CHAPTER 3

Trends and Drivers of Vulnerability in SSA Drylands

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This chapter first presents an overview of the main trends in human and livestock population dynamics and livelihoods (poverty, food security, education, and health) at the level of drylands livestock-dependent households. It then describes the drivers of households' vulnerability to the four categories of shocks—climate, disease, prices, and conflict.

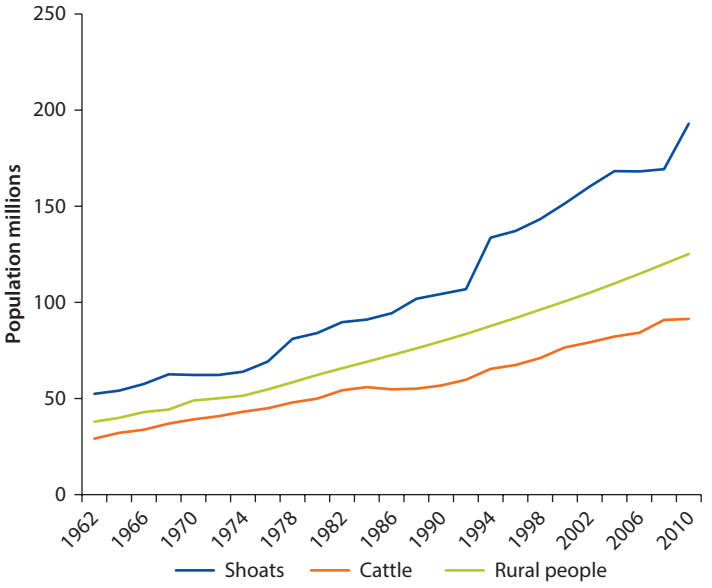
General Features

Human and Livestock Population Dynamics

The population living in drylands zones of the focus countries[1] is estimated to include between 25 and 41 million pastoralists and 71 and 94 million agro-pastoralists. Overall, strong population growth has occurred in dryland regions of Sub-Saharan Africa (SSA). Touré et al. (2012) found an increase in the overall rural population of the West African drylands of 2.4 percent per year over the period 2005–2010. Over the period 1960–2010, the human population increased 3.6-fold, leading to the emergence of urban centers and a rise in the sale of meat, milk, leather, and hides. Rural populations are still very young, with high dependency ratios caused by the outmigration of more active men.

Data are scarce on the growth of pastoral and agro-pastoral populations/arable farmers and their differential birth rates. The conventional wisdom is that nomadic pastoralist populations have lower natural population growth rates than sedentary farming populations. Some hard data come from a study of two villages in Niger, where Swift (1977) reported that the nomadic Fulani and Touareg had an annual growth rate of 11 per 1,000 people, whereas the semi-

Figure 3.1 Livestock and Rural Human Population Trends, East Africa, 1960–2011

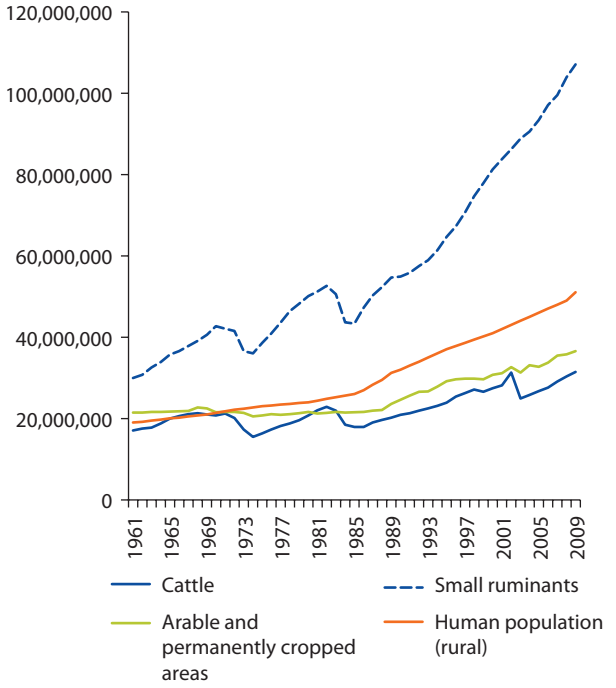


Source: FAOSTAT (2012).
Note: Data for Ethiopia are not included.

and fully sedentary groups and all rural people together had an annual growth rate of 23–25 per 1,000 people, although some of these data have been challenged in part because of their limited sample size (Randall 2012). This book (chapters 2 and 5) projects an increase of 3 percent per year in the pastoral population and 2.5 percent per year in the agro-pastoral population, taking into account outmigration and absorption in other sectors resulting from gross domestic product (GDP) growth.

Figures 3.1 and 3.2 illustrate the rapid increase over the past four decades in total livestock numbers, and in particular the rapid increase in small ruminant numbers. It is interesting to note that with an annual growth of between 3.1 and 4.4 percent between 1980 and 2010,[2] the livestock population increased faster than the human population (1–2.5 percent growth per year), but this rate is in line with the future projections. This means that on average, the herd/flock size per household and per pastoralist has gone up. However, as discussed below, livestock holdings of the poor are going down due to changes in livestock ownership patterns. Moreover, the overall averages conceal important regional and species differences. For example, the USAID-funded Pastoral Risk Management Project (PARIMA) (Desta and Coppock 2004; also reported in Headey, Taffesse, and You 2012) found a clearly declining herd size in cattle, probably the result

Figure 3.2 Livestock and Rural Human Population Trends, Sahel Region, 1961–2009



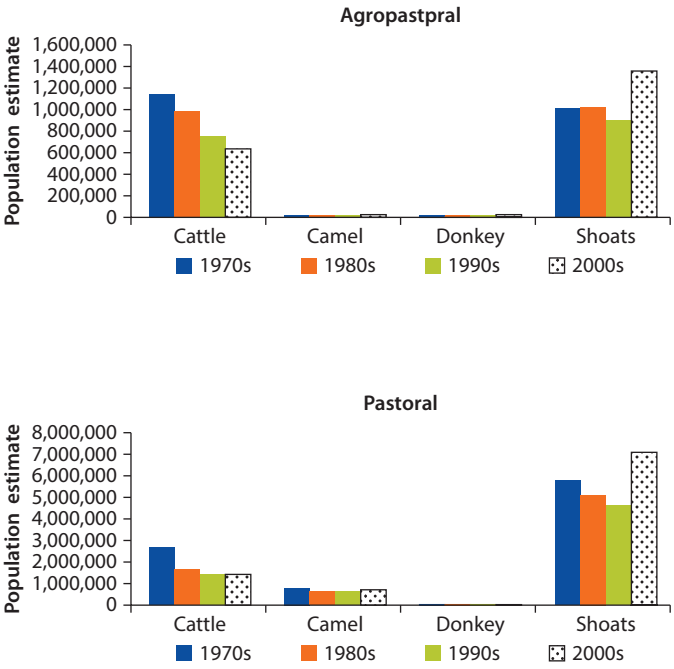
Source: FAOSTAT (2012) and adapted from SIPSA atlas.

of consecutive droughts and herd sizes falling below the minimum level for recuperating from weather shocks.

Figure 3.3 shows the trends in livestock population in agro-pastoral and pastoral systems in Kenya from the 1970s to 2000s. Both systems reflect the same decline in cattle and an increase in small stock, the latter notably in the past decade. Camel populations have remained more or less constant in pastoral areas over this same period in Kenya, although aerial census data suggest the population is moving southward. The camel population has reportedly significantly increased in Ethiopia (Ethiopia LMP, in press).

In the Sahel, the livestock population increased from 14,499,000 TLU[3] in 1950 to 26,243,000 TLU in 1983 and 39,759,000 TLU in 2003, and as shown in chapter 2, to 52,565,000 TLU (including Nigeria) in 2006. However, TLU per capita declined as the human population increased: it was 0.98 in 1950, 0.83 in 1983, and 0.68 in 2003. In almost all Sahelian countries, small ruminants and especially goats showed a higher growth rate, reflecting their short reproductive cycle, their capacity to adapt to degraded rangelands, and their strategic role in the household economy as highly liquid assets (Dicko, Djitèye, and Sangaré 2006).

Figure 3.3 Livestock Numbers, Agro-pastoral and Pastoral Systems, Kenya, 1970s to 2000s

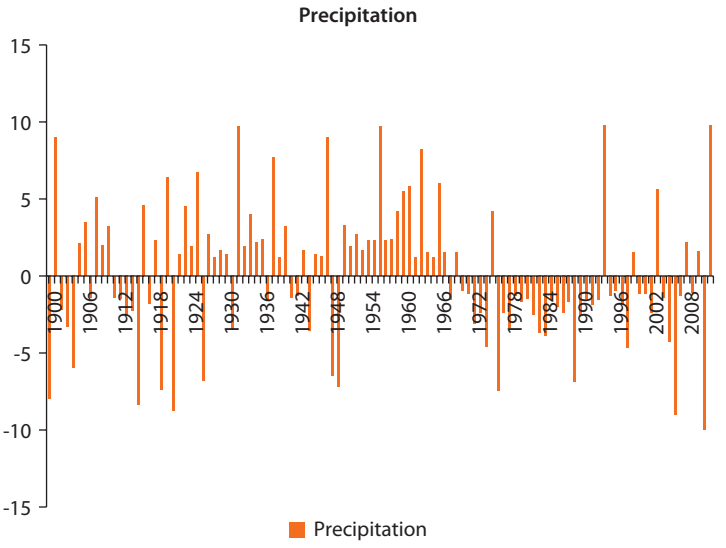


Source: Kenya Department of Resource Surveys and Remote Sensing (DRSRS).

Climate

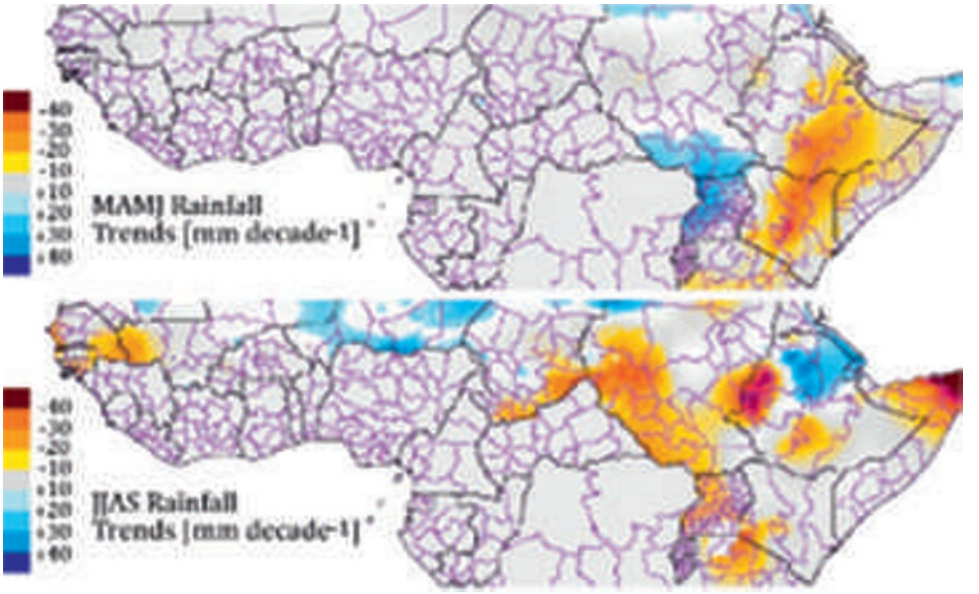
Figure 3.4 and map 3.1 show rainfall trends for the Sahel and East Africa from 1960 to 2009. There are marked differences, with a bi-modal rainfall distribution in most of East Africa, with short rains occurring from October to December and long rains from March to May. Further north (much of Ethiopia, Sudan, and Eritrea) a mono-modal cycle occurs, with the primary rainy season falling during June to September (Giannini et al. 2008). In the Sahel, rainfall is also mono-modal, with most precipitation occurring from June to September. Climate variability is one of the major characteristics of the drylands areas, with a coefficient of variation of rainfall[4] of 30 percent for the Sahelian areas and 44–65 percent in East Africa. This variability can be observed over time and space. Together with high temporal variability, the other main feature is rainfall's high spatial variability, given the storms that occur during the monsoon. As a consequence, rainfall can be very heterogeneous on a single day over a 10-km distance, and also highly variable over a year within a 20–30 kilometer range.

Figure 3.4 Annual Variation in Rainfall Index, Sahel, 1900–2010



Source: University of Washington Global Historical Climate Network Data.

Map 3.1 Rainfall Trends, East and West Africa Drylands



Source: International Livestock Research Institute (ILRI). Used with the permission of Polly Ericksen (ILRI). Further permission required for reuse.

Regarding past trends in the Sahel, the period 1900–1950 was marked by a fairly regular alternating pattern in which three to four humid years were often followed by one to two dry years. From 1951 to 1969, a long series of humid years occurred, followed from 1970 to 1993 by a long series of dry years. However, the period 1994 to 2011 was marked by alternation of one humid year followed by three to four dry years. Over the longer term, a picture of "re-greening" of the Sahel emerges, with, according to remote sensing indicators and ground observations, increased production on sandy or clay soils that dominate in pastoral sceneries, although on shallow soils there is a continued regression (Mortimore 2014). West Niger appears to be an exception to the regional trend to re-greening (Dardel et al. 2012; ECliS 2012).

For East Africa, the data show a definite increase in temperature over the last 50 years. Precipitation trends are much more difficult to assess, but the data indicate a decrease in March–June rains in much of East Africa, and a decline in June to September in some key parts of Ethiopia, Somalia, and Sudan. Figure 3.4 also shows a clear downward trend for the June to September rains and a highly variable trend for Kenya and Ethiopia for the March to June rains. However Washington et al. (2011) find disagreement among multiple data sets for 1961 to 2000, with either a drying trend or none at all.

For future trends, there is a large variability in the prediction of climate models, but there seems to be some consensus that a "significant decline in precipitation" will occur in the western Sahel (OECD 2010a), with no clear trend in the Central Sahel. For East Africa, the predictions are for increased precipitation (IPCC 2013), although the region has experienced at least five major droughts since the beginning of the century. Analysis of four global climate model outputs suggests that large areas of East Africa will experience greater rainfall intensity (Ericksen et al. 2013).

Natural Resources

Pastoralism has been defined as a finely-honed symbiotic relationship between local ecology, domesticated livestock, and people in resource-scarce, climatically marginal, and often highly variable conditions. It represents a complex form of natural resource management, involving the direct interaction between three systems in which pastoral people operate: the natural resource system, the resource users system, and the larger geopolitical system (Pratt, LeGall, and de Haan 1997).

Pastoralism is based on the grazing of natural vegetation, whose nutritional value and spatio-temporal distribution depends on the variability and intensity of annual precipitation. Access to grazing, crop residues, and water for livestock in the dry season is of critical importance. The highly variable rainfall is a primary driver of vegetation growth, which closely follows rainfall amount, frequency, and duration (Vetter 2005; Ellis and Galvin 1994). For example, the relationship between aboveground biomass and rainfall is about 8 kg Dry Matter (DM)/ha for every mm of rainfall over 20 mm in East Africa (Deshmukh 1984).

In the arid zones, mobile forms of livestock production are the only large-scale agricultural option. For West Africa, this normally involves a north (rainy season) to south (dry season) cyclic movement, with a growing tendency for movement deeper into southern regions in recent years. In East Africa, the movement of herds is less regular. Crop production may be practiced opportunistically in the arid zones, with highly variable results. In the semi-arid areas, agro-pastoralism combines grazing livestock with crop production, with varying degrees of intensity and integration between the two activities. Cropping can range from very opportunistic planting of some small plots in wetter areas or years, basically as "coping" strategy to complement livestock production, to a major settled economic activity providing an income diversification strategy to livestock production. Because cropping is becoming more common in all areas, the traditional distinction between pastoralists and agro-pastoralists is fading and might disappear. Data from Maasai communities in southern Kenya and northern Tanzania compiled by Homewood, Trench, and Kristjanson (2009) indicate that anywhere from one-half to more than 88 percent of these households cultivated crops in 2004, despite poor returns relative to other income sources and high risk of harvest failure. Traditionally, the majority of agriculture in drylands has been rainfed, but a notable increase in irrigation is attracting major interest (Sandford 2013; Mortimore 2014); this might affect critical dry season grazing and thus undermine the viability of the entire pastoral system. It might, however, be an interesting option for alternative sources of income to address the structural poverty of pastoral and agro-pastoral populations, as discussed in more detail below and in chapter 4.

For the Sahel, based on the analysis of the estimated average rainfall for the 2000–2010 period, Garba et al. (2013) provide the following zonal distribution:

- The Sahel-Saharan zone, with under 150 mm annual rainfall (that is, AI 1 = 0.00–0.05), is suitable for short-cycle plants and sparse perennial grasses that are grazed by herds (mainly camels and goats) managed by nomadic herders during their movements between available watering places;
- The northern Sahelian subzone, with 150–300 millimeters annual rainfall (that is, AI 2 = 0.06–0.20), almost no woody plant cover, and biomass production of up to 400 kg DM/ha (Boudet 1977), is mainly used by nomadic and transhumant herders;
- The typical Sahelian subzone, with 300–450 millimeters annual rainfall (that is, AI 3 = 0.21–0.50), characterized by a broad range of diverse vegetation types according to the main geomorphological units, is used for agro-pastoral production side by side with pure pastoralism. On sandy soil, there is barely 5 percent woody plant cover. Average annual grassy biomass production ranges from 500 to 2000 kilograms DM per hectare over a north-south gradient;
- The southern Sahelian subzone, with higher rainfall (450–600 millimeters) (that is, AI 4 = 0.51–0.65) and woody plant cover ranging from 5 to 30 percent over the north-south gradient, is mostly used for agro-pastoralism.

In all areas, the spatial distribution of forage resources is highly variable depending on soil type and land use. The quantity and quality of forages also vary widely over time, seasons, and total rainfall. For example, the feeding value quality of natural vegetation in the low rainfall, northern parts of the Sahel is much higher than in the sub-humid zones. Herd management strategies are defined by strong seasonal contrasts between highly digestible green fodder from two to three months of rainy season in the Sahel and straws and low digestible litter in the long, dry season, part of which is lost by livestock trampling, fire, and insects. As shown in chapter 5, forage resources meet the needs of the livestock population in certain areas and are chronically insufficient in others (Miehe et al. 2010).

While the Sahel has been often been associated with land and vegetation degradation (for example, Dregne (1986) and early NOAA (National Oceanic and Atmospheric Administration) studies by Tucker, Dregne, and Newcomb (1991)) highlighted the resilience of the vegetation and spoke of an "expanding and contracting vegetation." This resilience is demonstrated in photo 3.1.

Herd accumulation, often mentioned as one of the main driving forces of land degradation in the drylands, is a sensible strategy for the individual live-

Photo 3.1 Changes in Vegetation Demonstrate the Resilience of Sahelian Ecosystems

Source: Hiernaux et al. (2016).

Note: The photos on the left of the Hombori Hondo site (in April 1985 and September 2008) show the regeneration of the herbaceous layer with herbaceous annuals and development of a pioneer shrub population (*Leptadenia pyrotechnica*). The photos on the right of the Kelma Seno site (in September 1986 and September 2007) show the regeneration of the herbaceous layer with annuals and the collapse of the old population of the same pioneer shrub. These illustrate the strong resilience to drought of the herbaceous annuals and the more complex dynamics of the woody population.

stock keeper, considering his or her current social, institutional, and incentive frameworks. In particular:

- Lack of attractive alternative investments for the pastoralist, as livestock asset investments earn a much better rate of return given the lack of formal credit or other savings mechanisms available to pastoralists;
- Lack of alternatives to reduce drought or disease risks, leading individual pastoralists to increase the number of animals to spread those risks; and
- Open access grazing, which means that incremental costs of keeping additional animals are practically zero, leading to the very rational decision to keep more animals even if they gain very little weight.

It is therefore not surprising that Lybbert et al. (2004) and McPeak, Little, and Doss (2011) did not find any evidence that overstocking by other herders has an impact on individual herder behavior.

In West Africa, a clear change has occurred in the relationship between pastoralists and arable farmers/agro-pastoralists. In the past this interaction was quite peaceful, with a strong symbiotic relationship. Pastoralists benefitted from the grazing of crop residues such as millet straw, and arable farmers benefitted from the manure droppings that maintained the fertility of their cropland. These interchanges were based on pure commercial principles, with pastoralists paying for the grazing of crop residues in areas with a high livestock but low arable farmer density, and arable farmers paying for pastoralists to night corral their animals in areas with a low livestock but high cropping density (McCown, Haaland, and de Haan 1979). Further interaction included a lively barter of milk for grain, as well as exchanges of services, as livestock-keeping arable farmers gave their stock to pastoralists for herding ("*gardiennage*") and pastoralists provided animals for traction to arable farmers.

Over the past two decades, this finely woven fabric of resource use and resource users has frayed, as these symbiotic relationships have changed quite radically. Arable farmers have increasingly invested in livestock, whereas pastoralists have been forced to take up cropping because their herd sizes fall below the minimum size needed to sustain their households. The reciprocal incentives for cooperation are therefore disappearing and, indeed, are changing into a competitive relationship for access to dry season grazing and water, leading to crop damage along transhumant routes (de Haan et al. 2014). In Niger, in particular at Djougou, the largely resident livestock feed needs plus the spread of fires and reduced access because of rangeland fragmentation, earlier drying of ponds, and competition for other water points all generate temporary and localized deficits (ECliS 2012).[5]

Production and Trade

Production

While the livestock population has increased both in the Sahel and in the Horn of Africa, *productivity per head* (TLU) has remained generally flat (although fol-

lowing recent droughts, a small decline has been observed in East Africa; see chapter 2). The lack of productivity growth is often blamed on herd accumulation.

Table 3.1 provides an overview of key technical parameters that determine productivity in livestock systems, as estimated for this book through an extensive literature review and consultations with experts. They form the basis for the livestock modeling reported in chapter 5. More detailed data, including on small ruminants, are provided in appendix A.

Herd offtake figures for cattle in pastoralist systems are lower than in commercial ranching. For example, an 8–13 percent offtake is found when FAOSTAT data for cattle numbers and number slaughtered are analyzed for Ethiopia, Mali, and Niger. Even lower percentages are reported (3.3 percent) for the Borana in Ethiopia (Desta and Coppock 2004) through recall methods over the period 1980–1997. For purposes of this book, mortality losses from drought were assumed to be 15 times higher than in a normal season, which would point to a lack of market access or willingness to sell of the pastoralists. These Borana figures led a recent study by International Food Policy Research Institute (IFPRI) (Headey, Taffesse, and You 2012) to argue for a major transformation through modernization. However, as argued in chapter 4, there might be some underreporting of sales, overreporting of deaths, and a shift from cattle to sheep, goats, and camels. On the other hand, as reported on page 35, the productivity per hectare of traditional pastoral systems is still the same or superior to the production in commercial ranches under similar climates in Australia and the United States.

Table 3.1 Technical Parameters Used to Estimate Productivity in Cattle, by Production Systems, East Africa and West Africa

	*West Africa**		*East Africa***	
	Pastoral	*Agro-pastoral*	*Pastoral*	*Agro-pastoral*
Cattle fertility (%)	51	51	55	53
Calf mortality (%)	24	19	22.5	19
Adult mortality (%)				
Age 1–4	7	3	7.5	7
Age >4	6	2	6	5
Cow milk offtake (liters/year)	457		300	285
Cattle live weight at slaughter (kilograms)				
Male	297		300	
Female	227		250	
Offtake (%)	12	12	10	9.5

Notes: *Based on meta-analysis carried out under this study by CIRAD, and expert consultation in Dakar; **Based on expert opinion and literature review by International Livestock Research Institute (ILRI) in particular from Shaw et al. (2006) and Shaw et al. (in press).

Trade

Pastoral production systems have long relied on trade, and the income earned from livestock sales is important to food security and income generation (Hesse and Cavanna 2010). For both regions, domestic trade is the most important subsector. Little (2013) estimates that for East Africa, more than 90 percent of livestock and meat trade is domestic. Considering the increased demand for meat from growing urban populations, it can be expected that the importance of the domestic market will increase even further.

But international trade is important as well, especially as governments often promote exporting. In East Africa, the Common Market for Eastern and Southern Africa (COMESA 2009) estimates the annual value of trade across five border areas (Ethiopia/Somaliland, southern Somalia/northeastern Kenya, southern Ethiopia/northern Kenya, western Ethiopia/eastern Sudan, and northern Tanzania/southern Kenya) to have a value of US$61 million annually. Much of this trade passes through unofficial channels and is therefore difficult to measure. The same COMESA brief estimates that intraregional trade has a value more than 10 times that of extra-regional trade. Export trade is significant for Somalia, Somaliland, and Ethiopia. In spite of the long running civil war, FEWS NET (Famine Early Warning Systems Network) and FSNAU (Food Security and Nutrition Analysis Unit) data estimate that 2.5–3 million animals are exported from the Berbera and Bosaso ports in Somaliland and Somalia, respectively, with about for example in the port of Berbera 60–70 percent of animals originating from Ethiopia. In 2012, Somalia and Somaliland together exported over 4.8 million animals to the Middle East (*Financial Times* Nov 25, 2013, based on data from the FAO FSNAU). Ethiopia's total exports of livestock and livestock products are valued at US$300–455 million, of which between US$150–300 million passes through informal channels (Gebremariam et al. 2013).

Significant differences exist between East and West Africa's national and regional policies with respect to the importance and potential for domestic and international (export) trade (for example, Moritz et al. 2010; Hesse and Cavanna 2010). In West Africa, North-South regional trade networks and the proximity of large urban centers to pastoral and agro-pastoral areas have allowed domestic and regional livestock markets to flourish (Turner and Williams 2002; Moritz et al. 2010).

In East Africa, public support for pastoral livestock markets has been less substantial, even though livestock production contributes a significant percentage to national GDPs (Hesse and Cavanna 2010). Exports to the Middle East remain important (Scoones and Woolmer 2006), and donors continue to invest in export schemes (Aklilu and Catley 2009). Verbeke et al. (2009) attributed a stronger market orientation among pastoralists in Kenya compared to Tanzania and Uganda to an institutional environment that is more conducive to the market participation of traditional cattle keepers. In general, richer pastoralists benefit more from market participation than do poorer ones (Turner and Williams 2002; Aklilu and Catley 2009). This is a function of several factors, including the

minimum herd sizes needed before market-oriented production is deemed viable, cash available to buy herds, social capital and information needed to negotiate good prices, access to credit, and transport infrastructure. More wealthy livestock keepers also have the capital to invest in fattening animals, as well as the means to obtain health certificates for export, licenses, and letters of credit.

Trade in milk is largely informal, although a more formal camel milk trade is slowly growing in Kenya. It should also be noted that trade in camels to the countries around the Persian Gulf is an emerging new opportunity, as Ethiopia, Kenya, and Somalia have a combined camel population of over 10 million and prices are good (Mahmoud 2013).

In West Africa, also almost all livestock trade is in live animals, inasmuch as current policies have been unfavorable to the development of animal product processing. The value of trade in live cattle increased in real terms from US$13 million in 1970 to US$150 million in 2000 (Williams, Spycher, and Okike 2004). Livestock trade from Sahelian countries to the coastal countries passes through three main corridors. In the West, the important flows are to Senegal, which imports more than 300,000 head per year from Mali and Mauritania. In the center, Côte d'Ivoire imports hundreds of thousands of animals per year from Mali and Burkina Faso. During the 2000s, trade with Côte d'Ivoire suffered significantly from political and military conflicts. Finally, the heavyweight of the subregion remains Nigeria, which dominates the transactions in the eastern corridor. Nigeria imports about 500,000 head per year, primarily from Chad, Cameroon, Niger, and Burkina Faso (with animals transiting through Togo and Benin).

Transaction costs in live animal trade are high. Transportation and handling costs can represent 40–60 percent of all cross-border trade costs involving live cattle, excluding the purchase price of the animals. This is in part because of illegal taxes levied by veterinary and custom control posts along the road by different institutions,[6] although the West African Economic and Monetary Union (WAEMU), which includes all Sahelian countries, has made a major effort to harmonize sanitary and custom standards.[7]

The West African drylands are a net importer of dairy products. Intensive dairy farms with imported dairy breeds are developing around urban centers, and increased use of crop byproducts has enabled agro-pastoralists to increase milk production as well. However, this is not enough supply to meet the growing demand. For example, the four west Sahelian countries, all members of WAEMU,[8] imported a total of 434 million liters in 2010, or about 15 percent of their total consumption. Despite commanding a higher price than imported milk powder, locally produced milk is attracting growing interest from local dairies, because it can be used to produce products with higher added value (Duteurtre and Corniaux 2013).

Few data exist on the competiveness of current production, but the general opinion is that the drylands red meat sector can compete with imported meat in the lower end of domestic markets. Local dairy production can compete in the fresh produce market, but not with imported milk powder.

Vulnerability and Poverty

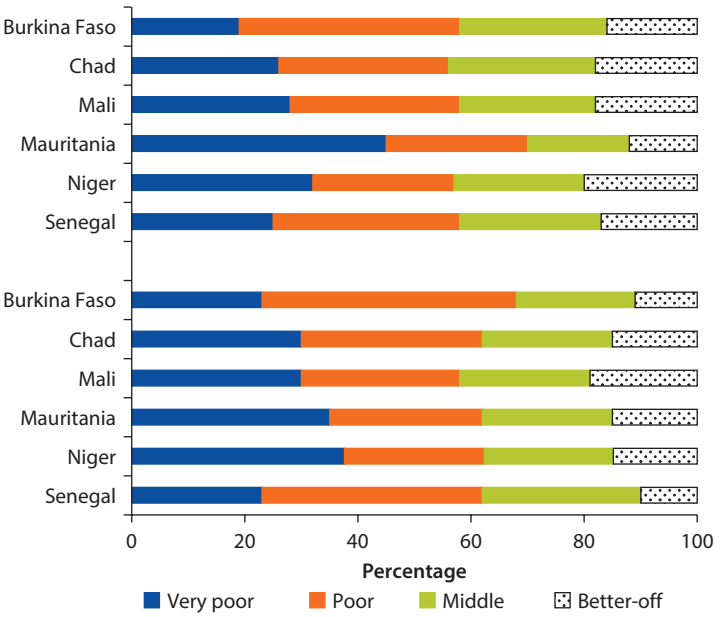
Asset (Livestock) Ownership

In many drylands regions of SSA, livestock systems are increasingly coming under pressure. Pastoral and agro-pastoral people alike have become highly vulnerable, and live perpetually in poverty or on the brink of it (figure 3.5). First, according to International Livestock Research Institute (ILRI) data (chapter 2), approximately 85 percent of pastoralists and 77 percent of agro-pastoralists live below the poverty line of US$1.25 per capita per day. Second, the basis of their livelihood is extremely narrow, as their livestock ownership is below the minimum required to meet their basic needs, avoid livestock inbreeding, and recover from drought. The minimum values cited in the literature range from 2.5 to 4.0 TLU per capita for pure pastoral households and about half that for typical agro-pastoralist households as they can supplement their livestock income with income from cropping activities (Sandford 2013).[9] A longitudinal study for East Africa carried out under PARIMA and summarized by Lybbert et al. (2004) estimated 15 TLU per household. A summary prepared by Food and Agriculture Organization of the United Nations (FAO) provides a range of 3.1–14 per AAME (African Adult Male Equivalent), or 15–70 TLU per household (Rass 2006).[10]

Most drylands households currently do not have anywhere near that many livestock: using ILRI data, the estimated 25–41 million pastoralist livestock keepers hold about 52 million TLU (equivalent to less than 1.7 TLU per capita), and the estimated 72–91 million agro-pastoral livestock keepers hold an estimated 71 million TLU (less than 1 TLU per capita). While official sources of livestock population data are often criticized for lack of precision, the data of Niger–which recently (2007)[11] carried out a comprehensive census and therefore has better-quality livestock data–confirm the Sahel-wide data. According to the FAOSTAT (2011) Niger data, which incorporate the results of the census, the country has 6 million and 2.7 million TLU in pastoral and agro-pastoral systems, respectively, owned by 3.2 million pastoralists and 4.6 million agro-pastoralists, or 1.9 and 0.6 TLU per capita, respectively. Given these and the prevailing low levels of production, these households have no possibility of earning a decent livelihood or recuperating from weather-related shocks.

These region-wide figures are confirmed by area-specific findings. For example, de Leeuw et al. (forthcoming) find that in most of the Kenyan arid and semi-arid land (ASAL) districts, livestock holding per capita has dropped to below 1 TLU. Osano et al. (2013) found 46 percent of households in 2008 and 80 percent of households in 2009 in southern Kenyan sites with livestock holdings below the threshold. This is of concern given the evidence of growing inequity in pastoral systems (Aklilu and Catley 2009; Homewood, Trench, and Kristjanson 2009). Households below this level find it difficult to move out of poverty even in good periods, while those households with higher levels of livestock can reproduce herds after droughts, but also use their animals for the critical social networks on which they rely (Little et al. 2008).

Figure 3.5 Incidence of Poverty in Pastoral and Agro-pastoral Populations, Sahel Region



Source: Household Economy Approach (HEA) Sahel profiles, 2008 to 2013 (http://www.hea-sahel.org/).

From the same survey, Little et al. (2008) reported that 70 percent of households had livestock holdings below 4.5 TLU per capita, whereas McPeak and Little (2014) highlighted the inequality, with a Gini coefficient for livestock ownership of 0.64, whereby the upper 10 percent of households control 42 percent of the livestock wealth. A similar picture is given by Homewood, Trench, and Kristjanson (2009), who show that in southern Kenya and northern Tanzania, the wealthiest 20–25 percent of households own 45–66 percent of all animals across their five study sites. At the same time, herds are being consolidated in the hands of so-called "traders" in East Africa (Catley, Lind, and Scoones 2013) and by government officials and traders in West Africa. Also Lybbert et al. (2004) show a long-term trend of declining herd size, at a rate of about 1.7 TLU/household/year, indicating a lack of resilience to fully recuperate from a drought shock. Shifting species composition (from cattle to small ruminants and camels) might be another cause.

The SHIP data from five focus countries[12] represented in chapter 5 provide a similar disquieting picture, with between 70 and 95 percent of pastoral households owning less than 15 TLU, although as argued in chapter 5, some underreporting of livestock holdings might have occurred in this survey.

In practical terms, this is shown by a survey carried out in Niger in 2009 (Save the Children UK 2009), which showed that approximately 57 percent of Katsinawa agro-pastoralists and 63 percent of Bororo pastoralists are below the threshold of 3 TLU per adult, with Katsinawa agro-pastoralists owning 1–5

cattle, 10–25 small ruminants, 2–4 donkeys, and 3–7 poultry and borrowing 0–2 cows, 1 goat, and 0–1 sheep; Bororo pastoralists own 3–6 cattle, 10–15 small ruminants, 2–3 donkeys, and no poultry. Given the productivity levels reported above, it is obvious (and confirmed by other field surveys and the modeling work herein) that no decent living can be expected from such meager resources.

Income and Expenditure

The major differences observed among drylands livestock keepers with respect to wealth are also reflected in their income sources and degree of diversification (Little et al. 2008; Homewood, Trench, and Kristjanson 2009; McPeak, Little, and Doss 2011). An in-depth analysis of data gathered from March to June 2002 in northern Kenya and southern Ethiopia as part of PARIMA, covering a drought and an early recovery (McPeak and Little, 2014), shows that even with a herd size of 26 TLU per household (4.4 TLU per capita), total income (for example, with home consumption of milk and meat from their own herd) amounted to only US$0.46 per day. Households with, on average, 7.3 TLU (0.9 per capita) earned a total income of only US$0.20–0.27 per capita per day. At least 40 percent of income from the small herd-owning households and 50 percent from the larger ones was from milk sales and home consumption. The calculations in chapter 5 confirm these low income levels.

If income derived from livestock is as modest as these examples suggest, clearly additional income sources will be needed, particularly for the poorer households. Surveys carried out in the Sahel show that outside employment can be a major source of income for poor households, whereas for wealthier households, the major sources of income include sale of cereals, livestock, and livestock products. As one author put it, "Wealthier households live by their production, but poorer households live by their work" (Holt 2011). A similar picture emerges from the report produced by Save the Children UK (2009) and partners using a Household Economy Approach (HEA) (see below): in Niger, the "better-off" and "middle" agro-pastoralists and pastoralists get almost 65 percent from livestock, while the "very poor" make only 10 percent from livestock. In terms of consumption, food purchase (cereals and other foods) is the main expenditure category, accounting for 75 percent of annual income of $US48 per person year cash income for the poorest agro-pastoralists and only 20 percent of the wealthiest group (US$134 per person per year cash income).

Remittances are an important source of income for inhabitants of the Sahelian drylands, including pastoralists. For example, it has been estimated[13] that 82 percent of households in four Nigerien departments[14] receive remittances; from 45 to 87 percent of these revenues are used for food purchases. The drop in remittances due to the war in Libya ranges from 51 to 75 percent.

The degree of food diversification at the household level depends very much on income level (the wealthiest households consume a larger share of milk than the poorest households, for example). On average, the "better-off" and "middle"

households spend two to three times more to access basic services such as education, health, etc. The handful of small ruminants owned by poor households are often sold or exchanged for food during the lean season. Rarely can small ruminants be used to get out of the poverty trap; poor households consume practically no animal products and have to buy most of their cereal food.

Poverty

The low asset base and modest level of income results in widespread poverty among drylands livestock keepers. In the four arid lands districts of Turkana, Marsabit, Wajir and Mandera in Kenya in 2005–2006, 74–97 percent of ASAL residents were counted as poor (Government of Kenya 2009), versus 46 percent of the general population. In Ethiopia, poverty levels of 36.1 percent and 32.8 percent are reported in ASAL areas such as Afar and Somali region, respectively, relative to a national level of 38.7 percent (MFED 2013). The lower level in Ethiopia might have been caused by different definitions of the poverty level. A more dramatic picture emerges from household surveys for four consecutive dry seasons (McPeak and Little 2004) in the pastoral areas of southern Ethiopia and northern Kenya. There, 49 percent of households wholly or partially dependent on pastoralism were below an income poverty line, which was set at a value equivalent to *half* the level of the UN extreme poverty line (US$1 of 1993 purchasing power parity) per person per day.[15] Data from northern Kenya show poverty incidences (which include income, assets, and food contributions of livestock) ranging from a high of 73 percent to a low of 13 percent, and a low correlation with market access (Little et al. 2008).

It has often been mentioned that income figures for pastoralists frequently omit nonstandard measures of income, since conventional estimates derived from household income alone omit the asset value of livestock (Little et al. 2008; Aklilu and Catley 2009) and fail to recognize that livestock are also a source of insurance, prestige, and other sociocultural values, providing a better livelihood than would appear considering income alone. While this argument might be valid for the wealthier and older parts of the population, for the poor and younger groups, the prospect of a decent income in the future will probably be critical, and household income is considered a critical indicator to assess the livelihood conditions of these livestock-keeping populations.

Food Insecurity

Similar to income level, the level of food insecurity among livestock-keeping groups is difficult to assess. Milk has traditionally been at the center of pastoral diets, but considerable variation exists among wealth groups. Seasonal and interannual variability also exists in terms of households' reliance on milk versus other sources of protein and calories (Sadler et al. 2010). In East Africa, the trend of purchasing more grains is increasing, and grains provide more calories than milk. Poorer households have less milk for either animal or human consumption, and

they often trade the milk they have for grains. More pressure on the little milk they have, however, also means that there is less milk for young animals, which increases calf mortality (Sadler et al. 2010). These same authors suggest that the role of milk in pastoral diets may decrease as pastoralists keep fewer cattle and more small stock. Meanwhile, milk markets are developing with the increases in urban populations. Sedentarization (settlement) can have a negative effect on household food security, as settled groups have less year-round access to milk, especially during the dry season when animals move (Fratkin, Roth, and Nathan 2004). These authors also found that human morbidity and poverty were higher in settled communities, leading to more food insecurity and disease prevalence. Deveraux (2006) notes a real paradox for some pastoralists, based on analysis of data from the Somali region of Ethiopia. Somali pastoralists have greater wealth relative to highland farmers, but are intensely vulnerable to livelihood shocks, particularly drought and conflict.

The close market integration of pastoralists and agro-pastoralists (Wane et al. 2010) can have a negative impact on food security. Milk that was once available for household consumption—and a particularly important food for children—may either be sold or left for consumption by young animals to promote their growth and improved production of meat for sale. Especially for poorer households with small herds, the effect of increased market involvement on milk availability and child nutrition is a concern (Sadler et al. 2010). On the positive side, the efficiency of extensive milk production systems has been demonstrated, for example, in Mali. This finding considers the positive role of extensive livestock systems in harsh environments, beyond food production alone (Vigne et al. 2013).

Chronic food insecurity clearly prevails in some pastoral areas and may have increased over the past decade, with repeated droughts triggering food insecurity. Reliable long-term data on child malnutrition are hard to find, and often the main evidence used is the number of people requiring food aid after a drought. The repeated triggering of such drought-related crises increases vulnerability, causing widespread malnutrition. In mid-2011 at the height of the last drought-related crisis, the Food Security and Nutrition Working Group reported global acute malnutrition rates of 38.3 percent across 18 areas in Somalia, 37 percent in Turkana, 24–27 percent in 11 northern Kenyan districts, and 25 percent in Bale province of southeast Ethiopia (FSNWG 2011).

The Result: Food Aid Dependency

Pastoralists and agro-pastoralists are highly dependent on emergency aid, as shown in table 3.2. They often live on the brink of poverty as their asset bases are too small when they are hit by conflict, insecurity, or drought. In East Africa alone, major droughts have occurred in 1998–2001, 2003/04, 2006, 2008, and 2009, with 42 million people displaced (of which a large proportion are likely pastoralists and agro-pastoralists).

Table 3.2 Impact of Drought Events, Ethiopia and Kenya

Major Drought Events	*Country*	*Humanitarian Aid Received (US$ millions)**	*People Affected (millions)*
2011	Kenya	427.4	3.75
2011	Ethiopia	823	4.5
2009	Kenya	432.5	3.79
2008	Ethiopia	1,078	6.4
2006	Kenya	197	2.97
2005	Ethiopia	545	2.6
2003/04	Kenya	219.1	2.23
2003	Ethiopia	496	12.6
1998–2001	Kenya	287.5	3.2

Source: Venton et al. (2013).
Note: *For Kenya, Government of Kenya and international humanitarian aid, for Ethiopia, international humanitarian aid only.

Education and Health

Indicators of educational participation and achievement have long been lower in mobile pastoral communities compared to national averages. Morton and Kerven (2013) cite data from Carr-Hill and Peart (2005) comparing gross enrollment ratios from 1999 to 2001; in Kenya, these rates were 12.9 percent in mobile communities versus 87.6 percent nationally, while in Ethiopia the discrepancy was 10.6 percent versus 57.4 percent. There is dearth of data about education in Sahelian nomadic areas. Despite this, Swift et al. (2010) cited information provided by national agencies in Chad estimating that only 2 percent of children were enrolled in primary education in community schools in nomadic areas. It should be noted, however, awareness is growing about the importance and benefits of education for mobile pastoralists (Little et al. 2008; Kratli 2000; Swift et al. 2010), with recent recognition that education is important for diversification.

Similarly, access to good health services is constrained by distance from urban areas, low population densities, and political marginalization. In Kenya, only 33 percent of people in the drylands areas have been vaccinated against measles, compared with 72 percent nationally; in Ethiopia, it is 28 percent versus 66 percent (Morton and Kerven 2013 citing Ali and Hobson 2009). They also have constrained access to clinics and other preventative services (Cohen 2005).

Exposure to Shocks

The exposure to shocks of livestock keepers is, to a large degree, determined by herd mobility, disease prevalence, market integration, and governance structures. Each is detailed below.

Mobility

The degree to which livestock-keeping households are exposed to shocks is greatly influenced by their mobility. When drought hits, disease strikes, or con-

Table 3.3 Comparative Productivity of Commercial Ranching and Open-Range Pastoral Production Under Comparable Ecological Conditions (Ranching = 100%)

Country	*Pastoral vs. Settled Ranch Productivity (%)*	*Unit of Measure*
Botswana	188	kg protein per hectare per year
Ethiopia (Borana)	157 (relative to Kenya)	MJ (Mega Joule) per hectare per year of gross energy edible by humans
Kenya (Maasai)	185 (relative to East Africa)	kg protein per hectare per year
Mali	80–1,066 (relative to United States) 100–800 (relative to Australia)	kg protein production per hectare per year
Uganda	667	Uganda shillings per hectare per year
Zimbabwe	150	Zimbabwe dollars per hectare per year

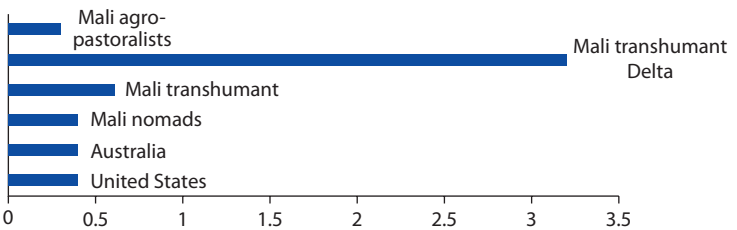
Source: Behnke and Abel (1996); Ocaido, Muwazi, and Opuda-Asibo (2009).

flict erupts, mobile households can move away to avoid being affected. Pastoral households are the most mobile, making them arguably less exposed to these types of shocks. Agro-pastoral households often have the ability to move their animals as well, but generally over shorter distances, leaving them more exposed to shocks. Quite a body of evidence now shows the superiority of mobile systems over sedentary ranching systems in terms of risk mitigation (table 3.3).

The comparison of mobile pastoralist systems with semi-mobile agro-pastoralist systems gives mixed results. On one hand, the review of livestock performance indicators (10) shows slightly higher mortality figures in the mobile, pure pastoral systems. On the other hand, earlier research on the Baggara in Sudan (Wilson and Clarke 1976) and in Niger (de Verdiere 1995) shows better performance for the mobile systems. The above-mentioned research in Mali (Breman and de Wit 1983) illustrated in figure 3.6 also shows the superiority in production of protein per ha of transhumant systems to ranching systems under similar climates in Australia and the United States.

Governments have had an ambivalent attitude towards mobility, and policy and legislation often offer mixed support for securing mobility. The need for stricter administrative control and the possibility of better service delivery in

Figure 3.6 Protein Yields in Extensive Systems in Mali, United States, and Australia (kilograms per hectare)



Source: Adapted from Breman and de Wit (1983).

health and education have often been used as arguments by public authorities to justify the promotion of sedentarization. Moreover, over the past two decades, mobility has become more restricted for reasons such as conflict, land expropriation, and changes in land tenure that favor privatization. This is still generally the case in East Africa, where there are no integrated or comprehensive national or local land use plans. The situation in Sudan offers an example of the way in which insecure land tenure undermines pastoralism. Pressures on pastoralist groups and their relations with other groups (farmers) over access to natural resources are a main underlying cause of conflict in Sudan (Young and Osman 2006). In other parts of East Africa, such as southern Ethiopia and southern Kenya, large livestock owners are adopting individual tenure and enclosing rangelands because individual titles offer improved security of ownership (Mwangi 2007; Tache 2013). Excision of key resource areas further undermines the ability of rangeland ecosystems to support livestock production. The fragmentation of range and forestland into small plots can lead to degradation and reduce livestock output (Hobbs et al. 2008). For example, the Thornton et al. (2006) model results show that in Kajiado, Kenya, subdivision of group ranches into small plots reduces the total number of livestock that can be sustained overall by more than 50 percent. Households then have to sell more animals for cash to buy food, so overall herd sizes continue to decline. The consolidation of larger private landholdings can exclude poorer pastoralists. Ironically and erroneously, in southern Ethiopia, managing drought risk is cited as one reason for the increase in enclosures, along with the rise of crop-based agriculture and private fodder production for animals on their way to markets (Tache 2013). In another estimate of the impact of expropriation of communal lands for irrigated agriculture, Behnke and Kerven (2013) estimate that denying herd animals access to bottom lands in the Awash valley of northeastern Ethiopia has a direct and significant effect on their productivity, resulting in almost total loss of GDP from such activities. Only very recently has the need for mobility been acknowledged in Uganda and Tanzania (chapter 4).

In West Africa, pastoral rights, including the right of mobility, are better defined. Several Sahelian countries have passed pastoral laws or codes that define the rights of pastoralists, including Mauritania (2000), Mali (2001), Burkina Faso (2003), and Niger (2010). Thébaud and Hesse (2008) provide a balanced review of these codes' contribution to pastoralism. On the positive side they: (i) give herders rights over the common use of rangelands and priority—albeit not exclusive—rights over resources in their "home areas," as well as rights to compensation in the event of loss of their lands to public interest needs; (ii) provide greater recognition of customary tenure arrangements, including the principle of decentralized natural resource management, and multiple and sequential use of resources by different groups at different times of the year (for example, herders' access to harvested fields); and (iii) reduce the need to manage conflict at the local level. Niger's pastoral code is the most recent (2010) and probably the most advanced, as it very explicitly recognizes that "mobility is a fundamental right of

herders and transhumant pastoralists." Implementation is still incipient in part due to lack of funds, but conflicts have practically disappeared in the regions where transhumance corridors have been marked.

Some of the earlier "codes" adopt a more technocratic and development-oriented approach in support of pastoralism. For example, Burkina Faso's pastoral code still provides for the establishment of special grazing reserves (*zones pastorales aménagées*), seeking to replace customary systems of resource access (driven by what is perceived by outsiders to be rather "messy" processes of social and political bargaining between actors) with a more orderly and technical system. It is erroneously believed that this would make pastoral production in the Sahel more secure. More recently, as exemplified by the recent Nouakchott Declaration, a general consensus seems to have developed exclusively recognizing "pastoralism as an effective practice and lifestyle suited to the Sahelo-Saharan conditions" as well as the right to mobility (Nouakchott Declaration 2013). Thebaud and Hesse (2008) made the point that "water rights are crucial to pastoralists to manage grazing lands sustainably and endow pastoral communities with assets that can be negotiated to access distant resources in times of crisis," but in the codes a functional link between access to water and access to grazing is often missing. The role of management committees is limited to surveillance of the water infrastructure, excluding the use of grazing resources or control over the number of livestock using the well.

More recent evaluations in West Africa confirm the above assessment. A recent review by the ECliS project (2012) notes that despite recent advances in legislation dealing with the pastoral economy, especially in Sahelian countries, and in regional regulations (UEMOA), pastoral mobility is increasingly hampered by the expansion of crops, but also by land policy and local governance. Rights on pastoral lands generally remain precarious and are not recognized by institutions (HLPE 2011), especially in the strategic areas of lowlands, riverbanks, wet valleys, forests, and pastoral reserves (Ickowicz et al. 2012b).

Disease Prevalence

Throughout most of the drylands, livestock are distributed sparsely over vast areas, making herd-to-herd transmission and therefore large-scale epidemic disease outbreaks relatively infrequent. Rinderpest, which some decades ago killed millions of animals, is officially eradicated. Regarding other contagious diseases, according to the World Organization for Animal Health OIE-WAHID[16] database, which is based on official national reports, the incidence of contagious bovine pleuro-pneumonia (CBPP) is sporadic in the Sahelian countries and most East African countries, with a somewhat higher prevalence in Ethiopia. *Peste de petits ruminants*, a contagious disease of sheep and goats, has a higher but still limited prevalence. Underreporting might be an issue here. However, parasites and nutritional deficits cause high levels of mortality and major production losses of livestock in the drylands especially for young animals, where environmental, feed, and sanitary factors combine to result in high mortality rates of

around 20–25 percent in East and West Africa (Ezanno, Ickowicz, and Lancelot 2005; Ickowicz et al. 2012a).

Sudden emerging livestock diseases and related sanitary bans put livestock keepers at a high risk of exposure. For example, Little, Teka, and Azeze (2001) illustrate how disease outbreaks linked to extreme weather (floods), especially Rift Valley Fever (RVF), are difficult for pastoralists to manage as they are infrequent and their impacts are poorly understood. The 12-month ban imposed by Saudi Arabia in 1996 on the import of all live animals reduced annual incomes of pastoralists in Somaliland by more than US$20 million and regional state revenues by about 45 percent. Nin Pratt et al. (2005) studied the effect of a further sanitary export ban from 2000 to 2003 imposed by Saudi Arabia and the Gulf States for RVF in Kenya. They showed that almost the entire population on the Somali-Ethiopia border was exposed to the price shock resulting from the ban. Not only did GDP drop by US$91 million (25 percent) in nominal terms, but pastoralists' livelihoods were also severely affected by the ban: pastoral income dropped by about 25–30 percent; the herd composition changed from cattle to goats and camels; and the number of animals per herd fell. In particular, the poorest pastoralists changed their consumption patterns, decreasing their purchases of food and grain. Marketing agents such as traders, brokers, transporters, and even clothing retailers experienced negative effects on income and the volume of business, while grain producers and retailers slightly improved their income.

Market Integration

Contrary to common belief, most households that depend on livestock as a principal livelihood source are reasonably well integrated into the market, both for livestock and for grains. This has obvious advantages, but it also leaves them exposed to price shocks (Ickowicz et al. 2012a; Aklilu et al. 2013). For example, Desta and Coppock (2004) found that over the 1980–1997 period, more than 90 percent of livestock keepers in northern Kenya and southern Ethiopia had been involved in livestock marketing. Regarding grain, falling per capita herd wealth encourages the exchange of protein for calories, that is, the sale of high-priced animal products to purchase cheaper grain (Ensminger 1996; Bollig 2006). Increased market integration can be both a boon and a hazard for pastoralists. On the positive side, Little et al. (2008) stress that the "caloric" terms of trade usually favor pastoralists who sell a few animals to purchase cereals and finance other needs. However, particularly in times of drought, livestock prices generally decline, but grain prices rise, and the greater reliance on cereals increases the exposure to price shocks. For example, Ickowicz et al. (2012b) found in a market survey in three Malian villages that the goat/cereal price ratio in good years was about double that of a bad year. They found also that greater market integration and related price volatility at the international level, such as the grain price spike in 2008, were transmitted to the cereal/livestock price ratio in the rural areas of the Sahel, and affected the more intensive livestock farms through higher feed prices. During the feed and food price spike, there were exceptional sales of small ruminants because farmers were forced to sell

more to cover their expenses (food consumption and water). The structure of sales of adult cattle could also change, with more beef offered on the markets as well as cows with calves instead of the culled cows usually sold, illustrating the weakening of the pastoral micro-economic model (Wane et al. 2010). Similar effects to those in response to drought are described in Gitz and Meybeck (2012).

Governance Structures

Conflict and insecurity are prevalent features of life for many pastoralists in arid and semi-arid zones and represent a significant obstacle to long-term development. Often localized in their immediate manifestations, they are also linked to longer-term and higher-level factors, including contested borders, failures of policing, and divisive politics, combined with long-term economic marginalization (Pavanello and Scott-Villiers 2013). Localized conflicts can lead to more widespread, even cross-border, instability. de Haan et al. (2014) distinguished four different causes of instability and conflict: (i) religious extremism, such as Al Qaeda in the Islamic Maghreb (AQIM) and Al Shabaab in Kenya and Somalia; (ii) rebellion and irredentism (that is, pan-nationalism based on ethnicity, such as in the case of the Tuareg and Toubou in West Africa); (iii) criminal activities (drugs, smuggling, kidnapping, and money laundering); and (iv) localized conflict between arable farmers and pastoralists over crop damage from livestock, access to water, and dry season grazing.

Regarding the latter, population growth combined with steady increases in animal numbers have led to increased competition for grazing land, particularly for the higher-potential dry season grazing areas, and water. For example, in the Sahel, cropland has increased 2.5-fold to the detriment of critical grazing areas, which have decreased by 13 percent. In parallel, the livestock population (expressed in TLU) increased 2.5-fold between 1961 and 2009 (SIPSA 2012). Various mining resources are also being tapped in previously grazed areas to meet urban and industrial needs. The changing relationship between pastoralists and arable farmers described above has further increased tensions.

This, in turn, has led to greater incidence of conflicts, which in the absence of effective governance systems sometimes escalate to major instability (OECD 2010b). The proliferation of small arms has increased the violence of cattle raids. Unclear governance arrangements (particularly devolution of power without budget, lack of participatory skills at the local administrative level, unclear and overlapping mandates of traditional and formal administrative systems, and governance structures that do not honor traditional institutions and arrangements) can exacerbate resource conflicts. Pastoralists have also lost trust in national and local administrations (Beeler 2006; de Haan et al. 2014).

Sensitivity to Shocks

The sensitivity to shocks of livestock keepers is to a large degree defined by their assets, their livestock vaccination coverage, and the number and diversity of their income sources. These factors are discussed below.

Assets

The size and composition of livestock ownership significantly affect households' sensitivity to climate-related shocks and disease shocks. Households with larger holdings, consisting of different species, can better spread climatic risks as they can divide their herds and deploy them to different locations. In contrast, households with smaller herds, consisting of the same species, are more sensitive to climatic risks and disease outbreaks, not only because their animals tend to be physically located in one place, but also because their lack of political and economic influence means their animals often get crowded out from critical dry season grazing areas. And as indicated before, livestock ownership is increasingly dominated by wealthy traders and civil servants.

Vaccination Coverage

Livestock vaccination clearly reduces households' sensitivity to contagious diseases. As indicated above, according to the official OIE database, the incidence of the major contagious diseases in drylands is limited, although the real prevalence might be masked because of underreporting. Further reduction and eventually eradication might be difficult, however. The highly mobile, low-density livestock population, spread over vast areas, results in high transport costs for already underfunded animal health service delivery systems, and means that effective vaccination coverage is generally very low (for example, it is only 20 percent in Senegal).

Number and Diversity of Income Sources

Households with multiple sources of income are less sensitive to shocks affecting a given income source than households that rely exclusively on a single income source. Remittances, of critical importance to survive any of these shocks, are increasing, probably for both pastoral and agro-pastoral systems. For example, the above-mentioned household survey in West Africa (Holt 2011) shows the importance of: (i) income from casual labor[17] and remittances, in particular for the poor; (ii) diversification in species composition of the herd (small ruminants, camels); and (iii) diversification of outputs, with the sale of milk of critical importance for women. Ridgewell and Flintan (2007) highlighted the importance of the collection of other range and forest byproducts, such as gum arabic, fuel wood, and medicinal plants. However, as shown by Devereux (2006), these other activities are less financially attractive than livestock or crop farming: livestock and crop production yielded a monthly income of Ethiopian Birr (ETB) 210 and ETB 216, respectively, while charcoal production and firewood collection resulted in income of only ETB 88–100 per month.

Ability to Cope with Shocks

The coping capacity of livestock keepers is influenced by their access to assets (particularly the amount and distribution of physical and financial assets), social

capital, safety nets, and technology services. The first three are detailed below, technology services are described in chapter 4. As described in box 3.1 and box 3.2, livestock systems in the Sahel and the Horn of Africa feature similarities but also differences when it comes to coping strategies.

Assets

After a shock has hit, a household's ability to cope with the effects and rapidly rebuild its livelihood depends in large part on its assets and the degree to which they can be liquidated and re-procured. Savings accounts held in financial institutions are perhaps the most liquid, but pastoralists generally distrust them. Only a small proportion of pastoralists hold some wealth in bank accounts; most use informal savings and credit mechanisms through shopkeepers (Morton 2007).

Social Capital

Households that have experienced shocks may be able to rely on social capital to help them cope. Following cultural traditions, relatives of distressed households frequently contribute resources to help distressed households get through periods of crisis. However, the social cohesion of pastoral people is deteriorating, both at the household level and at the clan level, as described for the Turkana in East Africa (Galvin et al. 2008) and the Fulani of Niger (Niamir-Fuller 1998), although the rate at which this social "glue" is disappearing varies according to ethnic group. The rebellion of many youth against traditional hierarchical authority structures and increasing levels of conflict are at least partially caused by competition for resources and the financial attraction of criminal activities. One potentially positive trend is the growing number of pastoral organizations (for example, the Pastoral Forum in Ethiopia; and the RBM/*Réseau Bilital Maroobé* and the APESS/*Association pour la Promotion de l'Elevage au Sahel et en Savane* in the Sahel). Kenya's former Ministry for Northern Kenya and Other Arid Lands, although now disbanded, made some key strides in getting recognition for the importance of pastoral rights and economic activities (Elmi and Birch 2013).

Safety Nets

Safety nets, including various types of emergency relief programs, can play an important role in helping rural households cope in times of crisis. However, because of their marginalization, pastoralists are often discriminated against or even excluded from safety net coverage. If poorly delivered—for example, if the aid ends up on the black market or benefits the wealthy—it can cause discontent and contribute to rebellion. Reasons for the lack of a timely and effective response in affected pastoral zones include: lack of available information; refusal to declare an emergency; the greater complexity of intervention in pastoral areas; security constraints for international staff; and lower priority given to pastoral zones by donors and governments (Sahel Working Group 2011).

Box 3.1 Vulnerability and Resilience in the Sahel: Senegal Case Study

Introduction

Almost 68 percent of Senegalese households own livestock. Senegal's livestock system remains dominated by traditional activities (for example, those that cannot be measured exclusively in quantitative or monetary terms). Livestock activities occupied 30 percent of the active workforce and contributed about 4 percent of gross domestic product (GDP) in 2006–2009. The system has significant nonmarket drivers that may be as or more important than market drivers.

Senegal has three main livestock subsystems:

- The *pastoral system* in northern Senegal (the Ferlo), which occupies 64,000 square kilometers, 31 percent of the national territory, with density between 2 and 10.6 TLU per kilometers;
- The *agro-pastoral system* in southern and eastern Senegal, mainly based on mobility and use of natural grazing and crop residues. Sales are mainly driven by financial emergencies, scarcity of pastoral resources, increasing land competition, bushfires, water access, weakness of animal byproduct markets, and structural lack of basic infrastructure (IDELE-CIRAD-CA17 2012); and
- The *intensive system* in urban and suburban areas (the Niayes), with animal disease (trypanosomiasis) in the so-called risk areas. These areas have high calf mortality, short length of lactation and milk production, low live-weight, and commercial disincentives to production (38 percent lower sales in risk areas) (Wane 2012).

Alternatively, it is possible to distinguish between: (i) the intensive commercial sector, which deals with disease and input price fluctuation at the production level; and (ii) the extensive pastoralist system, which traditionally faces climate and socio-anthropogenic changes including ineffectiveness of decentralization policies and weakness of local organizations (Dia, Becerra, and Gangneron 2012).

Exposure to shocks

In the *Ferlo* pastoral area, climate shocks have considerable impacts on resources and pastoral herd performance. In a drought situation, feed largely constitutes of imported inputs (Harder and Jung 2008) affected by increasing prices (Assani et al. 2012) that make pastoralists' livelihoods more fragile. Their vulnerability specifically raises the lack of consideration given to the economic role and function of pastoralists. In the south and east agro-pastoral areas, the main shocks other than climate change are structural and governance related. Conflicts originate from the competition for resource access and the erosion of traditional management systems, heightened by political and/or ethnic tensions. Conflict breakouts lead to less accessible roads and marketing corridors and weak productivity, and to pastoralists hurriedly selling their stock. Thus, herd size drops below viability thresholds. In the *Niayes*, more intensive disease-risk areas, the main shocks remain climate change (extreme temperatures, droughts, flooding, etc.) and rapid population growth. This modifies the host-vector contacts, particularly for African animal trypanosomiases (Pagabeleguem et al. 2012). With

box continues next page

Box 3.1 Vulnerability and Resilience in the Sahel: Senegal Case Study *(continued)*

rapid population growth, land use competition between crops and livestock results in fragmented areas, and by extension, in changing disease patterns, with increasing pressure in low disease-risk areas from greater host-parasite-vector interactions (Van den Bossche et al. 2010) and reemergence of other diseases or strains.

Sensitivity to shocks

Climate and natural resources: Climate shocks remain a major issue with important impacts: simulations in semi-controlled areas show a significant decrease in plant biomass in 2011 (0.85±0.48 tons per hectare) compared to 1964 (1.71±0.64 tons per hectare) and the number of species declined from 168 in 1964 to 92 in 2011 (ECliS 2012). At the same time, over the past 40 years, the national herd has roughly doubled in size. Since the late 1980s, animal numbers have increased rapidly, on the order of 2–3 percent per year according to Senegal's National Livestock Services. In contrast, the previous two decades were marked by relative stagnation due to two severe droughts that affected the entire subregion. The relative share of cattle decreased significantly from 1970 to 2010 in favor of small ruminants. However, in terms of TLU, the cattle herd was and remains largely dominant.

Vaccination coverage: With a coverage of 20 percent, Senegal is far from achieving the OIE standards for immunization (80 percent) due to asymmetric distribution of veterinary services in livestock areas. The national immunization program sometimes does not account for some (re)emerging or parasitic diseases, and is challenged by insufficient and inadequate domestic production of vaccines and volatile international vaccine prices. In addition, counterfeit drugs, estimated at 50 percent of drugs sold in the country, are not controlled. The increased incidence and pathogenicity of disease strongly constrain economic and sociocultural activities, thus increasing livestock keepers' sensitivity to the loss of livestock productivity and diminishing small producers' food security.

Number and diversity of income sources: Sales of live animals provide over 97 percent of livestock keepers' total income. Agricultural products are used essentially as a means of subsistence and contribute only marginally to household income (2 percent). Farm activities are organized between livestock production mostly for the market (with limits imposed by food security constraints particularly for dairy products) and food crops for home consumption. Bovine sales are mainly of cattle, with cows having relatively less commercial value due to their provision of milk and calves. More male sheep (67–80 percent) are sold than females (33–20 percent). Animal sales are unevenly distributed (Gini index = 52.8) and closely follow ecological disparities between the very driest north (>50 percent) and the more watered south (<50 percent) (Wane, Ancey, and Touré 2009). With the development of wage labor (25 percent in the Ferlo), the poorest households obtain income for rebuilding the livestock population, particularly after crises.

Ability to cope with shocks

By staying pastoralist-focused, traditional actors continue even today to respond to production shocks with many strategies: mobility, forced sales, herd splitting, herd diversification, flexible social organization, seasonal labor, use of wage labor, transfer of fertility with crop

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Box 3.1 Vulnerability and Resilience in the Sahel: Senegal Case Study *(continued)*

systems, etc. Whilst international and domestic price fluctuations and sudden climatic events (for example, the cold rain events of 2002) remain risky at the production level, the shocks seem to be much greater at the enabling environment level. The inability or delay in responding to shocks probably poses the major risks (loss of access to lands, instability and inadequacy of policy and regulatory measures, failure to establish and operate quick and effective veterinary response plans). Some problems (shrinking space, decreasing forage production, decreasing biodiversity, falling incomes) or constraints (low productivity, water scarcity) could become future risks or shocks to pastoral production systems and pastoralists' way of life (sedenterization, population growth, expanding agriculture) if responses at the local, national, and international levels are not better organized.

Public actions for the livestock sector to address climatic shocks now focus particularly on safeguarding a permanent supply chain for feed. In 2012, 21,000 MT of animal feed worth around US$7.5 million were mobilized and made available to farmers at a 50 percent discount. This exceptional measure assumed that livestock keepers would manage (and bank) the revenue surplus provided by the sales of feed animals through this program for use in case of crises. There is also a potentially positive trend in the growing number of regional and national pastoral organizations, which facilitate dialogue between actors and prevent eventual conflicts.

Source: Abdrahmane Wane (personal communication).

Box 3.2 Coping in Marsabit County, Northern Kenya

Marsabit County in north-central Kenya is one of the most arid and most sparsely populated parts of the country. The lowlands that make up the majority of the land area include deserts, grassland, and rugged lava plains. Annual precipitation in the lowlands is around 300 millimeters, so agriculture and horticulture are not practiced except for very modest efforts to grow forage in gardens adjacent to permanent springs at the edge of the Chalbi Desert. However, three highland areas rise up from the lowlands—Mt. Marsabit, Mt. Kulal, and Hurri Hills—where precipitation is higher (around 600 millimeters per year for Hurri Hills and 800 millimeters per year for Mt. Marsabit and Mt. Kulal). These three highland areas serve important functions in the hydrology of the greater area, being the main source of both surface water and groundwater for many kilometers. The portion of the lowlands that lies in the center of these three highland areas—Chalbi—is an enclosed basin. The desert at the center of the Chalbi basin is actually a salt flat lakebed, which often has standing water for short periods each year.

The region is one of the most remote parts of Kenya, although it is gradually being incorporated into national road and mobile phone networks. In the lowlands, livelihoods are dominated by pastoralism; only a small percentage of the population has any livelihood source

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Box 3.2 Coping in Marsabit County, Northern Kenya *(continued)*

other than livestock and occasional food aid. While a trend toward households establishing permanent homes in one of the settlements has been going on for the past two or three decades, a significant portion of the population is still genuinely nomadic. Even for those who have settled, much of their herd remains mobile, part of the household—often the young men—moving with it. In the highland areas, especially Mt. Marsabit, agriculture is more common, although even here livestock are still a critical part of most people's livelihood mix.

Aside from drought, the main shocks to people's livelihoods are loss of livestock to disease, conflict, and theft. Patterns of livelihood diversity play a central role in sensitivity to all three of these kinds of shocks, although in two contradictory ways. On one hand, sensitivity is exacerbated by the overwhelming reliance on livestock. On the other, other forms of diversity at household, community, and clan levels help to compensate for the lack of diversity in the main livelihood activity. For example, there is diversity across space pasture and forage resources and of herd movement. Different herders, even if they have very similar herd compositions, may take their livestock to different places based on social connections and on personal knowledge of the territory. While this does not result in diversity within the livelihood of a household, it does result in diversity within the community, thereby spreading risk. Related to this is the practice of herd splitting, which can serve a number of functions at once: it allows each species of livestock to be taken to areas best suited for it; it helps to spread risk, especially risk of losses due to theft; and it helps to reduce concentration of grazing pressure. Another form of diversity is the livestock species mix kept by each household.

Central to the strategies that Marsabit pastoralists use to cope with drought is the role that livestock play as an asset buffer, the strategy being to increase livestock holdings as much as possible whenever conditions allow. The ability to cope is, in part, a function of herd size, and fluctuation in herd size according to the cycle of droughts is accepted as part of life.

Of course, water resources for livestock are also critically important. In the lowlands, water sources tend to be ephemeral, except for a few scattered boreholes and reliable groundwater located around the periphery of the Chalbi Desert. However, what is important for coping with drought is not water resources themselves, but the spatial relationship between water and pasture resources. Gabra pastoralists often remark that where there is water there is no pasture, and where there is pasture there is no water. This distribution of water and pasture results in a mobility pattern for some Gabra and Rendille pastoralists that is, in some sense, opposite to that of other pastoralists: for many households, livestock are moved to the driest part of the territory (near the Chalbi Desert) not during the rainy season but during the dry season; during the rainy season, livestock are moved away from the desert toward parts of the territory where pasture resources are better but where only temporary water sources can be found. Once those water sources have run out, it is time to move back toward permanent water. For those who follow this pattern, the challenge during a drought is not to find water—the oasis springs and shallow wells around the desert are permanent. However, during a drought the availability of forage around the Chalbi Desert goes from bad to worse. The challenge, therefore, is to find places where water and grazing resources are sufficiently close to

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each other. One of the interventions of development partners aimed at this aspect of coping with drought has been to make water available in what have heretofore been only rainy season grazing areas via emergency water tankering during droughts into areas with good pasture, construction of pans and rock catchments, and, in a few places with good pasture such as in the plains east of Hurri Hills, boreholes.

While some aspects of coping with drought have deteriorated over time, coping capacity in Marsabit County generally remains strong, although a distinction needs to be made between capacity for short-term coping and for long-term adaptation. Here too, the situation is complex. Social and institutional networks are an important dimension of adaptive capacity. Among the Gabra, social capital, embodied in practical ways in a variety of traditional stock sharing and restocking mechanisms, can be very strong. Institutional linkages within Gabra society can also be quite strong. On the other hand, institutional linkages that extend beyond Gabra communities to the district level and higher are few and weak. Robinson and Berkes (2011) argue that the weakness of these linkages places a stark limitation on the adaptive capacity of Gabra communities and households, which is only partly compensated by well-connected formal sector actors such as nongovernmental organizations (NGOs) and government agencies.

Source: Cornelis de Haan (personal communication).

Notes

1. Djibouti, Ethiopia, Eritrea, Kenya, Somalia, Sudan and South Sudan (combined), and Tanzania for East Africa and Burkina Faso, Chad, Mali, Mauritania, Niger, northern Nigeria, and Senegal for West Africa.
2. FAOSTAT data 2011.
3. TLU is a unit to aggregate different livestock species based on 250 kilograms live weight. Here, based on the West African standard, 1 TLU is equivalent to 1.0 camel, 0.7 cattle, 0.1 sheep or goat, and 0.01 chickens. In East Africa, the factors are 0.7 for camels and 0.6 for cattle; the others remain the same. These factors are also used in chapter 2.
4. Standard deviation/average annual rainfall.
5. ECliS was a research project (2009–2012) aimed at assessing livestock husbandry's contribution to the interactions between society vulnerability/adaptability and agro-ecosystem vulnerability/resilience in West Sub-Saharan Africa (SSA) (Senegal, Mali, Niger, Benin). The CIRAD team and its partners conducted this project.
6. http://www.oecd.org/swac/publications/38768799.pdf
7. http://www.standardsfacility.org/Files/Publications/STDF_Regional_SPS_Stategies_in_Africa_EN.pdf
8. Burkina Faso, Senegal, Mali, and Niger.
9. http://www.future-agricultures.org/pdf%20files/Sandford_thesis.pdf.
10. http://www.fao.org/ag/againfo/programmes/en/pplpi/docarc/wp37.pdf

11. This Niger census in 2007 revealed that the number of cattle was largely underestimated, as technical service estimate population (and report in FAOSTAT) on the basis of constant annual growth rates and overlook external events that may have a marked impact on herd dynamics and production (droughts, epizootic diseases, etc.) (SIPSA 2012). This is a problem affecting all Sahelian countries.
12. Burkina, Niger, and Nigeria in West Africa and Ethiopia and Kenya in East Africa.
13. Inter-Réseaux Développement Rural and SOS Faim Belgium, 2012.
14. Loga, Tahoua, Tanout, and Gouré.
15. Quoted by Sandford in http://www.future-agricultures.org/e-debate/pastoralism-in-crisis/7646-too-many-people-too-few-livestock
16. http://www.oie.int/wahis_2/public/wahid.php/Diseaseinformation/statusdetail
17. Wane et al. (2010) also highlighted that with the emergence of wage labor, the poorest pastoralists are increasingly providing labor to the wealthiest pastoralists.