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LAND DEGRADATION NEUTRALITY

A rationale for using participatory approaches to monitor and assess rangeland health

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Preface

Rangelands are vast, vital ecosystems covering over half of the Earth's surface; they are home to hundreds of millions of people, rich in biodiversity and a source of essential ecosystem services (ILRI *et al*., forthcoming). However, rangelands are also typified by uncertainty, often characterized by highly variable precipitation and temperatures (Briske, 2017). Due to these conditions, large-scale herbivore movement including extensive livestock production has become the main productive use of the rangelands (Lund, 2007). The dynamic and somewhat complex characteristics of rangelands have made them difficult to comprehend and at times, well-intended actions have led to negative consequences. One such area has been the monitoring of the health of rangelands. Rangeland monitoring has traditionally been very science-oriented, often to the exclusion of the land managers, failing to take into account their land management objectives and thus disregarding the rich, local knowledge of the range accumulated over years and passed from one generation to another to optimize the use of these landscapes (FAO and IUCN, forthcoming).

New opportunities are emerging through the Sustainable Development Goals (SDGs), including land degradation neutrality (LDN) targets, and through new initiatives such as the United Nations Decade on Ecosystem Restoration that underscore the importance of land as a finite resource and therefore in need of attention, better management and restoration when degraded. This publication seeks to explore issues such as: What determines a healthy rangeland? How do we monitor change and trends? Whose aspirations for the land determine the management of and investments in rangelands? In so doing, it has two principal goals: i) to highlight the importance of understanding rangeland health in order to assist countries to address land degradation (LD) in rangelands and thereby achieve LDN; and ii) to explain why integrated and participatory approaches, including those that bring together local/traditional knowledge and science, are important for robust monitoring in rangelands. This publication is informed to a large extent by the country experiences in piloting the participatory rangeland and grassland assessment (PRAGA) methodology.

The PRAGA methodology has been developed by the Food and Agriculture Organization of the United Nations (FAO) and the International Union for Conservation of Nature (IUCN), in partnership with governments and scientists from participating countries and other partners in Kenya, the Niger, Burkina Faso, Uruguay and Kyrgyzstan (FAO and IUCN, forthcoming). The initiative was funded by the Global Environment Facility.

The main target audience for this publication comprises governments, practitioners and policymakers, as well as other actors interested in restoration and sustainable management of rangelands.

Structure of the publication

The publication begins by making a case for the importance of rangelands from the social, economic and environmental perspectives. This is important as rangelands have not always received due attention in comparison with other biomes, in spite of the significant contributions they make to livelihoods and ecosystem services. It then examines in detail land degradation in rangelands, considering that degradation and what constitutes degradation mean different things to different people. The publication attempts to piece together the major lessons learned from previous tools and approaches. These lessons set the scene for how improvements can be achieved going forward, including recent experience piloting the PRAGA methodology.

PRAGA builds upon FAO's Land Degradation Assessment in Drylands (LADA) and IUCN's participatory assessment methodologies and is designed to assess **rangeland health** according to the **management objectives** of local land users, based on a combination of scientific and local knowledge (FAO and IUCN, forthcoming). The aim is to support improved targeting of policies and investment. The core guiding principles of PRAGA include participation by local communities, cost-effectiveness in data collection and analysis, use of indicators that are locally relevant and cognisance of the multifunctional nature of rangelands.

Evidence-based and informed decision-making resulting from such activities are vital for the planning of rangeland management and restoration initiatives. PRAGA is an effective tool to support this evidence-based decision-making.

Acknowledgements

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The authors are particularly grateful for the feedback provided by Hassan Roba and FAO colleagues, which improved the quality of the report.

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The production of this report was coordinated by Vivian Onyango (FAO).

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Acronyms

CSO	Civil society organization
COP	Conference of the Parties
DPSIR	Driving force-Pressure-State-Impact-Response Framework
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross domestic product
GLADA	Global Land Degradation Assessment
IUCN	International Union for Conservation of Nature
LD	Land degradation
LDN	Land degradation neutrality
NDVI	Normalized Difference Vegetation Index
NPP	Net primary productivity
NGO	Non-governmental organization
PRAGA	Participatory rangeland and grassland assessment
PUA	Pasture user association
SDGs	Sustainable Development Goals
SOC	Soil organic carbon
SLM	Sustainable land management
UN	United Nations
UNCCD	United Nations Convention to Combat Desertification

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1 General context

1.1 Definitions

Rangelands cover approximately 54 percent of Earth's free land surface (ILRI *et al.*, 2021) comprising diverse land systems under a range of biophysical conditions, with 68 percent of them located in developing countries (Zhang *et al.*, 2013). Given this complexity, various definitions of "rangelands" exist, in addition to the cultural aspects often associated with other similar terms such as grasslands, drylands, shrub, chaparral, steppe, savanna, tundra and desert (Lund, 2007).

At another level, the term "rangeland" refers to the management unit – a sociopolitical construct, which may contain a wide diversity of other ecosystem elements and areas suitable for other uses such as cultivation. Some such elements may not be classified as rangeland ecosystems – for example, oasis ecosystems, wetlands, riparian forests, woodland patches, areas of "rich patch" vegetation, and higher altitude forests (e.g. mist or alpine forests). Nevertheless, these resources within rangeland landscapes are often critical – sometimes seasonally essential – to the functioning of the rangeland management units and the associated livelihoods (Davies *et al.*, 2015).

This publication adopts a more recent definition of rangelands as:

> land on which the indigenous vegetation (climax or sub-climax) is predominantly grasses, grass-like plants, forbs or shrubs that are grazed or have the potential to be grazed, and which is used as a natural ecosystem for the production of grazing livestock and wildlife (Allen *et al.*, 2011),

while grassland:

> bridges pastureland and rangeland and may be natural or an imposed ecosystem … and has evolved to imply broad interpretation for lands committed to forage use (Allen *et al.*, 2011).

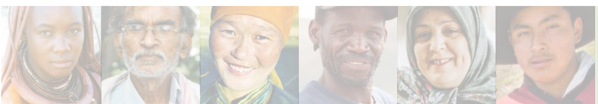
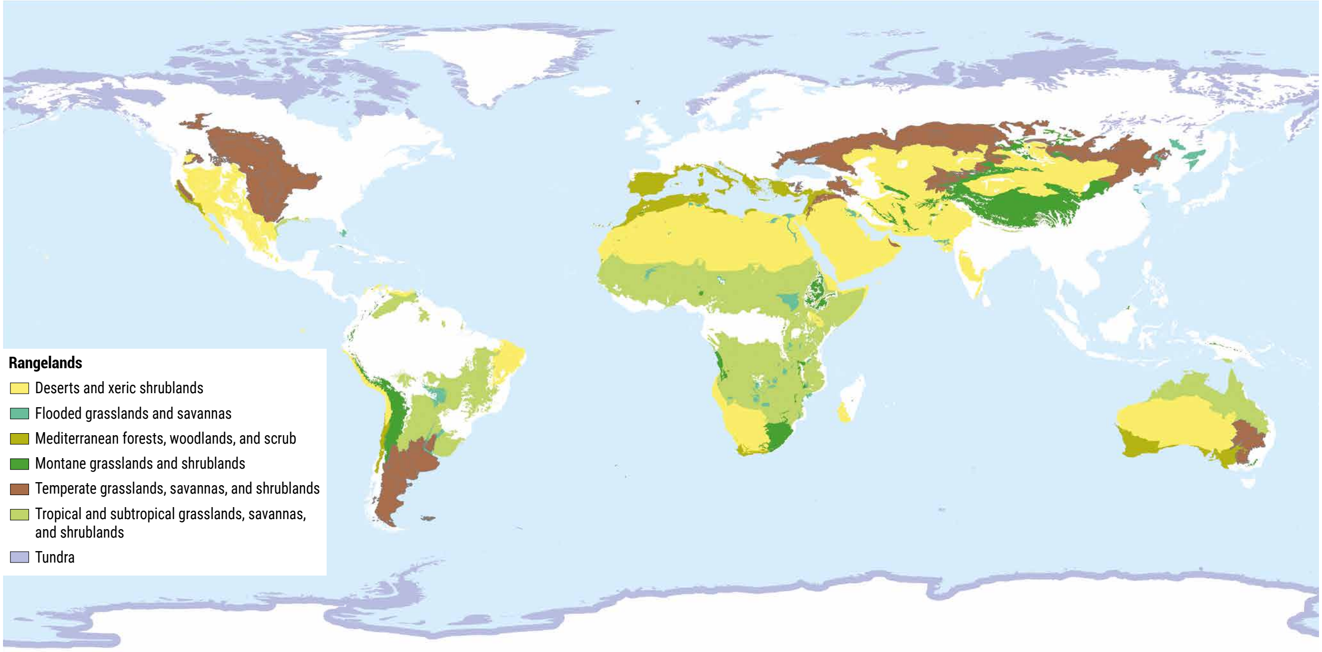


Figure 1. Map of world rangelands



Source: ILRI *et al.*, 2021.

Therefore, while rangelands are not a subset of grasslands, there is considerable overlap between the two.

The majority of rangelands are in drylands (Millennium Ecosystems Assessment, 2005). Dryland ecosystem functional groups are found in all seven terrestrial sub-realms in the International Union for Conservation of Nature (IUCN) ecosystem classification (Keith *et al.*, eds, 2020). For example, the "tropical and subtropical forests" sub-realm includes tropical/subtropical dry forests, while the "shrublands and shrub-dominated woodlands" sub-realm includes seasonally dry tropical shrublands and seasonally dry temperate heaths.

The production systems related to rangelands are very diverse. In some regions, native grasslands constitute the main source of feed for cattle and sustain private farm households. In Uruguay's Rio de la Plata region, 81 percent of grasslands are farms, of which 66 percent are family owned while the remainder are owned by corporations (Modernel *et al.*, 2016). In addition to livestock production, rangelands are also used by wild ungulates and for hunter-gatherer activities. No rangeland

system is entirely natural, as there are many degrees of human interference, from grazing and clearing to soil disturbance and fires. These practices are often an integral part of the ecological management and functioning of rangelands given their evolutionary development under such regimes (FAO, 2016).

1.2 Global rangelands and their importance

Rangelands are **dynamic, multifunctional landscapes** that play various environmental, economic and societal roles. Rangelands dominate in large areas of the Earth where ecological conditions support communities of grasses, shrubs and trees. These are typically regions with high climatic and ecological variability (short, medium and long term), which do not naturally tend towards a fixed ecological state (Behnke, Scoones and Kerven, eds, 1993). There is a general unfamiliarity and lack of consensus regarding what constitutes healthy, functional rangeland landscapes; furthermore, the generalized narrative that focuses on overgrazing, undernourished livestock, erosion, desertification, drought, famine and conflict has contributed to the negative stereotypes typically associated with these land systems (Liniger and Mekdaschi-Studer, 2019).

There are over half a billion people dependent on rangelands for their livelihoods including for the production of relatively cheap meat, milk, milk-based products, leather and natural fibres (Lund, 2007). This dependence includes the reliance on grasslands for food and forage production as they are the primary source of meat and dairy products. In developing countries, over 80 percent of small and large ruminants are found in rainfed grazing systems, predominantly rangelands (Steinfeld, Wassenaar and Jutzi, 2006).

In Near East countries, rangelands provide approximately 90 percent of the nutritional intake of domestic livestock, while in some African countries, this figure can reach 100 percent. Even in more developed countries such as the United States of America, which rely on grain-based feedlot systems to fatten and finish livestock before slaughter, natural forages and roughages account for 80–85 percent of intake when the animal's life cycle is observed (Huss, 1996).

Although only limited data are available on the value of services provided by rangelands on a global scale, this value may be astronomical – even incalculable. The United States of America cattle industry alone had a production value of USD 50.2 billion in 2017 (NASS, 2018); in the same year, the red meat and livestock

industry contributed USD 18.5 billion to the Australian economy, i.e. 1.5 percent of the gross domestic product (GDP), supported approximately 80 300 private enterprises and employed either directly or indirectly 404 800 people (Meat and Livestock Australia, 2020).

Rangelands are also a source of genetic resources, medicinal resources (e.g. biochemicals, drugs) and ornamental resources (e.g. materials for handicrafts and decorative arts). These ecosystems also generate supporting services essential for life, such as photosynthesis, nutrient cycling and soil formation. Forests and other climax vegetation types often receive more attention than rangelands for their role in water cycles; however, the quantities of water captured by rangelands and other dryland systems can be quite significant. For example, the Wadi Jizan in Saudi Arabia covers approximately 1 100 km^2 and the estimated surface flow to Jizan Dam is 90 million m^3 per year, despite its location in an area with typical annual rainfall of 100 mm (Huss, 1996).

Regulatory services to ecosystem processes including air and water purification and climate stabilization and regulation are essential for maintaining equilibriums and feedback loops and they are quickly gaining traction including with the Sustainable Development Goals (SDGs) (Zhao, Liu and Wu, 2020). Some of the contributions by rangelands to SDGs are elaborated in Figure 2.

Rangeland systems provide important cultural services with both economic and non-monetary benefits. Tourism, inspiration, tradition, recreation, religion, history, education, therapeutic effects, aesthetics and sense of belonging are all values linked to rangelands that create local patterns of political, social and economic behaviours (Lund, 2007). Many of the world's national parks and globally recognized landscapes are found in extensive rangeland areas, creating sustainable economic benefits for local communities while conserving vital habitats. The wild animals typically associated with rangelands are among the most recognized and emblematic in their respective countries and regions. Indeed, the pastoral component of many cultures and communities is the defining aspect that not only determines how they live but how they view and present themselves to the world (Liniger and Mekdaschi-Studer, 2019).

There follows a general overview of the key global rangeland ecological zones included in the PRAGA project, highlighting the vital role rangelands play in the respective regions.

Figure 2. Sustainable rangeland management and contributions to the SDGs

Sustainable rangelands management and the SDGs

Goal 1: No poverty

- Rangelands are multifunctional landscapes that support diverse livelihoods.
- Multiple uses exist for livestock and livestock products.
- Social systems and networks of communities are found in rangelands, e.g. pastoral communal networks contribute to risk reduction.

Goal 2: Zero hunger

- Rangeland landscapes support diverse food sources and healthy diets.
- Livestock convert plants to high quality proteins.
- Sale of rangeland products including livestock to buy plant-based foods allows for healthy diets.

Goal 5: Gender equality

- Gender duties are disaggregated, e.g. women manage small livestock and milk, earning income and livelihood for families.
- Women are recognized for their specialist knowledge in management of rangelands, especially resources located closer to homesteads.
- Men and women rely on natural resources and therefore healthy rangelands for their livelihood activities.

Goal 17: Partnerships for the Goals

- Cross-sectoral coherences can be realized through partnerships in support of sustainable rangeland management, e.g. through diverse government departments and ministries.

Goal 6: Clean water and sanitation

- Rangelands play a key role in the hydrological cycle allowing infiltration of rainwater, recharging underground water resources and reducing surface flows.
- Water and pasture management are linked in rangelands, therefore water points need to be reasonably distanced to enable balanced use of landscape and to avoid overcrowding and degradation of water and pasture resources.
- In drylands, pasture management is linked to water availability, with designated grazing areas for dry seasons and wet seasons to allow optimal use of landscape resources.

Goal 15: Life on land

- Rangelands are biodiversity reservoirs for both plants and animals.
- Sustainably managed rangelands supply several ecosystem services including pollination, soil formation and conservation.

Goal 13: Climate action

- Vast rangelands store and sequester considerable amounts of carbon.
- Vegetation cover in rangelands reduces the albedo effect.
- Strategies employed by local communities such as mobility enable resilience to climate change.

Goal 8: Decent work and economic growth

- Livestock production makes a substantial contribution to local and national economies.
- Rangelands make a direct contribution to local, national and international economies, e.g. through exemplary tourism attractions, the majority of which are found in rangelands.

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1.2.1 Sub-saharan savannahs & drylands

Rangelands in sub-Saharan savannas and drylands of Africa are very diverse ecosystems with a range of dominant species dependent on rainfall, soil type and management system. The Sahel is characterized by unimodal rains concentrated in August, while the Guinea Coast and Sudano-Guinean zones have bimodal rainfall regimes in June and October (Ta *et al*., 2016). East Africa has bimodal rainfall concentrated in March/April and October/November (Nicholson, 2017).

These rangeland systems often include dry forests, woodland, bushland, wooded savanna, shrubland, semi-desert and desert. Exceptional *sensu stricto* grassland is restricted to particular soil, climate and management conditions, for example: vertisols and certain types of shallow soils; aquatic meadows around rivers and ponds; very arid climatic conditions (e.g. those in the northern Sahel); and some southern African velds under management practices that tend to eliminate woody species. Most of the vast rangelands in sub-Saharan Africa are used for pastoralism – the extensive livestock production typified by mobility across space and time.

Box 1. **Pastoralism in sub-Saharan rangelands**

Pastoralism is important to many sub-Saharan economies contributing approximately 10–44 percent of the gross domestic product (GDP) of these countries while over 1 billion people benefit from the livestock value chain (Karaimu, 2013). In Kenya, pastoralism accounts for approximately 13 percent of the GDP through traditional (meat, milk and fibre) and indirect (tourism) benefits derived from pastoral landscapes (Nyariki and Amwata, 2019). Pastoralism is the dominant form of land use and economic activity for Sahelian countries, including the Niger and Burkina Faso. The three main pastoral systems – nomadism, transhumance and agropastoralism – use mobility to enable optimal use of the vast landscapes typified by dispersed pasture and water resources, by linking resource availability with use in space and time. In the Sahel, adapted mobility is increasingly important to deal with frequent droughts, expansion of crop areas (including along migratory corridors) and larger herd sizes (FAO and CIRAD, 2012). Diversity of the systems enables a range of animals to be kept, including cattle, goats, sheep and camels. Pastoralism provides a source of food from animal products and a means to acquire non-animal products (e.g. cereals) through the sale of small ruminants and livestock products (e.g. milk). Livestock are a source of social standing in communities, but they also support crop production in a symbiotic relationship where animals deposit manure in the fields while feeding on crop residues. Unfortunately, this relationship is

>

under increasing strain in some Sahelian countries due to conflicts over resources. Overall, there has been an increase in livestock production in both the Niger and Burkina Faso – largely due to increased livestock herds (De Haan *et al*., 2016).

Protected areas are also found in rangelands of sub-Saharan Africa, such as the transboundary W National Park in the Niger, Burkina Faso and Benin. The park, which is a designated United Nations Educational, Scientific and Cultural Organization (UNESCO) biosphere reserve, covers over 3 million ha and hosts rich biodiversity including the largest population of ungulates in West Africa (UNESCO, 2020). Many of the parks are also used periodically by livestock herds – albeit with some restrictions – as pastoralists search for better pastures for their herds. However, when well managed, the interference by livestock is beneficial to the ecological processes of the landscape with, for example, improved productivity as a result of grazing by mixed herds (Fraser *et al*., 2007).

Notes:

De Haan, C. Etienne, D., Garancher, B. & Quintero, C. 2016. *Pastoralism development in the Sahel: A road to stability?* Washington, DC, World Bank.

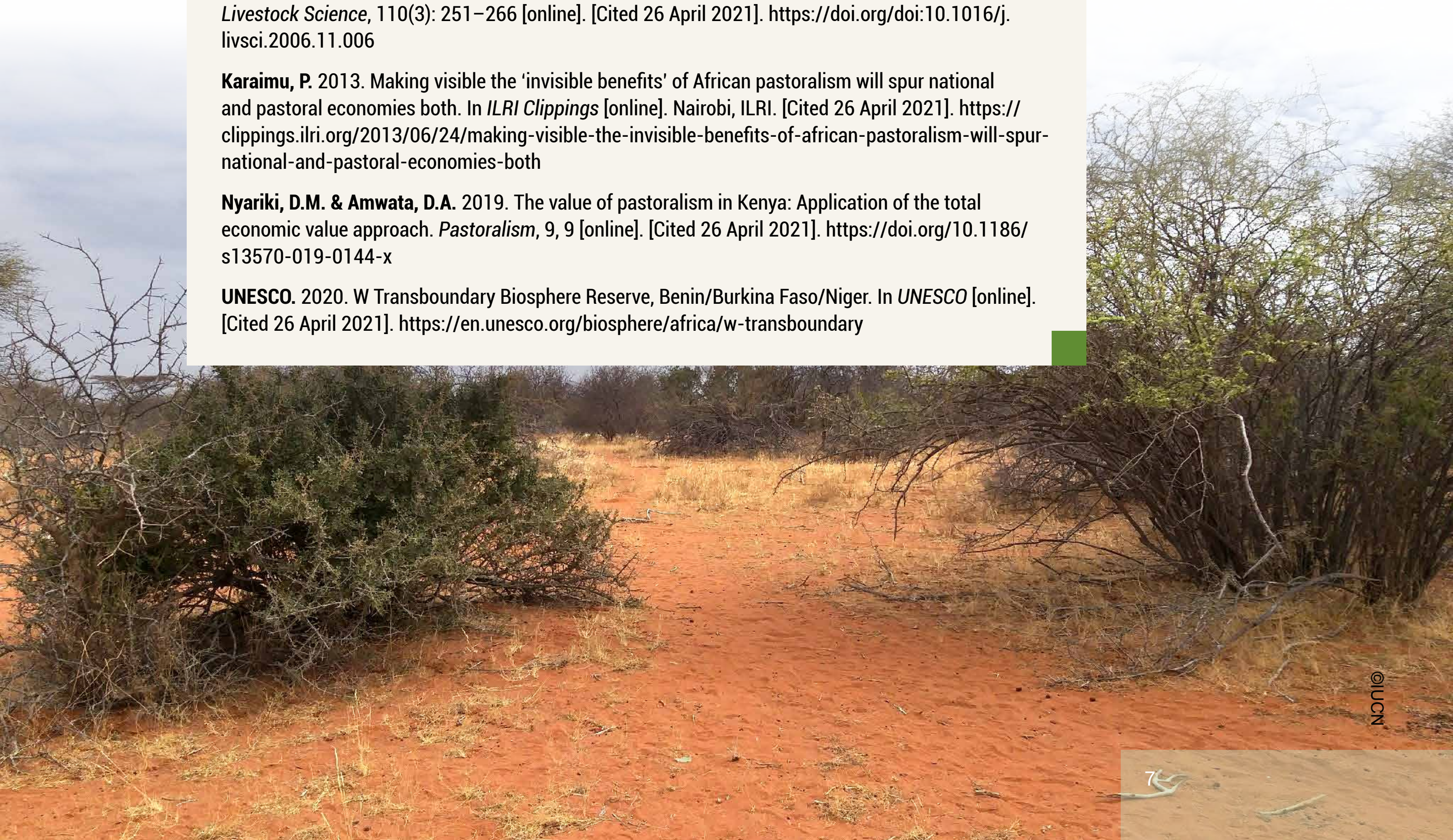
FAO & CIRAD. 2012. *Information systems on pastoralism in the Sahel. Atlas of trends in pastoral systems in the Sahel 1970–2012.* Rome. (also available at http://www.fao.org/3/i2601e/i2601e.pdf).

Fraser, M.D., Davies, D.A., Vale, J.E., Hirst, W.M. & Wright, I.A. 2007. Effects on animal performance and sward composition of mixed and sequential grazing of permanent pasture by cattle and sheep. *Livestock Science*, 110(3): 251–266 [online]. [Cited 26 April 2021]. https://doi.org/doi:10.1016/j.livsci.2006.11.006

Karaimu, P. 2013. Making visible the 'invisible benefits' of African pastoralism will spur national and pastoral economies both. In *ILRI Clippings* [online]. Nairobi, ILRI. [Cited 26 April 2021]. https://clippings.ilri.org/2013/06/24/making-visible-the-invisible-benefits-of-african-pastoralism-will-spur-national-and-pastoral-economies-both

Nyariki, D.M. & Amwata, D.A. 2019. The value of pastoralism in Kenya: Application of the total economic value approach. *Pastoralism*, 9, 9 [online]. [Cited 26 April 2021]. https://doi.org/10.1186/s13570-019-0144-x

UNESCO. 2020. W Transboundary Biosphere Reserve, Benin/Burkina Faso/Niger. In *UNESCO* [online]. [Cited 26 April 2021]. https://en.unesco.org/biosphere/africa/w-transboundary



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1.2.2. Pampas and Campos grasslands in southern South America

The grasslands of the Rio de la Plata Basin, comprising the Pampas ecoregions in Argentina, the Campos in Uruguay and part of Rio Grande do Sul in Brazil, constitute one of the largest temperate natural grassland regions in the world. These vast plains alternate flat surfaces with slightly undulating reliefs, and are characterized by vegetation that is predominantly grass species and almost completely devoid of trees. They occupy an area of nearly 70 million ha and have been identified as one of the regions with the greatest diversity of grasses on Earth: around 3 000 vascular plants, of which 450 grasses and 150 legumes are considered as forage for domestic grazing animals (Carvalho *et al*., 2011). They also host 300 species of birds, 29 species of mammals, 49 species of reptiles and 35 species of amphibians; approximately 5 percent of Latin America's soil organic carbon (SOC) is stocked here (Modernel *et al*., 2016).

The climate is temperate and enjoys the moderating influence of the Atlantic Ocean that reduces extreme conditions. Climate conditions differ following southwest to northeast gradients in annual precipitation (from 700 mm to 1 600 mm) and average annual temperature (from 14 °C to 22 °C). The relative dominance of C3 and C4 grass species results in two major biomes: Pampas and Campos. While C3 species dominate in the Pampas of Argentina, the Campos of Brazil and Uruguay are dominated by C4 grasses (Esteves *et al*., 2017).

Figure 3 A view of Uruguayan grasslands

Box 2. **Livestock production based on grassland in Uruguay**

In Uruguay, about half of the land under livestock and farming systems is privately owned while a third is under lease. In 2017, there were 12 million cattle and 6.6 million sheep in 47 000 establishments occupying approximately 15 million ha. Of the beef produced, 70 percent is for the export market and the value of the livestock sector is approximately USD 2 billion – i.e. half of the agricultural production (Perez Rocha, 2020).

In 2016, agricultural production generated 228 000 direct jobs – equivalent to 15 percent of the personnel employed throughout the country – and the livestock sector was the main source of employment for the agricultural sector (Perez Rocha, 2020). The advances in the national economy, of which agriculture and especially livestock were important drivers, allowed better access to basic services such as water, sanitation and electricity by both rural and urban populations. These changes have implied a reduction in the gap between living conditions in rural areas and those in urban areas. In fact, the dispersed rural environment presents better living conditions than the urban areas where poverty is higher. Nevertheless, new trends show increasing departure from rural areas and a falling rural population, which in 2018 accounted for just 4.76 percent of the total population. With an estimated 3 percent annual drop in rural populations, the long-term implications for livestock production and the health of grasslands remain to be seen.

Notes:

Perez Rocha, J. 2020. *El estado del campo natural en el Uruguay*. Montevideo, FAO. (also available at https://doi.org/10.4060/cb0989es).

1.2.3 Central Asian steppes and grasslands

The Central Asian steppes are located from Mongolia and northern China to Europe, within the Qinghai-Tibetan Plateau and along the adjacent mountain grazing areas of the Himalaya to Hindu Kush.

The open steppes in the region show an increase in precipitation as one moves away from central Uzbekistan and northern Turkmenistan and towards the upper latitudes of Kazakhstan. Another dryland area extends from the Aral Sea to Lake Balkhash and surroundings. The Tian-Shan Mountains and neighbouring chains capture much of the water that flows into the principal river systems and closed-basin catchments of the wider region (Lemenkova, 2012).

These grasslands and their associated communities saw dramatic changes in the twentieth century and with the expansion of the Soviet Union (Jamsranjav, 2018). Land cover change was particularly intense on the richer soils and drainage areas of

the steppes, as former grasslands and forests were converted to arable croplands. Changes in the former vegetation and water tables resulted in increased salinity of croplands and the wider landscape. Pasture production is believed to have increased under the Soviet system through pasture improvement, infrastructure development, education and maintenance of well-organized transhumance movements of livestock, people and materials; however, the impacts on the nomadic and semi-nomadic cultures were intense and have proven permanent (Mogilevskii *et al*., 2017). The extent and degree of land degradation (LD) caused by the intensification of rangeland production under Soviet rule is also debated among experts (Livine *et al*., 2017). Despite concerns regarding high levels of LD affecting pasturelands, questions remain about the assessment methodologies used, such as the over-reliance on satellite imagery to assess land cover and land cover change by using, for example, the Normalised Difference Vegetation Index (NDVI) as a proxy for LD and equating increasing greenness to increasing healthy rangeland conditions and vice versa. This publication argues that the use of such methodologies for rangelands can result in false alarms or may identify "degraded" areas where in reality the biomass has been temporarily removed by grazing and the land is otherwise healthy.

It is often access to and availability of water that determine patterns of rangeland use and management in the lower steppes and rangelands, while it is altitude – and to a lesser extent aspect – that define vegetation communities in more mountainous areas, as well as the seasonality and intensity of their use. Lack of investment and poor infrastructure maintenance have led to an intensification of livestock grazing around settlement areas; one consequence is that more distant, isolated and difficult-to-access pasture areas are being abandoned and degraded by bush encroachment (Hankerson *et al*., 2019).

Figure 4. Landscape photo in Naryn, Kyrgyzstan

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2 Land degradation in rangelands

2.1 Background

Definitions of land degradation and the associated indicators vary widely. The most commonly cited definition of land degradation is:

> long term failure to balance demand for and supply of ecosystems goods and services (Millennium Ecosystem Assessment, 2005).

The United Nations Convention to Combat Desertification (UNCCD) defines land degradation as:

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

There are still discrepancies in the assessment of the extent of degraded lands at the global, regional and even country level. Divergence in assessment approaches of land degradation previously resulted in substantial variation in the amount of degraded area: from < 1 billion ha to > 6 billion ha, with further disagreement regarding the spatial distribution (Gibbs and Salmon, 2015); however, there is currently more convergence. According to UNCCD, an estimated 25 percent of land is highly degraded, 36 percent moderately degraded though stable, and 10 percent is seen to be improving in terms of land potential indicators (Orr and Cowie, 2017). Land degradation is reportedly wiping out between 10 and 17 percent of global GDP every year due to an annual cost of approximately USD 6.3–10.3 trillion (ELD, 2015). This underscores the need to focus on stopping further degradation and promoting restoration of degraded areas. As there is a fixed amount of dryland on Earth, degradation reduces productivity and the opportunities that fully functioning ecosystems can provide for growing human populations.

Box 3. **Land degradation trends**

A global analysis of the period 1981–2003 using remotely sensed data revealed degradation of 24 percent of the land area. However, this analysis only showed vegetation changes during the monitored period and makes no assessments of what has been called "the legacy of thousands of years of mismanagement in some long-settled areas" (Bai *et al.,* 2008). The analysis revealed that cropland and forest land were overly represented: 19 percent of degrading land is cropland even though cropland only accounts for 12 percent of the land area and a further 4 percent in mosaics; 43 percent of degrading land is forest even though forest occupies only 28 percent of the land. The analysis found that drylands did not feature strongly in ongoing land degradation: 78 percent of degradation by area was in humid regions whereas 22 percent was in drylands (Bai *et al.,* 2008).

An analysis of long-term trends (25 years) using an inter-annual vegetation index as an indicator of biomass production decline or increase found that land degradation hotspots cover about 29 percent of global land area and occur in all agro-ecologies and land cover types. Anthropogenic declines in biomass productivity were found on 25 percent of croplands and vegetation–crop mosaics, 29 percent of mosaics of forests with shrub- and grasslands, 25 percent of shrublands, and 33 percent of grasslands, as well as 23 percent of areas with sparse vegetation. Biomass productivity improved on 2.7 percent of the global land mass (Bao Le, Nkonya and Mirzabaev, 2014).

Notes:

Bai, Z.G., Dent, D.L., Olsson, L. & Schaepman, M.E. 2008. *Global assessment of land degradation and improvement. 1. Identification by remote sensing.* GLADA Report 5. Wageningen, the Netherlands, ISRIC – World Soil Information.

Bao Le, Q., Nkonya, E. & Mirzabaev, A. 2014. *Biomass productivity-based mapping of global land degradation hotspots.* ZEF Discussion Papers on Development Policy No. 193. Bonn, University of Bonn, Center for Development Research.

2.2 Degradation in rangelands

In spite of their importance, rangelands have not tended to be the subject of interest or focus of study in the way that other ecosystems have been; as a global society, there is still much to understand about their dynamic nature. For instance, estimates on degraded areas change over time – not only as the rangelands themselves change under different management, but as changes occur in terms of definitions, indicators and assessment tools used (Jamsranjav *et al*., 2018; Liniger and Mekdaschi-Studer, 2019; Livine *et al*., 2017; Sabyrbekov, 2019). Studies in the first global rangeland assessment undertaken placed 73 percent of the world's rangeland in the "degraded" category; however, in recent decades there has been a significant fall in these estimates (Jamsranjav *et al*., 2018).

Gang *et al*. (2014) estimated that globally, 49.25 percent of grasslands are undergoing degradation and nearly 5 percent of rangelands are strongly to extremely degraded. The Global Land Degradation Assessment (GLADA) in 2008 reported that 16 percent of rangelands were undergoing historical change with 20–25 percent of the total land area reporting negative trends in productivity (Bai *et al*., 2008). However, the authors were torn: should declining trends in productivity from remote sensing be labelled as outright degradation or not actually defined as land degradation?

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

- **Differences in defining degradation**. This is particularly apparent when older reference conditions are compared to current field conditions. Moreover, some of the changes observed are reversible or form part of the rangeland's dynamic features; others are permanent, irreversible changes in ecological structures and/or functions (Isakov and Thorsson, 2015). The two are often difficult to separate, even more so in studies that are limited in terms of both time and funding.
- **Reliance on large-scale data sources such as satellite imagery and weak links to other factors affecting productivity.** Large-scale degradation assessments often rely on tools such as NDVI to determine land productivity and its trends. However, while NDVI can provide an indication of available standing biomass, the links to land productivity can be problematic when biomass is being removed only temporarily through grazing. In order to properly establish land productivity in areas undergoing consistent grazing, it would be necessary to establish control areas or some means of isolating other factors of change from grazing impact. In non-equilibrium systems, climatic factors such as precipitation should be considered, as they have greater influence on plant productivity than livestock grazing (Jamsranjav *et al*., 2018).
- **Limitations in scope.** Most national LD assessments targeting rangelands have limited spatial scope, principally due to the costs of assessment, and the results are correlated with similar areas. The isolation of drivers and the impact of livestock become less accurate as results from small test sites are scaled up to regional, national or international levels.
- **Lack of adequate engagement of land users to develop more complete models and poor understanding of rangeland dynamics.** Experts have argued for the need for increased communications with pastoralist communities to improve scientific approaches to assessment. It is necessary to integrate local knowledge and/or local ecological interpretation of rangeland health with scientific methods (Roba and Oba, 2008; Liniger and Mekdaschi-Studer, 2019). These are essential

for understanding, for example, how rangelands change seasonally or following precipitation events.

- **Differing management objectives.** Rangelands have multiple human and environmental dimensions, uses and interconnectedness of land functions; this can make it challenging to define their use or even their healthy on non-healthy state. The conversion of grasslands to croplands is categorized as degradation, while conversions to forestry are not – even though the latter can lead to wide-scale loss of biodiversity (e.g. under large-scale monoculture plantations). The conversion of grasslands to shrublands may be preferable for a camel producer, but may be considered degradation by the herbaceous-preferring cattle keepers.

The multifunctional nature of rangelands has seen them used by various groups with distinct management objectives over time. Historically, this use has been without many restrictions; in some cases, it has contributed to changing conditions of land and even reduced the potential to continue providing ecosystem goods and services. In rangelands, land degradation affects the availability of resources such as fodder (for livestock and wildlife), medicines (for humans and livestock) and timber, as well as biodiversity and the regulation of the local and global climate.

The principal types of land degradation in rangelands include decline in biomass production, soil erosion, presence of invasive species, loss of biodiversity and a reduction in essential ecosystem services. The causes of land degradation can be natural factors, such as frequent droughts due to climate change that hinder the ability of biomass to regenerate effectively, or anthropogenic factors, such as the conversion of grasslands or overgrazing when mobility is hampered. Underlying drivers of rangeland degradation include inappropriate policies, as well as poor recognition and understanding of the value of these ecosystems and how they operate, which leads to their mismanagement.

Studies show a dearth of investments for tackling land degradation, particularly in pastoral areas (Nkonya *et al.*, 2016), even in the presence of policy frameworks supporting sustainable natural resources management. However complex the situation may appear, studies show that investments to arrest or address LD often have high rates of return and benefit multiple economic sectors. It is not uncommon to see returns of up to 200 percent within the first five years; for long-term approaches (> 30 years) the return can be as high as five dollars for each dollar invested (Hawken, ed., 2017; Nkonya *et al.*, 2016).

Box 4. **Overview of land degradation impacts in Africa, Asia and Latin America**

Land degradation as a threat multiplier in sub-Saharan Africa

The patterns, processes and potential for reversing degradation and restoring dryland ecosystems are particularly important in countries like Kenya where over 75 percent of the land is classified as arid and semi-arid land (ASAL). Recent research suggests that land degradation is widespread in Kenya with over 60 percent of the land surface at risk of degradation (Mulinge *et al.*, 2016), with the risk particularly high in ASAL areas. The direct costs of land degradation due to land use and cover change were approximated to exceed USD 1.3 billion a year between 2001 and 2009, while indirect costs in terms of lost production of meat and milk were approximated to equal USD 80 million annually (Mulinge *et al.*, 2016). Land degradation, including the productivity of ASAL regions, is a key component of Kenya's vision for sustainable development. In 2016, Kenya committed to restoring 5.1 million ha of land as part of its commitment to land degradation neutrality (LDN) through the African Forest Landscape Restoration Initiative.

In the Niger, where livestock, crop farming and forest products are the main source of food and income, soil erosion and land degradation pose major environmental and development issues. Each year, more than 200 000 ha of cropland and rangeland are degraded due to human activities and climate change. In rural areas, the interconnection problems of poverty, vulnerability, land degradation and low agricultural productivity are very severe, exacerbating conflict due to scarcity of arable land, together with food insecurity, poverty, and other social and environmental problems. Fully aware of the linkage between land degradation and poverty, particularly in rural areas, the Niger has undertaken significant measures to promote sustainable land management (SLM) practices with the support of development partners. In 2014, it adopted a Strategic Framework for SLM and its Investment Plan 2015–2029, which is seen as a relevant tool for implementing national plans and programmes to combat land degradation, tackle loss of biodiversity, adapt and mitigate climate change, and improve agricultural productivity. In 2017, the country committed to achieve LDN by 2030 through reducing degraded land areas from 9 percent to 5 percent in order to increase vegetation cover from 17 percent to 19 percent and to improve in a sustainable way the livelihood of rural populations.

Transformation and degradation of natural grasslands in Latin America

Extensive livestock production has taken place for over 300 years; from the second half of the nineteenth century, the main trend in the historical transformation of native grasslands in the Southern Cone was the intensification of agriculture. This phenomenon was especially prevalent in Brazil, Argentina and Uruguay and from 2000 it increased in intensity. The major causes of degradation in rangelands are overgrazing by animals, invasive exotic

>

species and nutrient addition and/or the introduction of exotic forage species into native grasslands (Tiscornia, Jaurena and Baeethgen, 2019).

In Uruguay, the negative effects of these changes in land use include landscape fragmentation, loss of biodiversity, invasive species, soil erosion, and changes in water quality and rural lifestyles (e.g. the migration of the rural population at a rate of 1 percent a year, in particular the migration of the population economically linked to the livestock sector [Perez Rocha, 2020]). Yet, The Rio de la Plata Grasslands still maintain some of their original characteristics, especially the rich biodiversity and fodder production.

The cost of land degradation in Kyrgyzstan

The Global Mechanism of the UNCCD (UNCCD, 2018) estimated that land degradation costs Kyrgyzstan up to USD 601 million every year (equivalent to 16 percent of the country's GDP).

Kyrgyzstan has identified four priority areas with relative targets (Ministry of Agriculture, Food Industry and Amelioration, 2017):

- Improvement of environmental condition of pastures – through introduction of a pasture rotation system in at least 40 village districts (ayil aimaks).
- Better access to 10 000 ha of pastures – via improved pasture infrastructure (bridges/roads, water points).
- Sustainable land management – with adoption of SLM practices on 100 000 ha of land area (including both pastures and forests).
- Land improvement – with works conducted on 10 000 ha.

Kyrgyzstan presented a unique opportunity to test a methodology in a country characterized by a strong tradition of pastoralism, with experience and hands-on knowledge of pasture monitoring systems and indicators, as well as a legal framework with clear national LDN targets.

Notes:

Ministry of Agriculture, Food Industry and Amelioration. 2017. *High level note on Land Degradation Neutrality targets in the Kyrgyz Republic.*

Mulinge, W., Gicheru, P., Murithi, F., Maingi, P., Kihiu, E., Kirui, O.K. & Mirzabaev, A. 2016. Economics of land degradation and improvement in Kenya. In E. Nkonya, A. Mirzabaev & J. von Braun, eds. *Economics of land degradation and improvement – A global assessment for sustainable development*, pp. 471–498 [online]. Springer, Cham. [Cited 26 April 2021]. https://doi.org/10.1007/978-3-319-19168-3_16

Perez Rocha, J. 2020. *El estado del campo natural en el Uruguay.* Montevideo, FAO. (also available at https://doi.org/10.4060/cb0989es).

Tiscornia, G., Jaurena, M. & Baethgen, W. 2019. Drivers, process, and consequences of native grassland degradation: Insights from a literature review and a survey in Río de la Plata grasslands. *Agronomy*, 9(5) [online]. [Cited 26 April 2021]. https://doi.org/10.3390/agronomy9050239

UNCCD. 2018. *Country Profile Kyrgyzstan: Investing in Land Degradation Neutrality: Making the case – An overview of indicators and assessments* [online]. Bonn, UNCCD. [Cited 26 April 2021]. https://www.unccd.int/actionsldn-programme/ldn-country-profiles

2.3 What are the implications for pastoral communities?

Pastoral communities derive their livelihoods mainly from land-based assets and services. When these decline and the situation is exacerbated by, for example, climate change, poor policies and weakening governance structures, communities become increasingly vulnerable. These drivers, the pressures of land degradation or wider environmental degradation, are influenced by complex underlying factors that require better understanding if sustainable management and responsible investments are to be realized in rangelands. For instance, pastoralists employ a range of strategies to use relatively marginal rangelands and prevent their degradation. Strategies such as keeping mixed herds and mobility enable the tracking of spatial and temporal dynamics of nutrient fluxes without overgrazing, thus ensuring optimal use of the landscapes while allowing regeneration of vegetation. The resilience of pastoral systems is supported by adaptive responses to changes and dynamics in production and these are usually informed by deep local ecological knowledge. However, they are continuously constrained by anthropogenic interferences including subdivision and fragmentation of land, land conversion, fencing, and changing of livestock herds due to market demands and changing land cover. A linear response is therefore not ideal for responding to such challenges; a multi-pronged approach is required to interrogate underlying policies, take into account a wider socio-economic environment and understand the impacts of climate change on people and natural resources.

Figure 5. Camels in Kenya

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Pastoral systems are labour-intensive with a clear male–female separation of roles; as a result, land degradation affects women and men differently. Women for example often rely on resources located close to the homestead so that they can take care of small animals, sick and lactating animals; men on the other hand are often responsible for larger herds and resources located further away from home. Men may get entangled in conflicts as they seek pastures in faraway land or they may choose to concentrate on pastures closer to home, accelerating the land degradation (as is the case in Kyrgyzstan) and allowing men to potentially take over family resources initially managed by women. As local resources degrade, women may have to travel further afield to access natural resources, resulting in an increased workload (Karmebäck *et al*., 2015).

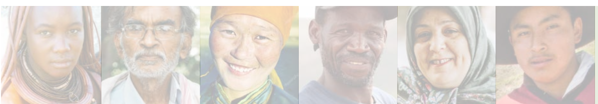
As working age men migrate to distant pastures for extended periods or exit pastoral systems for more financially lucrative opportunities in neighbouring countries and cities, more herding responsibilities fall to the women who are also consistently required to lead the household and ensure livelihoods for dispersed families. The impact can be both positive and negative: positive as women take on a leadership role, but negative as their overall workload increases.

Rangelands are dynamic and complex systems, and their assessment and management can therefore be difficult, given the multitude of interacting socio-ecological factors, including the production and management objectives of those that use them. It is important to integrate socio-economic dynamics when trying to understand the effects of land degradation on communities and design restoration programmes. Other underlying social conditions such as the unequal land rights of women compared to men in many pastoral societies should be carefully considered.

3 Assessment and monitoring of land degradation in rangelands

This publication outlines the importance of rangelands both to local communities for whom they are a source of livelihood and to global communities who depend on the ecosystem goods and services supplied by rangelands. It also highlights how – in spite of their importance – rangelands have not always received commensurate attention and lag behind in terms of the data needed to support their sustainable management. Faced with these challenges, rangelands must also deal with risks of degradation driven by a myriad of factors including rising population, climate change and weak governance and policies. Yet pertinent questions (and even disagreements) persist regarding the true extent of rangelands, what a healthy rangeland is and what constitutes a degraded rangeland. In order to move towards informed and suitable decisions on management and investments in rangelands, these divides need to be bridged.

The concept of rangeland monitoring was developed in the twentieth century with a focus initially on vegetation and later on soils in the United States of America (Karl, Herrick and Pyke, 2017). Various methods were developed in the last decade to assess and monitor land health/condition with the aim of arresting land degradation and promoting sustainable land management (SLM) in various ecosystems including rangelands. Rangeland health assessment protocols integrate different



components of soil, vegetation and water attributes to assess the condition of the land. However, the robustness of these methodologies is questionable when, for example, assessments focus on livestock grazing objectives only (Karl, Herrick and Pyke, 2017), such as the classification and description of plant communities or the production of forage. Compared with degraded plant communities, healthy rangeland plant communities are considered to have full ecological functions, able to provide quality ecosystem goods and services (Adams *et al.*, 2003). By assessing rangeland plant communities based on plant composition, net primary productivity (NPP), stocking rate and carrying or grazing capacity, resource managers and scientists seek to understand the condition of the plant species composition following grazing and other disturbances, compared to the climax plant community and the potential plant community (Adams *et al.*, 2003). Such approaches erroneously omit other indicators such as the management needs of the soil; moreover, they fail to incorporate local knowledge and instead focus on a broad and generalized understanding of plant communities.

Past assessments also notoriously omitted local aspirations in terms of land management and subsequently excluded herders in assessments and monitoring of land degradation. The narrative includes perceptions that herders over-utilize natural resources resulting in overgrazing and degradation (Roba and Oba, 2008). More recently, there has been increased attention to the potential of and need for local knowledge – including but not limited to traditional ecological knowledge – to be incorporated into rangeland monitoring and management programmes.

As these shortcomings become apparent, new methodologies are emerging including participatory approaches that integrate scientific and traditional knowledge (Reed, Dougil and Taylor, 2007); there is a realization that neither approach is satisfactory if applied as stand-alone.

Methodologies are driven and informed by improved understanding of the specific characteristics of rangelands and pastoralism:

- **Use and management of natural resources spanning ecological and political boundaries.** This adaptive strategy enables the spatial and temporal use of highly variable rangelands supported by robust social networks and relying on principles of flexibility and reciprocity. Participatory approaches can enable better understanding of how socio-ecological systems work, adjusting from time to time to fit changing circumstances.

- **Equilibrium and non-equilibrium models.** It has been argued that pastoral areas in the climatically variable arid and semi-arid lands lack an identifiable climax state, as abiotic factors such as rainfall define plant succession. This makes it difficult to establish baselines for future monitoring. Traditional monitoring parameters typically used in equilibrium systems, such as carrying capacity and stocking rate, can be misleading in ecosystems typified by shifting baselines. This also underscores the importance of considering historical trends and traditional knowledge to capture the dynamism of the systems.
- **Mosaic landscapes and scale of assessment.** Pastoral landscapes cover different ecosystems – grasslands, woodlands, forests, riparian zones and wetlands – with distinct uses in different periods. Forests and wetlands may be drought reserves and within these there could be pockets of highly productive resource areas such as riverine areas that support production all year round, even supplying a large proportion of all landscaped forage (Vetter, 2005). On the other hand, arid areas are used during wet seasons, often for short periods only, but they can provide highly nutritious fodder. In some cases, croplands straddle rangelands and when mutual relationships, such as manure exchange for plant residues to feed livestock, exist there is a temporal reduction of pressure on rangelands. In order to make well-informed decisions, taking into account all the different users, uses and types of ecosystems, the assessment must be at the landscape level and cover systems under management while also considering the mosaic of resources.
- **Management objectives.** The management objectives for the land have important implications for the indicators and what is being measured in general. Objectives such as "conservation vs production" will influence the nature of the assessment carried out – what is being measured, by whom and for what purpose. Management objectives also differ between pastoral users; for example, a healthy rangeland for camel production will differ from a healthy rangeland for cattle production. Thus, it is important to consult with local communities to understand the management objectives for the land, decide what will be measured and establish context-appropriate analysis. As pastoralism is the main use in pastoral areas, pastoralists must play a central role in setting management objectives for healthy rangelands.

- **Local and traditional knowledge.** A good land degradation assessment must integrate local/traditional knowledge accompanied by protocols for the application of this knowledge to enable better understanding of cause and change pathways and prioritize indicators for land degradation assessment (Roba and Oba, 2008). Local communities have their own established indicators for weather prediction, and they monitor changes in soils, vegetation and productivity to enable optimal use of available resources across time and scale. Local knowledge is valuable for improving quality of monitoring as it captures the rich history that is often not recorded. Moreover, close collaboration in assessments at the local level enables communities to take ownership of initiatives.

Figure 6. Field assessment activity with pastoralists in Kyrgyzstan

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3.1 Defining assessment and monitoring needs in rangelands

Human activities are the main causal factors in processes of land degradation (including rangelands), desertification and climate change. Consequently, land degradation should be addressed in relation to the management objectives of land users, allowing local knowledge to play an important role to develop and adopt ideal changes, building trust and understanding while reconciling the needs of local communities and other stakeholders (UNCCD, 2015a).

Assessment and monitoring of rangelands can be carried out for a number of reasons, including: to guide livestock grazing practices by local communities and subsidiary rangeland uses; to guide management of non-pastoral rangeland uses and values; and to track sustainability of land uses as the basis of public policy (Smith and Novelly, 1997). Assessment and monitoring can help improve understanding of the state of and trends in rangeland health and can therefore be done on different scales to meet the requirements of different users. The detail and the frequency of information used by herders or rural landholders to guide their management on a day-to-day basis may be different from that required by national authorities to guide investment priorities or policy planning and making.

Addressing the diverse needs of different user groups risks generating an overwhelming amount of data that can be costly to capture and difficult to manage (Karl, Herrick and Pyke, 2017). Furthermore, different users require information in different formats and may access it from different sources. To avoid costly or cumbersome assessments and to ensure that the information generated serves the needs of the target groups, it is essential to agree on the specific aims of the assessment from the outset and ensure that the methodology is suitable for these aims.

Restoration planners (public institutions and implementing partners) require information that allows them to compare the state of land health between landscapes in order to prioritize investments; they also need information on land degradation hotspots within landscapes to target interventions. The information should provide a reliable comparison of the state of the land and the principle drivers and pressures causing land degradation. Information on the impact of land degradation and suitable response measures can also be valuable for prioritization.

Methodologies and approaches need to be cost-effective, on the assumption that cumbersome and costly approaches can be a deterrent to adoption. Cost-effectiveness can also extend to the availability of technical expertise for data

analysis and the technical capacity of target audiences to interpret and use the assessment data. Simple synthesis maps can help guide decision-making and inform restoration actions.

Participation of different stakeholders serves a number of purposes, but the type of participation is guided by the needs of the primary audience for the assessment. However, it is vital that the assessment is guided by the management objectives of land users, informed by locally defined indicators and endorsed by land managers who are the ultimate beneficiaries of restoration actions.

A detailed stakeholder analysis is therefore essential, not only to identify the different stakeholders and determine their knowledge requirements from the assessment and monitoring, but also to identify stakeholders to involve in the different stages of assessment and monitoring.

3.2 Alignment between rangeland health assessment and land degradation neutrality indicators

Goal 15 of the Sustainable Development Goals is to: "protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss". Target 15.3 is to "combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world". In October 2015, Parties to the UNCCD agreed to adopt the target of Land Degradation Neutrality (LDN), defined as a "state whereby the amount and quality of land resources necessary to support ecosystem functions and services and enhance food security remain stable or increase within specified temporal and spatial scales and ecosystems" (UNCCD, 2015b).

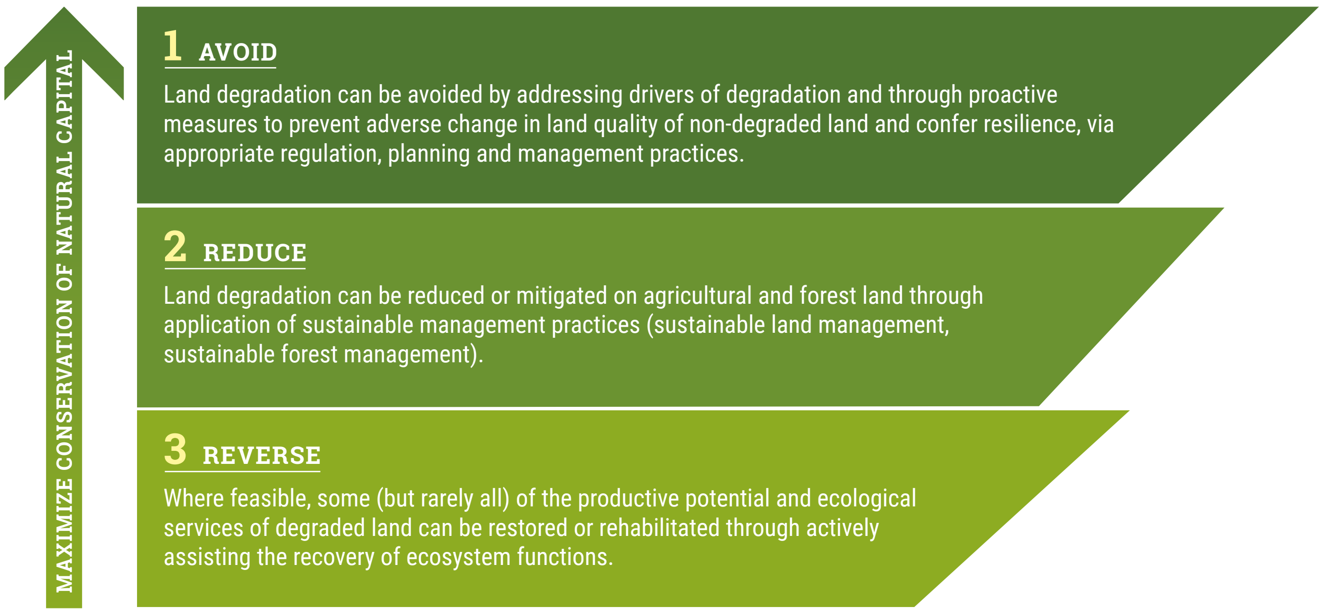
The LDN framework is largely based on the principle of ecosystem services, commonly defined as "the benefits people derive from ecosystems" (Millennium Ecosystem Assessment, 2005; Costanza *et al*., 1997). The underlying assumption is that land management must transition to models that reach full production potential in order to meet the increasing demands on land resources (from both human and other species), and it must do so in a way that preserves the ecological and climatic balance of the Earth, while facing more extreme climatic challenges. Land is a finite resource; it is increasingly degraded yet is required to produce more to meet growing demand. Struggles over dwindling land resources and poor governance protocols lead not only to their unsustainable use but also to conflicts. In this context of land scarcity, land productivity has to be viewed through the lens of multiple ecosystem services and their aggregate value to society.

3.2.1 LDN as national voluntary targets

The LDN framework is therefore a conceptual framework that seeks to allow for local, regional and national responses to LD by the division of land into management units, where resources and land planning allow for avoidance of degradation, as well as rehabilitation and restoration of degraded lands to establish a balance between the ecological loss of productivity and the restoration of ecological functions and services in other units within the same land cover class (Orr and Cowie, 2017). A conceptual framework allows users to establish connections between theory and action within complexity; it enables the presentation of principles, assumptions and rules in a structured format.

A principle of the response hierarchy (Figure 7) is that sustainable management of land to avoid LD should be given priority. Where land is degraded, priority should be given to in-site restoration, for example by switching from unsustainable to sustainable land management practices. However, the response hierarchy also recognizes that degradation will sometimes be unavoidable, and the resulting degradation must be counter-balanced elsewhere through restoration or rehabilitation activities, but always within similar ecosystems. This is important to rangeland ecosystems that have faced unrestrained conversions and degradation in the past.

Figure 7. LDN response hierarchy



Source: Orr and Cowie, 2017.

To date,[1] 127 countries have pledged to comply with voluntary LDN targets by 2030. To meet these targets, LDN has clearly outlined principles to guide practitioners (Appendix 1). The UNCCD Conference of the Parties (COP) has called upon the Parties to observe these principles and incorporate LDN into national and subnational policy and decision-making.

Land degradation neutrality brings numerous benefits:

- LDN acts as a catalyst, bringing to light the tragedy of LD and its effects within a positive, proactive approach.
- LDN rationalizes complexity issues within a framework matrix to aid in prioritizing actions that have the most potential impact.
- The division of land into scalable groups and units ensures that each ecosystem type is considered independently, reducing "offloading" or "offsetting" of LD and natural resource issues.
- The landscape units are incorporated into a holistic, landscape-wide approach.
- LDN gains the broad acceptance of political and scientific organizations, with nations across the world undertaking voluntary, national LDN targets.
- As a continuous process, it allows adaptive learning in the monitoring and planning of land resources. Multiple development objectives are achieved and United Nations obligations met, including the three Rio Conventions through the sustainable management of land.

3.2.2 How countries typically establish their LDN baselines and responses

In October 2015, Parties to the UNCCD adopted LDN as the primary target for the Convention and agreed on the **sub-indicators to measure trends in:**

- land cover;
- land productivity; and
- carbon stocks above and below ground.

Through the UNCCD LDN Target Setting Programme, countries have established national baselines against the three agreed indicators of land degradation neutrality and are defining their response measures.

Approaches adopted for the establishment of LDN baselines and responses:

- **Disaggregation by land use or biome.** A clear understanding of various land uses – including grasslands, forests and croplands – is key to ensure that "counterbalancing" takes place within the same biomes as stipulated under LDN.

[1] As at February 2021 (UNCCD).

- **Prioritization of LDN responses.** A recent study shows that the majority of countries have prioritized joint investments in restoration and SLM mainly in forests, agriculture and grasslands – albeit to varying degrees. The responses are set at the subnational and national levels and priority actions are articulated. Prioritization could benefit greatly from synergizing with other targets and obligations, including application of tools to facilitate prioritization, efficient resource use and multi-stakeholder collaboration (Gichuki *et al*., 2019).
- **Leveraging and aligning of LDN with other sectoral priorities and targets.** Member States that are signatories of LDN are also pursuing other targets aimed at enhancing the integrity of ecosystems through initiatives such as restoration. Complementary approaches are actively adopted in some countries with centralized coordination of implementation of various targets and intersectoral policies of LDN and the Bonn Challenge (Gichuki *et al*., 2019). Despite the obvious benefits, such as resource use efficiency, avoidance of negative trade-offs, policy coherence and better-aligned reporting, most countries are yet to exploit these synergies.
- **Institutionalization of LDN.** The adoption of LDN has been followed by accompanying policies and the appointment of an LDN national focal point to ensure, for example, cross-sectoral collaboration. Multi-stakeholder platforms provide support to ensure representation of different agencies and ministries. To date, most financial and technical support has been delivered by development partners who have an important role to play in ensuring coherence and partnerships.
- **Addressing sectoral challenges.** Despite the clear alignment of LDN with other obligations aimed at sustainable ecosystems, fragmentation of responsibilities is still rife in countries. This practice is the consequence of previously established governance structures where overlapping ecosystems may be under the jurisdiction of more than one government ministry, with different ministries adopting different approaches and objectives regarding the use and management of these areas. For instance, grasslands and rangelands are often divided and subdivided among different administrative levels and different types of land use, straddling different ecosystems such as woodlands and wetlands. Although exceptions exist, most countries do not group grazed lands or pastorally significant areas as cohesive legal or administrative units; therefore,

grasslands and rangelands within the same area often fall under different rules and regulations, with variations of pastoral lands falling under the control of a variety of government agencies, such as agriculture, forestry or reserves.

Although general guidelines exist, most countries are encouraged to design LDN baseline assessment and monitoring systems that are adapted to individual national and subnational contexts (Orr and Cowie, 2017). While there are clear benefits to this approach, the lack of a standardized assessment and monitoring system has led to diverse national approaches to monitoring and analysis among participant countries that lack consistency on national and subnational scales (Sims *et al*., 2020). For the most part, countries have until now relied heavily on technical and financial support from development agencies to develop these baseline and monitoring systems, in addition to support for incorporating the more challenging policy aspects relating to LDN principles.

LDN provides a means for drawing attention to rangelands as unique biophysical units with special management needs as well as highlighting the essential role they play in overall landscape processes and associated ecosystem services. The focus on their importance can catalyse the habitual monitoring of these ecosystems, which are currently less monitored than other biomes in major policy domains. On the other hand, the pursuit of LDN needs to integrate the specificities that characterize rangeland ecosystems and which are key to their robust monitoring, including those mentioned in the introduction to Chapter 3.

3.2.3 Key considerations for the establishment of LDN targets for rangelands

Rangelands as subnational land cover (whereas LDN targets are national)

Countries set national voluntary LDN targets against the three main indicators. However, in many countries, rangelands are subnational land covers and this must be reflected in the target set for their monitoring. The UNCCD guidance document posits that:

> the necessity for local interpretation and validation of land degradation trends is partly why the LDN Science Conceptual Framework encourages the establishment of national or subnational indicators (Orr and Cowie, 2017).

While this can be useful for contextualized interpretation, it requires the country to go a step further. However, it is not sufficiently covered within the current framework, and further resources and skill sets will be needed in order to take all opportunities to

integrate community/local indicators. Such indicators may be unique to the national framework of each country and therefore able to improve the quality of monitoring and decision-making on rangelands.

Need for coordinated baseline and monitoring

There is obvious synergy between LDN and other environmental objectives. Nevertheless, the setting up of mutual links around policies and approaches is yet to be optimized by many countries. Coordination of the different restoration agendas in rangelands can help fend off negative consequences, *inter alia*, landscape fragmentation, trade-offs and potential conflicts among land users (Gichuki *et al*., 2019). The UN Decade on Ecosystem Restoration is an encompassing umbrella within which coherence and coordination can be established.

Strengthening of quantitative with qualitative approaches

The ease, cost-effectiveness, range and possibilities that remote sensing offers for assessing and monitoring vast land areas mean that this system of tools is understandably favoured by most LDN applications and projects, especially for regional or national calculations of the SDG 15.3.1 sub-indicators. However, stand-alone remote sensing results with no further ground-truthing can be misleading – as already shown with the false positives concerning land productivity (Sims *et al*., 2020). Forage palatability is a key indicator of rangeland health, and a rangeland with just one plant type may be considered healthy from the perspective of pastoralists. As previously elaborated, NPP can provide an indication of available standing biomass, but links to land productivity can be problematic if biomass is being temporarily removed through grazing. On the other hand, biomass increase through bush encroachment can at first glance appear as a positive NPP, but as learned during LDN target exercises in Namibia, it could actually be a sign of LD based on local land use, and therefore a negative NPP potentially requiring major management inputs (UNCCD, 2019). Furthermore, governance structures are nearly impossible to map out using satellite imagery, yet they provide key information on the use and health of rangelands. As UNCCD proceeds with the integration of land tenure aspects into LDN, this can provide the space needed to strengthen remote sensing approaches with qualitative approaches including capturing local experts' knowledge.

3.2.4 Institutionalizing rangeland assessment to enable enhanced LDN target setting and progress monitoring

Rangeland assessments and long-term monitoring need to be institutionalized; this entails set rules, framing, setting and the necessary financial and human resources within permanent or long-term institutions on various scales. At present, this is not the case in many countries. If the LDN framework is to benefit from additional indicators at the subnational level, improved structures are required to articulate LDN on these scales in order to improve the effectiveness of national reporting. This can be framed within a hybrid system that enables cross-sharing of information, even streamlining similar reporting obligations such as the Bonn Challenge.

Institutionalization should cover the following areas:

- Integration of rangeland assessment into existing national frameworks for cost-effectiveness and to mainstream decision-making.
- Coordination across government ministries and assigning of responsibilities and clear mandates on data collection, sharing, storage and purposes in the short and long term.
- Broad stakeholder participation, bearing in mind that rangelands are mosaic landscapes with various users and interests.
- Provisions for and inclusion of local/traditional knowledge, recognizing its importance for government monitoring and decision-making.
- The role of land tenure in sustainable management of rangeland resources on various scales, including customary systems that may need legal backing.
- Integrated land use plans to reflect the mosaic nature of rangeland ecosystems developed in participatory ways with local stakeholders.

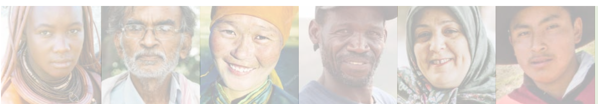
4

Towards better assessment of rangeland health: the PRAGA approach

Land degradation assessment in rangelands is not always straightforward due to, *inter alia*, biotic and abiotic variabilities in rangelands. In order to assess whether or not an ecosystem is degraded, soil, water and vegetation are the primary variables measured. However, Gilbey (2019) argues that this is a "value judgement" based on desired functions and which determines the specific characteristics of the variables to be measured.

In order to bridge the divide, LDN has established the three biophysical indicators introduced above (land cover, land productivity and carbon stocks). However, it is clear that additional indicators may be necessary – in particular at the subnational level – to increase the robustness of data while addressing specific LD drivers not adequately covered under the three LDN indicators. There are opportunities to do this by synergizing with complementary environmental commitments such as the Bonn Challenge and integrating other relevant SDG targets such as those concerning land governance (Gichuki *et al*., 2019) through policy and investment collaborations. Strategically, the complementary indicators can also provide avenues for identification of the locally relevant community indicators.

Chapter 4 presents the participatory rangeland and grassland assessment methodology (PRAGA), which provides a framework for inclusion of additional



indicators aimed at improving the efficacy of rangeland assessment. PRAGA was developed by FAO and IUCN and piloted in Kenya, the Niger, Burkina Faso, Uruguay and Kyrgyzstan in collaboration with the governments and other national partners.

4.1 Introduction to PRAGA

PRAGA was designed to assess the health of rangelands according to the management objectives of local users through integration of scientific and local knowledge.

The methodology aims to bridge existing gaps in rangeland assessment and thus:

- increase availability of information and data on rangelands;
- provide useful information and reflect the complexity of the rangeland degradation process;
- identify cost-effective options – given the high cost of accurate assessments;
- generate interest in large-scale ecosystem assessment in rangelands; and
- strengthen the capacity of local and national interested parties to assess land degradation and make informed decisions through the promotion of SLM to preserve the various ecosystem services provided by rangelands.

PRAGA aims to respond to the above challenges, taking into consideration the various rationales on why assessments and monitoring in rangelands need to be improved. The core principles of PRAGA are as follows

- **Recognition of the multifunctionality of rangeland landscapes** – rangelands can be very diverse and include natural resources that could be also classified in other ways.
- **Need for cost-effectiveness** – it is necessary to balance the need for national or global comparison with the need for local requirements, and it is therefore important to identify a minimum set of indicators required for reliable and cost-effective assessment.
- **Importance of participatory processes** – relevant stakeholders must be involved to: i) build trust with landowners and users; ii) draw on local knowledge; iii) negotiate the incorporation of science and local knowledge in the methodology; and iv) contribute more generally to empowerment and capacity building of rangeland managers, be they from the government or local communities (Figure 8).
- **Good practices** – they must be recognized and scaled up for their continued supply.

Figure 8. A workshop for consultation with local stakeholders in Uruguay

Figure 9. The nine steps of PRAGA

PREPARATORY PHASE	1	Partnership development: local and national ownership of the process
	2	Identifying the landscape for assessment
BASELINE PHASE	3	Baseline review
	4	Large scale assessment and remote sensing
PARTICIPATORY PHASE	5	Participatory mapping of target landscape
	6	Participatory indicator selection
ASSESSMENT PHASE	7	Composition and selection of assessment team
	8	Field Assessment
ANALYSIS AND INTERPRETATION PHASE	9	Data management post-assessment and validation

PRAGA uses the Driving Force-Pressure-State-Impact-Response Framework (DPSIR[2]) (Figure 10) to integrate local and scientific knowledge to explore potential drivers and pressures affecting rangeland health and provide preliminary insights on potential impacts and appropriate responses and interventions. This mainly involves analysing and connecting the socio-economic data (compiled at the baseline phase) with the participatory data to improve the understanding of the spatial and temporal interactions of the multiple drivers and pressures driving land degradation.

PRAGA aims to communicate the results of what is happening in the rangelands in order to:

- **Inform medium- and long-term decision-making** by rangeland stakeholders and guide collaborative actions between local government and pastoralists (communal land users, private landholders etc.). Agreeing on land management objectives is an important first step in the assessment methodology.
- **Identify trends in rangeland health** in order to guide management planning, such as prioritizing areas for investment in rehabilitation and restoration or areas that can support more intensive use.

4.2 How can PRAGA improve on LDN assessments?

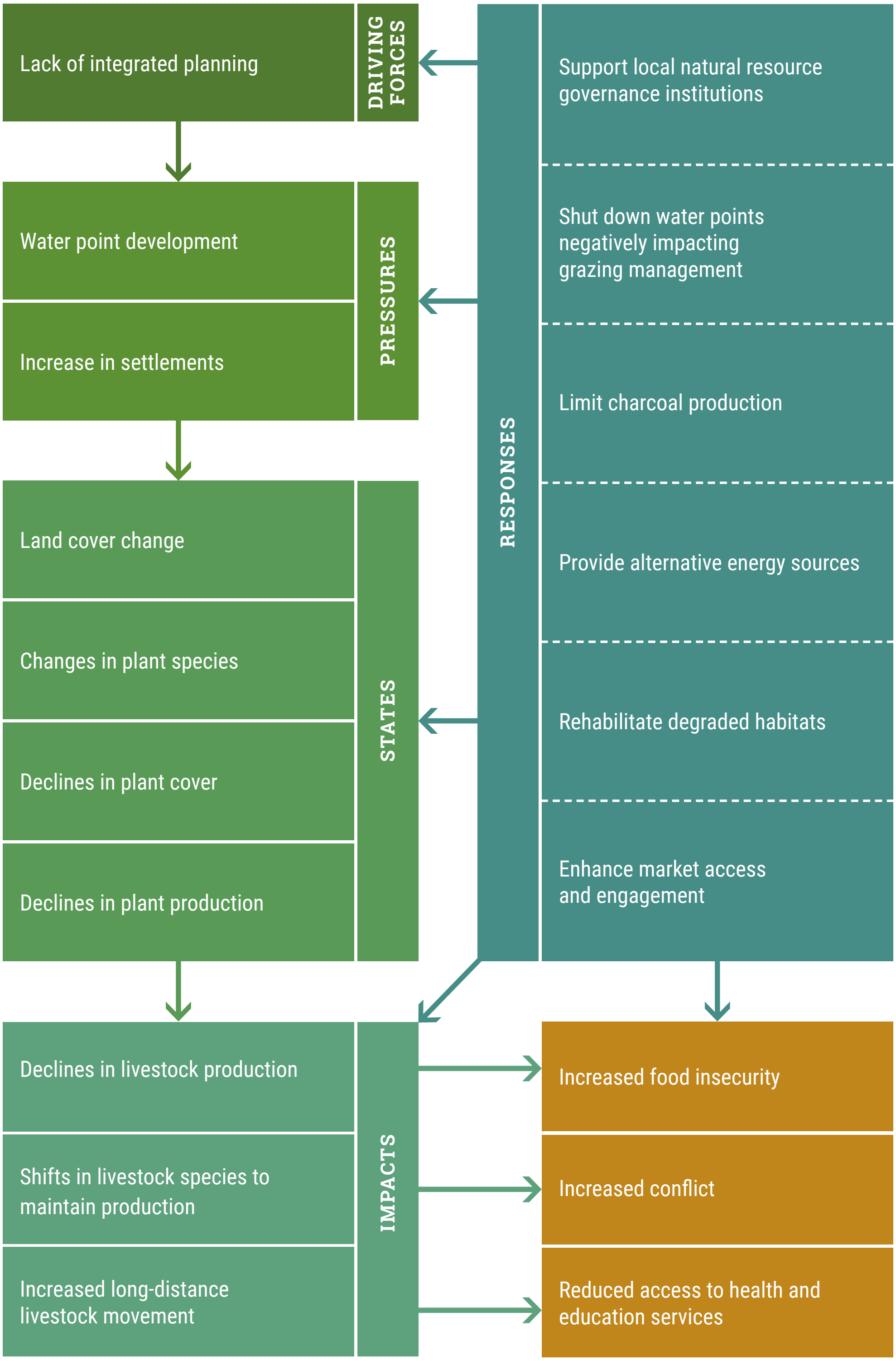
This section highlights key lessons learned in piloting PRAGA that could improve the robustness of land degradation monitoring frameworks such as LDN with respect to rangelands, bearing in mind the specificities and characteristics of rangeland ecosystems.

4.2.1 Landscape level assessment

The scale of monitoring is determined by factors such as bioclimatic zones, landscape and site variability depending on the policy and decision-making needs. Rangeland monitoring is needed at multiple levels and the nature of assessment may differ according to the level. For example, the information needs at the site level will differ from indicators that work at the landscape level, and will differ again for monitoring on the national or international scale. PRAGA specifically targets the gap in monitoring rangelands at the landscape level – the level at which typical restoration interventions take place. Monitoring at the landscape level should reflect

[2] DPSIR is a causal framework for exploring the various issues such as driving forces and pressures affecting the socio-ecological system, and monitoring the state of the system.

Figure 10. Analysis of the driving forces, pressures, states, impacts and responses to land degradation in Kenya



the mosaic nature of these landscapes both in terms of the resources and of the users of the landscapes as seen in Figure 11.

PRAGA employs a three-step scale approach that can support LDN monitoring in rangelands:

1. Beginning broadly in bioclimatic zones (e.g. Sahelian bioclimatic zones in the Niger).
2. Focusing on administrative levels (e.g. municipalities in Burkina Faso, counties in Kenya – within which specific hotspots of degradation have been identified using remote sensing).
3. Monitoring at the landscape level, which may be smaller or larger than the administrative level (e.g. in Kenya the landscape encompassed two counties), with a specific focus on site-level variabilities (allowing detailed analysis of identified hotspots).

At the broader **national level**, relevant government ministries, academia, research institutions, development partners and communities hold consultative meetings to identify macro-landscapes for assessment. At this level, some of the determining factors in the selection include pressures and threats to rangelands, heterogeneity of the landscape as a representation of typical rangelands, and governance of the rangelands.

At the **administrative level**, the definitions of a planning unit are determined, which implies a community, the community's use of resources, the management objectives and a focus on where the assessment will take place.

At the **landscape level**, key community informants determine the assessment sites based on factors such as resource management and landscape variability (e.g. features of vegetation and landforms). Ultimately, this enables the assessment to be carried out according to the management objectives of the land users.

PRAGA three-step scale approach in Kyrgyzstan

Bioclimatic. The bioclimatic zone selected comprises the rangelands across the different altitudes of the Tian Shan mountains and the associated valleys and steppes.

Administrative. The Naryn region was chosen for its role in transhumance movements of people and livestock. Within the region, work focused on the pasture areas provided to each pasture user association (PUA) under the Pasture Law (2009/2011).

Landscape. The units studied were principally high-altitude meadows and steppes used as summer pastures by the different PUA members.

Figure 11. Heterogeneous landscape assessment in Isiolo-Garissa counties in Kenya

Wayaam-Wanyaan micro-landscape

Wayaam (Borana name), Wanyaam (Somali name)

Reddish sandy soil with natural ponds and lots of forbs during rainy seasons. • Good for goats, camels, and settlement for wet season short term grazing. • Not suitable for long term grazing as is water scarce. • Also a salt deficient area.

Chari-Buure micro-landscape

Chari (Borana name), Buure (Somali name)

Hilly rocky/bouldery/stony landscape with sandy soils. • Good for all livestock species (but less so for camels due to the rocky soils) as a wet season grazing area especially goats. • Soil not susceptible to erosion. • Has stony soil with pockets of black cotton soil which affects livestock hoofs, hence not many people graze in this landscape and it's not suitable for settlement.

Ramaat-Ramaa micro-landscape

Ramaat (Borana name), Ramaa (Somali name)

Whitish sandy soil with good fodder for camels and cattle. • Water is scarce.

Omaar-Kunya micro-landscape

Silty clay gravely soil. • Predominantly covered by shorter trees and ephemeral annual grasses that emerge with the rains. • Predominantly a browsing landscape for camels and goats across all seasons with good grazing in the wet season. • Livestock in this area have high milk production and good body condition during the rainy season.

Kotisch-Aaathabale micro-landscape

Kotisch (Borana name), Aathabale (Somali name)

Black cotton (clay soil) landscape. • Characterized by short shrubs with lots of grasses and trees that indicate salinity like *Salvadora*. • Good soil for crop farming. • Soil not suitable for grazing immediately after the rain, and very dusty in the dry season. • Area suitable for all species of animals.

While the multi-scale framework for assessment encompasses the full system under management, it is also precise enough to examine the diversity of resource patches within a landscape. For the LDN framework, this type of approach can help reduce the false positives (see Chapter 3) but still be cost-effective by focusing on identified "hotspots" for degradation that are further subjected to landscape-level analysis.

Communities typically classify assessment landscapes as either micro or macro level, while scientists focus broadly on the ecosystem level (FAO and IUCN, forthcoming). The multi-scale framework allows for harmonization of these different assessment approaches, thus optimizing both scientists' expertise and local community knowledge (Figure 12).

Figure 12. A livestock herd on the landscape of Goure, the Niger

4.2.2 Indicators: types and selection

Monitoring can most effectively inform policy decisions when it is based on robust indicators. LDN provides three robust indicators that can be integrated into local monitoring; local knowledge can be complementary, both for enriching these indicators with locally defined indicators and for interpreting the LDN indicators. According to the Scientific Conceptual Framework for Land Degradation Neutrality:

> monitoring of LDN is based on evaluating the significant changes (positive and negative) in three global indicators (via associated metrics) which serve as proxies of most ecosystem services flowing from land-based natural capital: land cover/land cover change, land productivity/NPP, carbon stocks/SOC, and, for a few ecosystem services not covered by these, other SDG indicators, and/or national indicators (Orr and Cowie, 2017).

Local indicators are more user-oriented and aligned to local needs, helping local communities understand and articulate their perspective on rangeland management and degradation. Local indicators – which may be qualitative or quantitative – are applied by pastoralists in both short-term and long-term decision-making. Long-term monitoring allows pastoralists to adjust their production objectives. For example, if a landscape shifts from grass cover towards shrubs and trees, from a cattle production perspective, this will be deemed degraded; on the other hand, camels and goats could also be introduced to use that landscape, and from the perspective of a camel herder, heavy shrub cover may be desirable. This demonstrates the dynamism of pastoralism, but it can pose a challenge for defining land degradation: such is the ability of pastoralists to adapt their management to changes occurring in vegetation that the changed cover becomes desirable.

Scientific indicators tend to be long term and comparable across sites. Scientific knowledge can be very segmented with different experts involved (e.g. soil scientists and range ecologists); in contrast, local knowledge is integrated, with the community viewing land as a single continuum – soil, vegetation, water, livestock – all together. It is therefore vital to bring all experts to the local level to interpret indicators together with the local communities.

The application of scientific indicators in a participatory approach faces potential challenges. For example, differences arose in the practicalities of using the three LDN core indicators in the five pilot countries; for example, soil indicators were generally difficult to measure for the local communities in Kyrgyzstan, and as a result, scientific data became essential for measuring soil health.

The compatibility of scientific and local indicators varies considerably. Local knowledge of soil and water indicators do not necessarily correspond to scientific indicators; on the other hand, vegetation indicators may be more comparable. In the Niger, for example, the community considered pasture composition to be particularly important. Local knowledge on soil colour in Burkina Faso and on soil crust in the Niger were important indicators that could be used to assess rangeland health. Vegetation indicators, on the other hand, proved easier for local communities across the five pilot countries to measure through biomass and livestock grazing behaviour, and the presence or absence of certain plants (including palatable and non-palatable) or animal species.

Depending on the country context, interpretation of change using scientific indicators can vary as the interpretation of change is informed by the indigenous epistemology (FAO and IUCN, forthcoming). The planning unit is important as it determines the community and it is from the community that local knowledge is drawn. Discussions on indicators can take place at various levels, for example, commencing broadly at the international level (such as the three LDN indicators and the PRAGA domain of indicators) and thereafter cascading to the national and local levels. It is particularly important to consider not only the selection of indicators, but also their interpretation. Indicators can reveal the direction and extent of change, but in many cases only the land managers can determine if these changes are positive or negative based on their production objectives and their knowledge of the landscape and its history.

Figure 13. Field assessment in Naryn, Kyrgyzstan

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4.2.3 Land degradation and sustainable land management

Sustainable land management (SLM) was defined by the UN 1992 Rio Earth Summit as:

> the use of land resources, including soils, water, animals and plants, for the production of goods to meet changing human needs, while simultaneously ensuring the long-term productive potential of these resources and the maintenance of their environmental functions (UN, 1993).

FAO describes SLM as:

> measures and practices adapted to biophysical and socio-economic conditions aimed at the protection, conservation and sustainable use of resources (soil, water and biodiversity) and the restoration of degraded natural resources and their ecosystem functions (FAO, 2020).

There is a tendency to refer to SLM in terms of specific practices that can be scaled up (Liniger *et al*., 2011). However, sustainable management of rangelands often has to take place on multiple scales and can include broad approaches that enable sustained ecological functioning of the systems. SLM in rangelands can be achieved through large-scale herd management practices, sometimes coordinated over many thousands of square kilometres. In large-scale communal lands, this depends on livestock keepers moving their herds to utilize the preferred pastures for the different seasons, while allowing grazed areas to be adequately rested for recovery of biomass and plant reproduction. Defining these practices in conventional SLM terms is difficult, as the solutions are better described as landscape-scale governance rather than application of specific practices. The key to SLM in many rangelands is the capacity for large numbers of herders to organize large-scale herd movements. This does not lend itself to being packaged as "practices" *per se*, and SLM in rangelands is not generally based on specific approaches that can be "scaled up" in the usual sense of the word.

These types of practices or approaches would be hard to measure or even report under the current LDN indicator framework; yet they underpin sustainable management of these landscapes, thereby requiring special attention, recognition and support.

Natural resource governance refers to the:

> norms, institutions and processes that determine how power and responsibilities over natural resources are exercised, how decisions are taken, and how citizens – women, men, indigenous peoples and local communities – participate in and benefit from the management of natural resources (Campese *et al*., 2016).

SLM in rangelands depends on natural resource governance that allows groups of herders to reach and enforce management decisions. Often these decisions are at least partially dictated by weather and climate, but within a rangeland landscape, certain resources are likely to be protected for specific purposes or certain seasons, and their management is only possible when local governance arrangements are functioning.

Development interventions led by various parties (governments, NGOs, CSOs) should aim to strengthen existing local governance structures to be effective (Herrera, Davies and Manzano Baena, 2014), for example, in the implementation of communally agreed land management protocols. However, these governance structures should exhibit levels of flexibility in decision-making in order to be able to respond to an evolving situation, *inter alia*, access and management of critical grazing areas in the face of more frequent and longer droughts. Previously existing channels of communication and coordination between communities regarding reciprocal access rights to water and pastures can also be strengthened to improve collaboration within and between those communities that straddle rangeland landscapes.

A valid starting point when defining degradation vis-à-vis healthy rangelands is the recognition of local knowledge, tenure rights and management objectives of the land. It is just as important that all stakeholders understand and take into account the institutional (and not just technical) aspects of rangeland degradation, which are key for determining rangeland management and access. Governance principles such as participation and transparency in the use of and access to resources are effectively articulated at the local level and are almost impossible to map out using satellite imagery.

Highlighting non-degrading areas under SLM can help bring positive support to sustainable rangeland management, thus increasing the benefits to local and global communities. However, in reality, the three LDN indicators focus on land degradation and allow for only limited SLM assessment.

4.2.4 Community participation

PRAGA's strength lies in the participatory aspects that can help strengthen LDN frameworks in rangelands. These include communities' local/traditional knowledge that underpins the improvement of the quality of indicators, the selection of assessment sites and assessment period, the validation of assessment results and the overall buy-in to sustainable land management. Therefore, it is vital to create consultation spaces that foster openness to differing views including those of technical experts and local communities (Figure 14). In the right environment, it is possible to articulate and tackle both traditional challenges, such as poor representation of women, and new dynamics, such as the issue of declining livestock ownership among youth who are instead exiting the system. In a process of co-production and co-sharing of knowledge, provisions are required to feed data back to local communities for shared learning and negotiation of the next steps in land management, such as agreeing on restoration objectives.

Although the essence of participation is ensuring that the views of the community are taken into consideration, participation has become an overused term in the

Figure 14. Landscape mapping by communities in Isiolo, Kenya

development aid discourse. Participatory development approaches were popularized in response to the perceived failures of more top-down approaches. Participation not only helps to achieve better decision-making but also helps ensure that decisions are more likely to be implemented and enforced by all actors. Participation may also contribute to empowerment of citizens and fulfilment of their basic human rights.

The level of participation can range from little more than informing people that something is going to happen to involving a wide range of stakeholders in planning processes and even working together. Figure 15 shows how the level of participation also influences the number of people that can be involved. With large numbers of stakeholders, it can be challenging to maintain high levels of interaction, and there may be greater reliance on the role of selected representatives. When the aim is to simply inform the community, there can be more people involved than when the aim is joint planning or agreeing on specific issues (i.e. empowerment). In the

Figure 15. Levels of participation

Source: Regional Environment Center, 1996, p. 46 (adapted).

PRAGA experience to date, participation has been at the level of "joint planning" for landscape mapping and indicator selection, and at the level of "consultation" for validation of the assessment findings and interpretation of the results. Notably, the level of participation in the actual field assessment (data collection) has been necessarily low (involving just two or three community members of the several thousand holding a stake in the landscape).

The right to participate in critical decision-making is an important element of good governance and is established in international agreements (e.g. UNCCD, Convention on Biological Diversity), human rights law (e.g. International Covenant on Civil and Political Rights) and soft law commitments (e.g. United Nations Declaration on the Rights of Indigenous Peoples). Effective participatory approaches should be full, meaningful and effective. "Full" implies the inclusion of all relevant actors, including marginalized groups, within a safe space for different opinions to be voiced. "Meaningful" implies that participants understand the purpose and objective of the decision-making process and their role in it, and that the process is legitimate and accountable. "Effective" means that participation can genuinely influence decisions, that participants have access to information, and that the process is fair and transparent (FAO, 2016).

Full, meaningful and effective participation in all aspects of rangeland landscape assessment is unrealistic in most cases, given the large number of stakeholders who are fully occupied in livelihood generation activities including herd management. PRAGA targets different levels of participation at certain crucial stages in the assessment, but it avoids the risk of being paralysed by full participation at every step.

5 An enabling environment in rangeland assessment and monitoring

The monitoring of rangeland health should underpin sustainable management by informing on when to make interventions to reduce degradation and support good practices contributing to healthy rangelands. However, this cannot be done in the "business-as-usual" scenario whereby local communities/resource users are alienated from assessment and monitoring activities. Instead, it is the local community's management objectives that should inform the assessment aims and parameters (e.g. landscapes for assessment and indicators) and validate the assessment results. The rich knowledge held by local communities and spanning several decades is key to improving the quality of land monitoring frameworks such as LDN and other environmental monitoring frameworks. In addition, these participatory aspects provide space for engaging multiple perspectives and being open to differing opinions/perceptions and afford opportunities to identify bridges and barriers that have an impact on activities and long-term management of rangelands.

While it has often been argued that the costs of including local communities in monitoring are exorbitant, PRAGA shows that it is indeed possible to arrive at cost-effective options. However, further investment may be needed in low-cost but highly efficient technologies for assessment – for example, high-resolution remote sensing to cover wider landscapes and monitor more demanding indicators (e.g. SOC).

To be effective on various scales, rangeland monitoring initiatives should be hooked onto existing frameworks such as LDN while allowing flexibility within these frameworks. If rangelands are considered important biomes within the framework and UNCCD, the LDN framework can protect their integrity by guarding against their degradation.

Full recognition of the importance of rangelands is vital to guarantee continuous assessment and long-term monitoring in normative fiscal plans by governments on various scales, given that it is standard practice to monitor that which is considered important.

Long-term institutionalization of rangeland monitoring requires an enabling environment with the following features:

- **Support from a dedicated public institution** – providing key information for baseline development, sponsoring the process and even financing monitoring costs. Allocated funding to support monitoring needs can be budgeted for within public finance structures taking into account the repeated need for the exercise as deemed necessary by the main decision makers.
- **Agreement on the methodology and on universal indicators expected in all landscape assessments** – reached by the main stakeholders including local communities, government experts, academia and development practitioners. Linkages to existing dialogue frameworks can provide further benefits; in Uruguay, the Board of Livestock, "La Mesa", was instrumental in providing a structured dialogue space and in designing PRAGA priorities in the country including areas of policy influence.
- **Agreement over data ownership, storage and access** – considering that governments prefer to use data generated and owned by state institutions, underscoring their important role in the process. However, there should also be provisions allowing members of the public to access and use the data.

- **Strengthening of national expertise** – including from academia to help standardize the methodology and make it answer to country needs as well as the needs of training assessment teams and future generations of rangeland experts.
- **Capture and better communication of the contribution of rangelands on various scales** – promoting dialogues, alliances and partnerships in knowledge generation and evidence sharing on competitiveness and opportunities in rangelands and grasslands to increase their visibility and appreciation.
- **A dialogue space** – where different land users negotiate what is a healthy (or degraded) rangeland based on the management objectives of the various land users and recognition that these objectives are based on local contexts.

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Land degradation neutrality guiding principles[1]

APPENDIX 1

Principles related to frame of reference (LDN) (Module A)

1. Maintain or enhance land-based natural capital. LDN is achieved when the quantity and quality of land-based natural capital is stable or increasing, despite the impacts of global environmental change.
2. Protect human rights and enhance human well-being. Actions taken in pursuit of the LDN target should not compromise the rights of land users (especially small-scale farmers and indigenous populations) to derive economic benefit and support livelihoods from their activities on the land, and should not diminish the provisioning capacity and cultural value of the land.
3. Respect national sovereignty. Governments set national targets guided by the global level of ambition while taking into account national circumstances. Governments decide the level of aspiration and how LDN targets are incorporated in national planning processes, policies and strategies.

Principles related to the frame of reference (Module B)

4. The LDN target equals (is the same as) the baseline. The baseline (the land-based natural capital as measured by a set of globally agreed LDN indicators at the time of implementation of the LDN conceptual framework) becomes the target to achieve, in order to maintain neutrality.
5. Neutrality is usually the minimum objective: countries may elect to set a more ambitious target, that is, to improve the land-based natural capital above the baseline, to increase the amount of healthy and productive land. In rare circumstances a country may set (and justify) its LDN target acknowledging that losses may exceed gains, if they forecast that some portion of future land degradation associated with past decisions/realities is not currently possible to counterbalance.

[1] Taken from Orr and Cowie (2017).

Principles related to the mechanism for neutrality (Module C)

6. Apply an integrated land use planning principle that embeds the neutrality mechanism in land use planning: The mechanism for neutrality should be based on a guiding framework for categorizing and accounting for land use decisions and the impacts of land use and management with respect to a "no net loss" target.
7. Counterbalance anticipated losses in land-based natural capital with gains over the same time frame, to achieve neutrality. Achieving LDN may involve counterbalancing losses in land-based natural capital with planned gains elsewhere within the same land type.
8. Manage counterbalancing at the same scale as land use planning. Counterbalancing should be managed within national or subnational boundaries at the scale of the biophysical or administrative domains at which land use decisions are made, to facilitate effective implementation.
9. Counterbalance "like for like". Counterbalancing gains and losses should follow, as far as possible, "like for like" criteria and thus will generally not occur between different types of ecosystem-based land types, except where there is a net gain in land-based natural capital from this exchange. Clear rules should be established *ex ante* for determining what types of "net gains" permit crossing land type boundaries, to ensure that there is no unintended shifting in the overall ecosystem composition of a country and no risk to endangered ecosystems.

Principles related to achieving neutrality (Module D)

10. Balance economic, social and environmental sustainability. LDN seeks to maintain or enhance the quality of all ecosystem services, optimizing the trade-offs between environmental, economic and social outcomes. Implementing LDN contributes to sustainable development by integrating economic and social development and environmental sustainability within the biophysical limits of natural capital, and seeking to manage the land for ecosystem services while avoiding burden shifting to other regions or future generations.
11. Base land use decisions on multi-variable assessments. Land use decisions should be informed by appropriate assessments (land potential, land condition, resilience, social, cultural and economic factors, including consideration of gender), validated at the local level before initiating interventions to ensure evidence-based decisions and reduce the potential risk of land appropriation.

12. Apply the response hierarchy. In devising interventions and planning for LDN, the response hierarchy of Avoid > Reduce > Reverse land degradation should be applied, in which avoid and reduce have priority over reversing past degradation, so that the optimal combination of actions can be identified and pursued with the aim of achieving no net loss across the landscape.
13. Apply a participatory process. Planning and implementation of LDN involves well-designed participatory processes that include stakeholders, especially land users, in designing, implementing and monitoring interventions to achieve LDN. Processes should consider local, traditional and scientific knowledge, applying a mechanism such as multi-stakeholder platforms to ensure these inputs are included in the decision-making process. The process should be sensitive to gender, and imbalances in power and information access.
14. Apply good governance. Good governance underpins LDN and thus planning and implementation should involve:
    a) removing and reversing policy drivers that lead to poor land management;
    b) applying the principles and standards of the VGGTs[2] to ensure tenure rights and security in the pursuit of LDN;
    c) taking account of availability of resources (human and economic) for implementing good practices to combat land degradation and desertification;
    d) making provision for monitoring and reporting on LDN implementation;
    e) developing a mechanism for the coordination of integrated land use and management planning across scales and sectors to ensure stakeholder input to national and international decision-making and reporting;
    f) developing a mechanism for the timely review of implementation outcomes and recommendations for improvement; and
    g) ensuring upward and downward accountability and transparency.

Principles related to monitoring (Module E)

15. Make use of three land-based indicators and associated metrics: land cover (assessed as land cover change), land productivity (assessed as NPP[3]) and carbon stocks (assessed as SOC[4]), as minimum set of globally agreed indicators/metrics, which were adopted by the UNCCD[5] for reporting and as a means to understanding the status of degradation.

[2] Voluntary guidelines on the responsible governance of tenure of land, fisheries and forests (FAO, 2012).

[3] Net primary productivity.

[4] Soil organic carbon.

[5] United Nations Convention to Combat Desertification.

16. The integration of results of the three global indicators should be based on a "one-out, all-out" approach where if any of the three indicators/metrics shows significant negative change, it is considered a loss (and conversely, if at least one indicator/metric shows a significant positive change and none shows a significant negative change, it is considered a gain).
17. Make use of additional national and subnational indicators, both quantitative and qualitative data and information, to aid interpretation and to fill gaps for the ecosystem services not fully covered by the minimum global set.
18. Apply *in situ* validation and local knowledge obtained through local multi-stakeholder platforms to interpret monitoring data according to local context and objectives, within agreed guidelines.
19. Monitoring should be viewed as a vehicle for learning. Monitoring provides: opportunities for capacity building; the basis for testing hypotheses that underpin the counterbalancing decisions and the interventions implemented, the LDN concept, and this conceptual framework; and knowledge to inform adaptive management.

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