10 The pastoral farming system
Balancing between tradition and transition

Jan de Leeuw, Philip Osano, Mohammed Said, Augustine Ayantunde, Sikhalazo Dube, Constance Neely, Anton Vrielin, Philip Thornton and Polly Ericksen

Key messages

• The African pastoral farming system consists of livestock and drylands crop-based production that supports an agricultural population of 38 million people of whom 13.4 million in sub-Saharan Africa are extremely poor.

• Human population growth has resulted in low per capita livestock and land resources, and while the farming system has options to develop agriculture, further demographic expansion will exacerbate degradation and inequality.

• While there is potential for agricultural development, e.g. through intensification and greater market orientation, such development needs to take into account pastoral peoples’ access rights to resources and minimize trade-offs with current land and water users.

• Effective drought management, a key to the success of pastoralism, relies on multiple resource management strategies and community interactions. Therefore, there is a need for policies that strengthen the resilience of agriculture and pastoralists livelihoods through, e.g. support to livestock mobility, agricultural insurance, sustainable land and water management as well as monetary and legal support for effective implementation.

• Interventions that strengthen opportunities for a future outside agriculture, such as education and job creation, are needed for those living in chronic poverty.

Summary

This chapter reviews the performance of the pastoral farming system in Africa in terms of productivity, sustainability and human development outcomes. The chapter identifies strategic priorities to reduce by half, by 2025, the number of people living below the poverty line in pastoral farming system. While the pastoral farming system performs well in terms of productivity per unit area of land, economic sustainability is complicated by rapid population growth progressively reducing the livestock resource base per capita, and the system performs poorly in terms of human development outcomes such as poverty, education and health. The two most promising poverty escape pathways are intensification of the farming system through greater market orientation, secure access to natural resources and to supplemental feeds, and second, an exit from agriculture through education and development of alternatives for the young and pastoral dropouts. Other less prospective options are diversification of the farming system and obtaining off-farm income.
Overall description of the pastoral farming system

The pastoral farming system occupies 4.88 million km², with close to 30 per cent each in the Sahel, eastern and southern Africa and 16 per cent in northern Africa. Some 77 million people inhabit the system (average population density 15.77 persons per km²). Of these 77 million, 38 million people (49.4 per cent) are involved in agriculture.¹ The system contains a livestock population equivalent to 42 tropical livestock units (TLU).² This represents an average livestock density of 0.09 TLU/ha and an average holding of 0.90 TLU/person in agriculture. There is 330,000 km² (7 per cent of total land) under crop cultivation and 11,000 km² (0.2 per cent of total land) under irrigation (Table 10.1).

The word pastoralism originates from pastor or herder, and pastoral production revolves around herdsmen, mobile livestock and rangelands. In this chapter the pastoral farming system is defined as a land system with an average length of growing period (LGP) between 30 and 90 days (Figure 10.1). In the Sahel and eastern Africa more than 50 per cent of household income is generated from mobile livestock production (Swift 1988).

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Figure 10.1  The pastoral farming system and subsystems.
Source: GAEZ FAO/IIDSA, FAOSTAT, Harvest Choice and expert opinion.
In contrast, the pastoral farming system in southern Africa is dominated by ranch-based livestock production. The Sahelian, the northern and the southern African subsystems experience unimodal rainfall, while bimodality prevails in eastern Africa (Vrieling et al. 2013). Forage production is affected by this seasonality and inter-annual variation in precipitation, including cycles related to the El Niño Southern Oscillation (ENSO), with drier years associated with El Niño and La Niña events in southern and eastern Africa respectively, while rainfall in north and western Africa associates with the North Atlantic Oscillation. While rainfall declined and then recovered in the Sahel, trends were smaller or absent in the northern, eastern and southern African subsystems.

The three sub-Saharan subsystems are of equivalent size, but differ in human population and livestock density. The southern African subsystem has lower human (4.23 people per km²) and livestock (0.0565 TLU per km²) population densities than the Sahel (16.14 and 0.162) and eastern Africa (17.34 and 0.0903). The area under crop cultivation is low in all three subsystems, but is expanding in the southern Sahelian subsystem. Income poverty is widespread in all three subsystems, but the per capita livestock wealth is greater in southern Africa (1.50 TLU) than in the eastern (0.61 TLU) and Sahelian (0.97 TLU) subsystems.

During the wet season, high forage digestibility and high protein concentrations allow livestock herds to grow. Dry season forage and water shortages force herders to move herds, seeking water and fodder and herd survival elsewhere (Ayantunde et al. 2011). The subsystems differ in livestock mobility. Migration in the Sahel involves a regular, annual, long distance movement with ad hoc displacement during drought. In eastern Africa, migration involves short regular seasonal movement with ad hoc longer distance movements during drought, while migration occurs over shorter distances in northern Africa.
The Sahelian subsystem, extending from Senegal to Sudan, is characterized by the annual transhumance to the agropastoral and the cereal-root crop mixed farming systems in the south (Figure 10.2). The transhumance northward (Box 10.1) benefits from the high fodder quality in the Sahel, which spans hundreds of kilometres and lasts up to eight months (Ayantunde et al. 2010). Today, many pastoralists have settled and grow crops in the southern pastoral and the northern agropastoral system (Chapter 4 this volume).

**Box 10.1 Transhumance in the Sahel**

Transhumance is a seasonal north-south movement between wet season pastures in the Sahel and the agropastoral and cereal-root crop mixed farming systems to the south (Figure 10.2) where livestock resides in the dry season (Toure et al. 2012). This migration spanning hundreds of kilometres lasts from three to eight months. Transhumant pastoralism contributes significantly to West African livestock production and involves 70–90 per cent of the Sahel’s cattle, while transhumant sheep comprise 30–40 per cent of its small ruminants. During the dry season, most pastoralists graze their herds on the croplands in more humid farming systems to the south, generally on the lands of their families while a minority interacts with non-related agricultural communities. The benefits to pastoralists include herd productivity from grazing crop stubble left after harvest, reduction in herd mortality and production costs, and building social relations with host communities. To the host community, the benefits of transhumance include manuring of crop fields, availability of milk, and obtaining young animals for traction, dairy production and fattening. Despite these benefits, there is increasing conflict between transhumant herders and crop farmers because of damage to crops, increased competition for shrinking rangeland and fodder resources, and increased livestock production by resident populations (Turner et al. 2011).

In eastern Africa, pastoral livestock production does not include annual migration into more humid farming systems. With its bimodal rainfall and shorter dry season, livestock are moved over shorter distances to dry season pastures in years of good rainfall. However, the inter-annual variation in rainfall in bimodal systems (44–65 per cent CV in eastern Africa; De Leeuw and Tothill 1990) is much greater than in unimodal systems (20–30 per cent for the Sahel). As a result, the eastern Africa subsystem has a much higher inter-annual variation in forage production and availability. Mobility, the strategy used to cope with this volatility, works in case of local drought but is less effective when drought is widespread.

Ranching on privately owned land dominates livestock production in the southern African subsystem. Mobile pastoralism on communally owned lands is confined to northern Namibia and parts of Botswana. Elsewhere it has been replaced by ranching systems where animal movement occurs within and between large commercial ranches in the Republic of South Africa and Namibia that provide forage and water to overcome drought.
Pastoral herd management aims at a high proportion of cows for milk production for subsistence nutrition and sales (e.g. Box 10.2). Herd management also involves reproduction and herd growth, animal offtake and sales, grazing management and animal health care (Table 10.2). Management is flexible (FAO 2001) because pastoralists must respond to markets, security, weather, and grazing and water conditions. The pastoral farming system requires low physical inputs, but high inputs in terms of knowledge, social networks and labour. Long distance migration systems are more labour intensive than less mobile or sedentary systems (Turner et al. 2011), and labour shortage may constrict grazing, with negative effects on animal nutrition, health and herd productivity. The demand for external inputs such as animal feed increases with declining mobility.

African pastoralists are ethnically diverse, with 34 linguistic groups and 4 phyla: the Afro-Asiatic, the Nilo-Saharan, the Niger-Congo and the Khoisan (Blench 1999). The eastern African subsystem has the highest linguistic diversity (25 language groups) followed by the Sahel (11) and southern Africa subsystem (3 groups). Ethnicity influences the species kept and economic practices. The Afro-Asiatic groups are predominantly camel keepers, while the rest are primarily cattle keepers. Pastoralists respond to socioeconomic realities and opportunities, and may change their livestock specialty...
Table 10.2 Key features of pastoral management systems in sub-Saharan Africa

<table>
<thead>
<tr>
<th>Management issue</th>
<th>Key feature</th>
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<tbody>
<tr>
<td>1 Herd size</td>
<td>Varies and tends to increase with mobility. Transhumance herds in west Africa have 50 head of cattle or more whereas sedentary herds often have fewer than 10.</td>
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<tr>
<td>2 Feed resources</td>
<td>Depends on natural pastures including fallows, with increasing importance of crop residues, weeds and roadsides in west Africa. Supplementary feeds are rare but increasingly given to lactating cows or fattening animals.</td>
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<tr>
<td>3 Herd management</td>
<td>Herd mobility, herd diversity (different species and breeds), optimized number of females and herd splitting practised to enhance herd growth and reduce risk.</td>
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<tr>
<td>4 Grazing management</td>
<td>Inter-annual variation in grazing itineraries because of variable availability of forage and water. Night grazing is common in west and eastern Africa.</td>
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<tr>
<td>5 Herd reproduction and breeding</td>
<td>Pastoralists control reproduction, particularly in cattle, through selective mating. All females reproduce, but only a few good males are kept while the rest are sold.</td>
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<tr>
<td>6 Herd growth</td>
<td>Reproductive females enter herds through birth, inheritance, loans, animal exchange and purchase. Mating bulls enter herds mainly through inheritance, animal exchange and purchase.</td>
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<tr>
<td>7 Animal health</td>
<td>Generally poor access to veterinary services due to cost and distance. Drugs and vaccines are available at markets, but quality is poor and fake products are common.</td>
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<td>8 Women’s activities</td>
<td>Mainly milking, processing of milk and sale of dairy products. They generally control the proceeds of sale for household nutrition.</td>
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Source: Ayantunde et al. (2011); FAO (2001).
(e.g. from cattle to camel keeping); some may adopt a different economic specialization (e.g. hunting in addition to herding) while some return to their ethnic specialization, or change completely due to ethnic assimilation. The Maasai and the Samburu in Kenya, for example, have in the past adopted diverse, economic activities of herding, foraging, beekeeping, smelting and forging, and cultivation at different times (Sperling and Galaty 1990).

Women’s roles in African pastoral systems are diverse, differentiated and complementary to those of men (Homewood 2008). Herding remains in the hands of young men (Figure 10.3), while older men are involved in management and negotiations over trade, marriage agreements and sanctions for infringement of customary institutions controlling resource access (Homewood 2008). Women in most cases have responsibility for house construction, movement of the camp, child-care and food, fuel and water provision. Women control milking and milk marketing (Boxes 10.2 and 10.3) with the exception of the Peulh or Fulani where men are also involved in milking. With knowledge on milk production of specific animals, women also contribute to breeding decisions. Dairy sales comprise a major, and usually the sole, source of income for many pastoral women. The sale of milk is also an important income source for women in peri-urban areas, some of whom are destitute widows (Fratkin and Smith 1995). These women can be supported to increase their income through interventions targeting improved milk marketing, especially through local cooperatives (Coppock et al. 2011).
The pastoral farming system faces risks, including drought, disease and violence, that cause volatile animal production and sudden animal loss. Drought affects the pastoral system in multiple ways. It interrupts herd growth, reduces birth rates and increases livestock mortality. It affects milk production because of lower production per lactating cow, and fewer lactating cows due to mortality and failure to conceive. The effect of drought lingers on after the rains return; milk production resumes with delivery of newborns following the regeneration of the range. However, without restocking, herds take many years to recover (Lesnoff et al. 2012). Thus, the impacts of drought are complex, involving the interaction between shortfalls in forage and water resources, starvation, weakened animals, disease and resilience of animals, rangelands and pastoralist coping strategies. There is ample information on the effects of drought on specific parts of the pastoral system. However, apart from the study on multiple effects of drought on pastoral systems in Maasailand (Bekure et al. 1991), detailed insights on how drought affects the pastoral farming system and the associated livelihoods across Africa are only beginning to emerge.

Pastoralists have developed strategies to enhance the drought resilience of their farming system and livelihoods, including livelihood diversification and strategies to prevent and cope with drought-related animal loss. Mobility to divert livestock to better pastures and water, the major drought-coping strategy (Zwaagstra et al. 2010), requires intensive social networking to obtain the goodwill of neighbouring communities when need arises. Other traditional risk aversion interventions include destocking and splitting a family’s livestock over multiple, dispersed herds. Strategies to mitigate the effects of animal loss include changing species such as from cattle to camels. Pastoralists also depend on social

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**Box 10.3  A Fulani household in the Sahel**

A typical household among the pastoral Fulani in the Sahel consists of an elderly male head, two wives, six to nine children and more than two male relatives. The family has settled in the southern part of the pastoral farming system, while herders move the livestock to and from the pastures in the north during the rainy season. The household head controls resource allocation within the household. Herds on average contain about 20 cattle, of which 65–75% are female, 20–25 sheep and goats, and 2–4 donkeys. Two or three of the cows and/or heifers are received under the traditional habbanayé scheme, which lends cattle to related pastoralists to reduce risk and strengthen relationships. The women milk the cows and milk is consumed fresh or soured, or processed into cheese that is sold. Milk production is high from August to November when feed resources including crop residues are available. The household grows millet for household consumption on 2 to 5 ha of land. Household grain harvest varies markedly from 800 to 2000 kg per year. The household sells little of the grain produced and depends on the sale of livestock and livestock products for cash. Livestock are sold to buy cereal for home consumption, and grain and sugar for family members who are taking the animals on transhumance. Total annual income varies from US$150–250 per person. Most is derived from livestock, while 20–40% may be from seasonal migration and off-farm income earned by adult males in the household.
safety nets such as assistance from wealthier relatives to restock herds following drought. Together this mix of strategies aims to secure the livestock resource base that underpins pastoral livelihoods and restore the herds when drought ends. Poor households losing their herds during drought typically strive to rebuild their herds, but when failing they face the risk of falling into a ‘poverty trap’ (McPeak and Barrett 2001).

Chronic disease and disease outbreaks affect pastoral animal productivity, leading to animal loss and poverty. While disease has a significant impact on pastoral livestock, there is a danger of exaggerating the importance of disease control when reviewing its potential in isolation from other livestock losses such as drought, predation and theft. Markets and volatile cereal prices are additional risk factors, particularly during drought when the declining terms of trading livestock for cereals weakens the ability to purchase food. The pastoral farming system is further affected by local violence and insecurity, for example livestock theft and conflicts over grazing areas. External risk factors tend to be slow and creeping, such as conflicts over land and water resources, because of settlers and agencies implementing cropping, irrigation and nature conservation, all of which reduce pastoral access to land and water.

In terms of food and nutrition security, pastoralists traditionally rely on milk and to a lesser extent on meat. Milk is directly consumed or exchanged for grains. Sadler et al. (2009) demonstrated the value of milk for child nutritional security and health. However, across dryland systems, ensuring adequate milk year round is a challenge. In normal years, a shortage of milk emerges at the end of the dry season; a prolonged dry season can reduce or halt milk production, resulting in acute food insecurity. Small ruminants and camels are valued in this respect, as they produce longer during the dry season. During droughts, milk production declines even more and the remaining lactating animals need to be protected with supplemental feeding.

Meat is consumed less frequently than milk. In the west African Sahel, young animals, especially males, are sold in the market for meat and as draught animals. Pastoral systems make important contributions to local and national economies, but this contribution is underestimated (Behnke 2010). About 80 per cent of red meat consumed in Kenya is produced in the pastoral systems within Kenya and neighbouring Somalia and Ethiopia. In Ethiopia, livestock contributed 45 per cent of agricultural Gross Domestic Product in 2008–2009, much coming from the pastoral system.

**Trends and drivers of change across the system**

*Population, hunger and poverty*

Rural population densities in the pastoral farming system range from 0.6 persons per km² in southern Africa to more than 14 in the Sahel. The higher growth rates for urban than rural populations (Table 10.3) suggest an outmigration to cities within the pastoral farming system and an exit from rural areas, a trend which may continue.

Poverty is a key driver of change. Income poverty presents an incomplete picture however, as many pastoralists depend on livestock and land assets, which should also be considered in pastoral poverty assessments (Little et al. 2008). A minimum of around 4.5 TLU per adult was required to support a traditional pastoral livelihood (McPeak and Barrett 2001). Today, pastoral diets include cereals, self-produced or purchased through sale of animal products. But even so, some 4.5 TLU per
Households with fewer animals are likely to fall into poverty traps, with insufficient cash income and gradually declining livestock assets because herd accrual does not compensate for sales and losses of livestock (Lybbert et al. 2004). The average per capita livestock holdings (TLU 0.97 in the Sahel, 0.61 in eastern Africa and 1.50 in southern Africa) are below this threshold in all subsystems. In Kenya, for example, per capita livestock assets have dropped because the human population growth rate exceeds that of livestock populations (Box 10.4). Thus, human population growth drives pastoral poverty, as many pastoralists have insufficient livestock to sustain a livelihood based on livestock only. This forces pastoralists to diversify into non-livestock income (Homewood et al. 2009), a trend common across rural sub-Saharan Africa.

The above stresses the importance of livestock as an asset. However, policies on poverty reduction in the developing world focus on income poverty. Income poverty is widespread in pastoral systems because many families have lost their livestock, but also because of long-term political neglect, marginalization, few economic opportunities and lack of access to services such as education and health (Little et al. 2008; Okwi et al. 2007). Prevalence of extreme poverty (<US$1.25/day) in the pastoral system is below 20 per cent only in Cameroon, Djibouti and Sudan, while Uganda and Nigeria have extreme poverty rates of 79 and 76 per cent respectively.

### Box 10.4 Population growth as a driver of change

The density of livestock in the Kenyan drylands has fluctuated but not changed much since the late 1970s (De Leeuw et al. 1998), but human populations have increased significantly. The numbers in the lower two maps in Figure 10.4 reveal that the average livestock wealth per capita was around the threshold required for a livestock-based livelihood in the late 1970s. Today this ratio has dropped to values below 1 TLU per capita in most districts. Human population growth increases the pressure on livelihoods as it reduces their livestock wealth. Most of the Kenyan drylands are arid, and a diversification towards agropastoralism or mixed crop livestock systems is possible only in the semi-arid zone. The map in the centre shows the distribution of rainfed, mixed crop livestock systems in the Kenyan drylands.
Figure 10.4 Spatial variation in livestock stocking rate per area and per capita, and population density in the arid and semi-arid lands (ASAL) of Kenya between the late 1970s and late 1990s.

Source: Maps based on livestock density and land cover data from Department of Resource Surveys and Remote Sensing (DRSRS) and De Leeuw et al. (1998), as well as the human population census from Central Bureau of Statistics (CBS), Kenya.
Income poverty can be transitory or chronic (structural). Transitory poverty refers to households lapsing temporarily into poverty due to shocks but retaining the ability to move out again on their own or through safety nets. Chronic poverty refers to households that are locked into poverty in the long term and are unable to escape without external assistance. Policies to address pastoral poverty should be tailored differently for households affected by transitory or chronic poverty. Safety net policies (e.g. emergency feeding programmes, disaster assistance and insurance) (Figure 10.5) are required to prevent households in transitory poverty from descending into chronic poverty, while cargo net policies (e.g. school feeding programmes, micro-finance and land reforms) are required to help chronically poor households (Barrett 2005).

Inequality in income and asset holdings, especially livestock and land, is another important aspect of poverty among pastoralists. Pastoral societies are commonly perceived as egalitarian, due to their communal land management, limited hierarchy, consultative decision making, the strong sense of social identity and the presence of social solidarity networks. This perception is reinforced by lower levels of income inequality (as measured by the Gini index) in pastoral areas relative to crop-based systems in Kenya. However, there is high inequity in the distribution of livestock, with few households owning most livestock (Homewood et al. 2009). This skewed distribution puts the wealthier livestock owners at an advantage over the poor in using the common pool resources such as the grazing rangelands. Table 10.4 shows the percentage of households in northern and southern Kenya with livestock holdings below 4.5 TLU per capita. In southern Kenya, there was a 24 per cent increase in the number of households in this category between

Figure 10.5 Beneficiary of Takaful insurance payout in Wajir, northern Kenya.
Source: ILRI/Riccardo Gangale.
2008 and 2009 due to drought. The table also shows a strong association between asset and income poverty – those with fewer animals also have less income.

Further, privatization and subdivision of pastoral land tend to increase gender disparity and inequity and widen the gap between the poor and the wealthy (Lesorogol 2003). This stratification among pastoralists into a relatively wealthy minority and a poor majority has implications for the economic choices and the livelihood diversification strategies adopted: (1) poverty strategies driven by necessity, often involving poor and marginalized households; (2) risk-management strategies in response to unpredictable and changing ecologies and economies, often involving moderately well-off households; and (3) strategies aimed at investment and accumulation of wealth, principally involving the richest households (Homewood 2008).

Natural resource management and climate change

There has been much debate about the resource-base-degrading effect of mobile livestock. An earlier theory, that mobile pastoral animal production results in overgrazing and resource degradation, has been challenged by an alternative theory that rangelands are non-equilibrium systems, where stocking density does not reach levels high enough to negatively affect rangeland production (Behnke et al. 1993). Following this paradigm shift it has been taken for granted that the non-equilibrium theory holds for pastoral lands. Modelling studies suggest that non-equilibrium conditions hold above a coefficient of variation (c.v.) of annual rainfall of 33 per cent. However, the larger part of the pastoral farming system, including most of the Sahel and the east African drylands has a c.v. of annual rainfall lower than 33 per cent (Figure 10.6), implying that livestock may reach equilibrium with rangeland resources and thus may degrade these resources. This result questions whether the non-equilibrium model holds for most pastoral lands and highlights a need for system-wide evidence on the state of rangeland resources and the impacts of livestock on them. Satellite-based remote sensing may assist in mapping the condition of rangelands over large areas; it does not, however, give information on the processes

Table 10.4 Percentage of people and their income and assets in four household categories classified by livestock holdings (TLU per capita) for northern and southern Kenyan pastoral areas

<table>
<thead>
<tr>
<th>Household category (TLU per capita)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1</td>
<td>1–1.99</td>
</tr>
<tr>
<td>---</td>
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<table>
<thead>
<tr>
<th>Northern Kenya</th>
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</thead>
<tbody>
<tr>
<td>Human population (%) (2000–2002)</td>
</tr>
<tr>
<td>Livestock (TLU) / capita (2000–2002)</td>
</tr>
<tr>
<td>Income / capita day ($) (2000–2002)</td>
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<tr>
<td>Income livestock (%) (2000–2002)</td>
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<tr>
<td>Southern Kenya</td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>Human Population (%) (2009)</td>
</tr>
<tr>
<td>Human Population (%) (2008)</td>
</tr>
<tr>
<td>Livestock TLU / capita (2009)</td>
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<tr>
<td>Livestock TLU / capita (2008)</td>
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</tbody>
</table>

Source: Northern Kenya data (Little et al. 2008) and southern Kenya data (Osano et al. 2013).
causing vegetation and land degradation. Long-term monitoring and experimental plots are required to understand vegetation and rangeland change processes.

Another way to approach natural resource management in rangelands is to consider the amount of biomass (forage) produced in relation to the rainwater used for this. Rain Use Efficiency (RUE) is the biomass produced per unit of rain, which varies in rangelands in Africa and elsewhere from 1 to 8 kg.ha$^{-1}$.mm$^{-1}$. Recent meta-analysis by Ruppert et al. (2012) confirmed the earlier suggestion (de Leeuw 1991) that increased livestock stocking densities are associated with reduced RUE. Given that C4 grasses have a potential RUE of 50 kg.ha$^{-1}$.mm$^{-1}$, the GWUE (green water use efficiency, the percentage of rainwater used for transpiration) of African rangelands varies between 2 and 16 per cent. This contrasts with GWUEs of up to 55 per cent achieved under similar conditions in the United States with better soil evaporation control (Slegers and Stroosnijder 2008). One way to enhance GWUE in rangelands could be managing grazing animals to retain sufficient vegetation cover protecting the soil. However, better soil and water management alone does not necessarily lead to increased livestock production because forage protein content tends to be higher where rain limits production than in more humid areas where low soil nitrogen results in low plant protein concentrations. The Sahel with <300 mm rainfall has protein concentrations of 12 to 18 per cent; in wetter areas where nitrogen is limiting protein concentrations fall below the 7 per cent required to maintain livestock body condition (Breman and De Wit 1983). Arid lands, with their low biomass, allow high livestock productivity and herd growth because of this; they contrast with more humid areas that, although having

Figure 10.6 Distribution of lands with coefficient of variation of annual rainfall higher and lower than 33%.
ample biomass, lack the forage quality to support productive livestock. GWUE enhancement strategies aiming at greater forage biomass will thus not necessarily increase livestock production; concurrent strategies are required to enhance soil fertility and forage quality.

Availability of and access to natural resources also affect the sustainability of the pastoral farming system. Excision of key pastoral resource areas or blocking access to them places great pressure on livestock mobility and upsets the functioning of the pastoral system (Niamir-Fuller 1999). Land use changes driven by demographic pressure, market expansion and increased private and public investment in pastoral areas, limits access to land and water, particularly when land is diverted from pastoral use into crop-based agriculture (Box 10.5). Abstraction of riverine water in highland areas, leading to reduced flows for downstream water users, also marginalizes pastoral resource users. Loss of availability and access to resources is also driven by policies favouring crop-based land uses and upstream water users. Appropriate policies are required to ensure that the traditional beneficiaries of these resources remain able to determine their future use.

The potential impacts of climate change vary regionally and may affect the productivity of pastoral ecosystems, increase food insecurity and cause a decline in GDP from livestock (Ericksen et al. 2012). The specific impacts of climate change on natural resources include changes in availability and quality of forage resources, access to water, species and breeds of livestock that can be kept, livestock mobility and conflict over natural resources. Climate change will likely affect forage availability and quality through changes in herbage growth and quality, floristic composition and importance of crop residues as animal feed. Forage resources will be further modified by climate-associated changes in soil fertility, land use and grazing management. Finally, an increase in extreme rainfall may affect forage yield more than any changes in the mean annual precipitation. The likely impacts of increased temperature on forage quality will be lignification of plant tissues with an associated decline in digestibility, while increases in CO₂ concentration will lead to more C3 species and dicots.

**Box 10.5  Land use as a driver of change in the Sahel**

The transhumant system in the western Sahel is exposed to a number of drivers of change (Ayantunde et al. 2011). Livestock trade has increased as a result of rising demand for animal protein in the growing coastal economies. At the same time land use change towards agropastoralism in the southern Sahel competes with pastoralism for land and water. In response to this, the wet season grazing has shifted northwards to divert livestock from croplands in the south. Concurrently there also has been a deeper penetration to the south by transhumant herds, attributed to the droughts of the 1970s and 1980s and the expansion of cropping into grazing areas in the Sahel. During the droughts, some pastoralists settled to grow crops and raise livestock as far south as northern Côte d’Ivoire and Benin. These settled pastoralists often serve as contacts for the transhumant herders, playing a key role in negotiating access to grazing resources and in resolving conflicts. These developments have led to an increased length of transhumance routes. The costs of this are further aggravated by a multiplicity of taxes levied by local government. These have increased with decentralization policies and laws which, while aiming at strengthening local government, have resulted in collection of additional revenue through local taxation (Ayantunde et al. 2010).
**Energy**

Pastoralists use renewable bioenergy in various ways. Bushfire suppresses shrubs and is used as a management tool to maintain rangelands in a grassland state. Fuelwood is used for cooking, heating, lighting and deterring predators. Pastoralists’ fuel requirements have increased following diversification to mixed diets composed of animal produce and cereals, which, unlike milk, need to be cooked to release full caloric value. Pastoralists also complement their income through production and sales of fuelwood and charcoal derived from rangelands. Together these various uses result in significant biomass extraction, but thus far there has been little study on the energy footprint of pastoral livelihoods.

**Science and technology**

Improvements in livestock productivity have been supported through breeding and the control and management of livestock diseases such as rinderpest, east coast fever (ECF) and trypanosomiasis. Key constraints in addressing animal diseases are the lack of low-cost, easy-to-use diagnostics, vaccines and control strategies for disease organisms and vectors. Recent advances in biotechnology could potentially lead to improvements in the diagnosis of livestock diseases; and genomics can support the development of a new generation of livestock vaccines, leading to successful livestock disease control and positive impacts on poverty reduction among livestock keepers (Perry and Grace 2009).

Advances in information and communication technologies (ICT) also provide opportunities for increased production, management and marketing of livestock in the pastoral farming system. ICT gives improved access to markets and price information that allows pastoralists to identify the points of sale with the most competitive prices for livestock and livestock products, and reduces financial transaction costs by using mobile money transfer services. Other potential benefits of technology include radio frequency identification (RFID) chips widely used in the southern Africa subsystem for cattle traceability. This enables the monitoring of animals, reduces risks from theft and controls bovine diseases such as foot and mouth disease.

GIS-based spatial technologies can also facilitate improved land management through mapping and planning, and by providing information on pasture and forage availability in response to variable weather. This information is essential for pastoralists to move strategically with their herds, to mitigate potential conflicts and to implement weather-based livestock insurance for herders, such as the Index Based Livestock Insurance (IBLI) being implemented in northern Kenya and southern Ethiopia to safeguard pastoralists against drought-related livestock losses. IBLI provides compensation based on area-average livestock mortality, predicted using the Normalized Difference Vegetation Index indicator derived from remote sensing satellites (Chantarat et al. 2012).

Lastly, numerous rainwater harvesting and soil-water retention technologies for crop production have been developed that have the potential to improve productivity, particularly in semi-arid areas. These can contribute to pastoral system diversification towards integration of crop and livestock production in agropastoral systems or support settlers used to crop-based agriculture who have moved into the pastoral system.

**Markets and trade**

Trade is an integral part of the pastoral system, but new challenges and opportunities are emerging. These include: (1) the increase in local and global demand for milk
and meat products, particularly in growing urban areas, which is driving domestic and export market growth; (2) the growing commercialization and penetration of domestic and foreign capital into the pastoral system, including private and government investment in infrastructure and technology; (3) climate change, including frequent droughts where pastoralists use markets for destocking, although often terms of trade have by then turned against them and they may hold onto animals; and (4) the increased need for diversification among different types of pastoral households (see section on population, hunger and poverty).

Like in other farming systems, richer pastoralists generally benefit more from market participation than do poorer ones (Aklilu and Catley 2010). Reasons for this include the minimum herd size needed for viable market-oriented production; cash available to buy animals and herds; social capital and information needed to negotiate good prices; access to credit; and transport infrastructure. Consequently, poor and wealthy households have different market strategies. The poor tend to trade more small stock because these require less cash to buy and sell. Wealthier herders have the capital to add value through fattening animals close to terminal markets, and they invest in larger and higher value cattle. The livestock supply chains in east Africa are becoming more stratified as they specialize to serve different market segments, and it is generally the wealthy that benefit from the expanding export markets. Pastoral production is still predominantly herd reproduction and milk, and thus increased commercial activity in meat sales poses the question how a broader group of pastoralists can engage in sales and in value-added activities. Otherwise the growth in meat demand is likely to benefit only wealthier pastoralists.

Pastoralists have long relied on local and cross-border trade and markets to purchase food and other commodities, especially in dry seasons when livestock productivity is low. With growing demand for livestock products, the income earned from livestock sales is increasingly important for household food security. There are key differences in livestock trade across regions and in national and regional policies supporting domestic and international (export) trade (e.g. Hesse and Cavanna 2010). In the southern African subsystem, especially in Namibia, Botswana and Zimbabwe (until recently), export-oriented production for Europe has been enabled and encouraged. In the west African Sahel, the north-south regional trade networks and proximity of large urban centres to pastoral and agropastoral areas have allowed domestic and regional livestock markets to flourish. In eastern Africa, there has been little state support for pastoral livestock markets, even though livestock contributes a significant percentage to national economies (Hesse and Cavanna 2010). The exports from east Africa to the Middle East remain important, and donors continue to invest in export schemes (Aklilu and Catley 2010). A key trade challenge remains the ability of African pastoral livestock producers to be competitive in international export markets given the low availability of veterinary services and limited capacity for adherence to sanitary and veterinary standards. With growing milk and meat demand, and customers expecting continuous supply, pastoralists need to become a more stable supplier of livestock commodities, notwithstanding the boom and bust cycle that characterizes pastoral livestock production.

Policies and institutions

The pastoral farming system is affected by many global, regional and national policies. The critical among these deal with governance and political participation (including security), economic development (including for agriculture, livestock and markets), natural
resources (including land, biodiversity and water) and development cooperation (including aid and humanitarian assistance). In previous decades, inappropriate policies and development interventions, which favoured crop-based agriculture and sedentary livestock production futures, have challenged pastoralism and associated livelihoods. Historically, this inappropriateness has stemmed from a lack of pastoralists’ participation and influence in decision making.

In recent years, policies have demonstrated a new-found support for pastoralism in general, and the pastoral poor particularly. Policy attention is also increasingly targeting conservation of the rangeland ecosystem, the facilitation of transboundary livestock movements and inclusive local policy processes. Policy and legal instruments are now formalizing pastoral people’s rights. In 2010, the African Union established a Continental Pastoral Policy Framework, which aims to: secure and protect the lives, livelihoods and rights of pastoral peoples and ensure continent-wide commitment to political, social and economic development of pastoral communities and pastoral areas; and reinforce the contribution of pastoral livestock to national, regional and continent-wide economies. In eastern Africa, the Intergovernmental Authority on Development (IGAD) and Food and Agriculture Organization (FAO) established a Livestock Policy Initiative (LPI) in 2009 to address the policy and institutional changes needed for the poor to benefit from enhanced livestock production. Through the LPI, ‘policy hubs’ are being put in place in member states to coordinate national-level processes. In the west African Sahel, the recent N’Djamena Ministerial Declaration of May 2013 mobilized participants from 17 countries to support strong governance, resilience, and social and economic viability of pastoralism in Saharan-Sahelian areas.

With respect to natural resources, the impact of land tenure policies on pastoral land and land use has been particularly profound. Traditional, indigenous land tenure has moved to modern, formal tenure systems in many areas as states have formulated and enacted land laws, policies and programmes to formalize property rights for land in pastoral drylands (Lengoiboni et al. 2010). This transition is accelerated by policies aiming to promote privatization of land, transforming pastoral resources from common property in which multiple users negotiate and compete for rights, to private individual property where land use regulation, access and exploitation is by an individual or corporate entity (Homewood 2004). These privatization policies are based on the premise that formalized tenure will lead to increased investment in land, a premise that remains debatable.

In eastern Africa, land is state-owned in Ethiopia and Tanzania, while Kenya has largely privatized pastoral lands in the south and communal tenure on trust land in the north and east. Uganda and Tanzania have both recognized customary and group rights in the land statutes entailed in the Tanzania Village Land Act (1999) and Uganda Land Act (1998), but their implementation remains ineffective among pastoral communities.

In the more intensive southern African subsystem, land privatization is more advanced than in the west African Sahel where pastoralists continue to migrate across vast swathes of communal, open access land that often spans multiple countries. The privatization of pastoral lands in southern Kenya developed in two steps, from formalizing collective ownership to subdivision of this collective property to individual tenure (Mwangi and Ostrom 2009). The outcome of privatization has not all been positive. The process has led to inequitable land distribution among households, and the exclusion of women and youth from land ownership as well as increased poverty because of indiscriminate and distress land sales. Furthermore, privatization has impacted pastoralism negatively while restricting livestock mobility with negative consequences for pastoralists during periods of drought (Nkedianye et al. 2011).
The fragmentation of rangelands also inhibits movement of wildlife, especially large mammalian herbivores, leading to increased human-wildlife conflicts around protected areas in the pastoral subsystems in eastern and southern Africa. Consequently, pastoralists are responding by developing new land management arrangements involving formalized rights to land through land titling and the reconsolidation of subdivided land to give access to grazing and water resources (Mwangi and Ostrom 2009). In wildlife-rich areas such as in Kenya and Namibia, this process also involves the establishment of conservancies, which seek to balance livestock and wildlife land use planning and allow pastoral communities to diversify and benefit from wildlife tourism (Box 10.6).

**Box 10.6 Community conservancies as innovations for land and wildlife management in Kenya and Namibia**

Community conservancies are widespread in the pastoral rangelands in Kenya and Namibia. Conservancies aim to promote better governance and benefit-sharing from wildlife and tourism. In Namibia, local communities have embraced conservancies as a means to manage wildlife and tourism activities on their land. By the end of 2010, there were 59 registered communal conservancies in Namibia, managing more than 132,697 km², accounting for 16.1 and 42 per cent of the total land area and communal lands in Namibia respectively. The conservancy approach is becoming effective as a conservation strategy, as demonstrated by the increase in wildlife populations and decrease in human-wildlife conflicts in communal areas. Conservancies also provide socioeconomic benefits such as income for local communities, employment opportunities and development of new skills and expertise, but their impacts on livestock production are less documented. The benefit-sharing occurs in six main categories: conservancy operational costs; payment of salaries for staff; direct payments to villages or individual conservancy members; contribution to capital development (e.g. construction of water infrastructure for people and livestock); investments in social programmes, including health clinics, education, support for HIV/AIDS afflicted families and soup kitchens for pensioners; supply of game meats to families and local schools; and pooling of cash income for investments in business and income-generating activities.

In Kenya, in 2010, there were a total of 41 community wildlife conservancies in the pastoral arid and semi-arid lands (ASAL), covering close to a million hectares (Osano 2013). A critical aspect of conservancies in Kenya is the land tenure system; over 65 per cent of all the conservancies are located in group-owned communal lands with the remaining 35 per cent found in privatized lands. Some 24 per cent of the conservancies provide direct cash payments to pastoral households in return for managing land for wildlife conservation and tourism, based on a payment for ecosystem services model. These conservancies generate money from both public and private sector sources in the tourism industry. In southern Kenya, conservancies have contributed to the reconsolidation of subdivided and fragmented lands, bringing these lands under common management. In northern Kenya, conservancies are promoted as an incentive to prevent the privatization and subdivision of currently communally held, group-owned pastoral lands. In addition, conservancies have provided a ‘safety net’ to pastoral communities during drought periods, and these benefits are expected to increase and become more important with climate change.
In terms of development assistance, the Official Development Assistance (ODA) investments in pastoral communities have been sparse at best, relative to assistance provided to development in general and crop-based agriculture specifically. The ODA for agriculture in sub-Saharan Africa decreased by 35 per cent between 1980 and 2005, notwithstanding a 250 per cent increase in overall ODA commitments over that period. It is unclear how much of the ODA is invested in pastoral livestock production, if any. Much of the resource invested so far has been directed to, and continues to be absorbed by, emergency relief and humanitarian assistance rather than development.

**Human capital/knowledge sharing/gender**

Generally, mobile pastoralists have been neglected by governments and excluded from social services. This has profound implications in terms of types of education and equity among the children educated. Beyond sheer remoteness, key constraints tend to be demand for children’s labour (FAO 2013), insufficient and inappropriate training infrastructure and curricula, and difficulty in retaining teachers. Some African countries are providing fixed and mobile community schools, which involve pastoral people in the education design. Gender inequity, with much lower rates of enrolment for girls than boys, is increasingly being addressed. The provision of formal education also transforms local patterns of knowledge generation, production and dissemination, leading to a fusion of indigenous and scientific knowledge. Pastoralists’ indigenous knowledge remains highly relevant in rangeland and livestock management, traditional veterinary services and drought forecasting, which can contribute to adaptation to climate change as exemplified by the pastoralists in the Sahel.

Other services such as extension and advisory services have been far from appropriate both in content and approach. Butcher (1994) highlighted that beyond the inevitable difficulties associated with low populations in large land areas, traditionally extension through public sector advisory services does little to support long-term livestock and pastoral development. Traditional extension follows more of an economic development approach that is technologically biased and targeted at sedentary, male livestock keepers. What is needed is a social approach addressing a full complement of integrated services including health, water, range management and veterinary care. While improvements have been made in participatory approaches such as community animal health care, the formation of water commissions, and livestock insurance schemes, there is room for improvement in participatory planning approaches and institutional development within these systems (Butcher 1994; REGLAP 2012).

Pastoralists are in a continuous cycle of innovation and adaptation. For example, the use of mobile telephones, now with solar rechargers, has dramatically changed traditional pastoral practices due to faster and reliable access through mobile phone and internet to information, including on rangeland quality, water points, weather patterns, disease outbreaks, markets and prices. This also allows pastoralists to send and receive money virtually, circumvent insecurity, be involved in distance learning and participate in various processes remotely.

**System and subsystem performance**

There are ample case studies, but no synthesis exists on the system performance of the pastoral farming system. Table 10.5 summarizes the performance of the three pastoral subsystems in terms of productivity, sustainability and human development outcomes.
Productivity

The overall productivity of the system is affected by the extent and productivity of rangelands. The extent of rangelands is declining in the Sahel and eastern Africa, due to land use change towards crop agriculture. Although fluctuating from year to year, rangeland productivity appears to have been stable since the late 1980s, as seen from long-term satellite imagery. Figure 10.7 shows that length of growing period has been stable for part of the pastoral farming system, while it varied in other parts (Vrieling et al. 2013). Conditions improved in the southern Sahel, while for some areas within the Sahel and eastern Africa (for Kenya only for the short rains starting around November), a reduction in length of growing period was observed. This could indicate that locally, rangeland productivity is declining. Another productivity indicator is the usage of crop residues, which are widely used in the Sahel and northern Africa, while there is potential for integration between crops and livestock in the other two subsystems.

Livestock productivity includes the production of milk and offtake of live animals (for meat), which is based on the growth of herds. Pastoral cattle milk production ranges from 0.5 to 2 litres per lactating cow per day (Breman and de Wit 1983). Mean annual increases in cattle herd live weight of 20 to 25 per cent are reported from the Sahel and Masailand (Bekure et al. 1991; Breman and de Wit 1983). Table 10.6 forecasts an increase in offtake rate and reduction in milk production in the eastern Africa subsystem and significant increases in beef offtake until 2030. Lack of data limits the ability to assess changes in livestock productivity in the Sahelian and southern African subsystems.
Figure 10.7 Change in length of growing season (LGS) across sub-Saharan Africa. Green = significant (Spearman rank correlation, $p < 0.10$) lengthening, purple = significant shortening of LGS. The inset on the right shows the same for areas in east Africa with a double season where the start of the second season is around October. Red lines demarcate boundaries of the pastoral farming system. Data is based on retrievals (1981–2011) from the Normalized Difference Vegetation Index (NDVI) dataset from the NOAA’s Advanced Very High Resolution Radiometer sensor using a local threshold method.

Source: Vrieling et al. (2013).
Earlier we reviewed the productivity of the pastoral farming system in response to some external drivers of change. This section reviews the capacity of the farming system to provide the biophysical, social and economic services and benefits in the long term, considering both internal and external drivers of change.

**Biophysical sustainability**

The conversion of rangeland to crop farming is affecting the provisioning of livestock commodities from the pastoral system. Although small in area, this effect is important because agriculture expands onto the more productive grazing lands. External drivers include climate change, which may lead to greater variability in rainfall, and increased incidence of drought, which challenges the resilience and sustainability of pastoral systems. Internal drivers of change include human population growth, the impact of grazing animals on soils and vegetation, and the impacts of range management and bioenergy extraction on forage availability. The rapid increase in human population together with deepening poverty in the pastoral system is likely to negatively affect productivity in three ways. First, land use change that favours crop production reduces the extent of pasture for livestock. Second, poverty and hunger reduce the availability of labour and lead to distress sales of livestock, reducing per capita livestock holdings. Third, our analysis (Figure 10.6) indicates that non-equilibrium theory does not apply to most areas of the pastoral farming system, which means that rangeland use by livestock is not always sustainable. The effects of bioenergy extraction are mixed; where it results in removal of trees and shrubs and higher grass production it will have positive effects on cattle productivity and negative impacts on browsers; additional negative effects can include carbon emissions and land degradation.

**Economic sustainability**

Mobile pastoral systems have higher economic returns per unit of land than ranching systems. In semi-arid areas, however, higher returns per unit of land used for cropland drives the conversion of rangeland to cropland (Norton-Griffiths and Said 2010). Despite this, large parts of the pastoral system remain under pastoralism because of cultural reasons, including the preference for livestock keeping, the desire not to depend on external

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**Table 10.6** Productivity of cattle, goats and sheep (shoats) and dairy in the pastoral system in eastern Africa.* Carcass weight and milk production in kg per year per animal, offtake rates in fraction per year of total animal population

<table>
<thead>
<tr>
<th>Year</th>
<th>Beef cattle</th>
<th>Shoats</th>
<th>Offtake rates</th>
<th>Milk production</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>127</td>
<td>13</td>
<td>0.09</td>
<td>0.26</td>
</tr>
<tr>
<td>1995</td>
<td>76</td>
<td>12</td>
<td>0.10</td>
<td>0.25</td>
</tr>
<tr>
<td>2030</td>
<td>70</td>
<td>18</td>
<td>0.16</td>
<td>0.34</td>
</tr>
</tbody>
</table>

* Djibouti, Eritrea, Ethiopia, Kenya, Madagascar, Mauritius, Mayotte, Reunion, Rwanda, Seychelles, Somalia, Sudan and Uganda.

Source: Bouwman et al. (2005).
inputs and labour, and the weather-related risk of crop failure. There are claims that climate change will alter the recurrence and intensity of drought, and that with progressive climate change, lands converted to crops may well revert to mobile livestock keeping as a more drought resilient option. However, the impact of climate change remains uncertain because of a lack of consensus on future rainfall trends.

The ongoing decline in livestock resources per capita is a major factor undermining the economic sustainability of the pastoral system, because it leads to increasing numbers of families with too few animals to sustain an economically viable, livestock-based livelihood.

Options for economic growth exist in expanded market orientation for commodities from the pastoral farming system. The development of trade, markets and associated investments in infrastructure such as roads and transport facilities, grading systems and traceability has a positive effect as it brings demand closer to the producers. Science, technology and improved human capital have a positive impact on livestock productivity but are generally more available to the wealthier pastoralists that have better access to capital, markets and improved disease-control drugs and techniques. There is also potential for growth in markets for biofuels and ecosystem services such as carbon, biodiversity and wildlife conservation (Figure 10.8). The conservancies in Namibia and Kenya where

Figure 10.8 Game farming business operation in Eastern Cape, South Africa called Ezulu Game Reserve, providing trophy hunting of extra-limital species such as sable antelope (seen here on the photograph), waterbuck, giraffe, red lechwe and impala. In the Republic of South Africa and Namibia, former livestock farms (cattle, sheep and goats) have been purchased by foreign investors and developed with luxury lodges for the trophy hunting business.

Source: Tony Palmer.
pastoralists benefit from livestock and income from wildlife-based tourism are an example (Box 10.6). To date, however, the involvement and benefits to pastoralists from carbon markets have been limited, but this could be improved through voluntary mechanisms such as the Verified Carbon Standard that seeks to facilitate social benefits from carbon markets. Finally, education has an important positive effect on economic sustainability.

**Social sustainability**

Pastoralists’ livelihoods revolve around livestock and natural resources, especially land and pasture. In addition to providing nutritional benefits, livestock are also valued for social identity, as a means of establishing and maintaining social ties (e.g. through marriages), and for insurance purposes. Land, which is traditionally owned communally, is also critical as a substrate for natural resources including forage, pasture and water. Pastoralists create social bonds and norms in the form of social relationships and networks, which include bonding ties among families and friends within a community, and bridging ties to outsiders for political support and information. The social sustainability of the pastoral system depends on pastoralists’ responses to social, economic and environmental changes (Galvin 2009). These affect the four central features of social capital: relations of trust; reciprocity and exchanges; common rules, norms, and sanctions; and connectedness in networks and groups (Pretty and Ward 2001). Pastoralist social institutions and networks are important for migration and transhumance, but these networks and larger social capital are breaking down due to a combination of factors, principally increased socioeconomic stratification along wealth, assets, land privatization, insecurity, conflicts leading to famine, and political and policy changes. Increasing socioeconomic stratification among pastoral communities compromises relations of trust and diminishes the effectiveness of traditional institutions of reciprocity and exchange. Wealthier families increasingly derive their norms and values from the modern state rather than from traditional society, thus undermining the impact of customary rules. In addition, poverty occasioned by low per capita livestock holding means that poor pastoralists are unable to help each other.

Rangeland privatization has also expanded the gap between wealthy and poor pastoralists. The wealthy can now exclude the poor from their privatized land and sometimes restrict them from accessing water resources, while still making use of common pastures, saltlicks and communal water pools, leading to mistrust and conflicts (Lesorogol 2003). The subdivision of privatized land also diminishes collaborative management of resources due to an increase in individually controlled pastures and water, loss of cultural traditions as pastoralists sedentarize, and a reduced number of people living together in common homesteads. Since the late 1990s, there has been a growing trend of absentee ownership of livestock herds (particularly cattle) in west African Sahel (Toure et al. 2012). These absentee owners are often salaried workers and relatively well-to-do business people based in urban areas who invest in livestock and contract them to herders (pastoralists) to manage. Some of these absentee owners are of pastoral ethnic origin but are no longer engaged in pastoral farming due to education and salaried jobs. The caretaking agreements with the herders are often complex depending on the relationship with the absentee owners. One common trend in managing these herds is that the absentee owners restrict the herders from taking their herds far away to ensure regular monitoring and to prevent theft. The immediate implication of a growing number of absentee owners and the associated short distance grazing itineraries is exacerbation of competition for grazing resources and conflict.

Political insecurity, including violent conflicts in the form of cattle raids, and competition for pasture especially in the dry season, are leading to changes in land use and
movement patterns, decreasing the effectiveness of traditional social networks (Pike 2004). The social sustainability of the pastoral farming system will depend on the development of social resilience where pastoralists learn from past experiences and actively integrate new knowledge to control their access to resources in new ways. This may include strengthening of bonding and bridging ties such as new forms of post-privatization, collective rangeland management in southern Kenya and the development of pastoralists’ associations that promote conflict resolution, peace building and resource management.

**Human development outcomes**

The southern Africa subsystem performs better than the Sahelian and eastern African subsystems for three out of the four human development outcomes: food security, access to health services and education (Table 10.5).

Food security in the pastoral farming system is volatile given the high inter-annual variation in rainfall, which affects productivity of livestock, milk and meat. In years without drought, the nutritional status of pastoralists during the dry season is better than that of sedentary, crop-producing populations in rural Africa. During drought, however, both eastern Africa and the Sahel are prone to famine and heavy reliance on relief food supplies (Headey 2011). Given the erratic availability of rainfall, attempts to achieve greater food security require either greater stability of forage and water supply, for example forage reserves (grass banks), or non-livestock-based interventions such as alternative sources of income and social safety nets. In the long term, interventions to promote food security can be achieved through policies and institutions that promote resilience, such as timely livestock-saving interventions during droughts, maintenance of mobility to support livestock production, livestock insurance and commodity markets (Devereux 2009; Headey 2011).

In general, healthcare service delivery is poor in the pastoral farming system because of remote conditions, low population density, poor infrastructure and pastoral mobility, which increases the costs of delivery and constrains health delivery (Sheik-Mohamed and Velema 1999). Mobility and drought are critical determinants of health status of pastoralists. Although water and pasture are common reasons for migration, pastoralists also move to avoid certain human and livestock diseases. During their movements, nomads can be active transmitters of diseases to their host communities. Conversely, they can also be passive acquirers of diseases when they are exposed to health hazards. Droughts lead to high concentration of pastoralists in relief camps, where they suffer from very high mortality rates (Sheik-Mohamed and Velema 1999).

Healthcare provision is better in southern Africa than in the Sahel and eastern Africa subsystems. Improvements in healthcare service delivery to pastoralists should include both direct and indirect interventions (Prothero 1994). Direct interventions include immunization and vaccination especially for measles; malaria vector control combined with drug protection for high risks groups such as pregnant women and children under five; provision of primary health care (PHC) through integrated fixed and mobile health units that are established according to local patterns of seasonal movements; and the recruitment and training of nomadic, community health workers to work among pastoralists (Sheik-Mohamed and Velema 1999). Indirect interventions include the provision of food that is adequate in quantity and quality to reduce susceptibility to diseases related to malnutrition, and supply of clean water and sanitation (Prothero 1994). In addition, there is need for collaboration between public health and veterinary services to meet essential health interventions for people and livestock in remote rural areas. This can, for example, be
achieved through joint vaccination campaigns for livestock and people, which have been successful and highly appreciated by nomadic pastoralists in places such as Chad.

The provision of education in the pastoral farming system is also a challenge, hence the low levels of access to basic and secondary education among pastoral communities. An assessment of the education of nomadic peoples in eastern Africa found that gross enrolment ratios (GER) for primary education in pastoral areas was less than half of the national ratio (Carr-Hill 2005). In Kenya, studies show that pastoral areas account for 18 per cent of Kenya’s primary school-age children, but have 46 per cent of the absenteeism, and that less than 10 per cent of children that enrol can reach the last grade of primary school (Watkins and Alemayehu 2012). In addition to increased investments in education facilities, especially around trading centres, provision of mobile and distance-learning opportunities for pastoralists should be encouraged. Improved access to quality and appropriate education is considered the most important pathway for improving human development and can enable pastoralists to successfully diversify into non-farm activities through acquisition of new skills.

Income poverty is another key constraint to food security and human development in the pastoral system in Africa. Families with low income cannot afford to purchase food and do not have enough milk-producing animals, hence they suffer from malnutrition. Low incomes also mean not being able to afford curative health services, medical treatments and education for children. Poverty reduction interventions have great potential for improving human development outcomes in the pastoral farming system, but to date, pastoralists’ inclusion in poverty reduction programmes has been inadequate and insufficient.

### Strategic priorities for the system

Dixon et al. (2001) assessed the potential of five different pathways to allow 50 per cent of the poor in this farming system to escape poverty by 2015. That assessment ranked exit from agriculture higher than the other options in agriculture (Table 10.7). The assessment in 2015, which was done by the authors of this chapter, reaffirms exit from agriculture as a prime poverty escape pathway. This option needs serious consideration by policy makers and pro-pastoral donors and NGOs because of the dwindling per capita livestock wealth and resulting, ongoing exit from livestock keeping.

Exiting pastoralism requires a package of policy interventions. First, some pastoralists, especially the educated ones, can be absorbed into the formal labour market in local industries (e.g. mining and tourism) and urban areas enabling them to escape poverty.

<table>
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<tr>
<th></th>
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<tbody>
<tr>
<td>% of total ag pop</td>
<td>–</td>
<td>40</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td>Intensification</td>
<td>4</td>
<td>1</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Diversification</td>
<td>1.5</td>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Increased farm size</td>
<td>1.5</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Off-farm income</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Exit from agriculture</td>
<td>1</td>
<td>5</td>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>

Sources: See Chapter 1, ‘Farm household decisions and strategies’ and Chapter 2, ‘Household strategies’. 
Second, some pastoralists may migrate into other systems, as occurred during the
droughts in the Sahel when pastoralists migrated and settled in the neighbouring agropas-
toral system. Lastly, the most poor – stockless, landless, uneducated and unskilled –
may exit pastoralism and spiral further into poverty due to a lack of skills and capital to
adopt alternative livelihoods. For this group, exit from pastoralism is usually involuntary
and extremely painful. It is a forced choice when all the livestock is lost without the
prospect of returning to livestock keeping. The extreme reluctance to leave animal-based
agriculture is understandable, because a life without livestock typically results in further
spiralling into poverty and food aid dependency. Policy often does not recognize this
gloomy perspective, neither does it provide the social and educational support needed to
establish the personal ambitions, self-confidence and competencies required for a future
outside pastoralism – particularly if the knowledge and skills required are fundamentally
different from pastoralism. Dedicated policies are required to develop alternatives for
pastoral dropouts and provide education support. This is most urgent in eastern Africa
and the Sahel (Table 10.8). It is less urgent in the southern African subsystem where
population densities are lower and education is already more attainable for the largely
sedentary population.

Intensification, diversification of the farming system and off-farm income are other
poverty escape pathways. Increased farm or herd size was considered impracticable by
our peers because this would require reducing the farm or herd size of other livestock
keepers, an agenda that is not manageable in the resource-constrained drylands of Africa.
In extensive livestock production systems, intensification generally refers to the process
of replacing traditional subsistence production with systems that range from very small-
scale to medium-scale commercial production, which implies breed improvements and
a certain degree of confinement (hence less mobility), access to more nutritious feeds,
potable water and vaccines, and specialized skills in animal health, care and nutrition.
Table 10.8 summarizes the relative importance of several poverty escape pathways in the
three subsystems.

<table>
<thead>
<tr>
<th>Poverty escape pathway</th>
<th>Sahel</th>
<th>Eastern Africa</th>
<th>Southern Africa</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Intensification</strong></td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
</tr>
<tr>
<td>• Settlement</td>
<td>+++</td>
<td>+++</td>
<td>+++3,6</td>
</tr>
<tr>
<td>• Tenure security</td>
<td>+++1,2,5</td>
<td>+++</td>
<td></td>
</tr>
<tr>
<td>• Market orientation</td>
<td>+++41,2,3,4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Technology</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Diversification of farming system</strong></td>
<td>++</td>
<td>++</td>
<td>+</td>
</tr>
<tr>
<td>• Land lease</td>
<td></td>
<td>++</td>
<td></td>
</tr>
<tr>
<td>• Crop production</td>
<td></td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>• Eco-tourism</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Payment for ecosystem services (PES)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>from carbon and water</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Increased farm or herd size</strong></td>
<td>++</td>
<td>++</td>
<td></td>
</tr>
<tr>
<td><strong>Off-farm income</strong></td>
<td>+++</td>
<td>++</td>
<td></td>
</tr>
<tr>
<td><strong>Exiting pastoralism</strong></td>
<td>+++</td>
<td>+++</td>
<td>+</td>
</tr>
</tbody>
</table>

Notes: Technology: 1 = hay, 2 = ICT, 3 = local animal breeds, 4 = insurances, 5 = crop residue, 6 = agrofor-
estry. Importance categories are: ++++ extremely high; +++ high; ++ moderate; + little.
Opportunities for intensification, diversification and off-farm income as well as strategic priorities for agricultural transformation are discussed in more detail for each of the three subsystems in Table 10.9 and in the sections below.

Needs that are common to the three subsystems include more secure access to grazing resources such as water and dry-season pasture; agricultural diversification; improved market information, marketing and value-adding of produce; and improved health services and education, including for women. However, implementation must differ between the three subsystems, due to their inherent differences in patterns of livestock mobility, human population, poverty, land use change and access to education and markets.

Table 10.9 Summary of the strategic priorities for agricultural transformation in the pastoral farming system

<table>
<thead>
<tr>
<th>Subsystem</th>
<th>Strategic priorities for agricultural transformation</th>
<th>System support to enable transformation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Direct agricultural changes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>System support to enable transformation</td>
<td></td>
</tr>
<tr>
<td>Sahel</td>
<td><em>Tenure security,</em> especially for land, and secure</td>
<td><em>Market orientation,</em> through: 1)</td>
</tr>
<tr>
<td></td>
<td>mobility and guaranteed access to critical resources</td>
<td></td>
</tr>
<tr>
<td></td>
<td>such as water, grazing lands, saltlicks and dry-</td>
<td>2) better organization of pastoralists</td>
</tr>
<tr>
<td></td>
<td>season pasture.</td>
<td>3) increase access to regular market</td>
</tr>
<tr>
<td></td>
<td></td>
<td>information, particularly for livestock</td>
</tr>
<tr>
<td></td>
<td></td>
<td>prices; 2) the use of modern ICT</td>
</tr>
<tr>
<td></td>
<td></td>
<td>techniques to enable pastoralists to</td>
</tr>
<tr>
<td></td>
<td></td>
<td>obtain information directly from the</td>
</tr>
<tr>
<td></td>
<td></td>
<td>market rather than to rely on</td>
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<tr>
<td></td>
<td></td>
<td>intermediaries that limit pastoralists’</td>
</tr>
<tr>
<td></td>
<td></td>
<td>returns from livestock; and 3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>value-addition along the market chain</td>
</tr>
<tr>
<td></td>
<td></td>
<td>to increase opportunities and returns</td>
</tr>
<tr>
<td></td>
<td></td>
<td>from livestock.</td>
</tr>
<tr>
<td></td>
<td><em>Diversification of the farming system,</em> especially</td>
<td><em>Diversification of income,</em> including</td>
</tr>
<tr>
<td></td>
<td>cropping and agropastoralism.</td>
<td>increased share of off-farm income,</td>
</tr>
<tr>
<td></td>
<td>This involves combining the production of crops</td>
<td>commerce, remittances and other</td>
</tr>
<tr>
<td></td>
<td>and livestock as a means of minimizing risk due</td>
<td>sources.</td>
</tr>
<tr>
<td></td>
<td>to climate change and variability, and as a strategy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>for food security.</td>
<td></td>
</tr>
<tr>
<td>Eastern</td>
<td><em>Sustainable intensification</em> for increased</td>
<td><em>Technology interventions</em> that reduce</td>
</tr>
<tr>
<td>Africa</td>
<td>productivity, through improved breeds with high</td>
<td>risk of losing animals, such as</td>
</tr>
<tr>
<td></td>
<td>quality and quantity of milk and meat.</td>
<td>livestock disease control and livestock</td>
</tr>
<tr>
<td></td>
<td></td>
<td>insurance against drought.</td>
</tr>
<tr>
<td></td>
<td><em>Increase access to the natural resource base,</em></td>
<td><em>Value-addition</em> along the market chain</td>
</tr>
<tr>
<td></td>
<td>in particular tenure security of pasturelands and</td>
<td>to increase returns from livestock and</td>
</tr>
<tr>
<td></td>
<td>water.</td>
<td>livestock products.</td>
</tr>
</tbody>
</table>
### Sahel

The first and major priority is *securing pastoral mobility* for herders and their livestock. This can be achieved through adaptation of legal instruments (where necessary), legal support for herders and farmers in understanding and applying regulations, coordinated land management and pastoral infrastructure (water points, corridors and designated grazing area), and research with herder organizations on supply of livestock feeds (imported and local). A major concern in securing herd mobility is communal arrangements and infrastructure such as cattle paths, and setting aside rangeland and free access to water points. Increased size of and secure access to key resources, particularly water and pasture, are important prerequisites for livestock mobility and livestock-based poverty escape. The ECOWAS (Economic Community of West African States) agreement on livestock

<table>
<thead>
<tr>
<th>Southern Africa</th>
<th>Increase feed availability and quality, particularly in the dry season through identification and exploitation of alternative sources of feed such as byproducts from other agriculture systems.</th>
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</thead>
<tbody>
<tr>
<td>Market orientation, promoted through strengthening of livestock cooperatives for beef production and marketing; supporting cooperatives and collective actions to reduce the costs of inputs and enhance the understanding of market requirements; and reduce the role of speculators in the value chain.</td>
<td></td>
</tr>
<tr>
<td>Technologies within existing ICT infrastructure (e.g. mobile telephones) to increase information dissemination on input and output markets, and livestock traceability systems.</td>
<td></td>
</tr>
<tr>
<td>Enabling policies to allow and promote livestock mobility both within and across borders, ensure security of herders and their livestock, and support traditional institutions in conflict resolution and peace building.</td>
<td></td>
</tr>
</tbody>
</table>
mobility guarantees free movement across borders in the region, but it is being undermined by illegal levies charged by the police, army and the local government; the latter supports these charges under the guise of decentralization that empowers the local government to manage natural resources.

A second option is diversification of the farming system, especially into cropping and agropastoralism. This could combine the production of crops and livestock as a means of minimizing risk due to climate change and variability, and as a strategy for food security. To enable transformation in this subsystem, other strategic priorities are improved market orientation, resource tenure security and income diversification. While pastoralists increasingly grow crops, access to land and tenure insecurity remain major constraints to long-term investment in the land. Lastly, promoting off-farm income especially from commerce and remittances is critical because these are major sources of livelihood diversification for an increasing number of pastoral households, a trend that may persist. For those for whom the above options are not viable, exit from farming is the only pathway left.

**Eastern Africa**

The three main strategic priorities, in order of importance, are: sustainable intensification, for increased productivity through improved breeds with high quality and quantity of milk and meat production, which can be achieved through interventions that broaden the resource base such as hay harvest and storage; increased size and secure access to the natural resource base, in particular pasturanelands and water; and diversification of the farming system, especially to engage in small-scale crop farming and leasing land for large-scale commercial agriculture, ecotourism and provision of ecosystem services. This requires educating pastoralists on appropriate farming techniques. Most critical, however, are land market regulations especially concerning large-scale land acquisition to mitigate potential negative outcomes for pastoral communities. To enable transformation in this subsystem, other strategic priorities are: (1) technology interventions including investments in physical and technological infrastructure, roads and ICTs to facilitate improved market access and information flow, and enhance disease surveillance and control to meet international sanitary and veterinary standards; (2) value-addition; (3) enabling policies on livestock, natural resource management and other sectors including security; (4) off-farm income and remittances, including commerce as pastoralists become involved in livestock and other trades; and (5) education to provide pastoralists with the knowledge and skills to gain employment in different sectors, better engage in livestock trading and invest in alternative livelihood activities.

**Southern Africa**

The top priority should be to increase feed availability and quality particularly in the dry season through exploitation of alternative sources of feed such as byproducts from agriculture systems. To enable transformation in this subsystem, other strategic priorities are: (1) market orientation especially to strengthen livestock cooperatives, particularly in the beef sector, to improve marketing; (2) supporting collective action processes, including collective herding at village level to reduce labour requirements and improve the utilization of the dwindling grazing resource base; (3) technologies within existing ICT infrastructure such as mobile telephones and RFID to increase information dissemination
on input and output markets, and livestock traceability systems respectively; (4) policy actions to enable livestock mobility, which is heavily restricted in the region due to strong regulations governing inter-country or between green and red (foot and mouth areas) zones within countries; and (5) strengthen security and collaborative resource management to reduce animal theft particularly on the borders of Lesotho and South Africa, and reduce communal conflicts over the ownership, use and management of grazing areas and watering points. Notably, security operations by government agencies should be complemented by platforms at grassroots level to facilitate the mutual sharing of boundary resources, given that where traditional institutions are strong there tends to be better management of grazing and water resources. Lastly, off-farm income, especially remittances, play a major role in sourcing of inputs such as veterinary medicines and supplementary feed for livestock. However, the relative contribution of these remittances is dwindling as the costs of direct human needs (food, medicines, education, etc.) are increasing rapidly.

**System conclusions**

The pastoral farming system performs reasonably well in terms of productivity with options for further productivity gains in milk and meat. The sustainability performance is more variable. While the returns per hectare are stable or may increase in part due to increased market orientation and higher offtake rates, there is a decline in livestock wealth and returns per capita. The Sahelian and the eastern African subsystems seem to perform poorly in terms of human development outcomes.

The various drivers of change affect pastoral livelihoods differently. Markets, technology, human capital and the development of pro-pastoral policies and institutions open opportunities for increased productivity, and can expand economic benefits from livestock and various livelihood diversification strategies. Population growth is reducing the average livestock numbers per household at a rate of 2.5 to 3 per cent per year, with effects on income poverty and wealth distribution. A lack of information on the rates of change of other drivers prohibits an assessment of their combined effect. While these positive drivers stimulate the economy of the pastoral farming system at large, it is questionable whether, for the average household, these positive drivers compensate for the effects of population growth.

The sustainable development goal (SDG) number 1 is to eradicate poverty by 2025. Agricultural intensification and exit from pastoral farming are the two most important pathways for pastoral households to escape from poverty. The first is a pathway for the better-off who are still in pastoral farming. The second is the involuntary choice of the stockless, landless, uneducated and unskilled.

For households still farming, pro-pastoral land use change and adoption of crop-based systems, including agropastoralism and irrigated cropping, are among the strategic interventions to reduce poverty in the pastoral farming system. Crop agriculture typically occupies the wetter lands, which are also crucially important for a vibrant pastoral farming system. Selectively changing the land use of these more productive patches of land marginalizes the livestock producers who are left with the less productive remnants, a process that has been occurring for a long time. This situation is further aggravated when pastoralists lose access to their traditional water resources in the converted lands. Addressing the social needs of pastoral communities through crop-based futures has implications for the productivity and resilience of the pastoral farming system. *Laissez faire* policies typically open opportunities for a happy few to acquire land for cropping and other non-pastoral
land uses at the expense of those left behind. These trade-offs are typically not considered. Better-integrated policies are required, and when embracing crop-based futures it is desirable to include all stakeholders in deciding the future of their land.

For pastoral dropouts, dedicated policies are required to support education and development of alternatives. The opportunities for livelihood diversification and off-farm income differ for the three subsystems.

**Notes**

1. Agriculture includes crop and livestock production.
2. A Tropical Livestock Unit is a 250 kg animal weight-equivalent index, which allows species of various weights to be combined.

**References**


The pastoral farming system


FAO, 2013. *Children’s Work in the Livestock Sector: Herding and Beyond*. Economic and Social Development Department, FAO.


