Enabling pastoralist management of rangelands to achieve Land Degradation Neutrality

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Rangelands cover 54% of the global terrestrial area and are threatened by land conversion and degradation, which erodes their global value and weakens the livelihoods of pastoralists who manage them. Sustainable Development Goal Target 15.3 on Land Degradation Neutrality (LDN) provides a framework for sustainable rangelands management, but countries face several challenges in achieving LDN targets in rangelands. Overcoming these challenges requires countries to enable appropriate investment in sustainable rangelands management by enhancing governance and land tenure, strengthening policies across several sectors, halting conversion of rangelands, and adopting suitable progress indicators for monitoring rangeland health and pastoral governance. Governments should place greater emphasis on the value of sustainable rangelands management for delivering national environmental and development commitments and should encourage investment and interdisciplinary research to promote the multiple values of healthy rangelands.

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Rangelands are defined in this article 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" (Allen *et al.* 2011). They are natural or semi-natural land-use systems grazed by both livestock and wildlife that account for 54% of the global terrestrial area, encompassing grassland, desert, savanna, tundra, shrubland, and woodland biomes (www.rangelandsdata.org/atlas). Rangelands are multifunctional landscapes that generate globally important ecosystem services (Briske and Coppock 2023), store 30% of the global terrestrial carbon pool (Lal 2011), contain one-third of global biodiversity hotspots, and are home to many iconic and charismatic species (Davies *et al.* 2012). They are complex social–ecological systems influenced by interaction between climate, ecology, management, culture, policy, and market forces (Liniger and Mekdaschi Studer 2019).

In a nutshell:

- Rangelands managed by pastoralists are globally substantial in extent and value, but they are threatened by degradation driven by land conversion and mismanagement
- Many countries include rangeland restoration in their National Voluntary Targets for Land Degradation Neutrality under the UN Convention to Combat Desertification, but implementation rates are constrained by low levels of public and private investment
- Investors and policy makers need better indicators for monitoring and validation of rangeland restoration and for safeguarding pastoralists' rights
- Unconventional thinking is urgently needed to support pastoralist adaptations, such as herd mobility and communal tenure, and to secure rangeland governance for large-scale rangeland restoration and resilient pastoralist livelihoods

Most rangelands are used for extensive livestock production, which we refer to as pastoralism, encompassing nomadic, transhumant (seasonal migration of livestock between grazing lands), and sedentary herding (UNEP 2019; UNCCD 2024a). Pastoralists harness the resources of rangelands through low-intensity and low external input livestock production, relying on mobility and communal herding strategies to access resources and manage risks (Liniger and Mekdaschi Studer 2019). Here, we focus on mobile, communal pastoralism, which can be substantially more productive than sedentary ranching due to the wider range of species involved and products generated, the heterogeneity of resources available, and the climate resilience that diversity and mobility confer (Herrera *et al.* 2014).

Pastoralist communities are often socially, economically, and politically marginalized, yet they make major contributions to national economies and to the maintenance of rangeland ecosystems (Nori and Scoones 2023). Pastoral food products account for around one-third of global protein

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intake, although global estimates are fraught with difficulties of definition and measurement (Cherlet *et al.* 2018). Pastoralists shape rangeland landscapes, safeguarding ecosystem services, providing buffers against extreme events, and stocking carbon, while preserving cultural, aesthetic, and tourism-related values (Waterhouse *et al.* 2024).

Land degradation in rangelands

Rangeland degradation is reported in many countries and is often attributed to overstocking, continuous grazing, encroachment by invasive species, and land conversion (Bedunah and Angerer 2012), although empirical evidence of pastoralists' responsibility is frequently weak or absent. Rangeland degradation is driven by numerous underlying factors, including population growth, inadequate governance, misdirected investment, and gaps in knowledge and technology (Nori and Scoones 2023).

Rangelands face anthropogenic pressures that lead to environmental degradation and reduced productivity, contributing to poverty, insecurity, land-related conflicts, and the displacement and sedentarization (where nomadic or semi-nomadic peoples transition to a more sedentary lifestyle) of pastoralists (UNEP 2019). A recent report from the UN Convention to Combat Desertification (UNCCD) estimated that up to 50% of rangelands may be degraded (UNCCD 2024a); in contrast, Cherlet *et al.* (2018) estimated that 18.5% of the world's rangelands are degrading while the Rangelands Atlas (www.rangelandsdata.org/atlas) shows that productivity is increasing in 31% of rangelands and declining in 15%. Such uncertainties may be repeated at the national level, may lead to misunderstandings about rangeland management, and can be a barrier to investment.

While overgrazing is often cited as the main cause of land degradation, insufficient rest periods for land after grazing are frequently the result of restrictions on mobility (Sharifian *et al.* 2023). Most rangelands are grazing-dependent and restoring rotational grazing has proven key to reversing rangeland degradation (Liniger and Mekdaschi Studer 2019). However, by assuming that livestock cause rangeland degradation, many governments implement measures to curtail pastoralism (Nori and Scoones 2023). Several countries classify rangelands as wastelands and actively promote land conversion (Kronenburg García *et al.* 2023), although 12% of rangelands are conserved within protected areas globally (www.rangelandsdata.org/atlas).

Rangeland resilience depends on ecological connectivity and is compromised by fragmentation of landscapes due to land conversion, a considerable proportion of which has been driven by conversion to cropland (Ramankutty *et al.* 2018). Moreover, new threats to pastoral landscapes are emerging from climate-change mitigation projects, such as those related to afforestation (Briske *et al.* 2024) and renewable energy (Waters-Bayer and Wario 2023).

Pastoralism depends fundamentally on mobility and common property regimes, sometimes across international boundaries, and pastoral societies have developed sophisticated governance arrangements to manage these features. In several countries, these features have been portrayed as anti-state and anti-development, resulting in the enactment of policies that undermine rangeland governance, erode pastoralism, exacerbate conflict, and disregard pastoralists' human rights and rights to natural resources (Bassi 2017).

Compared to the industrialized livestock sector, pastoralism has inferior access to markets, finance, infrastructure, and essential services such as education and health. Pastoralists are typically afforded weak land and water use rights, and often face intolerance regarding health and environmental rules and taxation (Liniger and Mekdaschi Studer 2019). Policies of subsidizing feed resources to alleviate grazing pressure on rangelands have backfired by increasing livestock populations, curtailing mobility, and lowering the overall resilience of pastoral systems (Louhaichi *et al.* 2016; Yu *et al.* 2021).

Land Degradation Neutrality as a framework for sustainable rangelands management

In 2015, the UNCCD adopted Sustainable Development Goal (SDG) Target 15.3 on Land Degradation Neutrality (LDN) as a primary target, inviting countries to set voluntary national targets to achieve LDN. Since then, more than 130 countries have established voluntary targets to achieve LDN (UNCCD 2024b), approximately two-thirds of which include rangelands (Gichuki *et al.* 2019).

The UNCCD defines LDN as "a state whereby the amount and quality of land resources necessary to support ecosystem functions and services and enhance food security remain stable or increase within specified temporal and spatial scales and ecosystems" (UNCCD 2015). LDN is achieved by balancing losses with gains within a given land type and landscape through a combination of restoration and sustainable land management (Cowie *et al.* 2018). The LDN Scientific Conceptual Framework recommends first prioritizing avoidance, then reduction, and finally reversal of land degradation. It emphasizes that measures to achieve LDN simultaneously contribute to restoring vegetation cover, boosting soil organic carbon, conserving biodiversity, and achieving climate-change mitigation and adaptation targets (Cowie *et al.* 2018).

Several challenges may be faced in achieving LDN targets in rangelands, including interpreting indicators of rangeland degradation, diagnosing the extent of degradation, and identifying appropriate restoration options (Panel 1 and Figure 1) (Bestelmeyer *et al.* 2011). Measures that contribute to rangeland degradation, such as land conversion, afforestation, fragmentation of landscapes, and barriers to mobility, continue to be promoted as solutions to rangeland degradation (Davies *et al.* 2015). In most countries, pastoralists face severe development challenges and levels of poverty and vulnerability,

which undermine their capacity to manage rangelands sustainably (McGahey *et al*. 2014). A more nuanced understanding of distinct types of rangeland degradation and state-and-transition models is needed to improve diagnosis of appropriate restoration options and to implement the LDN response hierarchy.

To achieve LDN, countries are recommended to develop enabling policies and regulations, sustainable institutions, access to finance, and improved use of science. They are also recommended to mainstream LDN targets into national development plans, including addressing land governance and tenure according to local conditions and not relying solely on individual land titles, which often fail to increase land-tenure security. Countries should elevate the importance of rangelands in national restoration programs and overcome challenges around jurisdictional roles and responsibilities: for example, those between ministries of agriculture, environment, wildlife, and other natural resources. They are further recommended to integrate LDN into land-use planning mechanisms to counterbalance assessed losses with equal or greater gains (Cowie *et al*. 2018).

LDN is complementary to most other SDGs, although concerns have been raised over potential trade-offs with food production and economic development, which must be carefully managed (Feng *et al*. 2024). Protection and restoration of rangelands under LDN targets can benefit from cross-sectoral collaboration and reporting to improve efficiencies in restoration of lands and landscapes. Greater attention is needed to implement policy and mobilize investment for LDN delivery, which in most countries falls short of what is required (Gichuki *et al*. 2019).

Legal frameworks supporting traditional land institutions and tenure are critical for delivering LDN. The challenge is to develop or implement modern legal frameworks to protect customary land-tenure systems, including legally recognizing common property ownership, flexible and intermittent occupancy of land, mobility and access rights, and mutual support mechanisms. Innovation is needed in recognizing pastoralists' traditional institutions and customs that underpin land governance and in enabling pastoralists to use their traditional ecological knowledge to continue adapting to the social and ecological changes that affect rangelands (Davies *et al*. 2016). Although pastoralist communities are recognized as Mobile Indigenous Peoples under the UN Declaration on the Rights of Indigenous Peoples (UN 2007), many countries do not recognize their status as Indigenous peoples, limiting their territorial claims and other rights (Bassi 2017).

Realigning policies and investments for rangelands

The sustainability of pastoralism is frequently undermined by policy barriers to effective herd management and to investment in sustainable rangeland management (Davies *et al*. 2010). Failure to design policies and investments for rangelands, neglect of pastoralists' rights, and policies to deliberately curtail pastoralism (eg land privatization, bans on mobility) threaten rangeland sustainability. After decades of neglect, the development needs of pastoralists will not be addressed with sector-specific policies. Sustainable rangeland management requires an overarching policy commitment to pastoralism as a legitimate land-use system, which will guide development of more enabling environments (Bassi 2017).

Land-related policies should be informed of the risks and opportunities related to pastoral rangeland management. Climate-change policies should promote the role of rangelands in sequestering carbon and adapting to climate change (Dondini *et al*. 2023). Conservation and environmental policies should protect the value of rangeland habitats and ecosystem services, enhance ecological connectivity, and promote potential benefits of pastoralism, such as fire-load reduction (Rouet-Leduc *et al*. 2021). Ensuring the legal protection of rangelands, including common lands, as well as securing pastoralist land tenure, mobility, and rangeland resting periods, are crucial for long-term sustainability (Gemechu and Dalle 2023).

Pastoralist communities are particularly vulnerable to the impacts of drought, which can result in the depletion of

Panel 1. Restoring rangelands through opportunistic grazing in Tunisia

Since 1990, Tunisia's Office of Livestock and Pastures has used rangeland resting to restore degraded arid lands, banning grazing for three consecutive years while compensating pastoralists with feed. This rigid system led to challenges, as surplus biomass during rainy years went unused. Opportunistic grazing, allowing targeted use in favorable years, improved productivity by 270% and biodiversity by 220%, strengthening ecosystems and rural livelihoods (Figure 1; Louhaichi *et al*. 2022b, 2024).

Figure 1. Opportunistic grazing during a favorable year in central Tunisia. Image credit: Mounir Louhaichi.

rangeland resources essential for their livelihoods (Piemontese *et al.* 2024). As a result, many pastoralists are forced to abandon their traditional way of life and seek alternative means of survival (Tugjamba *et al.* 2023). This shift has important implications for both the individuals and the larger community, as it can lead to increased poverty, food insecurity, and social destabilization (Muhammad *et al.* 2019). Drought resilience programs should recognize, respect, and build on pastoralist adaptations to risk and uncertainty, including communal tenure, mobility, protection of pasture reserves, resource pooling, and other practices (Nandintsetseg *et al.* 2024).

Pastoralists have historically been coerced to accept radical change to their land tenure (for example, based on subdivided land and private ownership). However, lessons are emerging for securing communal tenure in ways that support pastoralist mobility and management. Customary (traditional) forms of land tenure can be effective if they are formally recognized, with emphasis on coordinating pastoral use and strengthening community governance rather than formal land titling (Herrera *et al.* 2014; Robinson and Flintan 2022).

Sound governance systems are instrumental for defining legal and customary land rights and promoting participation in decision-making to enable management of rangelands at scale. Participatory land governance is important for rangelands when the access to and use of resources are ruled by non-exclusive, overlapping, or collective rights; when the landscape is composed of mosaics and different tenure regimes; or when rangelands are managed by multiple stakeholders. Innovative ways to expand the participatory governance of pastoral lands include new partnerships, multistakeholder platforms, and improved application of science in policy-making (Herrera *et al.* 2014; Davies *et al.* 2016).

Achieving LDN in rangelands requires substantial scaling-up of suitable investments combined with appropriate social and environmental safeguards. Many countries have established legal frameworks that can support pastoralists to strengthen natural resource governance, and some have also demonstrated progress in rangeland restoration. However, few countries have unlocked the private investment needed to take these experiences to scale. A major barrier to investment is the absence of adequate monitoring of progress toward meeting LDN targets and the outcomes and impacts of rangeland restoration (Gilbey 2018).

Sustainable pastoral production can be enabled by policies that allow differentiation and traceability of products, livestock insurance, non-livestock income opportunities from rangelands such as eco-tourism, innovative financial tools, tailored infrastructure and technology, and synergies between urban markets and pastoral enterprises. Legislation should seek to enable innovation in marketing pastoralist products and improve coordination between public sectors to respond to the diversity of values and the complexity of scale in rangelands (Briske and Coppock 2023; Nori and Scoones 2023).

Investors, including pastoralist entrepreneurs as well as external businesses, need confidence that investment in local institutions to strengthen governance will generate returns through rangeland value chains or ecosystem services. Governments need confidence that these approaches work to justify public investments that provide incentives to the private sector, for example through blended finance, subsidies, or environmental stewardship payments (Bonilla-Cedrez *et al.* 2023). Rangeland users need clear evidence of the economic, social, and environmental benefit of their efforts to restore rangelands (Fetoui *et al.* 2021). Further investment to reduce knowledge gaps about rangeland values and opportunities and rangeland ecology (Louhaichi *et al.* 2022a) would require verifiable data on rangeland status and trends, recognition of actions carried out by pastoralists, and better dissemination of validated knowledge (Mahdavi *et al.* 2023).

Sustainable rangelands management will require financial instruments that economically empower pastoralists while respecting their management practices (Davies *et al.* 2015). Investments are needed in several sectors to improve value chains and markets, increase the use of information technology, adapt infrastructure, promote livestock health services, and develop insurance and other risk management mechanisms. However, investments must be designed to reinforce pastoralist institutions and governance rather than circumvent or undermine them, and investments are also more likely to contribute to sustainable rangelands management if they incentivize the multiple ecosystem services provided by rangelands (Davies *et al.* 2015; Nori and Scoones 2023). International institutions should develop new entry points for rangelands, making them a priority for financial support and helping pastoralists to acquire drought insurance, increase savings, gain access to online banking, and attract more private investment in pastoral areas (UNCCD 2024a).

From benign neglect to investing in global heritage

The UN designated 2026 as the International Year of Rangelands and Pastoralists (IYRP), reflecting the growing global concern over development failures and land degradation in these regions. Many countries need to recognize the importance of rangelands and prioritize public investment in rangeland services and infrastructure (Metternicht *et al.* 2019). Even in cases where finance is available, countries may lack capacity for building the case for investment or for using public investment to catalyze private investment in land management. Greater emphasis should be placed on the value of sustainable rangelands management for delivering multiple national commitments, such as LDN, and on creating an enabling environment for private investment while at the same time respecting pastoralists' land and human rights (Gichuki *et al.* 2019).

Sustainable development for pastoralists and rangelands requires innovation in adapting services and technologies to the logic of pastoral management systems, rather than the other way around. Adapting development to the practices that have traditionally enabled sustainable rangelands management is consistent with progress and is not regressive. National LDN commitments create opportunities for rethinking rangeland restoration by highlighting the threats of land conversion and ecosystem degradation, challenging notions of what constitutes sustainable rangelands management, and raising the level of national ambition toward rangelands. Pastoralists can take better advantage of emerging opportunities, such as those presented by new markets, societal transformations, and even climate change, if their adaptive capacities are strengthened and their rights are respected.

In addressing the climate and biodiversity crises and achieving LDN, rangelands play an important role, one that requires urgent action to ensure sustainable pastoralist development. Multisectoral attention can be driven by public policy that commits to pastoralism as an effective and legitimate land-use system, respects the rights of pastoralists, and increases public investment in pastoralist development. Specific policy attention is required to strengthen local governance and enable pastoral stewardship of rangelands, including providing security, upholding the rule of law, ensuring legal protection of communal resource rights, and supporting local organizations for participation of pastoralists (Panel 2 and Figure 2) (Davies *et al.* 2016).

The IYRP marks the coming together of distinct professional communities concerned with rangeland science and management, pastoralist rights, and social development to advance a common agenda. Interdisciplinary research and development on pastoralist and rangelands management can help spur confidence in rangeland investment and monitor progress toward development targets such as LDN. Countries and their development partners are beginning to implement rangeland restoration projects that build on pastoralist governance and management practices, creating new opportunities to measure impacts and evaluate approaches. The trend toward investment in pastoralists as stewards of sustainably managed rangelands can be accelerated with improved evidence of the cost effectiveness of enabling actions as well as with improved targets and performance indicators that reflect not only environmental, social, and economic benefits but also the diversity of rangeland ecosystems and rangeland governance.

Panel 2. Rangeland resource governance in Mongolian pastoral systems

A program in Mongolia's Gobi Desert strengthened community organizations to improve pasture management by coordinating herd movements, improving water sources, and designating winter grazing areas (Figure 2). Improved sites generated on average 11% more biomass and 12% greater income along with other socioeconomic benefits. The community-driven approach, facilitated by district community organizers and strong community leadership, was critical to success (Leisher *et al.* 2012).

Figure 2. Mongolian grassland management. Image credit: Hanspeter Liniger.

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Data Availability Statement

No data were collected for this study.

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