by a second one later. This procedure can also be an advantage in concerns of management of expectations.

The altitudinal/jigsaw approach required a relatively high level of coordination among the different actors during the process of the study. As a first step towards regional cooperation, this was an advantage of the process but management of communication and responsibilities must be adapted to the special requirements of this multi-country approach.

The institutional and political environment of the region proved to be unsteady. Due to the involvement of five countries, a number of changes in the relevant regional and international organisations, political structures, and personnel posed an obstacle to continuous involvement of all relevant partners. Regular and shared updates of the stakeholder map and structure is recommended to become an integral part of comparable projects.

At the regional level, common projects could help get the republics work on similar issues together and foster greater collaboration to address the issues of land degradation more effectively.

Recommendations and next steps

National-level policy recommendations

Out of each country study, researchers established the most pressing issues to be addressed with the greatest economic and environmental rewards. These are presented here, and also available in each country report (*www.eld-initiative.org*).

Policy recommendations: Kazakhstan

Designate the saxaul forests of Balkhash as specially protected natural territories or reserves, and seek to extend the areas under protection nationwide. Given the vast size of the saxaul forests, establishing protected status will go a long way towards conserving the value of land across Kazakhstan.

Raise awareness of the concept of ecosystem services and formally introduce them into legislation in order to value, protect, and exploit them sustainably. This should include a government supported assessment of natural capital throughout the country for other ecosystems to develop economic understanding of their value.

Expand the economic assessment of ecosystem services in all major regions and ecosystems of Kazakhstan. This can be accomplished through scientific and technical capacity building within research institutes and universities including incorporation into university curriculae. The dissemination of methods and tools for economic assessments of land and land-based ecosystems should also be shared with other similar areas of Central Asia, allowing for a coalescing of efforts and a transboundary approach to sustainable land management.

Develop strategies to empower the Forestry and Wildlife Committee at the Ministry of Agriculture to undertake decision-making for the protection of valuable biological resources. This entity is in the best position to determine, implement, and regulate optimal scenarios for the conservation, sustainability, and economic and environmental benefits for local populations, as well for Kazakhstan.

Establish an inter-ministerial republic committee responsible for the achievement of land degradation neutrality. Synthesising the capacities and priorities of different ministries is key in developing an effective, unified approach to meet the goal of land degradation neutrality as laid out by the UNCCD. Regional plans should also be developed that take into consideration local conditions and needs.

Policy recommendations: Kyrgyzstan

Implement sustainable pasture management practices, with carrying capacities clearly identified and strictly observed. This should include measures of pasture rotation, seeding and re-cultivation, vegetation survey, forage analysis and soil analysis. Local populations must be informed about the limits and current state of the pasture.

To further develop institutional capacity of pasture committees. At the moment, committees are concentrating efforts on pasture access and infrastructure. However, they should equally conduct monitoring of pasture health and carrying capacities, and develop capacity to support economic valuations of the land and land-based ecosystems.

Increase livestock productivity to reduce pressures on pastures while maintaining economic benefits for farmers. Productivity is currently very low, increasing the quantity of animals needed while making per head costs very high. Increasing this productivity is thus necessary to allow farmers to have fewer livestock and reduce the pressures and resulting land degradation,

while still being able to maintain economically beneficial incomes.

Income diversification to reduce reliance on livestock breeding. In the absence of alternative job opportunities or livelihoods, livestock breeding has become a common last resort. Therefore, to decrease pressure on pastures, it is necessary to diversify and support alternative income earning possibilities for local population. For example, the development of ecotourism and independent entrepreneurships can be supported at the local level.

Root economic understandings in holistic and complete perspectives of benefits derived from land and land-based ecosystems. For instance, carbon storage is now a key international issue affecting local populations and it is important to consider potential sources of income for local populations associated with its storage.

Create a unified and accessible common platform for knowledge and experience exchanges on pastures. A hub must be established to advance the level and cohesion of available and developing knowledge on land use and management of pastures that take place in the territory of the Kyrgyz Republic. The current plethora of different donor-funded projects should be brought together in one platform to increase efficiency across efforts to ensure the sustainability of land use and pasture management across the country. This can also act as an access and focal point for donors and other stakeholders.

Policy recommendations: Tajikistan

Build capacity for, and raise awareness of, sustainable land management and ecosystem service use understanding and evaluation at national, regional, and local levels of management. To obtain maximum benefits from ecosystem service use and prevent land degradation, a network of experts and specialists needs to be established, as well as facilities to train them. Further, functional relations need to be established across management scales, including capacity built at local management levels, as they are focal nodes and interfaces between research institutes, policy-/decision-makers, and land users. Training can be regional or national, but must be able to adapt national policies to their own local needs. This will require a system of training, communications, mass media outreach, and knowledge exchanges.

Further, as land users like farmers will be the actual implementers, they require capacity building and training in sustainable land management practices. Farmers are critical in demonstrating to policy-/decision-makers the actual benefits realised from the implementation of sustainable practices. Through public outreach, further evaluations of existing ecosystem services and use can be achieved. Training and understanding is also needed in formal education. This can be supported through developing educational materials/aids of successful case studies, best practices, and findings from ELD research, conducting special modules on evaluating and conserving ecosystem service values, and general support for scientific research, conferences, and workshops.

Laws and policies inclusive of ecosystem services. Basic terms and definitions must be agreed upon, legal and regulatory frameworks for their evaluation and use set, secondary legal acts for implementation, evaluation, and maintenance, and legal training to raise awareness of new legislation and regulation for local authorities and users. We suggest the introduction of taxes and fees for ecosystem services, paid for by local users.

Develop a more effective approach to management and finance planning and develop internal capabilities to implement sustainable practices on the basis of recently approved national guidelines to address insufficient pastoral resource management jointly with the state enterprise "Trust of Pastures and Amelioration". Responsibility for the management of all pasture systems is with the Ministry of Agriculture, who can integrate long-term thinking for sustainable pasture management. The following points should be considered:

- Introducing monitoring systems is critical, as it is currently not done. Evaluation of new plant introductions, carrying capacity, grazing pressures, and regional needs must be established. Such systems will also be essential for reporting to international institutions, such as the UNCCD;

- Rotation is part of current policies, regulations, and pasture management, and cannot be seen separately;
- Infrastructure needs to be improved to provide access to remote pastures. Currently, only the most experienced shepherds are able to reach these challenging but productive lands;
- Establish regional breeding programs to optimise livestock (sheep, cows, goats) quality and diversity, and increase productivity. Such programs require careful analyses and planning as shepherds do not want to end up with an unmanageable amount of degrading livestock;
- Establish regional seed banks and nurseries, and provide new species that increase soil and pasture productivity and provide added economic benefits. New varieties in mixed pastures can enhance vegetative health, but plants must be allowed to regenerate and reach palatable levels;
- Create better governance to enable farmers to store fodder reserves at the household level, as well as winter crops. Some farmers lack access to winter pastures and keep animals in their homes, but require advance planning to calculate feed requirements;
- Agro-tourism, eco-tourism, and hunting must be explored for land users in the region as well. Authorities should be encouraged to organise product exhibitions and local craft markets to demonstrate the viability of these alternative incomes;
- Incentives can be provided through awareness raising on the long-term effects of degradation, pasture improvement for sustainable use, and the value of sustainable land management. It is challenging to change everything at once, and it is difficult to see beyond the short-term costs to long-term productivity. Thus, training and education for all stakeholders on ecosystem services is very necessary, and requires government or other funding resources and incentives.

Laws and agreements on limits of livestock must also be established. A maximum number of livestock should be legally controlled and monitored – as farmers tend to conceal the actual number of animals in their possession from governance representatives. This can be supported through increased executive powers for local communities. Pasture management committees funded and staffed by farmers can establish flexible, simple penalty processes to enforce adherence. In addition to caps, it is necessary to regulate and enforce three-day pasture rotations. Violations should be addressed through transparent and strictly controlled penalties, managed by the local governance through representatives of *jamoat* and district committees, as economic leverage is the most effective for pastoralists beyond training and education. Meanwhile, positive incentives should be sought for farmers who voluntarily adopt alternative and sustainable approaches and can be showcased as pioneers.

There also needs to be agreements of shared land usage with neighbouring countries; shepherds from Kyrgyzstan often use Tajik pastures as they are more accessible for those living close to the border, but this use should take place and be monitored under internationally negotiated sustainable land use principles.

Following the voluntary guidelines on the responsible governance of tenure of land, fisheries and forests in the context of national food security from FAO with its recent technical guide on improving governance of pastoral lands is highly recommended. Transboundary cooperation in Central Asia and surrounding countries on joint pasture and water management, as well as wildlife preservation should also be sought. Joint efforts can facilitate coordination efforts with international donors working in these fields, and discussions of this nature can also support knowledge exchange on best practices in shared regions.

Improve the efficiency and long-term sustainability of irrigated land use through sustainably increased productivity and the creation of intensive orchards. There is an order from the President of the Republic of Tajikistan No. 683 (2009) that supported the establishment of 46,900 hectares of new orchards and vineyards from 2012-2014, and a 2015 resolution that envisages the creation of another 20,000 ha by 2020. In addition to this ongoing effort, the government should increase opportunities for the economically rewarding practices of intensive gardening on irrigated and rain-fed arable, cultivated, and newly developed land. This can be through the provision of long-term loans with low interest rates, and grants to support farmers' transition. To raise demand and increase benefits, there can be support for multinational companies or intergovernmental agreements with countries like Russia and Kazakhstan in the export of fresh, dried, and processed fruit products.

Awareness must be raised on the economic efficiency of the suggested measures through the organisation of training courses, seminars, field agricultural schools, demonstration videos, and other materials. These should also raise local awareness of the need to address domestic food security. This can be supported by the Institute of Horticulture of the Tajik Academy of Agricultural Sciences and Tajik Agrarian University, to improve the level of competence of farmers and local experts through training and the inclusion in government programs of new projects on the assessment and development of intensive orchards.

Policy recommendations: Turkmenistan

The challenge of maintaining the natural balance and existing biodiversity alongside further development of livestock as well as desertification processes and climate change will require the accomplishment of the following interdependent and mutually complementary recommendations:

Establish an organisational structure for pasture management at the national level, tasked with implementing the work necessary for sustainable land management in pastures. This is necessary in developing *a unified national system of accounting, monitoring and redistribution of pasture land* between users on long-term lease conditions. This must be rooted in an understanding of what directly or indirectly leads to sustainable pasture use, including grazing techniques and standards, pasture rotation, etc.

Conduct regular, comprehensive geo-botanical studies of rangelands every eight years. This will allow for updated databases on the dynamics of fodder stocks and carrying capacities of the pastures, including data on water sources. This will require periodical cadastral evaluations.

Provide rangelands with accessible, guaranteed water and fodder stocks to support the needs of herders and farmers as they transition to land management practices. For water, this includes centralised provision of water, and the rehabilitation, reconstruction and maintenance of traditional water sources, including water wells and reservoirs. For fodder, this will require allocation and redistribution of resources in irrigated areas.

Include dedicated sections on centralised water supplies for pastures and the allocation of irrigated areas for fodder production in state programs, for the development of agriculture. An analysis of the legal and regulatory framework of land and water use, and formulation of recommendations for the legal support of these tasks will also be necessary.

Develop a payment mechanism for pasture use (direct natural-resource differentiated payment). It is important to identify the legal payment mechanism in terms of the amount (depending on pasture quality), which authority establishes it, for what, and where payments are directed and sent. This needs to be rooted in an economic analysis of the costs and benefits arising from ecosystem service use and alternative scenarios against currently degrading practices.

Implement the recommended ecologically and economically viable alternatives to improve pasture productivity while maintaining the biodiversity of rangeland ecosystems, including:

- Improving sandy desert zone pastures through optimal year-round pastoral plant communities;

- Establishing autumn-winter pastures through artificial sowing (mostly in gypsum desert zones and piedmont areas);
- Improving productivity of saline rangelands in the clay desert zones, based on local surface water runoff from takyr soils;
- Establishing saxaul forest plantations (mainly around desert settlements) that contribute to the regulation of microclimates.

Policy recommendations: Uzbekistan

Increase the effectiveness and sustainability of irrigated land use practices near Tashkent and other major cities, in terms of productivity as well as in response to the terms of international conventions regarding carbon emissions. What may help achieve this is increasing flexibility to implement crop rotations that are both economically and environmentally rewarding, that help increase farmers' incomes as well as bolster the national economy, while also preserving the natural properties of land (nitrogen, water cycles, biodiversity, etc.). This can also ensure that the population of major cities will have sustainable supplies of food products from Uzbekistan, and act as a buffer against unnecessary reliance on degrading land practices or import markets.

The calculations of the ELD Initiative Uzbekistan study showed the potential economic value of moving beyond business-as-usual to more inclusive alternative scenarios of biomass retention, crop rotation, and afforestation. Support will be needed for the involvement of research institutes at national and international levels, to cooperate with farmers in refining and optimising beneficial crop rotation and cultivation practices across the country, while creating adaptable frameworks for localised implementation.

Further, in accordance with international conventions, Uzbekistan has pledged to reduce carbon emissions. The ability to select cost-effective crop rotations of cotton and wheat alongside fruits, vegetables, and legumes, can help increase carbon sequestration, provide adaptive measures to climate change, and assist Uzbekistan in meeting these internationally-agreed upon goals.

Raise awareness about the possible added economic benefits brought by alternative and more sustainable land management options for irrigated agriculture. This includes the organisation of training sessions and seminars, agricultural field schools, demonstration videos, and other accessible materials to demonstrate outcomes of sustainable land management and encourage associated practices. These activities can help raise local-level awareness of farmers and managers on the possible ways to address environmental issues through their land use.

Review the implementation of market conditions on water use in agricultural practices and increase the involvement of water user associations at the local level for improved water and land management. Water is a key element in irrigated agriculture. Currently there is no assessment system or metering to measure actual water consumption through the irrigation and leaching of fields. This could eventually lead to the introduction of fair water prices that support optimal water use. Water user associations are also key in usage, as they have already established frameworks at the local community level. They can contribute greatly to determining regulatory levels and being conduits for best practices.

Establish mechanisms for the processing of additional agricultural products. Economic valuations show potential added value of diversifying a portion of agricultural land currently used for cotton or wheat production. De-emphasising short-term maximum yields of these crops can lead to increased overall returns while also bolstering the availability of subsistence foods and other services provided by the ecosystems. To support the implementation of agricultural diversification, on-the-ground technical and technological support mechanisms need to be put in place. Additional preferential financing for processing food and fodder crops can raise value at a local level.

Attract international firms and markets for the export of key crop products. Improving the sustainability of crop and land management could help meet and keep potential demand for exports to large markets like Russia. Sustained export demand could contribute to sustain or even increase prices for food products provided by farmers. Attracting international firms could help target such large markets and intergovernmental agreements could play a key role in this. Further, close cooperation with other Central Asian countries in research and practical projects within regional international programmes can support transboundary benefits and knowledge exchange on best practices.

Support the involvement of the Institute of Agricultural Economics in raising the capacity of farmers and local professionals to achieve increased economic and environmental well-being. By providing state-of-the-art understandings and the most current research, their contributions are critical to success. This can be achieved through the inclusion of new projects for assessment and development of irrigated agriculture taking into account a wide range of ecosystem services in government programmes.

Regional-level policy recommendations

On the basis of the research and the process of the project, each study lent itself as a platform to establish national policy recommendations rooted in scientific and economic understanding towards sustainable land management. Out of this, and with a view towards cohesive regional success, there are common trends and goals across Central Asia that can form a starting point towards action.

Rethinking solutions

Technical solutions that are economically beneficial to populations of the republics of Central Asia do exist and are often economically viable. One of the barriers to their adoption being faced is the lack of consideration of wider economic benefits of ecosystems – such as carbon storage – making options that would benefit Central Asia republics appear non-viable from an economic perspective. The second problem is related to deep-rooted cultural identities and customs, which do not necessarily support a transition degrading practices to more sustainable ones. Affinity for changes is not common, and proposed changes often face resistance amongst all various stakeholder-groups. To accomplish this, stakeholders should be involved in the development and planning process, which provides a sense of ownership and thus greater incentive to follow-up with implementation. It should also be a transparent process, in which the rationale, justifications, and incentives are emphasised.

Raising awareness

Raising awareness for the need to combat land degradation is very complex as it is a multi-layered phenomenon affecting local, national and regional scales. As the mainly rural population is highly dependent on productive land to meet their basic needs, vulnerability steadily increases and their livelihoods are at stake. Nonetheless, political awareness about the urgent need to combat land degradation is still not prevalent and often neglected for political reasons. On the contrary, the perceived ecological and economic value of land is considered very low and current policies in place fuel unsustainable land use trends rather than prevent it. The attitude of the rural population towards the values of productive land and especially sustainable use is more complex. In many cases, people are aware of their dependence on natural resources and sometimes even of deteriorating practices. Nevertheless, they are often bound to these processes for cultural or traditional reasons or due to a lack of alternatives. In other cases, they cannot opt for more sustainable practices as their living conditions are so vulnerable that they simply cannot afford to wait for long-term benefits. Thus awareness raising must be geared to the needs and preconditions of the respective target and stakeholder group.

Raising awareness for the situation in Central Asia must also take place in a global context and at international conferences. The close interrelation of land degradation and climate change can help to shape a common profile of the countries shared challenges. Shaping a narrative and position that makes the regions challenges and opportunities more visible in the international context is a useful approach in developing international relationships that foster support toward the implementation of sustainable land management. Strategies can include:

- Using media to share findings and best practices;
- Creating web platforms for inter-governmental issues, as well as finding ways to build accessible bridge of information flows to rural communities and older generations who rely less on technology for knowledge exchanges;
- Highlighting the potential for Central Asian countries to become global leaders in the fight against land degradation;
- Bridging gaps between relevant target groups to facilitate knowledge exchanges;
- Identifying and establishing ‘champions’ of the cause to raise awareness and garner momentum, who could be at the ministerial level but also from the public and civilians.

Organisation and empowerment

In the Central Asian republics, development potentials are inhibited due to poor governance of land and natural resources. Land degradation processes, such as salinisation, soil erosion, and overgrazing, are widely spread in the fragile semi-arid environment and further aggravated by climate change. Furthermore, ministries responsible for land use management are the least powerful and influential ones in each of

the five countries. Urgently needed responses to address the issue of land degradation in its full trans-boundary and trans-sectoral dimension, and acknowledging land as the essential basis for rural development, call for an increase in cultural, political, and social cooperation at different levels:

- Build relations between:
  - scientists and land users (farmers, pastoralists, etc.);
  - government and scientists;
  - sectors and ministries;
  - Central Asian and bordering countries;
- Establish management committees and where they are already in place mandate them with clear responsibilities and enable them to exert these;
- Establish national and regional intersectoral committees with the mandate to establish holistic management schemes with international support;
- Establish expert committees that can build on available information and advise relevant government institutions.

Research and training

To address such a multi-faceted and layered issue, it is critical to build both understanding and capacity within the region. This approach can be supported by creating university level-curricula and research programs that specifically target the economics of land degradation and cost-benefit analyses for sustainable land management scenarios. These can be inclusive of shared programs for regional researchers focusing on transboundary issues in Central Asia. Following the ecosystem-focused approach presented here can help to make programs relevant for all Central Asian countries and thereby facilitate exchange and future cooperation. It can also involve developing open, accessible courses to build capacity for various stakeholder groups, from land users to government representatives. Specific strategies and areas of support can include;

- Identify best land practices (biophysical, cultural);
- Close knowledge gaps through valid research, examples including:
  - ELD country-level reports;
    On-going economic research (e.g., GEF);
  - Literature review (WOCAT, CACILM);
- Build capacity, improve technology, and train practitioners;
- Develop drought resistant crops;
- Continue economic training for researchers and decision-makers (ability to independently perform and apply cost-benefit analyses);
- Farmer-field schools;
- Establish educational programs focused on holistic and sustainable land management;
- Create cooperation at the international level with universities (using already existing links and connections, e.g., via authors of these studies) to provide the region with educated scientists for further research projects.

Phase II, Next steps

The presented case studies and literature resources highlight the prevalent effects from their collective Soviet heritage, which remains crucial to address when tackling ongoing land degradation. It is vital in enabling decision-makers to create political and legal environments that facilitate implementation in order to address these issues, and to actually take the '+1' step towards tangible action. Going forward, strategic steps recommended are for implementation.

Implementation: Using the scientific results and economic arguments of the studies presented here for reforming sector strategies, including:

- Establishing ownership and land rights (legal);
- Setting up land rental schemes;
- Applying appropriate technology and infrastructure;
- Facilitating access to relevant technologies;
- Ensure water access (wells);
- Develop sustainable irrigation and drainage systems;
- Promote drought resistant crops;
- Monitor land and resource use (regulatory);
- Diversify livelihoods (economic);
- Encourage and facilitate eco-tourism and agricultural tourism;
- Public awareness and communication programs for alternative management.

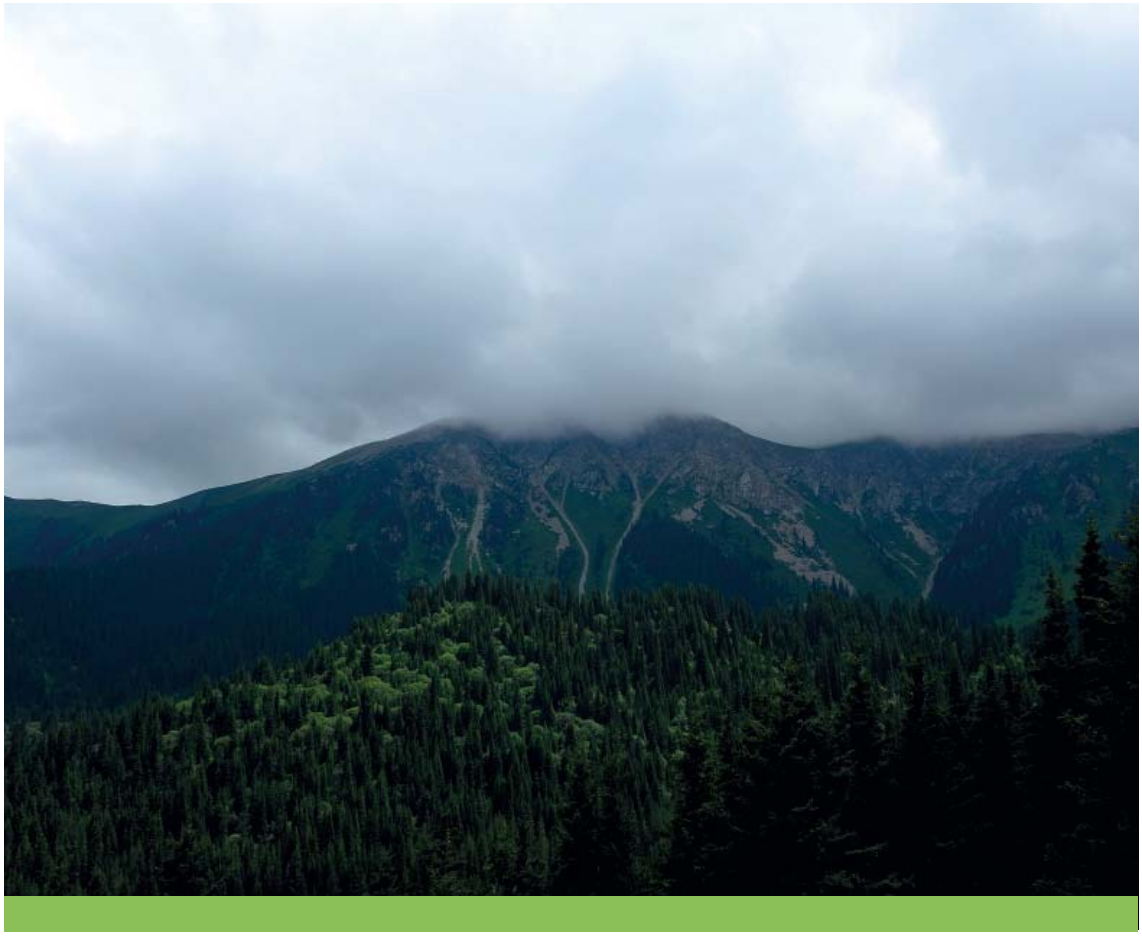
Additionally, diversification of income helps reduce vulnerability of populations to land degradation and climate change, and can also provide opportunities to undertake alternative practices that. There may need to be some intense work to find suitable ways around cultural factors and identities. If reduction of livestock is the aim of diversifying income sources, there also needs to be some thinking around livestock expansions as a vehicle for savings in lieu of a banking system.

Alignment of national and regional policies with international initiatives, such as the UNCCD's land degradation neutrality can support national endeavours to up- and out-scale potential sustainable land management schemes. A multitude of donor agencies are eager to support such processes. Further, a regionally coordinated approach to link the land degradation themes with efforts to create a more sustainable economy can help to reach agreed targets under the UNFCCC and CBD convention as well. International cooperation is a key factor to success due to the cross-boundary character of land degradation in Central Asia.

On the scientific side, because of the way this project was built, based on representative selected case studies, mapping of net benefits has not yet been undertaken. This would be essential to achieve land degradation neutrality and its measurement by each land cover class.

Regional commitments to address land degradation and ensure that the efforts to combat land degradation can be addressed mutually. The recent decisions by the Interstate Commission for Sustainable Developments should be followed up and implemented.

As a next step, the proposed land use alternatives should be tested across the different countries in the relevant areas. A possible framework for such a process could be the CACILM 2 project. Under CACILM 2, a specific component is dedicated to provide economic valuations and should be jointly utilized by all involved countries to develop a regionally relevant picture of the potential of sustainable land management to achieve economic prosperity.



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