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Pastoralism and the Green Economy – a natural nexus?

Status, challenges and policy implications

WISP World Initiative for Sustainable Pastoralism

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- Developing international and national environmental instruments
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For more information visit www.iucn.org, www.iucn.org/drylands/ and www.iucn.org/wisp

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Acronyms

AU: ..... African Union
BCP: ..... Biocultural Community Protocol
CAFO: .... Confined Animal Feeding Operations
CAP: ..... Common Agricultural Policy
CBD: ..... Convention on Biological Diversity
CCA: ..... Community Conservation Agreement
CPR: ..... Common Property Regime
DDT: ..... dichlorodiphenyltrichloroethane
DNA: ..... Deoxyribonucleic Acid
EAFRD: .. European Agricultural Fund for Rural Development
EU: ..... European Union
FAO: ..... Food and Agriculture Organization
GCA: ..... Game Controlled Area
GDI: ..... Global Drylands Initiative
GDP: ..... Gross Domestic Product
HNV: ..... High Natural Value
ICCA: ..... Indigenous Community Conserved Area
IFAD: ..... International Fund for Agricultural Development
IIED: ..... International Institute for Environment and Development
IPA: ..... Important Plant Area
IUCN: ..... International Union for Conservation of Nature
LPPS: ..... Lokhit Pashu Palak Sansthan
LU: ..... Livestock Unit
MA: ..... Millennium Ecosystem Assessment
MDG: ..... Millennium Development Goal
NAMA: ... Nationally Appropriate Mitigation Action
NAPA: .... National Adaptation Programme of Action
NGO: ..... Non-Governmental Organization
PES: ..... Payment for Ecosystem Services
PUG: ..... Pasture User Group
REDD: .... Reducing Emissions from Deforestation and Forest Degradation
SDG: ..... Sustainable Development Goal
TDBP: .... Tanzania Domestic Biogas Programme
UK: ..... United Kingdom
UNCCD: . United Nations Convention to Combat Desertification
UNEP: .... United Nations Environment Programme
US: ..... United States
USA: ..... United States of America
USD: ..... United States Dollar
VCS: ..... Voluntary Carbon Standard
WCS: ..... Wildlife Conservation Society
WFEN: ... Wildlife Friendly Enterprise Network
WISP: ..... World Initiative for Sustainable Pastoralism

Navajo sheep and goats in New Mexico: Credit Michael Benanav

Background to the study

The "Green Economy" is a vision of the future wherein material wealth is not generated at the cost of increasing environmental risk, ecological scarcity or social disparity. Considerations over "green" development for the global livestock sector are at an all-time high and whilst countries grapple with what this entails, many of them possess large areas of rangelands that are managed through pastoralism and which already make a major contribution to environmental sustainability and the economy. This role is poorly understood, neglected and even eroded by misguided policies, investments and attitudes. Not only does pastoralism have a major role to play in management of natural capital and sustainable production but the aspirations of the Green Economy offer a powerful opportunity to overturn years of prejudice and misunderstanding of pastoralism.

This study focuses on pastoralism's current and future potential for securing sustainable management and green economy outcomes from the world's rangelands. It synthesises existing evidence and uses practical examples from mobile pastoralism in Europe, Latin America, North America, Central, Western and Southern Asia, Australia and throughout Africa to both demonstrate the system's inherent characteristics for adaptive sustainability and some of the key opportunities and challenges for promoting development in rangelands. Finally, the study identifies the key enabling conditions required for pastoralism to deliver on its potential role in a Green Economy.

This report is financed by UNEP and is part of the efforts of UNEP, IUCN and the World Initiative for Sustainable Pastoralism (WISP), to provide the social, economic and environmental arguments for increased recognition of sustainable pastoralism as a viable land management option for the world's rangelands.

Sheep moving across landscape, Spain. Credit: Jesus Garzon

Executive summary

The Green Economy concept has recently gained significant traction due to mounting global fears over multiple crises of climate change, energy, food and financial systems. Transitioning towards a Green Economy—*an economic system in which material wealth does not increase environmental risk, ecological scarcity or social disparity*—will require growth strategies in which production and consumption does not continue to come at the expense of natural capital and social equity. In the livestock sector this requires a three pronged approach: reduced consumption of livestock products; greening the intensive system as much as possible; capitalising on the inherent sustainability of pastoralism for local, regional and international markets.

Three principal elements are essential to understand the role of pastoralism in delivering sustainable outcomes: (i) the contribution of pastoralism to the maintenance of natural capital; (ii) pastoralism's resource efficiency and sustainable production in highly variable dryland environments; and (iii) the conditions that enable pastoralism to deliver on its green economy potential. The objective of this study is to review the state of knowledge on these elements and reveal the key priorities for enhancing pastoralism's role within the transition to a Green Economy.

Pastoralism's green economy potential

Pastoralism—extensive livestock production in the rangelands—is one of the most sustainable food systems on the planet. It plays a major role in safeguarding natural capital across a quarter of the world's land area, although in many developing countries this stewardship has been eroded by decades of underinvestment and misdirected development. On the other hand, a number of industrialised countries are demonstrating ways to invest in pastoralism as a multifunctional livestock management system which provides ecosystem services that extend well beyond the boundaries of the rangelands. Rangeland ecosystems are grazing dependent and sustainable pastoralism maintains soil fertility and soil carbon, water regulation, pest and disease regulation, biodiversity conservation and fire management. Grazing lands cover five billion hectares worldwide and sequester between 200-500kg of carbon per hectare per year, playing a leading role in climate change mitigation. When assessments are adjusted using standard life-cycle methodologies to account for pastoralism's positive environmental externalities the system has lower emissions per unit of production compared to more intensive feed-lot production systems.

Development in pastoral areas worldwide falls far behind that of other communities, creating poverty and vulnerability that undermine the sustainability of the system. Pastoralists suffer both from low investment and mal-investment, which have combined to weaken natural resource management and the pastoral economy and contribute to degradation of pastoral resources. Inappropriate development policies have often weakened traditional land tenure and natural resource governance systems and restricted the herd mobility that makes the system work, and denied pastoralists the basic services required for development, such as education, security and health. Where pastoral land management has become unsustainable it can often be attributed to structural changes, such as to resource governance or land rights, which constrain the way pastoralists use their knowledge of the environment.

Pastoralism delivers a wide range of economic values from areas of low overall biomass productivity that are ill-suited to intensive management systems. Pastoralism is uniquely adapted to utilize the great diversity and unpredictability of rangeland resources with utmost efficiency. Although pastoralism is considered a low-input low-output system, it makes intensive use of natural, human and social capital to produce an array of economic, environmental and social goods and services. Pastoralism has been shown, based on a review of many studies, to be between 2 and 10 times more productive per unit of land than the capital-intensive alternatives that have been put forward. Unfortunately many of these benefits go unmeasured and are therefore frequently squandered by policies and investments that seek to replace pastoralism with more capital intensive modes of production.

Enabling conditions for sustainable pastoralism

Enabling conditions are needed for pastoralism to fulfil its potential in the Green Economy, but intensification and expensive new technologies are not the answer. Pastoralist under-development is primarily due to marginalisation and exclusion of pastoralists, neglect of their rights, and impediments to tried-and-tested rangelands management strategies. Significant and cost effective development can be had through addressing these constraints, for example by improving pastoralist representation in decision making, protecting communal land rights and transhumance corridors, linking government with customary institutions, improving access to equitable markets, strengthening access to healthcare and education, especially by women. Whilst such interventions or processes are low cost they are highly demanding of skills that are often poorly available and there is a major need to upgrade the skills of pastoralist development agents. Furthermore there is need to address the major knowledge and information gaps that persist around pastoralism such as knowledge of rangeland ecology or data on pastoralist development indices.

To reach their full potential pastoral systems must evolve their traditional adaptive strategies in order to manage both existing and emergent risks. This includes managing threats that could be posed by the pursuit of a Green Economy, such as “land grabbing” for biofuel production. It also includes managing the risks of climate change and the likelihood of increasing climate hazards. Pastoralism is far better equipped to deal with climate uncertainty than other forms of agriculture, lacking the rigid seasonality of crop production and having the capacity to move between resource and climate zones. The key to enhancing this natural adaptability is to manage for uncertainty rather than attempting to regularise and standardise the system.

Strengthening the role of pastoralism in the Green Economy will require attention to widespread market failures and investment gaps. This includes strengthening marketing channels for multiple primary goods, such as milk, meat and fibre. It also includes addressing market failure around ecosystem services provided through sustainable pastoralism. Attention must be paid to removing disincentives in fiscal policy and providing incentivising services, including financial services such as basic savings and credit facilities. Modest investments are required in infrastructure to facilitate the marketing and innovations required to capitalise on the diversity of goods and services from pastoralism. Much more support is needed for niche marketing of a diversified portfolio of products from pastoralist systems, particularly efforts to add value or protect production processes through certification. Linked to this, more effort is needed to reform standard foot-printing tools for evaluating the environmental performance of livestock products in order to clearly inform consumers of issues surrounding water scarcity, carbon emissions and freshwater pollution.

Recommendations

To realize the potential of pastoralism as a contributor to the Green Economy will require global leadership and the **establishment of a global development framework for sustainable pastoralism**. Taking the lead from Rio+20, the post-2015 global development agenda must address gaps in the Millennium Development Goals that allowed pastoralism to be left behind, and must particularly address sub-national development disparities as well as issues of natural resource governance at the local level. Improved environmental indicators are needed and must include attention to natural rangeland ecosystems as well as forests and water resources.

To understand the value of pastoralism, environmental and economic monitoring must **disaggregate the costs and benefits of intensive and pastoral livestock sectors in economic planning**. There is currently no universal framework for comparing the environmental performance of different livestock systems and standard approaches to quantifying natural resource efficiencies fail to adequately capture pastoralism's resource efficiencies. The livestock sector may require a dualistic approach: one that seeks to generate sustainable growth strategies and indicators suitable for the commercial livestock sector whilst also seeking to better quantify and enhance the positive externalities associated with low-input pastoralism.

To promote growth in the pastoralist sector it is critical to **connect pastoralists better to domestic and international livestock markets**. Sustainable development within pastoral drylands requires reform of international trade policies that distort agricultural markets and undermine pastoralist economies. This includes developing regulations to protect niche markets for pastoral goods and supporting certification standards for the marketing of environmentally sustainable pastoral products. Pastoral systems possess many unique characteristics that are ideally suited to growing niche markets for more environmentally sustainable products such as products derived from meat, milk, hides, wool and fibres.

The roles of pastoralism in both food production and environmental sustainability are overlooked by narrow sectoral approaches, leading to decisions that are inefficient at a system, landscape or national scale. The cost of maximising efficiency in one part of the pastoral system—for example maximising meat output—is often greater than the benefit, since costs include the loss of ecosystem services and biodiversity as well as reduction in other livestock outputs, such as milk, fibre and hides and the overall resilience of the system. However, capitalising on the full range of values requires very different investment and policy. It is vital to **capitalise on the environmental benefits of pastoralism and expand green niche markets**.

To enable pastoral management of the rangelands requires better recognition and legitimization of common property regimes. Efforts must be made to **strengthen property rights and governance over rangeland resources, recognising the right to manage resources**. In many cases this will require forging new relationships between government, often at the local level, and customary institutions for natural resource management. To facilitate the participation of pastoralists in strengthening local governance and improving natural resource planning it is important **to integrate pastoralists into the development mainstream through improved human capital and knowledge**.

Pastoralism lies at the nexus of the three pillars of sustainability and provides a combination of social, environmental and economic benefits. It occupies at least one quarter of the global land area and the sustainability of land use across this vast area relies fundamentally on how pastoralism manages rangeland biodiversity. To this extent the viability of rangelands depends on how pastoralists conserve nature. Some countries already compensate pastoralists for the environmental services of their rangeland management, which helps to envision a future Green Economy in which pastoral livestock production is valued for its combined economic and environmental roles, in which high-value meat, milk and fibre is produced in sustainably managed communal rangelands, and in which pastoralists are enabled to fulfil their roles as custodians of their environment.

Amboseli, Kenya. Credit: Jonathan Davies

Pastoralism and an inclusive green economy

The idea of a global green economy has been around for a long time—at least since Stockholm 1992[1]—but growing concerns about climate change have recently elevated the debate to one of pressing global importance[2]. With the current emphasis on greening some of the most polluting sectors of the economy it is easy to overlook existing economic activities that already contribute to sustainability, and which offer inspiration for the future. Pastoralism is one such economic activity, practiced on more than a quarter of the world's land surface, in rich and poor countries alike, and contributing significantly to both food production and protection of the environment.

Pastoralism refers to the extensive production of livestock in the rangelands, in which managed herd movements are necessary for sustainability. Pastoralists predominantly maintain herds of ungulates, which, depending on location, can include cattle, yak, sheep, goats, horses, donkeys, reindeer, camels, llama and guanaco, as well as a number of non-ungulate species. Many pastoralists keep a range of different species to exploit different ecological niches or to maintain productivity under different climatic conditions. Pastoralism is practiced in more than 75% of the world's Nations. Some reports estimate that pastoralism is practiced by somewhere between 100 to 200 million people[3], yet the precise figure could be closer to 500 million, and this uncertainty reflects the weakness of available data on pastoralism generally. Practitioners are often called pastoralists, although there is an increasing association of the term "pastoralist" with an ethnic identity rather than an economic activity[4]. For the sake of this report we are focusing on pastoralism as the rangeland management system, and therefore pastoralists as the rangeland managers.

Pastoralism is practiced on more than a quarter of the world's land surface, in rich and poor countries alike, and contributes significantly to both food production and protection of the environment.

Pastoralism evolved in response to natural climatic changes and prospered for centuries under conditions of high environmental variability, which is fundamentally different from the uniform production systems within which most intensive livestock production systems or technologies were developed. Pastoralists raise domestic livestock in the rangelands by tracking resources as and when they become available, following well-established seasonal routes as well as maintaining contingency grazing reserves for harsh years of

Rangelands, our global heritage

Rangelands are geographical spaces that are dominated by grasses and may or may not include scattered woody plants. They include a variety of types, including savannah, prairie, grasslands, and steppe, and together account for between one quarter and one half of the world land area. Rangelands may be edaphic (natural) or anthropic (man-made), and they consist primarily of indigenous vegetation. They are typically managed through extensive livestock production, to the extent that many rangelands could be considered as semi-natural environments. In general rangelands are un-tilled, and they are particularly influenced by the actions of herbivores, whether wild or domesticated, as well as by the influence of fires, which can also be natural or man-made. Rangeland "landscapes" consist of a mosaic of ecosystems and habitats, which along with extensive areas of brush or grassland can include wetlands and riparian areas, mountains, and forest patches[5].

drought or blizzard. These rangelands co-evolved over millions of years with vast herds of ungulates and are completely dependent on herbivore action for their maintenance. In most cases this dependency is satisfied by pastoral grazing management, maintaining ecosystem functioning and building natural capital. Pastoralism has played a significant role in both food production and the delivery of globally significant ecosystem services from rangelands for millennia and mobile pastoralism is known to enhance rangeland biodiversity, rangeland carbon stocks and support the conservation of rangeland habitats[6]. Until recently this role has been poorly understood or respected by development policy and practice.

Mobile pastoralism enhances rangeland biodiversity, rangeland carbon stocks and supports the conservation of rangeland habitats.

Conceptual framework – pastoralism as part of the inclusive green economy

The Green Economy is essentially a new economic paradigm that will require transitioning towards an economic system where material wealth is not generated at the cost of increasing environmental risk, ecological scarcity or social disparity. It will require developing strategies and indicators for economic growth that effectively monitor environmental externalities and social disparities to ensure production and consumption does not continue to come at the expense of natural capital and social equity. For the global livestock sector this will mean greater efforts to ensure that adequate incentive frameworks and policies are in place to improve environmental performance among producers. Consumer pricing and labelling must reflect the environmental externalities associated

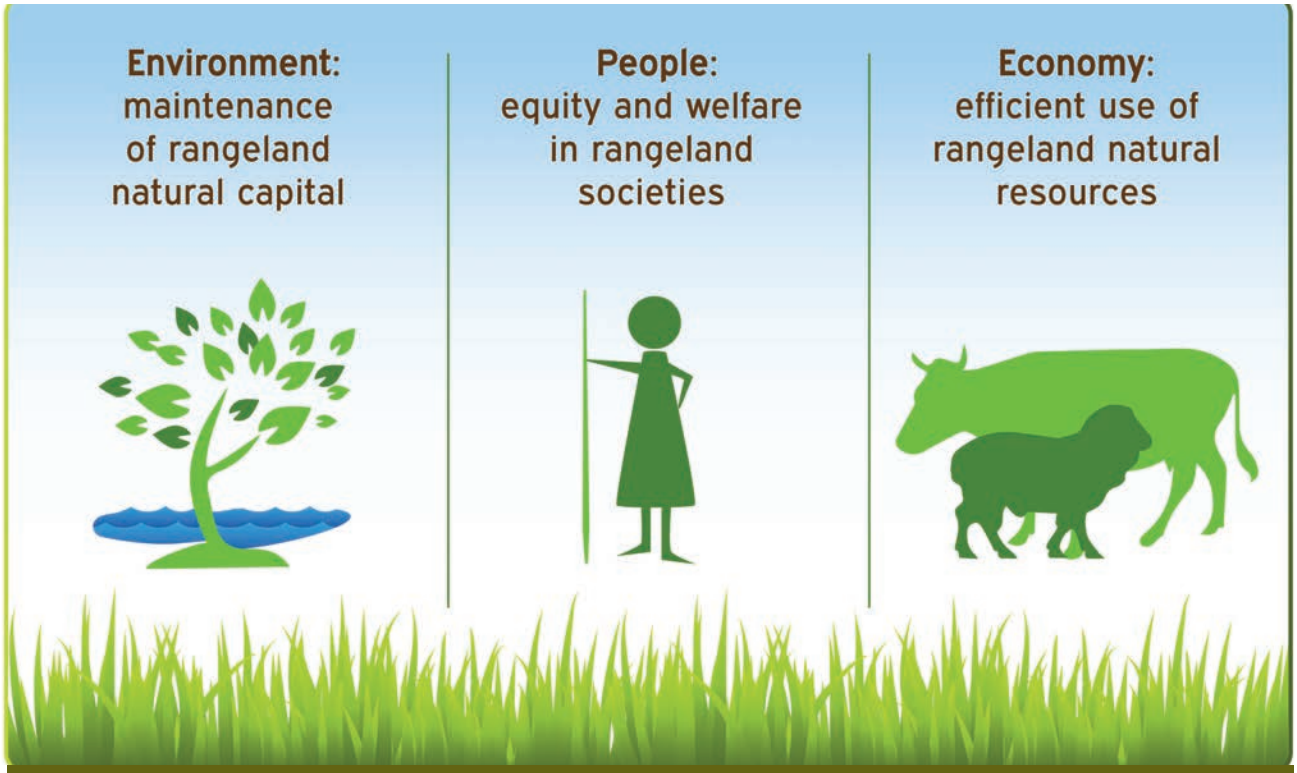

Figure 1: The role of pastoralism in a green economy.

with the globalized trade in animal products and feed crops. This requires further investment in standardizing measurement systems for analysing the sector's environmental footprint. However, this approach—of focusing on a narrow range of animal products— will neglect the green growth potential associated with the millions of pastoralists and smallholders still practicing more traditional forms of livestock production.

Securing pastoralism's potential within the transition to a global green economy will require a different set of tools and approaches to those currently proposed for greening the intensive livestock sector.

Securing pastoralism's potential within the transition to a global green economy will require a different set of tools and approaches to those currently proposed for greening the intensive livestock sector. It requires recognition of pastoralism's current role, and future potential, for achieving sustainable development outcomes from rangelands. To achieve this we must understand and address the plethora of constraints pastoralists face in deploying herd mobility as a management strategy to make resource-efficient and sustainable use of biologically diverse, and often climatically unpredictable rangelands.

Yet in many countries pastoralism is delivering far below its potential due to the lingering belief that it is either economically or socially backward, or environmentally harmful. However, a growing number of governments and nongovernmental actors also refute this belief and it is possible to write this report thanks to the growing evidence to the contrary and to the persistence of millions of pastoralists who manage the world's rangelands, who together have generated a wealth of experience from which we can learn and benefit.

This report utilises a broad green economy framework to guide discussion around the potential of pastoralism, and the constraints pastoralists' face, in securing resource efficient, sustainable development outcomes. This recognises that for green growth policies to support, rather than undermine this potential, the knowledge base needs to be developed around three elements that are essential to secure pastoralism's role in delivering green growth: (i) contribution to the maintenance of natural capital; (ii) evidence of pastoralism's resource efficiency; and (iii) identification of key enabling conditions required for pastoralism to deliver its green economic potential.

The following sections of this report review current knowledge in relation to each of these three elements as a means to open up debate around pastoralism's current and potential role within the Green Economy. The collection of evidence presented in this report should represent a starting point from which space could be created for pastoralists themselves to engage in dialogue and debate to develop their own defining vision for their role within the Green Economy.

Quantifying the potential pastoralism holds for safeguarding natural capital and understanding the enabling conditions needed to realise these benefits will be vital to secure the contribution from the world's rangelands to tackling some of the most pressing threats to human well-being. Given the rapid growth of international green markets and investment over the last few decades this report also explores how far pastoralism has begun to innovate and capitalize on these markets, alongside some of the potential challenges associated with green investments. While more dialogue and debate is needed with pastoral groups themselves*, the report concludes by defining a series of key recommendations for policy and practice that begin to outline some of the important considerations needed to enable a transition to inclusive green economic growth in pastoral lands.

Rangelands and pastoralism: an intimate relationship

Herd mobility is now widely understood as the key to sustainable development in pastoralist systems (Niamir-Fuller 1999). Rangelands evolved in parallel with the evolution of herding ungulate species and the two are inter-dependent; ungulates have shaped rangeland ecosystems and biodiversity just as rangelands have shaped the evolution of ungulates. Pastoralism also evolved within this system and over millennia has developed intricate management systems and cultural norms that under extensive conditions ensure sustainable use of highly variable resources. Flexibility in herd sizes, labour intensity and reliance on a wide range of outputs are key strategies pastoralists use to create highly resilient livelihoods. Restriction of mobility has been shown to disrupt the inherent resource efficiencies associated with pastoralism causing under-exploitation of some resources and over-exploitation of others, with the outcome being rangeland biodiversity loss in both cases.

* The main elements of this publication have been shared with pastoralist leaders and pastoralist civil society organisations at a recent Global Gathering of Pastoralists, entitled "Pastoralism for a Sustainable Future: From representation to action", organised by the World Initiative for Sustainable Pastoralism (WISP) and the World Alliance of Mobile Indigenous Peoples (WAMIP) in Kiserian, Kenya 9th – 15th December 2013.

Social equity as the platform for sustainable development

The Green Economy concept places a strong emphasis on improved human well-being and social equity and there are, unfortunately, many factors that currently impede pastoralists from playing their role in the Green Economy and from being effective stewards of the world's rangelands. Pastoralists in many countries are marginalised: receiving low public investment, excluded from decision making, and in some cases facing punitive measures from their government for their lifestyle and production system. Whilst not a universal situation—a number of countries display an affinity with their pastoral heritage and support pastoralism through economic and environmental measures—marginalisation does nevertheless appear to be common, particularly in developing countries. Marginalisation of pastoralists contributes to short-comings in human well-being in a number of ways, such as through development of inappropriate polices, food insecurity, and conflict[7].

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Human development and food security indicators remain critically low in many pastoralist areas and generally far lower than in other agro-ecological zones. Studies investigating development indicators at the national level reveal that for dryland countries—where the majority of pastoralists live—average infant mortality rates are at least 23% higher than non-dryland countries[8]. Investigations comparing infant mortality rates across biomes in Asia revealed drylands have higher rates than any other biome[9]. Similarly, attempts to map poverty levels across livelihood zones in sub-Saharan Africa found on average 52% higher levels of income poverty in pastoral drylands[10].

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In Kenya indicators for life expectancy, school enrolment and the Human Development Index are far lower and poverty levels far higher in the Arid and Semi-Arid Lands dominated by pastoralists[11]. The pastoral North Eastern province has the highest poverty level of 70% in 2005/06 compared to a national average of 46.6%[12]. Poor development progress in the country's dry pastoral areas compared to more favourable

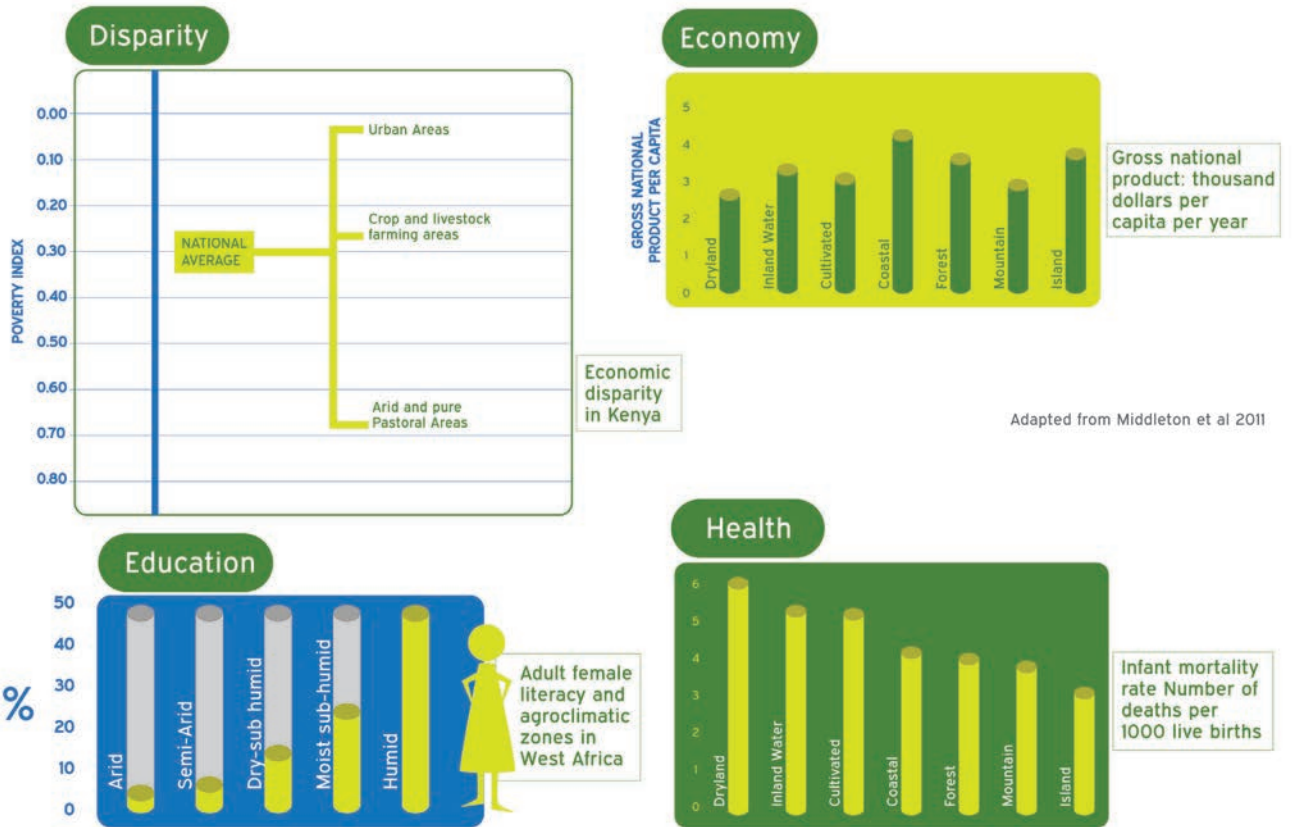

Figure 2: Human Development Failures in Pastoral Systems

Low performance in pastoralist school enrolment and human health cannot simply be attributed to mobility: in many cases services are not provided or are provided inappropriately.

agro-ecological zones can be seen through indicators of progress towards Millennium Development Goal two: achieving universal primary education. Net school enrolment rates in primary education have risen nationally from 70% in 2000 to 92% in 2008, yet comparable improvements have not occurred in North Eastern Province where the net enrolment rate was 31.9% in 2008[13].

In Africa more broadly, food emergencies remain a frequent occurrence in the pastoralist areas of 31 countries[14]. The provision of basic infrastructure vital for economic development such as surfaced roads, electricity and communications is critically low in pastoral drylands. The delivery of basic services through investment in traditional sedentary service centres in key settlements is challenged by a low, often highly mobile population which requires service delivery at multiple sites to effectively reach the population. At the same time, low performance in school enrolment and human health cannot simply be attributed to mobility. In many cases services are not provided in any form—settled or mobile—or are provided inappropriately, for example school terms not corresponding with the pastoral calendar, or health facilities staffed by outsiders with no local language skills[15].

Women's and girl's use and access to health facilities and education opportunities are especially low in pastoral societies due to both a lack of appropriate service delivery and the cultural norms of pastoral societies. This is demonstrated by evidence from statistics on the health and education status of pastoral girls and women relative to males[16]. Women are frequently excluded from decision making and are denied inheritance rights. In some communities harmful practices remain commonplace, including arranged marriages for girls at a young age[17].

Women's and girl's use and access to health facilities and education opportunities are especially low in pastoral societies.

Women Pastoralists Gathering, India. Credit: Michael Benanav

In many developing countries, knowledge gaps and misunderstanding of pastoralism contribute to marginalisation and failure to deliver basic services. Several governments have viewed mobile pastoralism as archaic and pastoralists as backwards, and have made strenuous efforts to settle pastoralists and radically change the pastoral production system[18]. Pastoralist rangeland management has been depicted as irrational for various reasons, ranging from purely a cultural attachment to their herds[19] to fundamental flaws in their communal tenure system[20]. This has prompted efforts to replace mobile herding with sedentary livestock production, to reform customary tenure systems through privatization, and to convert pastoralism from a multi-species, multiple values system built around the protection of a diverse resilient set of indigenous livestock, to a single-output system often orientated towards meat production and reliant on the introduction of exotic species or genes[21].

There is a close link between the widespread misunderstanding of pastoralism and marginalisation of pastoralists. In many countries pastoralists are denied the opportunity to refute poorly-informed public statements and to directly influence public opinion; media coverage of pastoralist issues is often guilty of not even talking to pastoralists to hear their side of the story[22]. Additionally, by excluding pastoralists from decision making and public planning governments, their rich knowledge and understanding on rangeland ecology and natural resources is omitted.

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Pastoralist knowledge is essential for maintaining management practices that result in the sustainable, efficient use of rangeland resources. The acceptance of indigenous knowledge systems as an asset for enabling sustainable land management is increasingly reflected in the statements of a number of National Biodiversity Strategies, and more broadly environmental policy and planning is now taking greater effort to understand and accept these knowledge systems. Yet the persistence of sectoral policies that simplistically associate environmental degradation with overstocking suggest that pastoral rangeland management continues to be misunderstood, and much more can be done to protect and promote local pastoralist knowledge systems. Sustainable development outcomes are achieved where pastoralism is viewed as a viable and respectable way of life and where public policy can respect and reinforce pastoralist knowledge[23].

Sectoral policies that simplistically associate environmental degradation with overstocking suggest that pastoral rangeland management continues to be misunderstood.

Disregard for pastoral knowledge, exclusion from decision making, and general under-valuing of pastoralism as a land use strategy all contribute to the conversion of pastoral lands to other uses, and the acquisition of pastoral rangelands by non-pastoralists[24]. In some countries, pastoral lands have been reallocated to non-pastoralist communities without regard for the usufruct rights of pastoralists. Typically, it is pastoral lands with proximity to a steady supply of water that are transferred to crop farming communities, contributing to local hostilities. These patches are often critical to the functioning of the whole pastoral system and their removal can cause widespread impoverishment and contribute to rangeland degradation[25].

Globally, reports of pastoral groups losing access to important rangeland resources have increased as the large-scale acquisition of land for various green purposes rises, particularly in areas of Africa, Asia, and Latin America where governance weaknesses and poor land use planning persist[26]. Increased demand for biofuels was also closely linked to the food commodity price rises of 2008/9 which further intensified the land grab phenomena by prompting investment in land as part of agricultural investment strategies for both speculative and immediate purposes. Increasing demand for land for carbon offsets can also be linked to some land grabs in pastoral areas.

Land use change in pastoral rangelands, particularly in sub-Saharan Africa, is further complicated by the growing phenomenon of pastoralist drop-outs. When pastoralists leave the pastoral livestock economy they may find opportunities, sometimes provided by

Reports of pastoral groups losing access to important rangeland resources have increased as the large-scale acquisition of land for various "green" purposes rises.

development agents, to adopt crop farming. Former pastoralists often have a traditional claim to land through their community, even though converting land to crop farming can be shown to compromise the pastoral system as a whole, possibly contributing to further dropping-out of pastoralism. Governments face a significant challenge in understanding and planning equitably for such land use change, particularly in the absence of accepted rangeland landscape planning tools and in an environment of weak land rights and communal tenure.

Population growth and increasing urbanization are having, and will continue to have, profound impacts upon demographic trends within pastoral rangelands. Over the next forty years, pastoralist populations in many rangelands are expected to double. In Africa population growth rates in pastoralist areas is estimated at 2.5 to 3.5% per year and in some countries the pastoral population growth has approached a 25 year doubling rate. The population of Mauritania, a country where at least 70% of the population are pastoralists, is predicted to increase from 3.3 million to 7.5 million by 2050[27]. Urbanization is also accelerating rapidly in pastoral rangelands. In the Sahelian drylands of West Africa the number of towns with more than 100,000 inhabitants increased from five to 25 from 1960 to 1990[28]. As the number of settlements multiplies in the rangelands, a lack of planning can lead to major encroachment on rangeland natural resources with significant implications for resource rights and management.

Population growth and increasing urbanization are having, and will continue to have, profound impacts upon demographic trends within pastoral rangelands.

Rapid human population growth within pastoral rangelands coupled with increasing integration into markets and the cash economy creates additional forces attracting pastoralists to restructure their livelihoods around urban centres and settlements. In some regions these trends have ignited a debate over the future of pastoralism itself and under a more moderate stance it is considered important to begin developing “exit” strategies for pastoralists in order to help people leave the system. For example, livestock numbers in East Africa have remained fairly constant because of disease epidemics and losses from floods and drought, whereas the human pastoral population continues to grow, meaning more people are reliant on fewer livestock. In the Ngorongoro conservation area in Tanzania the Maasai population increased by 6% per annum from 23,000 to 50,000 in the 1990s, whilst livestock numbers remained constant. As some households could no longer rely on livestock alone, people have responded by switching towards agro-pastoralism and ecotourism and have become increasingly commercialised in their livestock production[29].

In most rangelands seasonal herd movements are an ecological necessity and even where households have settled, pastoralists have found ways to continue transhumance whilst benefiting from many of the advantages of settled life.

While these demographic realities play out it is clear that livestock keeping remains deeply embedded in all pastoralist cultures and settlement of pastoral households need not imply reduced productivity, destitution or environmental degradation. In most rangelands seasonal herd movements are an ecological necessity and even where households have settled, pastoralists have found ways to continue transhumance whilst benefiting from many of the advantages of settled life. The challenge for public policy is to maintain the economic and environmental benefits of mobile pastoralism whilst providing appropriate services to satisfy basic rights, and whilst respecting and upholding the resource rights of pastoralists and other rangeland stakeholders, recognising that these rights are complex, overlapping, and possibly conflicting.

Watering the herds in Kenya. Credit: Michael Benanav

Maintenance of natural capital

Pastoralism's role in the maintenance of natural capital

Pastoralism is a system that relies fundamentally on biodiversity: on pasture and browse to feed livestock; on water and minerals for animal health and productivity; on trees to provide shade, fuel and construction materials; and on a great diversity of other "non-pasture rangeland products". To some extent pastoralists would be better thought of as grass farmers than livestock producers—although this would belittle the importance of other biological diversity—and the viability of their system depends profoundly on how they conserve nature. At the heart of the environmental sustainability of pastoralism is the adaptive management of pastoralists, based on their local and indigenous knowledge, culture and institutions. Among the many tools that pastoralists deploy to manage their rangelands, the most distinctive and probably the most significant is managed mobility of livestock herds.

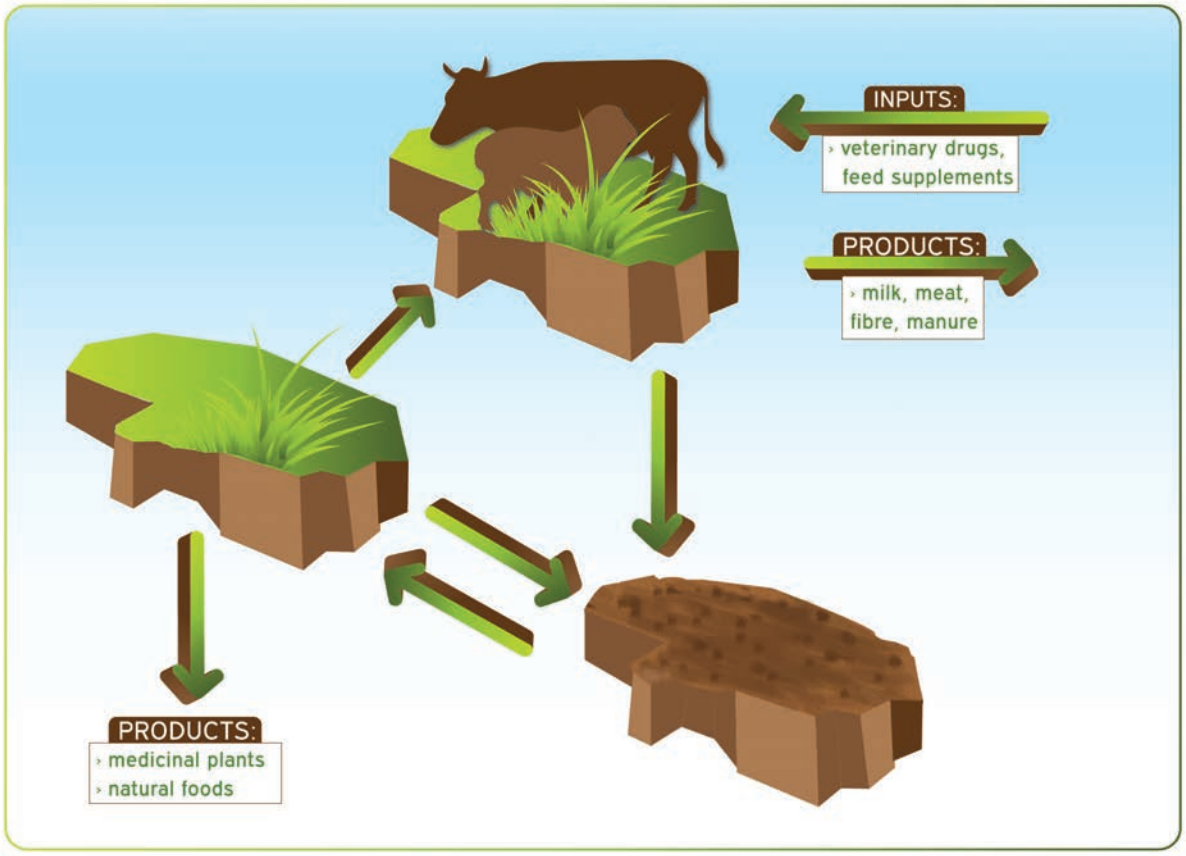
To some extent pastoralists may be better thought of as grass farmers than livestock producers.

Mobile and extensive pastoralism as a land use system is highly adapted to the environmental extremes and variability of rangeland ecosystems.

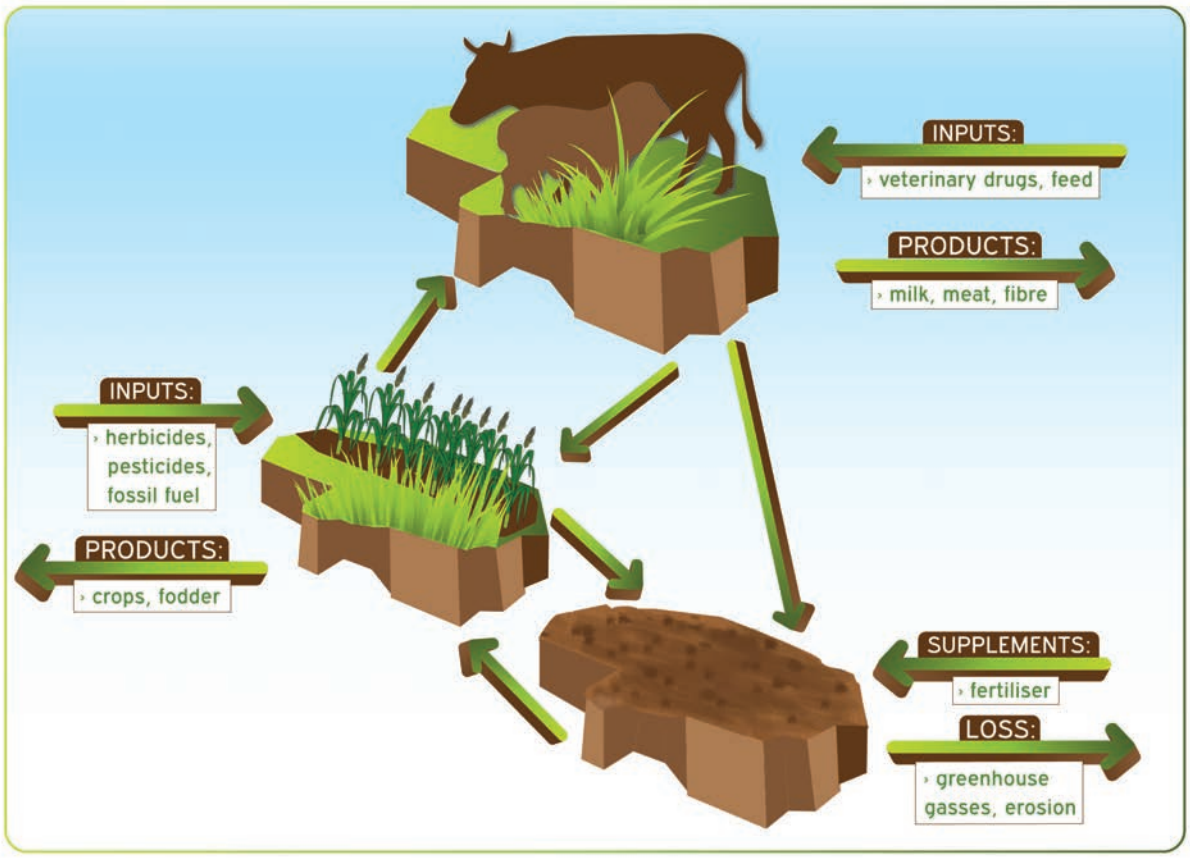
At least 25% of the world's land area remains under the management of pastoralists, including significant areas on all continents. In sub Saharan Africa alone some 16% of the population rely on pastoralism for their livelihood, and in dryland countries such as Mauritania and Somalia pastoralists represent a majority of the population[30]. Mobile and extensive pastoralism as a land use system is highly adapted to the environmental extremes and variability of rangeland ecosystems. Pastoralist systems are characterized by low stocking rates in relation to land area, compared to higher stocking rates per unit of land in mixed crop-livestock systems typically found in temperate, sub-humid, humid or highland climates[31].

To some extent past failures in land use policy and development approach in pastoral lands, particularly in developing countries, are becoming recognised by policy makers and amongst the donor community. The situation has changed following more widespread awareness of key advances in our knowledge

1. Pastoral



2. Mixed Farm



Saleem 1998

Figure 3: Comparing pastoralism's management system with mixed crop livestock operations.

of pastoralism and the dynamics of rangeland environments, culminating in new approaches to pastoral development over the past decade. These new approaches recognise the inherent resilience of rangeland ecosystems which operate under varying degrees of ecological disequilibrium, whereby under more variable arid conditions ecological changes are often decoupled from grazing pressure. Opportunistic stocking strategies which closely track ecosystem resources have been proved to be more economically profitable than sedentary ranching systems based on conservative stocking rates[32].

Opportunistic stocking strategies which closely track ecosystem resources have proven more economically profitable than sedentary ranching systems based on conservative stocking rates.

Most rangeland ecosystems are directly dependent on the action of ungulates, both wild and domestic. Pastoral management of livestock plays a critical role in protecting biodiversity and in keeping rangelands open and inter-connected, which is important for the maintenance of biodiversity and the flow of ecosystem goods and services[33]. Since rangelands depend on herbivore activity for their overall ecosystem health, a too conservative stocking rate will not provide the necessary grazing pressure[34].

Pastoral livestock management protects biodiversity and keeps rangelands open and inter-connected, helping to maintain biodiversity and the flow of ecosystem goods and services.

Livestock grazing and management also play important roles in the continued flow of a range of ecosystem goods and services, from soil fertility and the distribution and diversity of plants, to the effective management of biomass leading to optimum conditions for soil carbon sequestration and the management of fires[35]. The global significance of these services can extend well beyond the boundaries of the rangelands as typified by the huge potential offered by improved grazing management on grasslands for soil carbon sequestration. Some rangeland soils retain carbon for longer periods than forest soils and due to historic carbon losses rangeland soils are said to be far from saturation[36]. Estimates suggest that that improved grazing management on the world's five billion hectares of grasslands could sequester about 409 million tonnes CO_2 equivalent per year[37] which equates to roughly 9.8% of annual anthropogenic carbon emissions. Other research has given a similar estimate of total potential for carbon sequestration through implementing changes to rangeland management at around 12 – 18 billion tonnes of CO_2 over a 50 year period[38] (or 240-360 million tonnes of CO_2 per year).

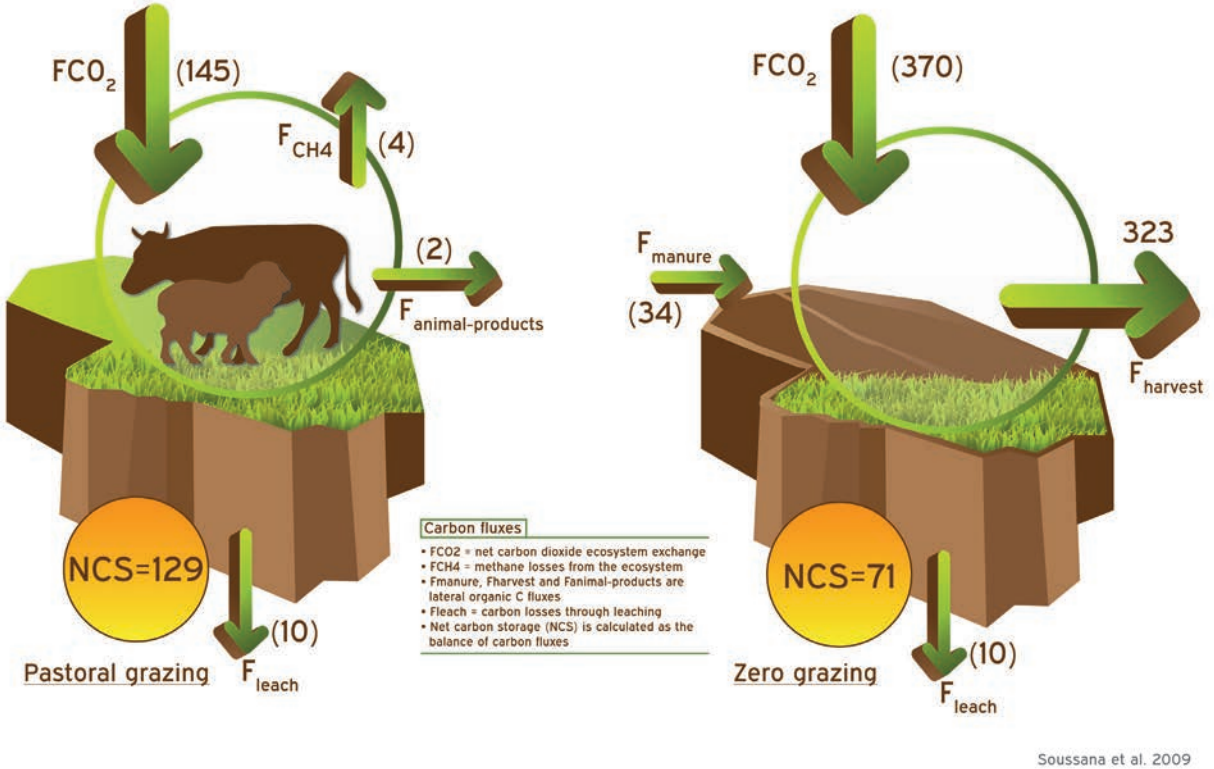


Figure 4: Livestock systems and the carbon cycle.

Improved grazing management on global grasslands could sequester about 409 million tonnes CO_2 equivalent per year: roughly 9.8% of annual anthropogenic carbon emissions.

Further regulating services include enhancing the resistance of rangeland ecosystems to invasion by native and exotic species, and the regulation of pests and diseases. In Australia, for example, short rotation intensive livestock grazing by pastoralists on invasive grass species has been found to be of critical importance to conserving populations of the endangered bridled nailtail wallaby[39]. Livestock provide numerous services to rangelands; seeds are transported over large distances, soil crusts are broken allowing seeds and water to penetrate the soil, plant matter is rapidly decomposed and manure is put back into the system, and mature grasses are grazed leaving space and light for growth of fresh vegetation. In the semi-arid pastoral systems of Spain sheep transhumance along traditional migration corridors has been found to support habitat connectivity and biodiversity through the transport of seeds and insects by sheep[40]. Carefully managed livestock grazing by mobile pastoralists can also reduce soil erosion and facilitate water retention by promoting pasture growth and minimising bare soil[41].

Pastoral societies also maintain irreplaceable non-material ecosystem values which are important for human wellbeing. These include various "cultural services" such as the maintenance of landscape recreational values for society at large. Other cultural services include the maintenance of traditional knowledge systems that have evolved over thousands of years and have a built in adaptive nature, yet are critical to the on-going protection of cultural norms and practices that support rangeland management. Because pastoralism is dependent on the continued provision of ecosystem services, pastoral societies naturally adopted cultural principles and management practices that support the maintenance and enhancement of ecosystems. A multitude of examples can be cited: in West Asia and North Africa the Bedouin's practice the *al Hima* system of communal rangeland protection; Moroccan pastoralists protect their grazing zones through Aghdal; in eastern Africa the Boran have long-established *Koraella* and *koradheda* for respectively governing wells and pastures; Tanzania's Sukuma tribe use an institution called *Ngitili*, whilst the Barabaig equivalent is called *getabaraku*[42].

Most conservation strategies are formed around the perspective that pastoralists' livestock and rangeland management strategies out-compete wildlife for grazing, reduce biodiversity and threaten the extinction of key species[43]. However, while some conflicts do exist between extensive pastoralism and wildlife at the species level, there is increasing evidence of the compatibility between the practice of extensive pastoral production and ecosystem conservation objectives[44]. There are certainly cases of more vulnerable ecosystems such as the Trans-Himalayan grasslands where livestock have been found to have a more negative impact on plant species richness than wild graziers[45]. In these more vulnerable ecosystems careful management is needed to avoid negative biodiversity impacts. There are also cases where both wildlife and livestock management interventions can directly influence the balance of co-benefits towards either side, but on the whole conservation outcomes are far more influenced by other external factors such as structural land use change or conversion to mechanised agriculture[46].

The periodicity of grazing and its intensity is one of the most important factors determining the sustainability of rangeland management, and periodic bursts of intense grazing pressure can be beneficial[47]. As a result, pastoralism and its associated management practices have created some of the most biologically diverse savannah ecosystems in the world[48], a fact attested in some locations of East Africa by the presence of higher densities of wildlife in pastoral areas adjacent to national parks[49]. A large body of literature now exists illustrating that under appropriate mobile management, livestock are beneficial to rangeland productivity and biodiversity.

Pastoralism and its associated management practices have created some of the most biologically diverse savannah ecosystems in the world.

At the genetic level the opportunistic stocking strategies and selective breeding strategies adopted by pastoralists for centuries have resulted in a diverse range of locally adapted livestock breeds that are highly resilient to disease outbreaks and drought. Drylands, where two thirds of rangelands are found, maintain 46% of global livestock diversity[50] and in many countries pastoralists are the only livestock keepers actively maintaining this genetic diversity. These animals are uniquely adapted to the demands of pastoral management systems, such as long-range movements or remaining productive under extreme climate stress.

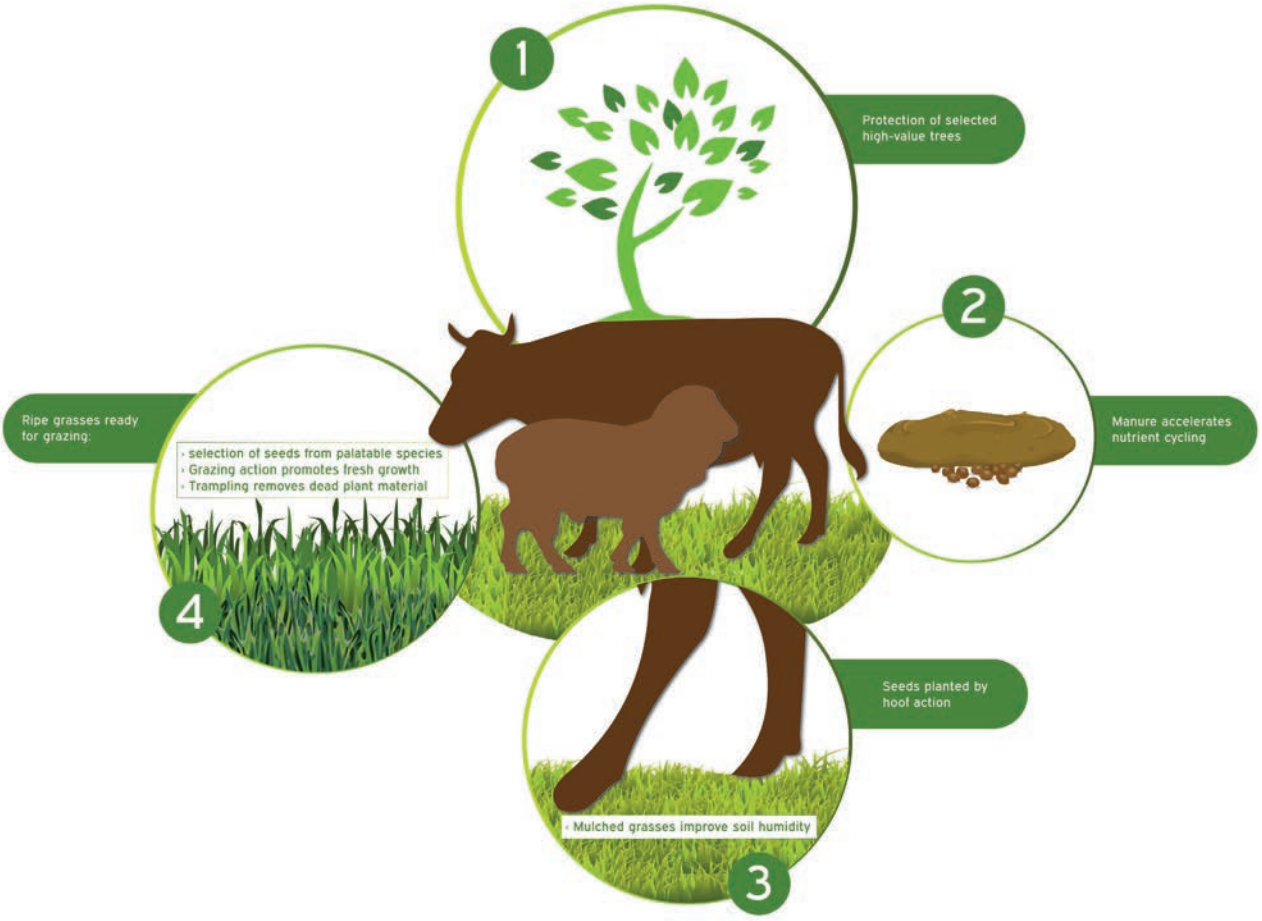


Figure 5: Grazing benefits to rangelands.

Pastoralism and its associated management practices have drylands, where two thirds of rangelands are found, maintain 46% of global livestock diversity and in many countries pastoralists are only people actively maintaining this genetic diversity.

Status and trends in rangeland natural capital

Most global assessments of degradation in rangelands or drylands have been plagued with uncertainty, reflecting the poor quality and comprehensiveness of global datasets. In fact most efforts have focused on drylands, responding to the need to monitor implementation of the United Nations Convention to Combat Desertification†. Early attempts at estimating soil degradation claimed 20% of drylands were affected,[53] while other assessments concluded that 70% of drylands are subject to some form of degradation[54]. The Millennium Ecosystem Assessment (MA) concluded with 'medium certainty'

Protecting genetic diversity in pastoral livestock

Eighty-two per cent of the world's consumption of livestock products comes from only 14 breeds worldwide[51]. Pastoral breeds are uniquely adapted to the environmental and production conditions of pastoralism, remaining productive under duress and able to provide relatively reliable yields of a number of goods from highly variable resources. When these breeds are viewed under the narrow lens of single product livestock systems—such as beef—there is often a drive to replace them. The loss of animal genetic resources from pastoralism as a traditional agricultural system is more serious than the loss of crop diversity because the gene pool is much smaller and very few wild relatives remain. In total 209 breeds of cattle and 180 breeds of sheep have become extinct and a further 210 surviving cattle breeds and 179 sheep breeds are considered "critical" or "endangered"[52].

† Put simplistically, the convention defines desertification as land degradation in the drylands.

Most global assessments of degradation in rangelands have been plagued with uncertainty, reflecting the poor quality of datasets.

that the true figure is approximately 10-20% of drylands. It is estimated that about 1-6% of the dryland human population live in degraded areas. The MA also recognised that policies seeking to replace pastoralism with sedentary agricultural practices in drylands can contribute to desertification.

Many rangelands experience long periods of water scarcity and most dryland people defy the 2,000 cubic metres per person per year threshold thought to be required for human well-being and sustainable development subsisting on far less[55]. Pressures from population growth and land use change are intensifying in drylands and a rapid acceleration of water scarcity is predicted. Reliable data on water availability and use are scarce, but there is evidence that changes to water access and demands within some pastoral systems has intensified water scarcity and degradation processes. In North Africa's steppe region the use of trucks by pastoralists allowed herders to keep animals continuously on formally seasonal rangelands by transporting supplementary water and feed. This has resulted in overexploitation of pastures where water scarcity formally limited grazing and allowed vegetation to recover[56].

The mechanisation of water delivery systems and the spread of borehole or dam technologies are now common features in many pastoral landscapes. In Australia and Africa vast areas of rangeland previously utilized only seasonally by domestic livestock are now accessible year-round as a result of the expansion of borehole technologies. By removing water-related limits to livestock growth these developments can encourage uncontrolled herd growth and a decline in mobile herding strategies causing groundwater depletion, land degradation and inequity in water access and use. In some dryland areas of Kenya 58% of water demand is met by utilizing groundwater in districts where only about 20% of the area has good groundwater potential[57]. During droughts this means there is often insufficient supply to meet demand resulting in the drying and siltation of water holes and disruption of natural water flows.

Pastoral breeds are uniquely adapted to the demands of pastoral management systems, such as long-range movements or remaining productive under extreme climate stress.

Pasture management plays an important, but poorly quantified positive role in the dryland water cycle, creating the ecological conditions for improved water infiltration and reduced run-off thereby raising water tables[58]. This is often most noticeable when the service from pastoralism is eliminated. In Kazakhstan the abandonment of vast pastures of the dry-steppe and semi-desert zones coupled with a rapid decline in the Saiga antelope has led to widespread changes in vegetation and soil composition, and the expansion of lichen-covered soils which has increased erosion and reduced water penetration to the soil inhibiting the growth of some plant species[59].

Removing water-related limits to livestock production can encourage uncontrolled herd growth and a decline in mobile herding strategies, leading to rangeland degradation.

Grasslands store approximately 34% of global terrestrial stocks of CO_2 but some 18-28 billion tonnes of carbon are estimated to have been released from dryland soils as a result of desertification[60]. Some estimate that desertification from livestock overgrazing emits as much as 100 million tonnes of CO_2 equivalent per year[61]. However, in rangelands most carbon is stored below ground and up to 70% of dryland soil carbon can be lost through conversion to agricultural use. There is evidence that effective animal grazing by pastoralists promotes the above ground biodiversity and biomass production needed to maintain these rangeland carbon stores[62].

Understanding the link between biodiversity loss, overgrazing and land degradation in drylands is challenged by the overall lack of environmental monitoring and by limited disaggregation of biodiversity data to examine species that exclusively utilize rangelands[63]. Overstocking is frequently attributed as a significant factor in biodiversity loss, but it is important to appreciate the various factors restricting mobility that result in the excessive accumulation of livestock on rangelands. In the Mediterranean drylands a recent assessment identified overgrazing as the most significant threat to plant biodiversity across 67% of the region's Important Plant Areas (IPAs)[64].

In the effort to diagnose threats to pastoral ecosystems it is important to remember that biodiversity loss can result as much from under-grazing as overgrazing. Many ecosystems have adapted to the presence of livestock grazing for so long that the removal of livestock can be disastrous to biodiversity. For example, the actions of livestock and their owners in North America over the last 200 years have created a unique ecological state and removal of livestock would likely trigger a transition to a new ecological state less

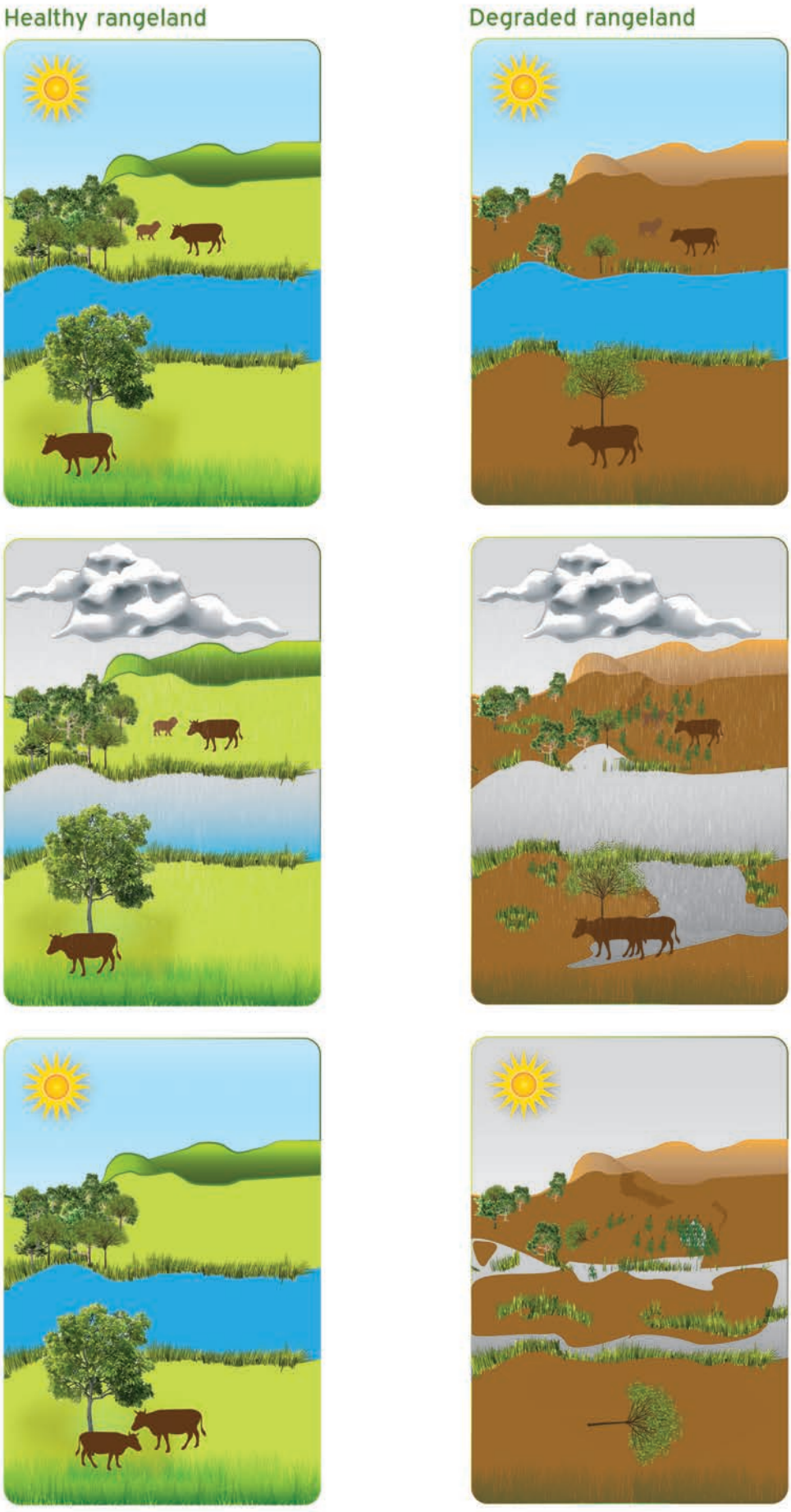


Figure 6: Pastoralism and ecosystem management (pastoralism's role in water cycles through creating healthy ecosystems).

Grasslands store approximately 34% of global terrestrial stocks of CO_2 but some 18-28 billion tonnes of carbon may have been released from dryland soils through desertification.

suitable for wildlife diversity[65]. On the alpine pastures of Europe plant and animal biodiversity declined significantly after livestock farmers shifted towards valley bottoms and abandoned transhumance to mountain grazing zones[66].

The spread of invasive alien species is a significant threat in many pastoral systems and livestock can become vectors for further rapid dispersal. In the drylands of Africa, the Middle East and Central Asia the species, *Prosopis juliflora* or mesquite, once widely introduced as a species ideal for dune stabilisation, has quickly become an alien invasive to the point where over 10 million hectares of rangeland have been encroached. Invasive species such as mesquite reduce access to productive resources, such as pasture and water, by forming impenetrable thickets or by lowering water tables and their economic impact is often highly significant[67].

In the effort to diagnose threats to pastoral ecosystems it is important to remember that biodiversity loss can result as much from under-grazing as overgrazing.

The loss of natural capital in pastoral systems is often simplistically associated with an over-accumulation of livestock which can in some cases lead to solutions that aggravate the situation. More complex drivers of change are usually observed—as mentioned in the previous chapter—including restrictions to mobility and loss of important natural resources, fragmentation of landscapes, and breakdown in communal governance arrangements. Attempting to replicate the ecological and economic efficiencies of mobile livestock grazing within fenced pastures has proved challenging. Sedentary livestock production systems in rangelands are often associated with a series of environmental problems including soil erosion, degradation of vegetation and encroachment by unpalatable shrubs, carbon release from soil organic matter decomposition, loss of biodiversity due to habitat changes, and adverse impacts on soil hydrological function and water cycles.

The continuous or repeated short duration grazing that vegetation receives in sedentary rangeland management can cause intensive defoliation of plants, reducing root growth and plant ability to access soil water and nutrients which over long periods can favour declines in perennial grasses and encroachment of the range by unpalatable shrubs. For example, in southern Africa the establishment of sedentary livestock ranching schemes resulted in vast areas of rangeland becoming encroached by unpalatable shrubs which in South Africa alone is estimated to affect over 13 million hectares of rangeland[68].

Sedentary livestock production in the rangelands is often associated with soil erosion, degradation of vegetation, bush encroachment, carbon release from soil organic matter decomposition, biodiversity loss, and adverse impacts on water cycles.

Loss of pastoral lands through their conversion to other uses remains a widespread challenge. Pastoralism relies on key resource patches that may only be used seasonally but which are essential for the functioning of the overall system: e.g. riparian and wetland zones in the drylands, or valleys in mountain pastoral systems. These resources are often coveted by other users, but when they are put under other use and made unavailable for pastoralism, the opportunity costs can outweigh the benefits. Studies in Kenya and Ethiopia have questioned the merit of some irrigation projects, showing that, whilst returns per hectare may be greater than the same hectares under pastoralism, entire rangeland ecosystems may be rendered less productive through the loss of a few essential resource patches. When measured at a landscape or a national scale, conversion of rangelands to irrigated crop lands is not necessarily economically rational[73].

Growing awareness of the value of ecosystem services and improving tools for their assessment are creating new opportunities for improved landscape-scale rangeland natural resource planning. However, in developing countries there are particular challenges in assessing rangeland landscapes at the appropriate scale to make the right investment decisions. This may be partly due to knowledge gaps and lack of appropriate tools, but is also often linked to the low priority given to rangelands.

When measured at a landscape or a national scale, conversion of rangelands to irrigated crop lands is not necessarily economically rational.

Man herding cattle, Southern Sudan. Credit: John Wollwerth

Summary

The ability of pastoralists to sustainability manage their environment is of vital importance to the continued flow of agro-ecosystem services and global environmental benefits from the worlds rangelands. Sustainable pastoralism plays a significant role in protection of rangeland ecosystems and biodiversity. Owing to their vast extent—over a quarter of all land—land use changes within the rangelands influence atmospheric circulation systems well beyond their boundaries[74]. Transfer of inappropriate technologies, management practices and policies from more stable ecological systems has undermined pastoralism's ability to maintain natural capital within rangelands. New tools and approaches are needed to enable more coherent planning of rangelands ecosystems at the appropriate scale and to ensure that changes in land use and land ownership are socially equitable, economically rational, and environmentally sustainable. Failure to achieve inclusive green economic growth in the rangelands will mean a significant failure of the global community to achieve sustainable development, and efforts to support and enhance sustainable pastoralism must be included within any strategies to achieve sustainability within the global food system.

Herd mobility and rangeland management

A major part of the problem is that these enclosed management units are often unable to mimic the opportunism and flexibility associated with landscape level grazing by migratory herbivores. The grazing patterns typical at these scales include a limited period of intensive grazing followed by long periods of little or no grazing, natural fire regimes and a shifting mosaic of intensively grazed and underutilized patches, which creates conditions that are critical for the maintenance of the biological diversity of rangeland ecosystems[69]. Innovations in rangeland management, such as "Holistic Management"[70], have begun to promote improved planned grazing in an attempt to mimic natural herbivore processes, based on short duration intensive animal impact interspersed with appropriate periods of rest. It is argued that rangelands have co-evolved with large herds of ungulates and the two are inter-dependent, with herbivores providing a range of services from spreading seeds, accelerating nutrient cycling, and breaking soil crusts to promote germination[71]. While long term ecological studies by rangeland ecologists are yet to objectively quantify the ecological effectiveness of this approach its proponents claim to have achieved sustainable grazing at stocking rates 1.5 to 2 times higher than conventional continuous grazing management[72]. The traditional seasonal movements of pastoralists have long been considered to mirror the natural movements of wild herbivore herds and there is a growing recognition that pastoralists have been implementing these 'innovative' herding strategies for centuries.

Sheep grazing in mountains Spain. Credit: Jesus Garzon

Resource efficiency and markets

The various crises around food security and climate change have increased the attention on the sustainability of the global livestock sector and these discussions have started to reopen a debate over "green" pastoralist development. The livestock sector currently occupies 30% of the world's ice-free surface, contributes 40% of global agricultural GDP, and provides income for more than 1.3 billion people as well as food and income for more than 800 million food insecure people[75]. Yet in many countries the livestock sector has dramatically industrialised and globalized increasing its use of natural resources such as land, water, nutrients and fossil fuels. With global demand for meat and milk products projected to increase by 73% and 58% respectively by 2050 (relative to 2010 levels) there is mounting concern about the sector's continued demand for natural resources and its contribution to climate change, land degradation, biodiversity loss and water pollution. A recent FAO report concluded that the livestock sector is responsible for 14.5% of global human-induced greenhouse gas emissions and 9% of the sector's emissions result from the expansion of feed crops and pastures into forests[76].

The livestock sector as a whole has dramatically industrialised and globalized, increasing its use of natural resources such as land, water, nutrients and fossil fuels.

Greening the livestock sector

The Green Economy concept has recently gained significant traction due to mounting global fears over multiple crises of climate change, energy, food and financial systems. There is wider acknowledgement that sustainable development should consist of growth within the limits of various social and planetary boundaries[77]. The growth of green investment markets in agriculture, energy, infrastructure and environmental protection have also stimulated interest in the Green Economy as a means to build a more sustainable and resilient economic system. To adjust the livestock sector as a whole to a future green economy requires a three pronged approach:

1. Reduced consumption of livestock products;
2. Greening the intensive system as much as possible;
3. Capitalising on the sustainability of pastoralism by enhancing diversified local, regional and international pastoral economies

However, because improvements in productivity in intensified livestock systems have reduced the natural resources required, studies comparing water, land and $C0_2$ use with pasture based production often show higher environmental impacts per unit of production in extensive systems. Advances in animal health, genetics and feeding systems have enabled industrialised countries to reduce land requirements for livestock by 20% while doubling total meat production. For example, over the last 70 years the US dairy sector has improved productivity per unit of milk four-fold to the point where the national herd contains 16.4 million fewer dairy cows yet overall produces 31.2 billion kilograms more milk per year. This represents a 41% reduction in the sector's carbon footprint[78].

The argument follows that since population increases and changing dietary preferences are expected to place unprecedented demands for animal products from a global livestock sector already suffering major sustainability issues, improving the environmental performance of the sector globally and closing efficiency gaps in underperforming developing country livestock systems using technology transfers will be essential to ensure improved sustainability in the global livestock sector. In grassland-based livestock production systems alone, grazing intensity is projected to increase by 50% as early as 2030[79]. A production revolution of a similar magnitude to the agrarian green revolution is predicted for the global livestock production system, driven by an expected 70% increase in the demand for livestock food products as rising urban human populations in developing countries adopt dietary habits similar to those of industrialised countries. According to the FAO report "Livestock's long shadow" environmental impacts per unit of livestock will need to be reduced by half to avoid increasing ecological impacts beyond present levels[80].

A production revolution of a similar magnitude to the agrarian green revolution is predicted for the global livestock production system.

In response to these concerns several new global policy initiatives have emerged that aim to develop appropriate policy responses to stimulate sustainability within the livestock sector[81]. At the same time recognition is growing of the vulnerability of the global food system to climate change, with increasing levels of production dominated by industrialised agricultural practices. A system that decouples integrated crop-livestock farming and generates landscapes where biological diversity and environmental variability have been replaced

While some traditional pastoral systems have adopted aspects of intensification, most pastoralists continue to practice a low input, multiple output land use system uniquely adapted to environments ill-suited to industrial livestock or crop production.

by farming systems based on uniformity and increasing reliance on external inputs often at the expense of resilience[82]. In response many civil society and indigenous groups are now seeking protection for the right to define locally-appropriate, genetically diverse food and agricultural systems; and alternative development approaches that seek to enhance traditional multiple-output farming systems such as food sovereignty and the concept of endogenous food systems are beginning to gain traction among policy makers[83].

At the international level, however, increasing productivity through intensification continues to be advocated as a means to mitigate most environmental impacts associated with both conventional, high input livestock production and traditional, low input pastoral productions systems[84]. While some traditional pastoral systems have adopted aspects of intensification such as the targeted use of supplementary feed crops, most pastoralists continue to practice a low-input, multiple-output land use system uniquely adapted to environments that are ill-suited to industrial livestock or crop production.

Standard approaches to quantifying natural resource efficiencies associated with different livestock production systems do not account for the additional social and environmental values that pastoralism provides. There is currently no universally accepted framework for assessing and comparing environmental performance across different forms of livestock production; although the FAO launched a programme in 2012 that seeks to harmonize the assessment and monitoring of livestock food chains[85]. In many cases, comparing the natural resource efficiencies of traditional pastoral systems that are orientated towards multiple production objectives against more intensive modes of production in is unconstructive, since pastoralism is adapted to regions that do not support more intensive forms of production. However, since the two sectors compete for public and private investment it is important to demonstrate where the value of pastoralism lies.

Standard approaches to quantifying natural resource efficiencies associated with different livestock production systems do not account for the additional ecosystem and cultural values that pastoralism provides.

As with all forms of land use, the extent to which pastoralism has intensified its use of financial capital and recent technological innovations varies greatly by country. In industrialised countries for example, pastoralism is more likely to make use of a limited quantity of purchased feed and drug inputs. In some industrialising countries government subsidies have greatly intensified pastoralism, to the extent that external feed supplements greatly outweigh the importance of the rangelands and rangelands become little more than a holding ground for commercially-fattened stock[86]. However, pastoral management continues to provide a wide range of services and products to both herders and society beyond simply direct marketable values. Maximising resource efficiency in only selected parts of the system, by over-emphasising a narrow range of products for example, can undermine the system's overall resilience and demonstrates a lack of understanding or appreciation for the multiple benefits of pastoralism.

Pastoral intensification

While pastoralism is considered in standard economic terms as a low input, low-output system, it actually delivers a wide range of poorly quantified economic values from rangelands of relatively low biological productivity that are ill-suited for intensive production. In the 1970s and 1980s a number of high-profile initiatives were implemented to intensify pastoralism in sub-Saharan Africa that led to increased poverty, economic stagnation and environmental degradation. These investments focused on new forms of more exclusionary land tenure, restriction of livestock mobility and rearing of exotic livestock breeds for meat markets. Their failure was due to the greatly increased requirement for external inputs and the reduction in diversity of outputs combined with breakdown in rational herding strategies to cope with climatic variability[87].

Policies in North Africa and West Asia have similarly focused on raising productivity through use of fodder imported to the system and focus on a narrower range of markets, creating pastoral systems that no longer rely on sustainable management of the rangelands and instead are supported by nationally subsidised inputs. Intensification in European pastoral systems has taken a different turn, with a change from production based subsidies in the 1990s towards greater emphasis on environmental performance. The European Agricultural Fund for Rural Development (EAFRD) for the period 2007-2013 had three objectives, including one to improve the environment and the countryside by supporting land management. The Community Strategic Guidelines for Rural Development emphasises the preservation and development of "High Nature Value" (HNV) farmland and forestry and traditional agricultural landscapes as one of the priority areas of Rural Development. Pastoralism is recognised as one of the most important HNV farming systems in Europe[88]. In addition, "Natura 2000" is a network of Protected Areas in Europe and includes a large number of pastoral rangelands where shepherds can benefit from payments and other incentives for environmental stewardship[89].

Pastoralism delivers a wide range of economic values from rangelands of relatively low biological productivity that are ill-suited for intensive production.

Although some pastoral intensification policies have been unsuccessful, comparison of systems between countries shows that major increases in productivity could be possible based on similar livestock production models. In many developing countries productivity is substantially higher than is reflected in national accounts, since government data is collected in the market place, but due to the lack of infrastructure much pastoral produce goes unaccounted. In 2006, sales of livestock produced in pastoral systems in Spain, a country with a pastoralist herd size of about 8.6 million livestock units (LU), were over USD 2300 million. In the same year, Mali (8.4 million LU) and Ethiopia (9.8 million LU) recorded significantly lower figures despite having similar national herd sizes (USD 428.5 and USD 364 million respectively). Kyrgyzstan, with a total pastoralist herd size of about 1.8 million LU, achieved USD 192 million: roughly half the sales of Ethiopia and Mali despite having less than a quarter of the livestock herd. The Kyrgyz data highlights the disagreement between the observed off take rate and the transactions registered in the available statistics, suggesting that unregistered sales could represent at least 50% of the total transactions. Similarly, in Ethiopia the unofficial trade and illegal cross-border sales were estimated at USD 138 million per year, i.e. about 38% of all the country animal sales[90].

Gujarat shepherds. Credit: Jonathan Davies

When intensification experiments sub-Saharan Africa were abandoned in the 1990s, pastoralism quickly reverted back to extensive management as herders knew it would be significantly more productive[91]. In the aftermath of State driven experiments with collectivization and intensification in the rangeland countries of the former Soviet Union, increased extensification has been reported as pastoralism reverted to more environmentally and economically rational land use practices[92]. In the southern United States pastoralists have also begun establishing more communal systems of rangeland management to overcome the limitations of land fragmentation[93].

It is clear that the concept of intensification of pastoralism needs to be re-examined, since pastoralism traditionally makes highly intensive use of labour and social capital, in return for a great diversity of benefits, including multiple products and multiple environmental and cultural services. Transitioning from a highly labour-intensive mobile, multiple-value production system towards a sedentary, capital intensive single-output development model may appear to achieve resource efficiencies for that particular output (usually meat), but this narrows the range of products delivered by the system at the expense of overall social and environmental health. Improved tools are needed to effectively quantify the environmental efficiencies associated with pastoralism and we need to rethink what we mean by agricultural intensification in the pastoral context. A new paradigm of intensification is required for pastoralist development, in which increases in productivity are measured across a range of diverse outputs, in response to a diverse range of inputs. This would be better thought of as optimisation.

Comparison between countries shows that major increases in productivity could be possible based on similar pastoral livestock production models.

Economic & natural resource efficiency

Worldwide there is great diversity in the extent to which pastoralists have intensified their use of capital and engaged in markets, and in developing countries there are clearly many avenues yet to be exploited. Despite this, most pastoral systems continue to deliver multiple products, with an emphasis on consumption of livestock products (milk, fibre, power etc.) rather than the livestock themselves. Whilst meat is an important output from nearly all pastoral systems, its share of the total pastoral economy is less than 30% in many cases[94].

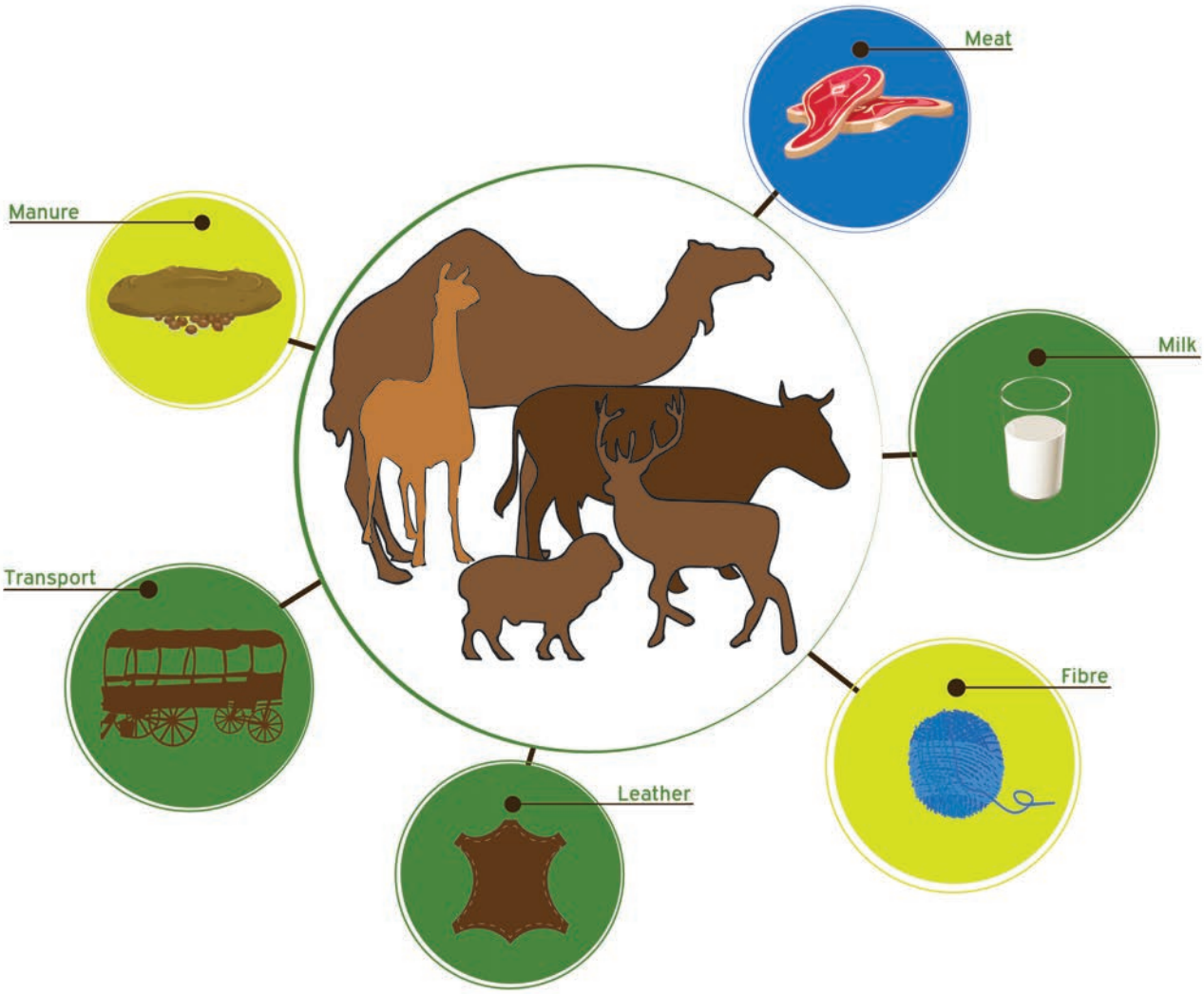


Figure 7: Sustainable pastoralism multiple species, multiple products.

Transitioning from a highly labour-intensive mobile, multiple-value production system towards a sedentary, capital intensive single-output development model narrows the range of products delivered by the system at the expense of overall social and environmental health.

Mobile livestock production has a unique ability to efficiently track ecological resources and the resultant low reliance on external capital inputs means the system performs better in economic terms than most attempts to intensify it to date. In the former Soviet Union, the pastoralist systems of Kazakhstan, Kyrgyzstan and Turkmenistan were estimated to have 50% lower production costs than other Soviet livestock systems. Even when agricultural economists have compared the direct values of pastoralism against those of commercial ranching under the same arid conditions, pastoralism has been shown to be between 2 to 10 times more productive[95].

Pastoralists' livestock convert crop residues and fibrous materials of little alternative monetary value into high quality protein. From a nutrient cycling perspective extensive pastoral systems are practically closed systems powered by renewable solar energy captured by rangeland vegetation. Studies of the nutrient balance within African pastoral systems conclude that even though Pastoralist's livestock can transfer an estimated 4kg per ha^{-1} of

Even on the basis of direct values only, pastoralism has been shown to be between 2 to 10 times more productive than commercial ranching under the same arid conditions.

nitrogen and 0.4 kg per ha^{-1} of phosphorus to water points or kraals in the form of animal dung, all in all grazing is likely to have no measurable effect on soil nutrient balance due to vegetation nitrogen fixation and natural nutrient contributions from rainfall[96]. Moreover, integrated crop-livestock systems in developing countries are often dependent on pastoralism for vital soil nutrients given the limited access to synthetic fertilizers. In West Africa research has estimated that livestock fertilizing croplands need to graze 15-45 ha of rangeland to meet the manure requirements of 1 ha of millet[97], which means no more than 9% of the land in these semi-arid systems should be continuously cropped if soil fertility is to be maintained by livestock alone[98].

In some areas pastoralists are beginning to intensify parts of their production system through introducing purchased supplementary feeds for part or all their herds. Yet this may be more a response to mitigate the risks associated with adopting a more settled, diversified economy rather than to increase productivity or re-orientate production entirely around markets for livestock commodities. For example, some Fulbe pastoralists in northern Cameroon have intensified their production system by permanently splitting part of their herd and replacing free natural feed with purchased, capital-intensive forage by-products purchased from settled farmers such as cottonseed cakes. Although reproductive rates improved, annual production costs per animal were over five times higher than livestock raised under mobile conditions which provided a far more efficient return on the investment of both human and financial capital[99]. However, risk reduction was the main reason for intensifying the production of these peri-urban herds, as losses from mobile herds in the rangelands from theft and lost animals were twice as high.

Access to formal financial services remains poor across many pastoralists systems, despite some recent advances in mobile banking technologies (e.g. mobile phone banking in eastern Africa). Livestock historically represented the most secure means for households to accumulate and store financial capital and they represent a form of natural savings. A low reliance on capital intensive inputs such as feeds and fuel makes pastoralism insensitive and resilient to capital market risks such as inflation. That said, as pastoralist populations

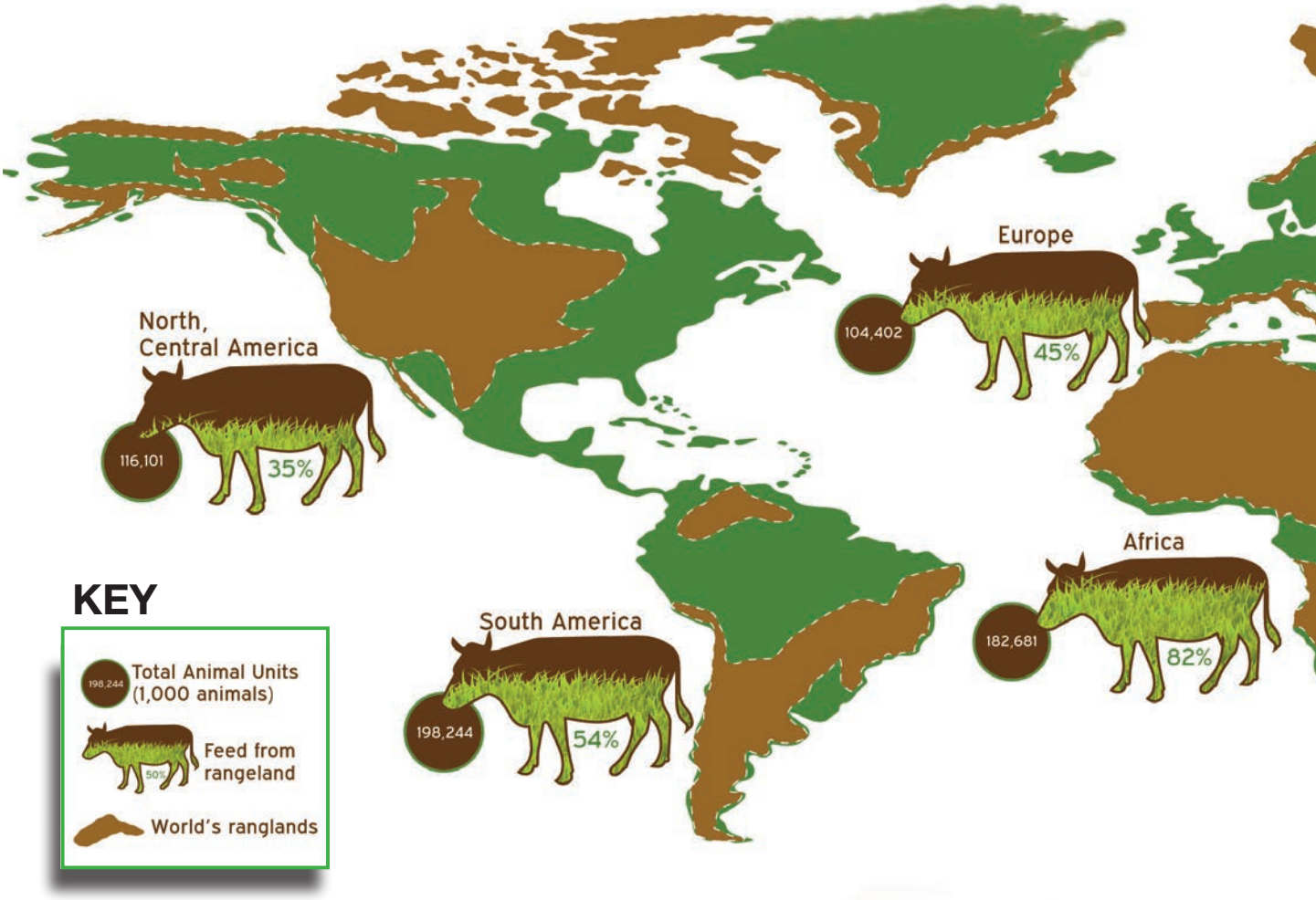


Figure 8: Global rangelands and livestock production.

Pastoral systems are practically closed systems powered by renewable solar energy captured by rangeland vegetation.

grow, households are becoming more reliant on the purchase or cultivation of cereals which in turn exposes them to commodity market risks. Some pastoral groups in Africa now gain up to 85% of their food needs from purchased food[100].

Carbon efficiency

There have been a number of efforts to compare the carbon efficiency of pastoral and intensive livestock systems in recent years, driven by the growing global interest in climate change and its mitigation. However, studies have generally been constrained by their poor recognition of the positive role pastoralism plays in promoting carbon sequestration, failure to recognise the natural carbon emissions from the same land under its natural conditions (including large herds of wild herbivores), and narrow emphasis on livestock methane emissions. For example, a green economy planning process in Ethiopia recently concluded that productivity gains in the country's livestock sector mainly through improved breeding had the potential to reduce 45 Mt CO_2e emissions a year by 2030. Part of the analysis that screened least-cost technologies to achieve this also recommended settling pastoralists given the large amount of land per unit of production used by extensive livestock farming[101].

Comparisons of CO_2 emissions from dairy production systems in North America with sub-Saharan Africa further illustrate the issue. Average milk yields are 9,000 kg/cow in North America compared to an estimated 250 kg/cow in sub-Saharan Africa which equates to a carbon footprint of 1.3 kg of CO_2e/kg of milk and 7.6 kg of CO_2e/kg of milk, respectively[102]. Similarly, even studies comparing the carbon footprint per kilogram of low input North American grass-fed

beef with high input intensive corn-fed feedlot beef report a 74% increase in carbon footprint per unit for pasture-raised beef[103]. The higher levels of CO_2 per unit of production are a factor of the slower growth rates and reduced feed conversion efficiencies associated with pasture raised livestock.

Comparisons of carbon efficiency in the livestock sector have not considered the positive role pastoralism plays in promoting carbon sequestration and the carbon emissions from the same land under its natural conditions.

A major part of the problem is the limitations of current methodologies to adequately account for the non-marketable public goods or non-commodity outputs that systems such as pastoralism provide to their communities and society at large such as carbon sequestration or the maintenance of biodiversity through their positive role in ecosystem processes. However, scientists analysing European pastoral systems have recently tried to address this deficiency. Studies using life cycle assessment to compare the carbon footprint of lamb produced by extensive pasture-based sheep farmers grazing various forms of natural and semi-natural landscapes in Spain (i.e. alpine grasslands and forest pastures) with more intensive forms of grazing management initially found higher greenhouse gas emissions per kilogram of lamb meat from extensive management[104]. However, when the ecosystem benefits of extensive grazing management were factored in, pasture-based production was found to have the lowest greenhouse gas emissions per kilogram of lamb produced[105].

In fact extensive livestock grazing of grasslands have been found to result in positive annual gains of soil organic carbon[107]. The net gains are possible through the integral role herbivores play in rangeland ecosystems, promoting vegetation growth, favouring growth of C4 plants, and accelerating nutrient decomposition and recycling. Grazing management of grasslands for meat production resulted in a net carbon storage of 471 CO_2e/M^2 per year, compared to 259 CO_2e/M^2 per year for more intensively managed grassland dairy systems involving multiple cutting of grass for feed[108].

Water resource use efficiency

Globally water use and pollution by the livestock sector is increasing and the FAO estimates that the sector accounts for over 8% of global human water use[109]. Studies of water use associated with different livestock production systems conclude that most water use along animal product supply chains takes place during the growing of feed crops[110]. Pasture raised livestock systems therefore have a smaller freshwater footprint than industrial livestock systems which directly compete with humans for freshwater resources. For beef production, water footprint studies have shown that industrial livestock systems have far higher freshwater and grey water (i.e. amount of water required to assimilate pollutants produced during feed crop and livestock production to return water to local safety standards) footprints due to pollution from manure waste at feedlots and on field soil erosion and leaching of fertilizers and agrochemicals during the production of feed crops. The global average water footprint for beef produced from grazing systems is 243 m^3/ton for grey water and 465 m^3/ton for freshwater, whereas for industrial beef systems this average increases to 712 and 683 respectively[111].

Chemical inputs

As global livestock production intensifies there are growing global concerns over the impact of increasing levels of chemical residues deposited by the industry on the environment. Examples include the increasing use of herbicides, pesticides and mineral fertilizers used in feed crop production and on pastures, veterinary antibiotics and heavy metals as additives to animal feeds to control diseases and promote growth in intensive systems, or the widespread use of detergents and disinfectants in intensive dairy production systems. In industrialised countries such as the United Kingdom, Canada, France, Germany and the United States over 50% of

Comparing the carbon footprint of pasture grazed against high input feed crop raised livestock products in North America

Growth rates of animals grown on grass are lower than intensive feedlot produced livestock in North America and therefore per unit of production carbon footprints are higher even though feedlot animals involve high levels of fossil fuel use associated with their corn-based diets grown with fertilizer inputs and the high use of fuel energy for transporting feed and animals, and their waste. This is because growth rates and finished weights are lower for animals fed on grass which are slaughtered at approximately 486 kg at 679 days compared to 569 kg at 453 days in conventional feedlot systems. It is estimated that as a result in a grass-fed system 4.5 animals are required (slaughtered animal plus population require to produce calves) compared to only 2.6 total animals in the feedlot system[106].

fertilizer applied to agricultural land can be directly or indirectly attributed to livestock production through its application on pastures or feedcrops[112]. In the United States livestock production is estimated to contribute one-third of the total discharge of mineral fertilizers from agricultural land to surface water which amounts to about 1,174,000 tonnes of nitrogen and 253,000 tonnes of phosphorus per year[113]. The impacts of high concentrations of nutrients from agriculture in freshwater resources are severe over-stimulation of aquatic plant and algae growth causing the eutrophication and algal blooms which have been linked to the appearance of "dead zones" devoid of aquatic life in marine or freshwater ecosystems. In the United States 70% of herbicide use in agriculture can be directly attributed to animal feed production of corn and soybean[114].

Veterinary antibiotic use in particular has increased globally and antimicrobials are now regularly administered in many livestock production systems. This is a particular cost in intensive systems where large numbers of animals are confined in close proximity creating ideal conditions for the rapid spread of disease. In the US the use of antibiotics in animal feeds has increased from 91,000 kg in 1950 to 9.3 million kg in 1999[115]. Antibiotics are poorly absorbed in livestock guts and between 30 to 90% of the parent compound is excreted in faeces and urine, often in a bioactive form, and the widespread application of animal wastes as fertilizer in industrialised countries is leading to concerns over residue impacts on the environment and the wider antibiotic resistance of microorganisms[116].

In comparison chemical usage during the production of pastoralist livestock is minimal as livestock graze natural rangelands where use of chemical inputs and veterinary services and supplies remains low. Under extensive conditions pastoralism also effectively distributes animal manure across the landscape such that manure represents an ecosystem asset instead of a waste product. Assessments of veterinary antibiotic use across the livestock sectors of predominantly pastoral countries demonstrate this. In Kenya an assessment of antimicrobial consumption in the livestock sector as a whole between 1995 and 1997 found on average 14,600 kg is used per year and that no antibiotics are used as growth promoters[119]. While this assessment grouped all animal food production systems in the country this minimal level of use may typify low income countries where pastoralism forms the major land use system.

Pasture raised livestock systems have a smaller freshwater footprint than industrial livestock systems, which directly compete with humans for freshwater resources.

It should be noted, however, that while the use of chemical inputs in pastoral livestock production is limited, large-scale chemical usage within rangelands can be seen in some areas, particularly to control important livestock diseases that restrict trade or damage human health. The mobility and close proximity of livestock and wildlife populations create ideal conditions for the maintenance and spread of various livestock diseases and cause a major problem for standard approaches to veterinary disease control. Certain rangeland countries with well-resourced veterinary departments have invested in widespread vaccination campaigns or disease vector control programmes. Vast areas of southern Africa were subjected to both aerial and ground chemical spraying campaigns in an attempt to eradicate the tsetse fly and associated trypanosomiasis disease first using organochlorines such as DDT and later less persistent chemicals such as endosulfans and pyrethroids. While now limited in extent, the use of aerial spraying continues in some southern African countries in concert with new techniques involving the direct application of chemicals on livestock or use of chemical bait traps[120]. Annually, livestock herders are known to administer 35 million doses of trypanocides in an effort to cure or prevent trypanosomiasis[121].

Environmental concerns over veterinary antibiotic use in the United States

In the US there are an estimated 376,000 confined animal feeding operations (CAFOs) which generate approximately 128 billion pounds of manure and consume about one third of the country's antibiotics. The US livestock sector more broadly uses about half of the 22.7 million kg of antibiotics produced annually[117]. In most cases animal waste from CAFOs is applied to nearby land within 10 miles leading to many cases where manure application exceeds the soil's capacity to integrate and breakdown both antibiotic residues and other pollutants leading to recorded contamination of freshwater sources. In a national survey of water contamination in streams the US Geological Survey found antimicrobial residues in 48 of the 139 streams sampled and animal waste was considered a possible contributor[118].

Peru. Credit: Jabier Ruiz Miraro

Pastoral livestock graze natural rangelands where use of chemical inputs and veterinary services and supplies remains low.

Market opportunities

Changing aspirations through education and improved access to information and consumer goods have transformed pastoralists' livelihood objectives and herders increasingly diversify their livelihoods and exploit various forms of cash income generation (i.e. migrant labour, livestock sales, dairy sales etc.). Improved access to markets for livestock products, fairer livestock prices and more reliable markets are now key development objectives for many pastoralists[122], and herders are increasingly calling for improved policy support for livestock marketing[123].

Market forces associated with the global livestock revolution are causing a variety of social and environmental changes for extensive, low input, pastoralism which vary across the system. In many areas pastoralism is undergoing rapid commercialisation and livestock markets are expanding. In Kyrgyzstan the pastoral economy is expanding rapidly into regional markets following an initial decline of livestock numbers following the subdivision of former cooperatives[124]. Similarly, Ethiopia experienced a five-fold increase in livestock exports between 2005-2011 totalling a value of 211 million US dollars in the 2010-11 financial year. Livestock exports from Somaliland alone doubled in 2008 and exports of camels trebled in 2009[125]. In many areas there has been a cultural shift in recent years towards increased commercialisation of milk but market failures continue to constrain the livestock sector and markets for milk are scarce despite the fact the market for dairy products in areas such as East Africa has been identified as two to four times greater than meat[126].

In other areas the pastoral economy is declining as it competes with other sectors for labour and market shares. In Europe increasing labour costs and market competition from intensive farming systems has led to a decline in traditional pastoralism causing land abandonment and reduced biodiversity across vast areas

Improved access to markets for livestock products, fairer livestock prices and more reliable markets are now key development objectives for many pastoralists, and herders are increasingly calling for improved policy support for livestock marketing.

of marginal farmland. In Spain the extensive pastoral economy continues to decline due to rural outmigration of labour caused by the existence of more profitable opportunities within the growing industrial sector and a reduction in labour demands within intensified farms[127]. Despite huge subsidies, development incentives for the livestock sector have undervalued the environmental services delivered by pastoralism in these landscapes. Conversely, in the drylands of developing countries the livestock revolution has renewed the interest of policy makers in development options to intensify extensive pastoralism, often around development options that seek to exclusively orientate production towards export markets for meat.

Pastoralists face major constraints in realising the economic potential of their system owing to high transaction costs, lack of financial services and excessive government bureaucracy and fees.

In general pastoralists face major constraints in realising the economic potential of their system owing to high transaction costs, such as long distances to processing plants, absence of formal markets, poor access to information and fair contracts, lack of financial services such as credit facilities and excessive government bureaucracy and fees. High transaction costs reduce the returns to labour in the pastoral system, increase poverty and food insecurity amongst pastoralists and in some cases deter producers from participating fully in markets. That said pastoralism produces a wide range of unique products (i.e. cheese, wool, hides, fibre, meat, milk) which have huge potential for growing niche markets that demand high social and environmental standards. Livestock continue to play important roles providing insurance against the risks of natural disasters, capital reserves for household wealth and as a hedge against inflation. Supporting the future transition of these trends towards green growth may involve marketing support to help pastoralists sell a diverse range of products better, rather than narrowing the range of products or attempting to sell more[128].

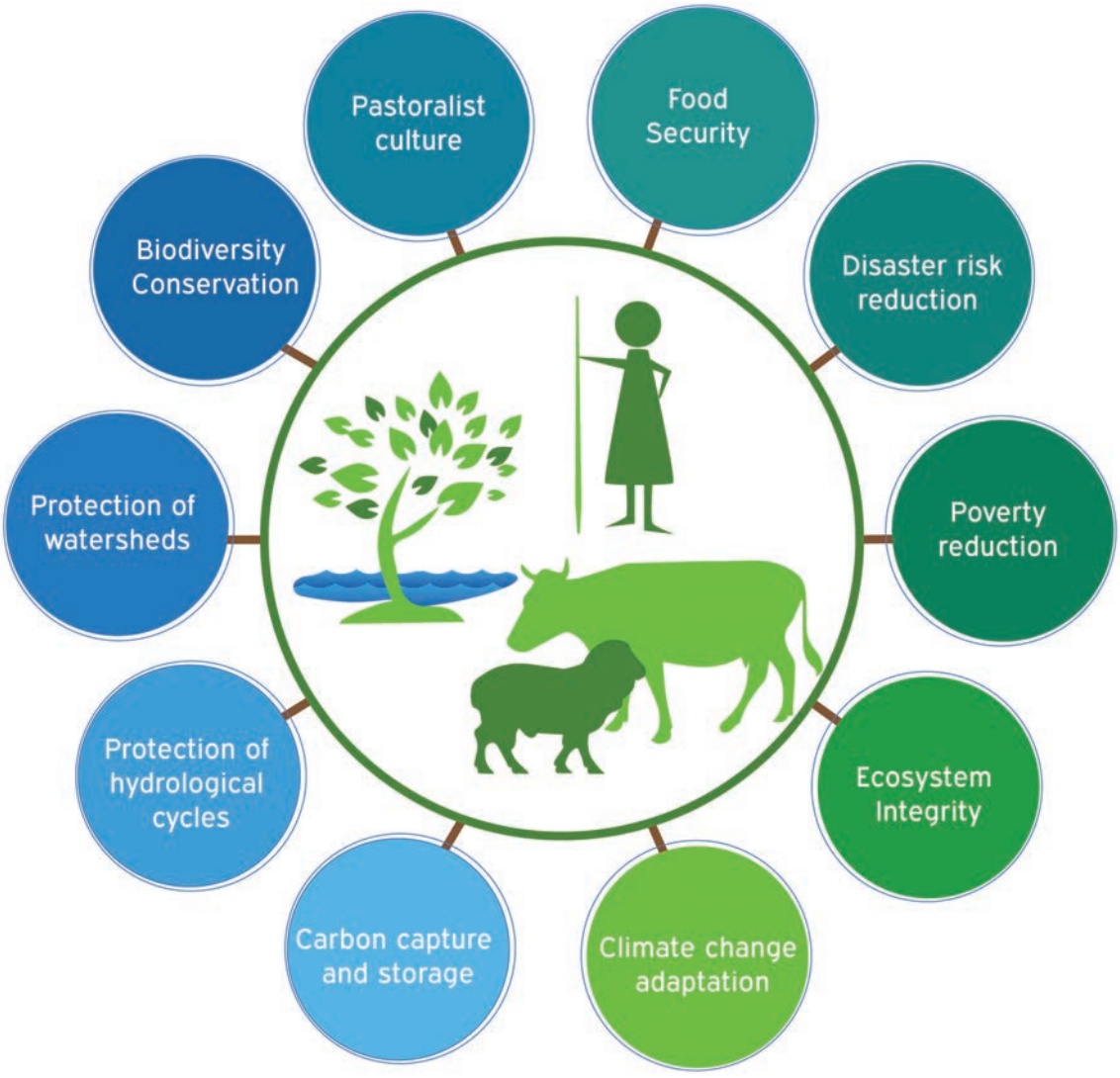


Figure 9: Multiple benefits of sustainable rangelands management.

Orientating livestock development policies towards export markets can have negative implications for pastoralists within counties focusing exclusively on this approach.

Orientating livestock development policies towards export markets can have negative implications for pastoralists within countries focusing exclusively on this approach. Accessing most export markets requires strict adherence to international trade standards for animal products which often means significant investment in additional fencing to create zones free of trade restrictive livestock diseases. Serious impacts for pastoralism such as reduced herd mobility, rangeland degradation and vulnerability to natural hazards have been observed in African countries such as Botswana that have excessively favoured this approach[129]. While increasing questions are being raised over the pertinence of these restrictions, consumer concerns over disease transmission and food safety in developed countries seem unlikely to tolerate a relaxing of these standards.

There is great potential to increase low input production in pastoral rangelands with only modest investment yet significant changes to reform outdated livestock sector policies (i.e. marketing, animal health, service provision) so that they encourage mobility, and strengthen rights and resource access[130]. Domestic demand of meat consumption in Africa alone has increased by over 50% in the last decade, yet the continent is currently a net importer of almost all livestock products except some products derived from small stock[131]. In some pastoral countries investment in areas where extensive pastoralism is practiced has been restricted due to assumptions that pastoralists live outside the cash economy or that mobile production systems are not compatible with modern marketing systems or value chains[132].

Improved marketing of pastoral products can contribute to the overall environmental sustainability of production. For example, in India's Thar Desert a social enterprise was established in 2010 to develop, promote and market environmentally friendly products from endangered rare breeds of camel herded by Raika pastoralists. Grazing by camels has created conditions that are vital to the conservation of this biologically diverse agro-ecosystem. However, economic marginalisation of the region has led to an outmigration of herders and a rapid decline in camel numbers, which has begun to negatively impact upon biodiversity in the Thar Desert. Closely supported by a local NGO called Lokhit Pashu Palak Sansthan (LPPS) the "Camel Carisma" social enterprise set out to create sustainable rural livelihoods for local communities by establishing markets for camel-based products. So far markets have been created within the ethical handicraft sector for various products made by the Raika from camel dung, wool or milk.

In seeking areas of livestock production where improved production could close "efficiency gaps" development planners may need to take a dualistic approach in which unique multiple-output land-use systems such as pastoralism are not considered alongside the commercial sector. While green policy prescriptions for the commercial sector can tackle increasing negative environmental externalities associated with sedentary production through increased regulation and technology transfer, extensive pastoralism can provide far greater global environmental benefits if supported effectively by interventions that support mobility and opportunistic management. A more appropriate way to support such a development transition as part of a resilient and inclusive green economy would be to focus first on development for domestic markets where fewer trade barriers exist.

Innovative markets for green goods and services

As economies develop two dominant consumer trends have been the shift towards increasing concern over healthier more nutritious foods and the need for convenient food options. Complete traceability of livestock products throughout the supply chain continues to be a top priority in industrialized countries especially after consumer confidence is knocked by supply chain scandals such as the 2013 UK "horsemeat scandal" which involved the false marketing of beef products containing horse DNA. As awareness over environmental impacts, food nutrition and animal welfare issues grow, so do niche markets for livestock products that demonstrate respect for animal welfare or environmental impacts.

By far the most established certification scheme that incentivises low-input livestock production systems is the market for organic products. While avoiding harmful additives, preservatives and agricultural chemicals has become consumers' top concern in most cases, a significant motivation by some consumers is to purchase organic food on environmental and ethical grounds[133]. Organic products fetch price premiums of an estimated 20-40% in most industrialised country markets. US certified organic beef sales totalled $100 million in 2009 and the market continues to show stronger growth than conventional beef sectors

Pastoralism can provide far greater global environmental benefits with greater attention to domestic markets where fewer trade barriers exist.

Extensive, rangeland-fed, low input pastoralism is intrinsically an organic system and niche markets could provide a significant marketing option in the future.

in many developed countries despite the fact that production costs can be higher per unit of production. In the UK the land area under organic production has increased from 0.3% in 1997 to over 2.3% in 2000[134] and much of these areas are semi-natural pastures which are less favourable to intensification but retain a high biodiversity value.

It is worth noting that in most developed countries the supply of organic beef cannot keep up with consumer demand and imports from countries with abundant rangelands such as Australia often make up the shortfall. Extensive, rangeland-fed, low input pastoralism is intrinsically an organic system and niche markets, such as organic, could provide a significant marketing option for pastoralists provided the increased cost burdens placed on producers in order to gain organic certification can be met. Australia has the world's largest area of certified organic land at about 12.1 million hectares, and 10 million hectares of this is extensive rangeland where certified organic livestock products are produced. However, one constraint these producers face is their distance to markets and strict controls on the length of time animals can be confined in stock crates of trucks which necessitates the need for a series of organic certified pastures along routes to abattoirs[135].

Targeting the present demand for organic livestock products in the export markets of Europe and North America may be beyond the capacity of many developing countries with pastoralist populations, given the need to overcome both onerous certification regulations and the international animal health regulations which would require significant investment in disease control and cold chain distribution systems. Additionally, consumer perceptions of environmental benefits of pastoral production must be weighed against perceptions of the environmental cost of long distance transportation. Nevertheless, as these same economies develop domestic demand from consumers will also grow, leading to potential new marketing opportunities. For example, growing consumer preference for grass-fed beef, following concerns over an increase in intensified feedlot beef production in South Africa, led to a certified grass-fed protocol and trademark being registered with the South African Meat Industry Company and Department of Agriculture in 2012 for Kalahari Grass Fed Beef[136].

Another important opportunity for pastoralists in the future may be the growing consumer awareness around ethical trade issues and growth of ethical certification schemes such as Fairtrade. Globally, the Fairtrade market is worth an estimated 5 billion Euros, which generated 65 million Euros in annual net premium payments for farmers and in 2011 global sales in Fairtrade grew by 12%. Engaging in Fairtrade markets may help to address many of the disadvantages pastoralists experience with their existing interactions with the marketplace, such as high transactions costs and limited access to market data, which often results in herders entering unfair contracts with traders and middlemen.

Further niche-markets can be developed to compensate pastoralists for their coexistence with wildlife and role in protecting biodiversity. For example, in northern Kenya the "Linking Livestock Markets to Wildlife Conservation" project enabled pastoralists to gain 30% higher prices for livestock than local markets[137]. However, most research into consumer demand in developed countries shows that animal welfare, health, and product nutritional values and taste are presently of greater concern to consumers than environmental impacts. To capitalise on the biodiversity values of pastoralism better-recognised certification schemes may be required.

The Certified Wildlife Friendly® trademark established by the Wildlife Friendly Enterprise Network (WFEN) is one example of a certification scheme designed to mainstream the concept of wildlife friendly products globally. So far the brand has been used to certify cashmere produced by the Grupo Costa del Río Colorado cooperative of goat herders in Argentina with support from the Wildlife Conservation Society (WCS). By facilitating access to higher value international markets in return for commitments to reduce stocking levels and adopt guard dogs to minimize human-wildlife conflicts, the scheme raised the income of cooperative members and reduced environmental impacts associated with goat ranching in Argentina's Patagonian Steppe[138].

Another example of an effort to develop a certification scheme that could potentially secure sustainable pastoral outcomes at the regional level can be seen in the Pampas grasslands of South America. Established through the support of Birdlife International the Southern Cone Grasslands Alliance the project has created a "bird friendly" beef certification scheme which has established certification standards and protocols that guarantee production systems are supportive of threatened Pampas grassland conservation. By 2012 improved grassland management practices were being

Pastoralists could benefit from growing consumer awareness of ethical trade issues and the growth of ethical certification schemes.

applied through the scheme across more than 70 ranches and other businesses, bringing a total area of over 300,000 hectares under conservation[139].

Growing societal awareness around the negative social and environmental externalities associated with globalised food systems and consumer appreciation for culinary, nutritional and cultural values of local food systems has also created a growing interest in the concept of alternative food networks[140]. Various new social movements, producer groups, development approaches and certification schemes have emerged which can be loosely grouped around the concept of alternative food networks or food sovereignty. The concept of food sovereignty is an alternative policy framework for food and agriculture that guarantees and protects people's rights to define their own models of production, food distribution and consumption. The food sovereignty movement is a reaction to the cultural standardization of modern globalised food production systems in which traditional farming systems such as nomadic pastoralism are increasingly threatened and outcompeted. It seeks to enact a transformative process that will "regenerate a diversity of autonomous food systems based on equity, social justice and ecological sustainability"[141].

An important alternative food network concept that pastoralists are increasingly benefiting from is the Slow Food movement. In contrast to increasing trends towards production intensification and processed food that dominate the global food system, the concept of "Slow Food" emphasizes unique local food systems, cultures and regional cuisines. In 2000 the Slow Food Foundation for Biodiversity established the Presidia project with the objective of protecting threatened products or production systems through connecting a network of small scale producers with niche market consumers such as chefs and speciality food purchasers under a recognized label. The project brings together communities of producers to jointly establish production rules and criteria for selecting products to be marketed under the scheme, typically based on unique taste or culinary qualities, risk of extinction, social and environmental sustainability of the production system, small scale, and unique history or culture. Several pastoral groups are now involved in the Presidia project and have successfully created niche markets for their products.

Rangeland livestock products are often proven to have both unique culinary characteristics and superior nutritional qualities in relation to more intensively produced alternatives. The Sami reindeer herders of northern Europe safeguarded the traditional

Niche-markets can be developed to compensate pastoralists for their coexistence with wildlife and role in protecting biodiversity.

Pastoralism can benefit from growing consumer appreciation of the culinary, nutritional and cultural values of local food systems.

preparation of the Suovas delicacy made only from tenderloin by creating a Presidia market and production rules that prevent substitution with intensively produced reindeer meat. Meat from free-range Sami reindeer grazed solely on natural pastures contain a high omega-3 polyunsaturated fat content and unique flavour, yet reindeer raised more intensively within commercial ranches and provided supplementary feeds such as grain have a mild beef-like flavour and a high content of omega-6 saturated fats[142]. Similarly the Diné sheepherders in the south-western United States have developed direct marketing networks through the Presidia Slow Food project for various products derived from their endangered Navajo-Churro sheep.

In addition to capturing the higher value of range-fed livestock products and marketing environmental services, pastoralists can also benefit from marketing the natural biodiversity that is produced from their rangelands. Under sustainable conditions pastoralism maintains biologically diverse rangelands that produce numerous high value natural products whose demand has increased in the global marketplace. In African rangelands Gum Arabic, derived from the sap of *Acacia senegal* and *A. seyal*, is in high demand for its use in various industrial applications from confectionaries, pharmaceuticals, cosmetics and chemical applications (inks and paints). Sudan, the main producer of Gum Arabic, has in the past generated an average US$50 million in annual sales[143]. Similarly, Devil's Claw a medicinal plant found in the pastoral savannahs of southern Africa is in demand for the treatment of arthritis and fetches over US$31 million in European Union markets[144].

In northern Kenya a social enterprise called Desert Edge has helped pastoral groups from the Samburu region to develop a value chain around various dryland products both domestically cultivated and sustainably harvested from their rangelands. In addition to providing training to women's groups and other enterprise associations, and investing in processing and marketing, Desert Edge have started the first international sustainable wild harvest certification scheme under the a new standard called FairWild. The enterprise also provides support services including technical extension, processing and marketing infrastructure, quality-control, product-development, aggregation, market-access and enhanced trade opportunities for these pastoralist enterprise groups. Desert Edge has increased incomes for over 5,400 households by creating markets and processing facilities for various sustainably harvested or domestically produced

Rangeland livestock products often have both unique culinary characteristics and superior nutritional qualities in relation to more intensively produced alternatives.

rangeland bio-products. Some of these products have also gained access to international markets[145].

"Landscape labelling" has begun to open opportunities for some pastoralists to gain added value from their livestock or rangeland products based on their green credentials. Landscape labelling is also a means to protect products and value chains linked to traditional practices that are being undermined by more intensive production systems. The *Crianceros* goat herders from Neuquen Province, in the high rangelands of northern Patagonia in Argentina, provide one notable example. The *crianceros* rear the Criollo goat, a hardy breed that flourishes in the low productivity of the Andres. Meat products from the breed are highly valued by consumers at the provincial capital's supermarkets, restaurants and butcheries, especially during periods of festivity when families traditionally barbecue goat meat. Recognizing an important opportunity to simultaneously improve *crianceros* livelihoods and maintain the biodiversity benefits of their land use system, a group of development officers, researchers, traders and professional organisations have begun a conservation labelling initiative aimed at organizing producers and increasing their returns from the marketplace based on improved marketing. The scheme led to an agreement to designate the "Northern Neuquen Criollo Kid" label to goat meat through a marketing scheme that emphasized both the breed, its natural production system involving careful transhumance and a common landscape identity, based on the pristine Andes Mountains, their climate, vegetation and customs. During the first year of the designation of origin being implemented producers were able to gain 10% higher returns from selling under the new label[146].

In Europe, landscape labelling has been supported under European Union law by the 1992 "protected designation of origin" framework and numerous certified and regulated special labelling schemes have emerged that protect pastoralist product marketing[147]. These impose certain production conditions and prevent false trade descriptions or the passing off of inferior products as sourced from traditional pastoral systems or production techniques. Marketing of traditional Roquefort cheese production by over 4,500 herders that graze distinct breeds of Lacaune, Manech and Basco-Béarnaise sheep, predominantly on the Causse du Larzac limestone plateau of Aveyron, is now protected under the framework. Similarly, alpine cheese producers in the Swiss Alps now have designation of origin protection to ensure that cheese labelled as "Alpine" is only produced from the milk of cows grazing mountain pastures, and not from more intensive dairy systems found in the alpine valleys. Where markets for products produced by extensive pastoral production systems risk being undermined by inequities in the global marketplace, governments can play a role in strengthening product labelling and marketing regulation as a means to protect pastoralism and the ecosystem services it provides.

Under sustainable conditions pastoralism maintains biologically diverse rangelands that produce numerous high-value natural products whose demand has increased in the global marketplace.

Landscape labelling has been defined as a new Payment for Ecosystem Services (PES) concept that seeks to combine elements of PES with those from the practice of product certification[148]. The approach overcomes many of the challenges pastoralists face entering formal PES arrangements such as issues associated with ensuring conditionality – the ability of producers to ensure that measurable ecosystem services have been secured – or with establishing equitable benefit sharing mechanisms within diverse pastoralist communities[‡].

Developing an inclusive green economy within pastoralist regions will require looking beyond direct use values such like meat, milk and fibre and taking into account the indirect values of pastoralism which are often less tangible and hard to quantify[149]. Livestock-related environmental services that can maintain or enhance natural capital—as discussed in the previous section of this report—can be promoted in various ways. These include pastoralist's themselves internalising the benefits through increased productivity of the system, through direct marketing (i.e. selling of medicinal plants or recreational services through tourism), or through indirect marketing (i.e. payments for ecosystem services where pastoralists are compensated at a landscape level through indirect investment into pastoralism).

Pastoralists in many countries have already begun to participate in pay-for-performance schemes that can ensure they are able to continue conducting management practices that secure them. In Andalusia, Spain, where a lack of grazing

‡ PES schemes are characterized as a voluntary transaction of a well-defined environmental service or land use likely to secure this service is bought by a service buyer from the service provider but only if the provider can assure that the service has been secured (conditionality).

Cashmere goats and fat tailed sheep, Mongolia. Credit: Piet Wit

"Landscape labelling" has begun to open opportunities for pastoralists to gain higher value from their livestock or rangeland products based on their green credentials.

within dryland forests has caused excessive fuel load build-up and more intense ecologically damaging fires, pastoralists were paid €40 to €90 per hectare per year under a performance-based firebreak grazing scheme financed by the regional government[150]. By 2011 the scheme had expanded to include 222 farmers who took responsibility for the management of 6,880 ha of forest fire breaks, but the programme was later abandoned. Throughout Europe pastoralists receive PES payments under the Common Agricultural Policy (CAP) and Natura 2000 programme established under the EU 1992 Habitats Directive. Alongside nature reserves, many of these areas include landscapes where grazing by pastoralists is vital for on-going biodiversity conservation and ecosystem services. There are numerous similar examples, such as payments to Swiss farmers whose grazing of alpine pastures is vital for avalanche control and thus tourism, or payments to British Shepherds by conservation trusts whose land depends on grazing to maintain its aesthetic appeal.

Pastoralism is attracting increasing interest in the context of climate change mitigation and carbon markets, given its critical role in the management of the world's rangeland. Recent price volatility aside, the growth of both compliance and voluntary markets for carbon has promoted the search for a wide range of terrestrial land-use based carbon offsets, beyond forestry and REDD+. Grasslands store approximately 34% of the global stock of CO_2 and estimates suggest that improving management and restoring degraded soils could sequester between 1300 to 2000 Mt CO_2e per year by 2030[151]. When rangelands are converted to cropland 95% of aboveground carbon and as much as 50% of belowground carbon is lost[152]. Studies from the drylands of South Africa have shown that overgrazed or degraded savannah ecosystems can have up to 35% less soil carbon[153]and 75% less above ground carbon and reconverting areas of agricultural land to rangeland use can restore carbon levels to 80% of their natural savannah levels over 100 years[154].

Developing an inclusive green economy within pastoralist regions will require looking beyond direct use values such like meat, milk and fibre and taking into account the indirect values of pastoralism which are often less tangible and hard to quantify.

Currently, grazing-related rangeland management activities are not eligible under most compliance markets, without which demand is likely to be limited for rangeland carbon. Rangeland carbon from intensive farming systems in the USA was eligible under a voluntary standard developed by the Chicago Climate Exchange, but this ceased trading in 2010[155]. Until then some progress had been made towards establishing a voluntary market with growing interest among some private companies and carbon funds[156], and in 2011 a voluntary market methodology for grassland carbon was submitted for approval under the Voluntary Carbon Standard[157].

At the project level transaction costs are likely to be higher in extensive pastoral rangelands where complex tenure systems mean benefit sharing mechanisms and monitoring systems are difficult and costly to establish. Innovative project designs such as public-private partnerships might address these shortcomings but on the whole these constraints risk limiting the financial attractiveness of the approach to investment in areas of privatized rangeland where transaction costs are reduced. Another issue is that these schemes tend to pre-determine eligible improved management practices and to make these administratively simple they favour simple techniques—such as fencing—over the complex investments needed to create enabling conditions for improved mobility.

The "Linking herders to carbon markets project in Mongolia" conducted a grassland carbon feasibility study to design a pilot carbon finance project using methods acceptable under an international carbon market standard such as the Voluntary Carbon Standard (VCS). A potential project area of 47,872 ha of degraded grassland in the Tariat Soum region was identified that could potentially sequester 45,000tCO_2e per year for 20 years through improved grazing management and investments to improve livestock productivity and marketing. The feasibility study found that revenues from the sale of carbon credits could cover the operational costs of local institutions managing the project and provide direct performance-based payments to herders from local Pasture User Groups (PUGs). Management measures to secure carbon sequestration included supporting PUGs to reduce livestock numbers initially in some parts of the landscape, whilst bringing other areas currently under-grazed into production. After these actions were completed the study concluded that improved rangeland productivity and grassland restoration would mean that herd sizes could increase to close to their current levels. If public funds were used to cover some or all of the start-up costs involved total net carbon revenues per household could vary from US$200 to US$600 per year depending on the price of carbon.

Grasslands store approximately 34% of the global stock of CO_2 and estimates suggest that improving management and restoring degraded soils could sequester between 1300 to 2000 Mt CO_2e per year by 2030.

Pastoralists in many countries have already begun to participate in pay-for-performance schemes that can ensure they are able to continue conducting management practices that secure them.

With the price of carbon showing fluctuation on both compliance and voluntary markets, it appears that, given their high risk nature, rangeland carbon projects are likely to remain of marginal interest to private investors at least for the moment. Investment of public funds and linking with other forms of international climate financing could be a means to overcome these constraints and begin pilot projects. Rangeland carbon projects may eventually become more mainstream as part of nationally appropriate mitigation actions (NAMAs).

When rangelands are converted to cropland 95% of aboveground carbon and as much as 50% of belowground carbon is lost.

Growing recognition of the compatibility between pastoral land use and conservation objectives at the landscape level has created opportunities for herders to benefit from a growing "willingness to pay" for the biodiversity conservation values associated with extensive pastoralism. For example, a number of national parks have established benefit sharing schemes whereby park authorities compensate neighbouring pastoralists for tolerating wildlife on their land as a means to keep dispersal areas and wildlife corridors open[158]. In some regions authorities have gone beyond this by directly allowing pastoralists access to protected areas and rewarding herders for their role in ecosystem management. For example, in the Aiguamolls de l'Empordà national park in the province of Girona in Spain, transhumant sheep flocks has been used as a management tool to maintain biodiversity within the saline wetland pastures of the park. In fact much of the network of pan-European protected areas supported under the Natura 2000 programme rewards extensive livestock grazing as an environmental management tool for biodiversity conservation.

On extensive rangelands outside of parks and protected areas these schemes typically involve pastoral groups signing binding Community Conservation Agreements (CCA) with conservation groups which outline certain land management commitments and pay-for-performance conditions. In eastern Africa conservation land leasing is one example whereby herders have been rewarded for their wildlife-compatible land management practices. Maasai land owners whose grazing lands fall within the ecologically important Kitengela wildlife dispersal area in Kenya have entered into land leasing agreements with conservation groups who lease land from households in return for commitments to maintain the land unfenced and open to both wildlife and livestock. By 2010 the scheme had enrolled 375 households securing a total of 16,500 ha of land within the corridor for combined wildlife livestock use[159]. Further studies have estimated that willingness to pay amongst the Nairobi public for securing the Kitengela wildlife dispersal area would account for US$1.2 million which could provide a longer-term source of financing[160]. In the Simanjiro district of Tanzania a similar scheme has been established where tour companies make an annual payment of US $4500 to communities to prevent agricultural encroachment onto a 23,000 acre wildlife corridor.

Compatibility between pastoralism and conservation creates opportunities for herders to benefit from a growing "willingness to pay" for biodiversity conservation.

There are also numerous examples of projects that support pastoralists to initiate or engage with conservation-related businesses, typically through creating favourable conditions for investment by tourism ventures on their lands[161]. Household surveys among Maasai pastoralists found that two thirds (64%) of households living adjacent to the Maasai Mara National Reserve earn some income from wildlife, with wildlife conservation accounting for an average 21% of annual household income[162]. Capturing of income by powerful interests can however dilute the impact of these schemes on pastoral poverty and undermine local support for conservation among the pastoral community[163]. Nevertheless, benefits of these projects are not only measured by direct household income, but can include capacity building of local institutions to manage revenue and to defend rights, as well as an array of social services and infrastructure projects.

Green innovations

Carbon emissions associated with capital inputs in pastoralist systems are currently low compared to more intensive livestock production (see carbon efficiency section), but as the pastoral economy integrates further into the market economy the need for fossil fuels increases as aspects of production are mechanised to save labour and time (i.e. water extraction, cooking fuel etc.). Changing consumption patterns, particularly associated with investment in some form of permanent habitation, drive up energy demand. Increasing commercialisation of livestock products (i.e. meat, milk, hides, fibres) also raises of the need for energy. Green technologies are therefore becoming increasingly relevant for many pastoralists and appropriate innovations and technology transfers may be needed.

In the high forests of Central Nepal the yak cheese production process by Tamang-speaking herders has raised concerns over fuel-wood demands and deforestation within a nearby Langtang National Park. A recent assessment suggested that, given the transhumant movement of yak herds between three to five temporary cheese processing centres, there is a demand for a renewable energy technology which is either cheap enough to be invested in at each location or easily transported. Small-scale biogas was found to be suitable in principle, although some changes to management practices may be required[164]. Some organisations are attempting to improve biogas technology for pastoralist conditions, such as adapting the design to reduce water requirements for applications in arid areas. In East Africa the Tanzania Domestic Biogas Programme (TDBP) is currently subsidizing a scheme which is helping over 200 pastoralists construct biogas plants which instead of using a 1:1 manure-water ratio can be used with a ratio of four kilograms of manure to one litre of water. However, the system costs 20 to 30% more than normal fixed-dome plants constructed by TDBP.

Supporting the growth of markets and supply chains for clean energy products in remote pastoral drylands is likely to result in numerous benefits for pastoralists in the form of direct livelihood improvements and more opportunities for livelihood diversification. This will likely impact most positively on women and children and also decrease the pressure on surrounding environment. Whereas under more nomadic conditions it is often impractical to invest in energy technologies beyond those that are easily transported, access to appropriate clean energy products becomes more important under a mixed sedenterization nomadic system.

Solar technologies offer solutions for improved access to energy in pastoral areas—for example for lighting or powering mobile phones—but the high cost of last-mile distribution has led solar suppliers, and indeed green energy entrepreneurs in general, to concentrate on commercial centres leaving rural areas such as pastoral drylands with low awareness and availability. Because national power grids rarely extend far into remote pastoral areas, most solar power solutions for households and small enterprises require batteries to store power for overnight usage and these often have a limited lifespan. Solar cookers offer significant potential to both reduce carbon emissions and generate carbon offset payments from the foregone use of biomass fuels in pastoral areas. Several examples of these projects exist in pastoral areas including the ActionCarbone project in the Andes and CO_2Balance project in East Africa.

Argentina. Credit: Pablo Manzano

Renewable energy may have particular application for water pumping in rangelands, particularly where pastoralists are reliant on deep groundwater boreholes. In Namibia herders rely on over 50,000 boreholes that tap deep underground aquifers for their water and solar energy has been used for pumping for over 30 years and from 2001 to 2006, 669 solar-powered wells were installed. In many countries the wind pumping sector is supported by local industries which can improve consumer confidence as suppliers remain accessible for parts and repair, often in contrast to the solar water pumping sector which tends to be dominated by multinational companies. The advantage of wind pumping over solar pumping is that the technology is robust and not easily broken or stolen, which is important in pastoral areas suffering from insecurity.

Summary

Growing global demand for livestock products is driving rapid industrialisation of the livestock sector worldwide, with major implications for land, water, nutrients and fossil fuels. Pastoralists may benefit from some elements of intensification in the sector, but their production system depends on a very different relationship with nature: one that is inherently adaptive and resource-efficient. Current approaches to quantify natural resource efficiencies in the livestock sector fail to account for the additional ecosystem and cultural values that pastoralism provides and improvements in accounting methods would be needed.

Growth of markets and supply chains for clean energy products in remote pastoral drylands will likely result in numerous benefits for pastoralists in the form of direct livelihood improvements and more opportunities for livelihood diversification.

Pastoralism delivers a wide range of economic and environmental values from rangelands of relatively low biological productivity that are ill-suited for intensive production. Nevertheless, major increases in productivity could be possible within the pastoral sector, but a different interpretation of intensification is required: one in which inputs of labour and social capital are recognised and the diversity of benefits from the system is respected. A model of optimisation of environmental and economic benefits should be adopted rather than maximising output of single products, factoring in the ecosystem benefits, including carbon sequestration, biodiversity conservation, and the relatively small freshwater footprint of pastoralism. Particular attention is required to establishing and improving access to markets for the diverse goods and services of pastoralism, including domestic as well as international markets, and also including innovative niche markets for environmental benefits and ecosystem services.

Herd of horses in desert, Mongolia - Credit: Pichugin Dmitry

Enabling pastoralism for a Green Economy

Strengthening basic human development

Investment in human capital is essential for economic growth and may, in rangelands, be more important than investment in physical capital[165]. Whilst pastoralists often have rich local and indigenous knowledge that is central to their sustainable management of rangeland resources, there are major gaps in provision of education and health services that set back their development and which may create obstacles to embracing new opportunities. At the same time many pastoralists receive inadequate security services and often have poor access to government in general. For many governments provision of basic services to pastoralists is a priority, although the challenge of adapting services to the pastoral context, and building the capacity of local service providers should not be underestimated. Alternative models of service delivery that integrate well with the pastoral system have improved development performance from education and healthcare to animal health. However, to work effectively at scale these approaches need complementary state regulation, investment, monitoring, and policy support.

Access to education can be improved through investment in a variety of models, including mobile schooling such as tented schools and distance learning, for example through radio. Boarding schools can be successful if the costs of school fees can be kept low and security or cultural fears—particularly for girls—can be ameliorated. Reviews of success factors in the provisioning of education services for pastoralists found that the most important factor governing the provisioning of successful schooling for pastoralists is the school culture and the way other pupils view pastoralism[166].

Models of service delivery that integrate well with the pastoral system need complementary state regulation, investment, monitoring, and policy support.

In Iran and Mongolia the introduction of mobile primary schooling systems has been successful and has now overcome the initial challenge of not having enough teachers from the pastoral community to function effectively. Amongst the Qashqa'i of Iran nomadic tent schools have improved literacy, gender equality, disease management and social mobility[167]. Education is often a precursor to effective engagement in development dialogue with government, as was the case in Iran where tented schools improved education and social mobility which enabled pastoralists to open effective dialogue with government and have a greater say in development planning issues[168].

The most important factor governing the provisioning of successful schooling for pastoralists is the school culture and the way other pupils view pastoralism.

Rural healthcare facilities in developing countries are often poor and where they are staffed by non-pastoralists in pastoral areas the outcome is often distrust and low use. Women often face greater challenges in accessing health services due to their dependence on men to sanction such treatment or to accompany them to health centres. When the availability of drugs and vaccines is restricted, mobile pastoralists have sometimes been excluded from treatment first. Mobile services can have higher costs than static service facilities, but combined systems of mobile outreach services and static health facilities can make more efficient use of existing infrastructure and human resources[169].

Insecurity presents a significant barrier to development and directly undermines the role pastoralism can play in the maintenance of natural capital in drylands. In Darfur, Sudan, for example, the on-going war that started in 2003 and which has displaced over two million people and witnessed 70,000 casualties, has disrupted complementarities between pastoralists and farmers and has contributed to pitting these groups against one another[170]. There are many causes of conflict, in many cases linked to insecure land tenure and the relative ease

Combined systems of mobile outreach services and static health facilities can make more efficient use of existing infrastructure and human resources.

Insecurity presents a significant barrier to development and directly undermines the role pastoralism can play in the maintenance of natural capital in drylands.

by which non-pastoral communities can acquire pastoral land. In some countries—notably in eastern Africa—armed livestock raids and resource conflicts have traditionally been sanctioned by customary authorities, but with improved weaponry and changing external influences these conflicts have escalated. However, causes of conflict are usually complex, with historical roots and often taking on political dimensions. This is a major concern in countries where pastoralists are poorly represented in political discourse.

Insecurity can significantly hinder livestock mobility in drylands leaving vast areas of rangeland under-grazed causing encroachment by shrubs, while intensive grazing pressure around more defensible areas leads to degradation[171]. Insecurity also hinders development progress by favouring short-term crisis management, but at the same time conflict-management programmes in pastoral systems can be an opportunity to strengthen traditional institutions and create new informal and formal mechanisms that enable more long term effective, equitable participation in development processes.

Considering the weak penetration of conventional security services into most pastoralist rangelands, the system displays a remarkable degree of cost-effective self-policing. Traditionally, pastoralists have used informal sanctions, reciprocity, spontaneous adaptations, and negotiated alliances as mechanisms to mitigate conflicts and these should be strengthened and built upon. Classifying insecurity in pastoral systems into "management problems", "disputes" and "conflicts" is a helpful step towards systematically determining suitable resolution mechanisms, but in practice there are often multiple layers and scales of complexity associated with pastoral insecurity and it may be more constructive to consider the phases associated with conflicts. The most effective approaches to tackling insecurity in pastoral systems are those that recognize the complexity of the issues and enable the system to maintain flexibility; rather than seeking to support or strengthen formalized systems that seek to stabilize pastoral groups within defined territories[172]. Women can also play a vital role in conflict-resolution and peace-building activities as their kinship ties and non-combatant status can enable them to enlist the support of elites, warriors, elders and government to resolve conflicts in ways not open to other actors.

Considering the weak penetration of conventional security services into most rangelands, pastoralism displays a remarkable degree of cost-effective self-policing.

Governance of rangeland resources

Most rangelands are managed communally and sustainable management therefore depends on the application of rules and regulations to govern use by a number—often a large number—of resource users[173]. The nature of those rules and regulations and the manner in which they are developed is the key to the success of common property regimes (CPRs). Successful CPRs usually rely on the established behaviour, or norms, of resource users and are to a large extent self-enforcing[174].

Effective governance of the rangelands depends on rules and regulations at a number of levels. In addition to local arrangements for communal resource management, governance is influenced by policies at the national or sub-national level which enable or regulate communal rangeland activities. Governance of the rangelands is also influenced by other stakeholders, some of who may be peripheral to the rangelands, whose actions impact in different ways on rangeland management: for example, up-stream water users. Effective governance therefore requires institutional arrangements to enable cross-sectoral planning and resource allocation.

Effective governance of the rangelands depends on local rules and regulations as well as policies at the national or sub-national level.

Securing land and resource rights for pastoralists is vital to create the enabling conditions that allow pastoralists and their livestock to continue their role as managers of natural capital in drylands. Land rights lie on a continuum, from the right of access and the right of use, through to the right of alienation. It is the right to manage and the right to enforce rules for periodic resting of rangelands that are most critical for sustainable management. In addition, some pastoralists may also need the right of passage to be upheld to allow access between different resource patches[175].

On a given area of communal pastoral land there may be complex overlapping rights relating to access, management and control that may be vested in different communities. This leads to a system where mutual trust and reciprocity, mediated through cultural specific institutional mechanisms and formal negotiations enable rights to be continually contested and renegotiated. Formalising land rights, when not conducted with due sensitivity, can undermine the systems' inherent flexibility which ultimately can restrict livestock mobility and the sustainability of land use. Where government policies have favoured privatization, negative outcomes such as increased conflict, impoverishment and degradation have occurred[176].

It is the right to manage and the right to enforce rules for periodic resting of rangelands that are most critical for sustainable management.

Polices that have firmly supported communal land tenure tend to result in positive outcomes for pastoral livelihoods and the conservation of rangeland environments. In Spain livestock mobility has been promoted by an Act of Parliament passed in 1995 that legitimizes pastoral use of the country's 120,000 kilometres of transhumance corridors, and in doing so this enables flocks to continue to serve as a vector of native plants, improve the fertility of mountain soils through manuring and ultimately play an important role in the preservation of the country's biodiversity. In Mongolia the resurrection of community pasture rules under the 2003 "Law on Land" and 2006 "New Amendments to the Law of Nature and the Environment" provides greater control over natural resources to customary institutions. While some issues of inequality remain, improved access and control over pastures has increased seasonal livestock movements resulting in increased income, the rehabilitation of extensive areas of rangeland and dividends to biodiversity and ecosystem services[177].

Formalising land rights, when not conducted with due sensitivity, can undermine the systems' inherent flexibility and the sustainability of land use.

One way to safeguard rangeland biodiversity, traditional knowledge and livestock diversity in areas where commercial exploitation is being developed is through biocultural community protocols (BCPs). BCPs put on record the contribution a community and its biocultural diversity makes to biodiversity conservation and is a means to strengthen local and national awareness of rights and access to resources. BCPs support the Nagoya Protocol on Access to Genetic Resources and Benefit Sharing under the UN Convention on Biological Diversity and provide a mechanism to contribute towards the Global Plan of Action for Animal Genetic Resources, an international agreement to protect diminishing locally adapted breeds implemented under the guidance of the FAO. So far at least five BCPs have been established by community groups including several pastoralist communities such as the Samburu of northern Kenya and the Raika pastoralists of Rajasthan, India[178].

Numerous examples are emerging of local natural resource governance being revived and reinforced to enable pastoralism. Traditional Agdal systems have been strengthened in Morocco, Hima systems are being revived in Jordan and elsewhere in West Asia, and customary governance systems are being legally reinforced in East and West Africa. Most examples illustrate the importance of working within existing legal frameworks and supporting implementation of public policy. They depend on empowering pastoralists, building the capacity of local non-government institutions (often customary institutions), and institutionalising participatory resource planning mechanisms. The benefits of these approaches are simultaneous improvements to the environmental, social and economic context[179].

The low visibility of nomadic pastoralists and lack of awareness of rights more broadly make efforts to lobby and defend land rights difficult. Securing customary land rights in most pastoral systems needs to occur with a concurrent process of strengthening customary institutions because effective, formalised, communal tenure will rely heavily on these institutions. It is also critical that issues of inequality that still exist in many customary institutions are addressed, such as the rights of women to participate in development planning and to own and inherit resources.

Enabling equal participation of pastoral women and men in development planning and policy reform processes is essential to allow pastoral governance to be legitimized and the development of policies that support pastoralism to deliver its full potential for sustainable, resource efficient natural resource use. In recent years significant progress has been made both in the empowerment of local pastoral communities or their institutions, and in the organisation, engagement and representation of pastoralist civil rights groups in policy reform processes[180]. That said, the degree of organisation and political representation of pastoral groups remains patchy and these initial steps now require the sustained support of donors and NGOs.

Strengthening rangeland resource governance is often possible within existing laws and policies – it depends on empowering pastoralists, building the capacity of local non-government institutions, and institutionalising participatory resource planning.

Divergent interests, historic clan-based affiliations and increasing social differentiation within and between pastoral communities by education and wealth status make consensus building at the national level difficult in some counties or regions. Creating a broad political constituency that can hold government to account will require measures to address these internal divisions. Concerns have been raised over the overt reliance on empowerment of “pastoral elites” within pastoralist civil rights organisations, but these educated and connected individuals play a vital role in connecting marginalised communities to government.

With an increasing trend towards formalising access to resources and land, women often lose rights to access certain resources that they enjoyed under more flexible customary systems. This can further marginalise women as they lose entitlements and command over certain resources. It is vital that any efforts to support the growth of a Green Economy in pastoral drylands are informed by a complete understanding of local power relations, particularly between men and women.

While national policies and investment priorities continue to constrain pastoralism and sustainable rangeland management, the development of policy and legal frameworks at different levels are helping to change the landscape for improved action. Several West Africa governments have passed pastoral laws that protect pastoral land and enhance livestock mobility. Guinea, Mauritania, Mali, Burkina Faso and Niger now all have legislation that specifically recognises and protects pastoral mobility, primarily out of a desire to mitigate the conflict between pastoralists and farmers[181]. Kenya in recent years has shown strong leadership in this regard seeking to mainstream drylands and pastoralism within development policy, which can be seen in both the country’s Vision 2030 and the establishment for a limited period of a specific government ministry for dryland development[182]. At the regional level in Africa the African Union (AU) Policy Framework on Pastoralism and AU Framework and Guidelines for Land Policy in Africa also provide a consistent framework to guide country level efforts to address development in pastoral regions.

Women Pastoralists Gathering, India. Credit: Michael Benanav

Efforts to support the growth of a green economy in pastoral drylands must by informed by a complete understanding of local power relations, particularly between men and women.

Many countries have developed policies that can strengthen pastoralism, but these policies are often not implemented in pastoral areas. Low policy implementation may be due to lack of awareness amongst pastoralists, lack of capacity in government, or lack of motivation on either side. Stronger development partnerships can be fostered by focusing on policy implementation and positioning both communities and external development agents as partners in development. Motivation can be built through stronger government-community relationships and more participatory planning, which contribute to greater accountability and responsiveness from government, particularly at local level[183].

Where policies have created space to decentralise natural resource governance through the empowerment of customary decision-making and local enforcement of rules and regulations, resource misuse and land degradation can be successfully reversed. Pastoral governance has been successfully strengthened by taking advantage of decentralisation in many countries, including Kenya, Tanzania, Botswana, Morocco, Jordan, Lebanon[184]. In Mongolia greater local governance over natural resources in pastoral areas demonstrates how community organisations have improved environmental condition through customary decision making, scheduled seasonal movements, and by lobbying for improved roads and repairs to wells that have improved access to unused pastures. Empowering community organisations may also address the exclusion of disadvantaged community members to be addressed.

Opportunities for more sustainable rangelands management and coordinated planning between sectors can be created through local government, particularly where this is sanctioned through policies of decentralisation. Local planning processes offer an opportunity for pastoralists to have greater input

Policy frameworks at national and regional level have created space for interventions that work with, rather than against the pastoral system.

to prioritisation of public expenditure and to influence potentially harmful investments. In some cases innovative mechanisms are needed to coordinate planning between resources that are managed on different scales, such as localised pastures, larger scale river basins, and transboundary rangelands.

Low policy implementation may be due to lack of awareness amongst pastoralists, lack of capacity in government, or lack of motivation on either side.

Local and sub-national level planning processes can also help to mitigate conflict between neighbouring resource users, particularly between ethnic groups that favour different land management practices. Whilst earlier sections have highlighted that converting rangelands to irrigation is often undesirable, there are many examples of crop-farming communities acquiring land in pastoral zones and converting it to cultivation. Given the weakness in land tenure security and the widespread biases towards crop cultivation in many developing countries, transfer of land ownership and land use change is a common problem that threatens both environmental degradation and conflict, as well as often not being in the national economic interest. Improved planning mechanisms and analytical tools are therefore needed, including land use zoning in some countries, to protect pastoral landscapes as well as to ensure appropriate integration of different land uses.

Strengthening resilience in pastoral economies

To make optimal use of the rapidly changing availability of resources in rangelands, pastoralist management systems must respond quickly and intelligently to unforeseen challenges and opportunities. This requires a high level of coordination between pastoralists and depends on heavy investment in social capital. Pastoralist adaptive capacities are traditionally strong but have been weakened where pastoralists have lost the ability to use their knowledge and apply their management and governance tools.

Pastoralists use a range of adaptive mechanisms to manage risks and vulnerability, associated with drylands, and their management is best described as adaptive and opportunistic, rather than optimization and control[185]. However, the pastoral economy is undergoing change in response to various factors, including climate change, environmental demands, market forces, shifts in labour supply, and conflict. Development planning and policy needs to be designed to build upon and improve pastoral risk management strategies in order to maintain the resilience of the system. The key to enhancing these natural risk management qualities will be to manage for uncertainty rather than attempting to regularise and standardise the system.

Innovative mechanisms are needed to coordinate planning between resources that are managed on different scales, such as localised pastures, larger scale river basins, and transboundary rangelands.

In pastoral areas a strong correlation can be found between transaction costs and participation in certain markets[186]. In many areas excessive government bureaucracy and fees have led pastoralists to seek unofficial markets, and this is a strong driver of informal, black market, and un-sanctioned cross-border trade. The smuggling of live animals, hides and skins from Ethiopia into neighbouring countries is estimated to cost the treasury US$100 million per year in lost revenue, illustrating the scale of these informal markets[187]. Reliance on these informal cross-border markets also results in lost revenue capture for pastoral groups and inefficiencies in the market, exposing trade to rent seeking behaviour[188].

Where formal domestic markets exist, a lack of access to price information and often high costs associated with getting livestock to markets means many pastoralists rely on brokers or middlemen. Whilst these agents play an important role in expanding market access, the information gap leaves pastoralists open to exploitation. In Kenya it has been estimated that pastoralists could be obtaining up to 70% of livestock prices at terminal markets, but in reality they average only 40%[189].

Improved planning mechanisms and analytical tools are needed to protect pastoral landscapes and to ensure appropriate integration of different land uses.

Afghanistan. Credit: Thomas Sommerhalter

Significant improvements to pastoral incomes could be gained from modest investment in developing national market chains and information systems. Improving the provision of processing facilities and transportation would improve access to certain markets resulting in reduced transaction costs. Improving access to financial services (e.g. insurance, credit and banking) and more organised national markets (e.g. pricing information and holding facilities) would also further reduce the costs and risks associated with marketing.

Most policy associated with livestock sector development in pastoral drylands is skewed towards production concerns, rather than system concerns. Support for increased commercialisation is important, but orientating policies towards maximizing off takes risks squandering and undermining the diversity of values generated by the system. Enabling the development of a diversified pastoral economy will enhance resilience and enable pastoralists to make effective sustainable management decisions

The key to enhancing pastoralist risk management is to manage for uncertainty rather than attempting to standardise the system.

Significant improvements to pastoral incomes could be gained from modest investment in developing national market chains and information systems.

within their rangelands. Lessons on benefit capture and the promotion of environmental services need to be transferred so that pastoralists in developing countries can benefit from the positive environmental externalities associated with their land use system.

Systemic issues within the global market for livestock products are driving inequality and restricting efforts to develop markets for pastoral livestock products. Increased globalised trade and heavy subsidies for agricultural sectors in developed countries mean many pastoralists are outcompeted in their own marketplaces. Several examples exist, such as the global trade in dairy products causing a saturation of the West African milk market with subsidized milk products from the European Union. In Burkina Faso, nine out of ten litres of milk consumed in urban areas are imported, and European subsidized milk accounted for half of all milk imports[190], yet large quantities of milk

Support for increased commercialisation is important, but orientating policies towards maximizing off takes risks squandering and undermining the diversity of values generated by the system.

are produced in the country's rangelands without access to the market. This phenomenon has stifled some efforts to develop a dairy sector among the unsubsidized West African camel herders of Mauritanian, for example[191]. In Afghanistan, wool produced locally by pastoral groups used in the famous Afghan carpets has been increasingly substituted with cheaper Australian wool, leading to processing facilities being relocated to urban areas, making markets harder to reach for herders. Peru, once the world's largest producer of Alpaca wool, has lost market share to producers in the developed world who have imported breeding stock and invested heavily in their own breeding programmes and biotechnology.

Protected Designation of Origin frameworks such as that passed under European Union law in 1992 offer a mechanism to protect traditional production systems such as pastoralism. As described previously the EU Protected Designation of Origin framework has allowed systems to be developed that enabled European governments to protect products and value chains linked to traditional practices[192]. Where markets for products of extensive pastoral production systems risk being undermined by inequities in the global marketplace, green economic growth strategies should seek to explore the use of designation of origin trademarks as a means to protect pastoralism and the ecosystem services it provides.

Access to financial services is often a limiting factor in pastoralist areas but improving access to appropriate financial services has multiple benefits for the overall resilience of pastoralism. Credit and savings facilities can help smooth the high variability of production and help herders replace livestock after drought. Credit can enable existing enterprises to expand, allowing pastoralists to diversify their household income and vulnerability to climatic shocks. Mobile banking programmes have allowed many pastoral drylands to overcome the lack of infrastructure investment but poor access to more mainstream financial services is hindered by the fact that pastoralists often have little in the way of conventional collateral and micro-finance providers do not understand the pastoralist economy.

Governments can play a role in partnership with the private sector to improve access to some financial services that reduce some of the production risks in pastoral drylands such as through underwriting aspects of index-linked livestock insurance schemes. In Mongolia a financial insurance scheme is now offered to pastoralists to cover herds against loss during natural hazards[193]. Using a mortality rate index insurance companies pay herders who purchase a commercial policy, whereas a public safety net programme compensates all herders should mortality rates pass a predetermined higher threshold. In other areas access to credit has been emphasized such as in Tibet where a revolving "sheep bank" has been established to loan sheep to poor families with fixed repayment terms[194].

Green economic growth strategies should seek to explore the use of Designation of Origin trademarks as a means to protect pastoralism and the ecosystem services it provides.

Pastoral men and women have complex patterns of entitlements and access to resources within different pastoral groups which are often overlapping and dynamic. Safeguards are needed to ensure that commercialisation of the pastoral economy does not impact negatively upon power relations between men and women, which in some cases can lead to an erosion of the practices that ensure sustainable natural resource management. Commercialisation can steer some resources away from women towards men as they become more valuable. The process can also lead to increasing individualistic behaviour which can result in the breakdown of societal support mechanisms upon which women rely on in times of need. Global assessments of gender inequality suggest that if women in rural areas had the same access to, and control over, land and resources as men they would produce 20-30% more food; enough to put 100 to 150 million people out of hunger[195].

Green economic development projects and pastoral livelihood initiatives, particularly green marketing opportunities and natural resource management, provide an excellent entry point from which to encourage the empowerment of marginalised groups in pastoral society. Economic empowerment is an important means to build women's self-confidence,

Improving access to appropriate financial services has multiple benefits for the overall resilience of pastoralism.

experience, social networks and access to social capital which in turn creates a broad foundation for addressing gender equality and empowerment in a broader sense. Women's economic empowerment can be gained through participation in many small scale renewable energy projects and payment for ecosystem services initiatives, especially where these require the establishment of microcredit associations or community management groups.

While the growth of green markets has provided opportunities for pastoralists to capitalize on the diverse ecosystem services provided by their land use system, the broader growth of global markets for green products and ecosystem services has created new risks to pastoralism and extensive rangeland resource use. International concern around climate change, global energy prices and national energy security has resulted in both regulatory and voluntary pressures to find alternative renewable sources of liquid fuels prompting international interest in biofuel production. Both the European Union and United States have enacted mandatory blending targets for the production of biofuels within the transport fuel mix which has dramatically increased demand, for example. Many African nations have also enacted national biofuel targets and several are developing specific energy policies for arid lands, creating further emphasis on production in drylands[196]. In this context many pastoral rangelands are increasingly seen as 'marginal' or 'idle' lands where the production of drought tolerant biofuel crops could lead to positive economic, social and environmental gains[197].

In recent years there has been an increase in land alienated from pastoralists for conservation purposes. This trend is driven both nationally through global commitments under the Convention on Biological Diversity (CBD) and locally through increasing interest from some international conservation NGOs and philanthropists in securing land for conservation. For example, the CBD's recently adopted Aichi targets call for the global land area under protection for biodiversity conservation to increase to 17% from its current level of 12.5%. When coupled with a growing disenchantment within community-based conservation initiatives and calls for a more hard edge approach, there are growing fears that this will prompt increased demand for an expansionist surge in protected areas causing further alienation

The growth of global markets for green products and ecosystem services has created new risks to pastoralism and extensive rangeland resource use.

Safeguards are needed to ensure that commercialisation of the pastoral economy does not impact negatively upon power relations between men and women, which in some cases can lead to an erosion of the practices that ensure sustainable natural resource management.

of pastoral land and resources rights[198]. For example, in Tanzania there are attempts to create an exclusive wildlife corridor along the eastern boundary of the Serengeti National Park that would alienate 150,000 hectares of Maasai grazing land, undermining the livelihoods of over 20,000 people. However, the Aichi Targets show the way forward by legitimizing Indigenous and Community Conserved Areas (ICCAs), which often fall in IUCN Protected Area Categories 5 and 6. Many pastoral rangelands would qualify for such recognition, massively expanding the area of land under protection providing governments an opportunity to revise wildlife policies to give ICCAs legitimacy.

Traditional mechanisms pastoralists use to adapt to climatic risks may not be sufficient and new adaptation mechanisms will become increasingly important.

The resilience of pastoral economies is threatened by climate change, yet pastoralists are traditionally among the most adaptable rural populations. Nevertheless, their resilience has been compromised by efforts to modernize their production system[199]. Pastoralism's resilience relies on mobility, informal social support networks, and the institutions and knowledge that reinforce them. In comparison to sedentary land use systems pastoral systems retain the flexibility to migrate in response to long-term climatic change.

Strengthening the adaptive capacity of pastoralism is an important component of long-term sustainability, but reviving traditional adaptive mechanisms may not always be possible, and in many cases may be inadequate, particularly in response to climate change. Climate change is predicted to increase temperatures in the Sahelian rangelands and will significantly reduce the length

Land disputes in Tanzania

In March 2013, the Minister for Natural Resources and Tourism announced that 1,500 square km of Game Controlled Area (GCA) adjacent to the Serengeti National Park would be gazetted as a wildlife corridor. However, GCAs in northern Tanzania overlap with virtually all the pastoralist areas of Loliondo, Simanjiro, Monduli and Longido Districts and recognising this conflicting policy pastoralists living in these areas have been attempting to strengthen their land rights for decades. Many of these communities were able to get title deeds for land in the early 1990s, which were later converted to "Certificates of Village Land" under the 1999 Land Act and Village Land Act. In 2009 the new Wildlife Conservation Act made all residence and grazing in GCAs illegal, and although safeguards meant to protect village lands that overlap GCAs were in place, these were never implemented. The latest move to upgrade 1,500 square km of Game Controlled Area (GCA) into a wildlife corridor means all local rights may be lost and pastoral land use prohibited.

Development planning and policy must build on and improve pastoralist resilience to climate change and enhancing risk management strategies is crucial.

of vegetation growing period and thus overall rangeland productivity, reducing the viability of livestock supported by the land and increasing the need for mobility[200]. Traditional mechanisms pastoralists use to adapt to climatic risks may not be sufficient and new adaptation mechanisms will become increasingly important. For example, in Ethiopia's pastoral Borana zone, the local institutions that support social safety networks have been eroded following years of cyclical drought, and external aid and state support schemes are not able to make up for this loss[201].

Development planning and policy to build on and improve pastoralist resilience to climate change and enhancing risk management strategies is crucial. Reviews of several national climate change policy frameworks (i.e. NAMAs, NAPAs) revealed some countries have under estimated the ecosystem management potential of extensive grazing[202]. Imparting new knowledge and blending traditional and modern adaptation measures may thus be important. Market orientated insurance instruments offer potential to mitigate weather-related risks, but these require strong partnerships between public, private and community stakeholders. Other relevant adaptation measures could include early warning systems, extension and education, micro-credit schemes and market-based adaptation practices.

Summary

Geographically, drylands are home to the world's poorest and most marginalised populations, and there is a clear correlation between the location of pastoral arid and semi-arid lands and poverty indicators. Progress towards the Millennium Development Goals (MDGs) in many pastoral drylands lags behind more favourable agro-ecological zones. Pastoralist life expectancy, school enrolment, human development indices and infant growth rates are significantly lower than national averages in many countries. Such disparities are a clear consequence of underinvestment, poor understanding of the pastoral system and an unsupportive legal, policy and regulatory framework for sustainable land management.

Nevertheless, progress is being made in addressing the enabling conditions that are essential for pastoralism to fulfil its potential to achieve inclusive, green growth. Organisation and representation of pastoral groups has improved and in many places pastoralists have been successful in demanding representation in decision making, or are challenging development plans that violate customary land rights. Service provision in some developing country pastoral areas has improved as governments recognise the inherent values held within these areas, or respond to historic underinvestment. Globally there is growing attention to rangeland governance and an increasing number of examples of local governance being strengthened, whilst policies and priorities at national level in several countries shows a marked improvement. Meanwhile, the growing global demand for meat and milk is creating economic opportunities for pastoralism which remain generally poorly exploited and there is significant scope for building pastoralist economies, whilst also capturing more value based on the stewardship of environmental goods and services.

Bactrian camel moulting, Kazakhstan. Credit: Maxim Petrichuk

Recommendations

Achieving a transition towards a Green Economy will require a concerted effort to ensure sustainable development for the world's rangelands. Pastoralism dominates these landscapes and plays an essential role in environmental stewardship, protecting natural capital and the flow of globally significant ecosystem services. Yet in the pressure to seek resource efficient economic growth within the global livestock sector this role is largely being overlooked and eroded. Based on the evidence presented in this study it is possible to make the following recommendations to policy makers that should be considered while governments develop strategies and plans for green growth.

1. Establish a global development framework for sustainable pastoralism

In 2015 it is expected that a set of Sustainable Development Goals will be agreed to replace the Millennium Development Goals. Whilst progress towards the MDGs has in some sectors and countries, been relatively successful, the goals had some significant shortcomings for pastoralists. These included lack of attention to good governance, including natural resource governance, absence of useful environmental indicators related to rangelands, and absence of sub-national target setting. As a result many countries have made significant gains whilst leaving pastoral populations under-developed, including with persistent failures in basic health and education.

The post 2015 Sustainable Development Goals must be monitored at sub-national level in order to avoid the inequitable outcomes from the MDGs. Natural resource governance—missing from the MDGs—should be included in the SDGs as a priority and environmental indicators must recognise sustainable management of rangelands. Indicators of sustainable land or soil management are particularly important to ensure ecosystems are being managed sustainably. Green growth must be monitored for potential negative consequences for pastoralism and safeguards are needed to ensure pastoralists' rights to land and resources are respected. UN Member States should be committed to upholding the rights of pastoralists and supporting their equitable and sustainable development, and should reward rather than undermine the environmental services they provide.

2. Disaggregate the costs-benefits of intensive and pastoral livestock sectors in green economic planning

Improved evidence on the environmental benefits of pastoralism is not yet influencing national planning in most countries. More evidence and improved use of that evidence is needed to convince decision makers of pastoralism's environmental benefits. The risk with developing sectoral targets is that land uses like pastoralism, with multi-sectoral benefits, are undervalued. Pastoralism might not be the main priority for either the agriculture or the environment sector, but its dual benefits mean that on aggregate, its value across sectors may be higher than other land uses.

Current economic models and tools for evaluating the environmental performance of the livestock sector inadequately capture the resource efficiencies and global environmental benefits that sustainable pastoralism can deliver. Improved tools are needed to monitor livestock production footprint that more accurately represent the environmental and social efficiencies of pastoralism, taking into consideration wider impacts of intensive systems including water pollution, freshwater competition, the rights of indigenous people etc. Policy and planning for a green economy must make a concerted effort to understand the multiple land use goals and the globally significant role pastoralism plays in the maintenance of natural capital. Some regulations, voluntary measures and technology transfers relevant to greening the commercial livestock sector may well be increasingly relevant to pastoral groups as herding becomes more sedentary and households invest more in fixed assets, but on the whole policy requirements are entirely different. A dualistic approach may well be favourable, prioritizing investment in appropriate regulation and technologies for the commercial livestock sector, while simultaneously supporting approaches that value and enable extensive pastoralism as a sustainable management strategy for rangelands.

3. Connect pastoralists to domestic and international livestock markets

Policies and investments are needed to connect pastoralists to markets and major increases in income may be possible without any increased productivity, simply by creating outlets and market access. It is crucial to provide markets for the full range of products that pastoralists produce to avoid some of the distorting effects of markets on production patterns. In many cases this includes markets for milk and fibre, which are often more valuable than meat in the pastoral economy, and which offer further opportunities for value addition through processing. Greater investment is needed in local-level processing and value addition, both to improve local revenue capture and to provide employment opportunities in pastoral areas.

Whilst there are huge underexploited opportunities to connect pastoralists with domestic markets, it is recognised that governments wish to increase international trade in pastoral products. However, global agricultural commodity markets are highly complex, subject to volatile price fluctuations, and expensive to engage in. For some products they can impose a major burden in the form of regulations and compliance systems that often mandate measures that restrict extensive land use practices. Protectionism in the form of aggressive marketing systems, subsidies and trade tariffs also characterise the globalisation of agricultural commodity markets and in places this has undermined efforts to promote sustainable domestic and export trade from the pastoral economy, contributing to negative social and environmental outcomes. As pastoralists increase their engagement in export markets, strong regulatory systems may become increasingly relevant, such as the protected designation of origin framework passed under European Union law. However, pragmatism is also required in developing countries that seek to raise their exports of livestock products. Trade barriers and consumer standards often present obstacles to trade with some of the richest countries and more effort is needed to promote regional and cross-border trade as well as to increase the share of national markets enjoyed by pastoral products.

4. Capitalise on the environmental benefits of pastoralism and expand green niche markets

Genetically diverse livestock raised extensively on natural rangelands produce an array of goods and services that cannot be replicated by intensive production systems. These include benefits to the environment as outlined in this report, as well as improvements in animal welfare and benefits to human health associated with livestock products of a particularly high standard. Growing consumer demand for such goods—for nutritious foods produced to high standards of environmental sustainability and animal welfare—has created various niche marketing opportunities that some pastoralists groups are capitalizing upon. Efforts to establish and protect production standards and certification schemes that facilitate these markets should be encouraged as one part of a dualistic approach to greening the livestock sector.

Pastoralists should be supported to capture the environmental benefits of their system through niche markets, payments for environmental services, and other compensation arrangements. Niche marketing opportunities extend beyond direct use values to a long list of ecosystem services that have green markets, and which should be exploited as part of a diversified pastoral economy. In many countries pastoralists can capitalise on the inherent environmental services of their industry through income from tourism. There may also be further opportunities for pastoralists to be paid for the environmental services of their system, for example sequestering and storing carbon, protecting watersheds or controlling wildfires. Whilst the transaction costs may be high, there are multiple co-benefits to sustainable rangelands management that deserve investment and the process of organisation for one market could reduce transaction costs for additional markets. Additionally, markets for non-pasture rangeland products, such as medicinal plants and fruits, should be strengthened and investments should be made in local processing and value addition.

5. Strengthen property rights and governance over rangeland resources

Under-development of the pastoral sector in many countries can be traced to marginalisation and exclusion of pastoralists from mainstream development, neglect of their rights, and impediments to tried-and-tested rangelands management strategies. Significant cost-effective development gains can be achieved through addressing these constraints, for example by improving pastoralist representation in decision making, protecting communal land rights, and linking government with customary institutions. A powerful case can be made for communal management as the foundation of sustainable rangeland management, but in many countries communal tenure arrangements are poorly supported by government, and capacities to secure such rights are weak. Equal rights to property ownership and inheritance, and participation in development decision making are priorities to address gender equality in pastoral societies.

Pastoralists can only deliver on their role as custodians of rangeland ecosystems if they are able to deploy their local knowledge and institutions in order to manage the rangelands effectively. With growing population pressures and increasing opportunities for capital investment, insecurity of pastoral tenure is becoming an increasing challenge. Strengthening natural resource governance through improved tenure and institutional arrangements can therefore be instrumental in enabling sustainable pastoralism. However, such processes, whilst low cost in comparison with technology-based solutions, are highly demanding of skills that are often poorly available and significant investment is needed to upgrade the skills of development partners and extension agents.

6. Integrate pastoralists into the development mainstream through improved human capital and knowledge

The root of many problems faced by pastoralists is their exclusion from decision making, which in some cases may be a deliberate effort of government, but may also be another challenge of their mobile lifestyle that keeps them away from polling booths and public dialogue. Many failures in pastoralist development—which have led to negative environmental as well as economic outcomes—stem from failure to consult pastoralists and from wide-spread misunderstanding of pastoral systems. It is essential to provide adequate space for marginalised groups within dialogue over the green economy and to reflect on the continued marginalisation of pastoralists from policy processes more broadly.

Building human capital and providing basic public services to pastoralists—including education, health and security—will strengthen their participation in public dialogue. Governments should not use mobility as an excuse for failing to provide basic services and should mandate ministries of health, education and security to provide services in a way that is suitable for a pastoral economy. In some countries this may need technical support and improved learning from other countries that have already pioneered appropriate approaches. Support for strengthening social services in pastoral areas should allow for the shortage of local skills at the outset and for the necessary delay in bringing the first generation of pastoralist children to the level of future service providers. Persistent knowledge and information gaps on pastoralism must also be addressed—for example knowledge of rangeland ecology or data on pastoralist development indices—to enable more informed planning and policy formulation. Successful economic development and sustainable land management in drylands depends on pastoralists and development agents being enabled to make informed choices to implement appropriate policies that support and enhance their production system.

Herdsmen by Tuul river. Credit: .Munkhbolor Gungaa

Conclusion

In 2012, heads of state of 192 governments met in Rio, Brazil, and renewed their commitment to sustainable development and promoting a sustainable future. In the conference output “The Future We Want" countries recognised that "fundamental changes in the way societies consume and produce are indispensable for achieving global sustainable development.” They also agreed to look for measures of growth that take environmental and social factors into account alongside GDP and to make greater efforts to pay for ‘environmental services’ provided by nature, such as carbon sequestration and habitat protection. Pastoralism is one of the few land use systems that is found worldwide, from the richest to the poorest countries, that offers genuine win-win outcomes of economic productivity and environmental conservation. Additionally, it is a system that plays an important role in mitigation of, and adaptation to, climate change: perhaps the most pressing issue of our time. Pastoralism must therefore play a central role in our sustainable future.

At the beginning of this report we said that to adjust the livestock sector as a whole to a future green economy requires a three-pronged approach: reducing consumption of livestock products; greening the intensive system; and capitalising on the inherent sustainability of pastoralism. The report has focused largely on the third prong, to correct what the authors perceive as a current bias towards reducing the environmental costs of the intensive livestock sector and responding to that sector’s environmental costs through reduced consumption. The report has repeatedly highlighted the challenge of inadequate data on pastoralism, but we believe it also provides a compelling case for much greater attention to, and investment in, pastoralism. We hope that this will galvanise action amongst the growing number of actors interested in sustainable pastoralism and we advocate for a stronger global alliance to build on this work and strengthen evidence and advice to policy makers.

Pastoralism lies at the nexus of the 3 pillars of sustainability and provides the triple win of social, environmental and economic benefits. It occupies one quarter of the land area and it is a system that relies fundamentally on biodiversity: pastoralists would be better thought of as grass farmers than livestock producers and the viability of their system depends profoundly on how they conserve nature. Already in some countries it is the environmental services of pastoralism that most influence policy and investment. These experiences inspire us to see a future global green economy in which pastoral livestock production is valued for its combined economic and environmental roles, in which high-value meat, milk and fibre is produced in sustainably managed communal rangelands, and in which pastoralists are enabled to fulfil their roles as custodians of their environment.

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