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Horn of Africa: Responding to Changing Markets in a Context of Increased Competition for Resources

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Abstract

The livestock sector in the Horn of Africa is evolving rapidly as a result of internal and external influences affecting production, marketing, and utilization of livestock and livestock products within the region. These changes are related to increases in human population; reductions in the sizes of land production units; changes in accessibility to land; climate variability; changes in livestock disease challenges; and changes in market opportunities.

These changes have affected different production systems in different ways. In pastoral production systems they have resulted in reduced productivity, shifts in herd composition and size in response to changing productivity potentials, environments, social/cultural adaptations, and land use practices. In mixed crop–livestock production systems population increase, reduced accessibility to land, and agricultural intensification have brought about more integration of livestock with agriculture, leading to well-developed dairy production in certain periurban areas. Demand for livestock products has been high, and in some places this local demand is coupled with an export market of live animals and milk.

Livestock production in the Horn of Africa has suffered a great deal from high levels of insecurity in many parts of the region, which have caused loss of stocks, markets, and livelihoods, especially among pastoralists. In the past, the political economy in several countries has put pastoral livestock production areas at a big disadvantage compared to urban and crop-farming areas. However, pastoral communities have adapted to the new challenges.

This chapter also discusses policy and societal responses to overall changes in the livestock sector in the Horn of Africa. We draw implications about identifying effective policy interventions that have been or could be

put in place in different regions that could eventually contribute to improving people's livelihoods.

Introduction

Background

For the purpose of this chapter, the region of the Horn of Africa comprises the following countries; Djibouti, Eritrea, Ethiopia, Kenya, Somalia, Sudan, Tanzania, and Uganda. Most definitions of the Horn of Africa exclude Tanzania, but because of its ties with the other East African countries in the region it must be included here.

These countries are characterized by diverse but interlinked cultures and agroecological and economic conditions. They belong to different sometimes overlapping political and socioeconomic blocks. The East African Community (EAC) includes Kenya, Uganda, Tanzania, and now Burundi and Rwanda; the Intergovernmental Authority on Development (IGAD) comprises Ethiopia, Eritrea, Kenya, Uganda, Somalia, Djibouti, and Sudan. Tanzania is the only country included in this chapter that belongs to the Southern Africa Development Cooperation (SADC).

Role of the Livestock Sector

Livestock production is an important component of the farming system in the Horn of Africa, contributing to the livelihoods of an estimated 40 million poor people (Upton et al., 2005). The livestock sector contributes significantly to providing income, employment opportunities, and food security; provides agricultural inputs through manure and draught power; serves as a risk-hedging asset; and plays important social and cultural roles. The use of animal draught power and biogas as clean energy alternatives to fossil fuels shows the contribution livestock can make to improving the environment.

The livestock sector is also a major component of country agricultural activity, ranging from 20% of agricultural gross domestic product (GDP) in Uganda up to 52% in Kenya and 88% in Somalia. Its contribution to the overall economy is also high, exceeding 50% of total GDP in Somalia and 8 to 17% in the other countries (see Table 2.1).

At the local level, livestock is a primary income source for many smallholders (figs. 1 and 2). For instance, in Kenya more than 30% of household income among smallholders comes from milk (SDP 2004a, SDP 2004b, Bebe et al., 2003). As in most of the developing world, the role of livestock in food security often occurs on the farm. Livestock contribute to sustained food security beyond meeting basic nutritional needs (Simpkin 2005). The ownership of livestock allows producers to maintain a diversity of assets that decreases nutritional vulnerability during times of drought or other shock. In emergencies, livestock can be easily moved or hidden and can give families access to protein and energy in a pattern that has become known as “conflict foods” production (Knips 2004, Simpkin 2005). In semiarid regions the prices of sheep and goats per head are comparatively higher than those of a bag of sorghum or millet. Through income generation, the livestock sector also provides food security to non-livestock owners (traders, transporters, butchers) working in the sector.

In unstable currency markets and in the context of weak banking systems, livestock “banking” lends stability to the family economy. Livestock are also somewhat less perishable than other living assets, thereby providing resources (e.g., money, eggs, milk) during times of hardship. Livestock also play a social role in rural communities in many countries in the Horn of Africa as a symbol and store of wealth and a source of gifts or sacrifice during traditional ceremonies such as burial proceedings and tribal weddings.

Table 2.1. Livestock contribution to agriculture and to the economy Year 2000

Country	Share of Ag. GDP in Overall GDP (%)	Share of Livestock GDP in Ag. GDP (%)	Share of Livestock GDP in Total GDP (%)
Ethiopia	52.3	32.5	17
Kenya	19.9	52.4	10.4
Somalia	65.5*	88.2*	58
Tanzania	45.0	27.9	12.6
Uganda	42.5	19.8	8.1

* 1990 figure, last available.

Source: FAO 2006, Knips 2004.

Composition of Livestock

A wide variety of livestock types are kept in different parts of the Horn of Africa. The charts in Figures 2.3 and 2.4 show that cattle are the most common and have the widest distribution across the region, followed by goats and sheep. Chicken are also widely produced, by traditional subsistence methods in rural areas and by intensive production in periurban areas. Turkeys are kept to a much lesser extent, mainly by small-scale producers, especially in parts of Uganda and near urban centers in other regions. Pigs are reared both by small-scale producers in villages and at commercial levels in periurban centers. Donkeys are kept for traction in many areas, especially in semiarid and arid lands. In the highlands of Ethiopia, crossbreeds of horse and donkey are kept for use in transportation. Camels are kept by most pastoralists for meat and milk and for transporting household belongings during migrations. Rabbits are reared on a

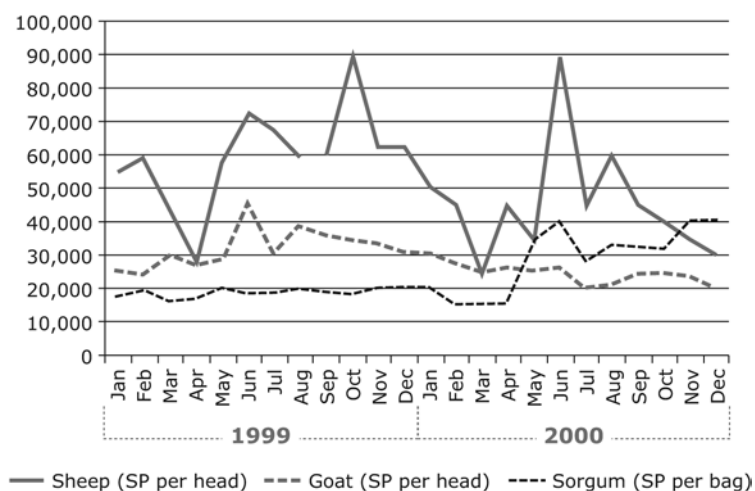


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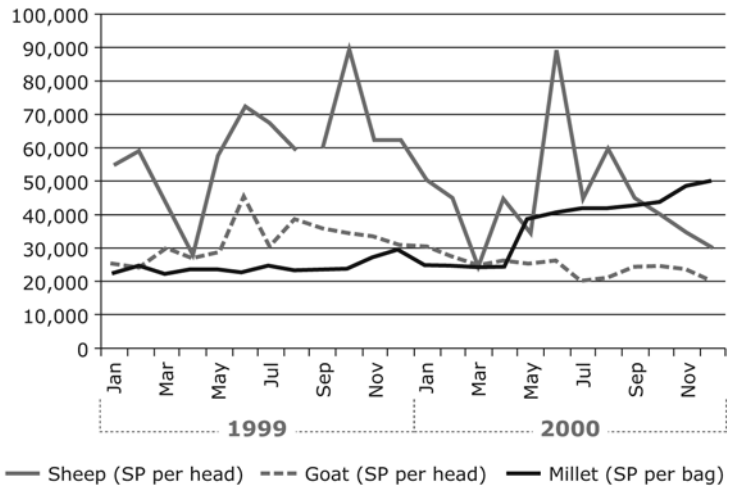


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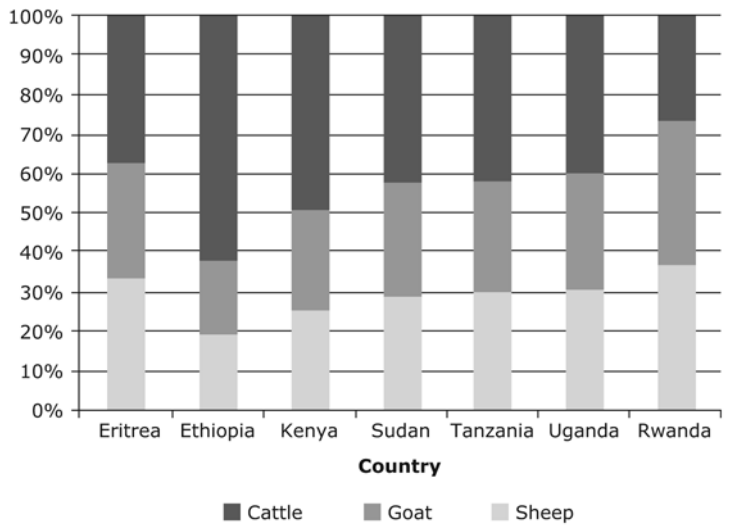


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relatively small scale for food and cash within the mixed crop livestock production systems.

Some Characteristics of Livestock Production Systems

Livestock production systems in the Horn of Africa vary mainly with the ecological potential of the area and can be characterized as follows:

1. Pastoralism (livestock only)
2. Mixed crop–livestock production systems (mixed irrigated and mixed rainfed)
3. Landless livestock production systems in rural and periurban areas

Figure 2.5 shows the distribution of livestock production systems according to agroecological potential and categorized into livestock-only, mixed irrigated, and mixed rainfed.

Pastoralism dominates the vast dry savanna rangelands. Geographically, pastoral systems are found in arid

and semiarid areas, except in Ethiopia, where pastoralism is practiced in some parts of the highlands (Seré et al., 1996). The pastoral system is dominated by nomadic livestock keepers who move from place to place with their stock in search of pastures and water, often within the range of their communal or clan territory. Livestock production among pastoralists and commercial ranches within pastoral areas is mainly for meat, hides, and skin and is characterized by rearing of indigenous breeds of cattle that are better suited to tolerate the prevalent dry conditions and diseases.

Despite their lower technological capabilities, pastoral communities have adapted to climate variability through sociocultural changes, including in livestock management, usually in response to climatic events such as drought (Galvin et al., 2001, Little et al., 2001). East African pastoralists have adopted a diversity of strategies to sustain production in the face of climatic challenges. These include moving livestock according to vegetation and water availability, changing the species composition of herds to take advantage of the heterogeneous nature of

the environment, and diversifying economic strategies to include agriculture and wage labor. These strategies are crucial for pastoralists' own livelihoods and important for national economies because pastoralists are responsible for providing a large share of livestock to markets in the region. In some cases some members of a pastoral community choose to migrate out of the pastoral system on a short-term or permanent basis, and this eases seasonal and drought-induced stresses among community members (Galvin 1992, Galvin et al., 1994).

Many pastoralists have become more sedentary, practicing crop cultivation in areas close to rivers and swamps so as to diversify their means of production, improve food security, and increase household income. Migration to work in towns is now common, especially among younger generations, whereas looking after livestock is left to the older generations. Scarcity of water resources has led to interventions by governmental agencies and donor communities to dig bore holes, dams, and water pans to provide water for animals and people.

Mixed crop–livestock production is practiced in the wetter subhumid and semiarid areas where rainfall is high enough to support cultivation of cereals and root crops. The geographical distribution of mixed crop–livestock systems in the Horn of Africa follows closely the elevation patterns. It is found mainly in areas with rainfall between 800 and 1500 mm per year (Maitima et al. 2004) but varies from place to place depending on other factors like soils and vegetation types and altitude.

In most humid areas of East Africa, the typical livestock production system is dairy production, and the main breeds are exotic cattle (Friesian, Guernsey, and Ayrshire) that produce higher milk yields than the indigenous breeds. This type of production system is practiced by sedentary farmers on individually owned land. Cattle are usually fed in small enclosures, supplemented by cut and carry of feed from other areas (Bourn et al., 2005).

The mixed crop–livestock system has been expanding in the Horn of Africa owing to the conversion of rangelands to cultivation (Olson et al., 2004). In some areas where rangelands have been converted to croplands there are mixtures of indigenous breeds and crossbreeds of indigenous and exotic species. Livestock products of most value in the mixed crop–livestock systems are meat and milk. Farmers in the mixed system also benefit from animal manure and draught power.

Landless livestock production is becoming more and more important with younger generations who have not yet been allocated land by their parents, and with people living in urban centers who produce livestock on small plots and undeveloped land owned by others. Although a few landless farmers have free-grazing animals, most animals are fed by tethering in communal areas like roadsides and under fruit trees in home compounds (Bourn et al., 2005, Canagasaby et al., 2005). Pigs and traditional chickens are kept within home compounds.

Urban and periurban industrial livestock keeping is a growing form of production within (intraurban) or on the fringe (periurban) of towns, cities, or metropolises, raising a variety of livestock at different scales. The animals raised are mainly dairy cattle, chicken, and pigs (Canagasaby et al., 2005). It is estimated that 200 million urban Africans will be partly dependent on urban agriculture for their food by 2020 (Urban Harvest 2004). Surveys have indicated for instance that one fifth of households in Nairobi, Kenya, and a half in Kampala, Uganda, were engaged in urban agriculture in the 1980s. Recent figures show higher proportions, especially in small and medium-sized towns. Horticulture and grazing are widely practiced along roadsides, stream banks, and in public and private vacant or abandoned land areas.

The impacts of farming system changes on the welfare of the region's livestock keepers, most of whom are poor, are difficult to assess without a prior investigation on the links and interactions among the drivers and their consequences. Such an investigation is important to help policy makers and researchers to identify appropriate responses to benefit the poorest farmers in the Horn. The information reported in this chapter is intended to fill this need.

Drivers

Livestock production in the Horn of Africa has undergone significant changes in the recent past due to a number of factors. These include changes in land use, growth in human population, technology adoption, socioeconomic forces (including market growth and liberalization, gender roles, and land policies), and the impact of livestock diseases and the interventions to control them.

Population Growth and Urbanization

Countries in the Horn of Africa have some of the highest rates of population growth in the world (Table 2.2). Kenya and Uganda, for instance, have witnessed rapid and steady growth in population for the last few decades, well above the average population growth of sub-Saharan Africa. This growth and the heavy dependence on land-based livelihoods have created an enormous amount of pressure on land leading to continuous subdivision of land into smaller production units, rapid land use changes, loss of vegetation cover due to conversion of natural vegetation to farms and grazing lands, loss of communal grazing and other communal lands, and increasing demand for food products.

Although human population has been increasing in almost the whole of the Horn of Africa, livestock population has either remained at the same level or, in some areas, has declined over time, especially on a per capita basis. For example, Jabbar et al. (2003) show that Ethiopia's per capita production of livestock and livestock products and export earnings from livestock have declined since 1974. The authors further report a general

Table 2.2. Some statistics for the Horn of Africa*

Countries	PPP GNI Per Capita	GNI Per Capita USD	GDP Growth (%)	Population Growth (%)	Malnutrition Prevalence (% of malnourished children under 5 years old)	Poverty Indicator (headcount ratio in % of population)
Ethiopia	780	160	8.7	1.8	47.2 (in 2000)	44.2 (in 2000)
Kenya	1540	530	2.8	2.3	20 (in 2003)	n.a. ^① ←
Tanzania	1200	340	7.0	1.8	n.a.	35.7 (in 2001)
Uganda	920	280	5.6	3.5	22.9 (in 2001)	37.7 (in 2003)
Sub-Saharan Africa	1840	745	5.3	2.1	29.4	n.a.

* The figures are from the year 2007 data, unless otherwise indicated.

Source: World Development Indicator database, World Bank 2008.

decline in the number of households owning different types of livestock and a significant drop in average livestock holdings per household in 1999 compared to 1991. High population growth in many countries in the Horn of Africa has created a scarcity of land within the high potential arable areas, resulting in migration into the pastoral areas. Land and resource disputes and conflicts in the region have sometimes led to full-blown conflicts over access to wetter, more fertile areas for farming and livestock keeping. However, in recent decades many sub-humid areas that had remained unoccupied for various reasons (mountain slopes, sacred forests, forest reserves, etc.) have been allocated or invaded by farmers from arid lands in search for fertile lands for cultivation. This has led to massive deforestation around all the major mountains in East Africa such as Mount Kenya, Kilimanjaro, and Elgon, the Mau escarpment, and others—leading to serious conflicts between communities, politicians, and conservations (Olson et al., 2004).

The growing population has spurred the already high demand for livestock products and put additional pressure on the inelastic domestic supply of livestock in each country. Because the per capita consumption of livestock products in some countries in the Horn of Africa was already among the highest in sub-Saharan Africa (as an example milk consumption per capita in Kenya reached 140 kg in 2004—four times the average in sub-Saharan Africa) high rates of population growth will increase consumption significantly. This trend of increasing livestock consumption is expected to continue as the countries' urban areas and economies expand fast.

Increased urbanization in many countries in the Horn has grown out of the development of markets for goods and services (e.g., tourism, manufacturing) with improved facilities and infrastructure that attract a growing number of migrants. Urbanization has also created livestock activities in periurban areas to satisfy urban demand in product quantity, quality, and form (e.g., ready-to-consume, or packaging for individual serving

sizes). Urbanization has therefore increased the need for more efficient distribution and delivery systems in the livestock sector of the Horn, and this can be seen in the shelves of bustling supermarkets and other food outlets in the major cities.

Economic Growth and Opportunities

Although the countries in the Horn of Africa include some of the poorest populations in the world, their economies have grown at an impressive pace in the past few years (see Table 2.2). This growth has occurred despite social and political crises, including wars over the last three decades. The growth has been highest in Ethiopia and Tanzania (Table 2.2). Such a high increase in income drives a surge in per capita consumption of livestock products long considered a luxury for the poorest. The high population growth of the region has increased livestock product demand even further.

Income growth, especially in the growing urban areas, is likely to shift consumer preferences toward safe and high-quality products. Development of the tourism industry, which contributes significantly to local and national economies, especially in countries such as Kenya and Tanzania, has enhanced this shift toward safer and higher-quality livestock products.

Economic growth in the Horn of Africa has also created resources to increase access to public services and development activities and has improved urban and rural infrastructure, communication, and education. Although the full effects remain difficult to assess immediately, these improvements have undoubtedly had some positive effects on the livelihoods of farmers and workers in the livestock sector.

Gender and age groups in the Horn of Africa, as in many other parts of Africa, have different roles in livestock production. But recent economic development has brought about some societal changes that have affected gender and age group roles in livestock production. For instance, an increase in school enrollment or emigration

to the cities has reduced the availability of young boys, who traditionally herd livestock. The task is then increasingly shared among other gender and age groups. Similarly, in many pastoral communities small ruminants are traditionally kept mostly by women, whereas large ruminants are mainly kept by men. But as men become more involved in cash cropping and in urban employment, women are increasingly taking over more responsibilities such as keeping and feeding large animals, in addition to their more traditional duties of milking and caring for young and sick cattle (Wangui 2003).

Environmental and Climatic Changes

Environmental changes in the Horn of Africa have been characterized by increasingly frequent and sometimes prolonged droughts (Nicholas 2002, Verschuren et al., 2000). These droughts have adversely affected livestock production, especially in the arid and semiarid regions where livestock production predominates. They have resulted in high livestock mortality, leading to high levels of poverty and hunger among livestock keepers—especially the pastoralists whose livelihoods depend almost entirely on livestock products. They have also affected the availability and distribution of livestock feed resources, resulting in reduced livestock numbers and changes in the types of animals kept by the pastoralists.

Climate change, as observed in the increasing aridity and spreading of deserts, has reduced primary productivity and water availability in many parts of the Horn of Africa leading to reduced carrying capacities of grazing systems. Figure 2.6a shows the dramatic shrinkage in surface areas of glaciers on Mounts Kilimanjaro, Ruwenzori, and Kenya due to global warming (Oludhe 2005)—over time this will reduce the availability of dry-season water for agriculture and livestock. Figure 2.6b shows the declining trends of June, July, and August rainfall patterns around Khartoum from 1961 to 2000 (Oludhe 2005).

Climate change poses many and diverse challenges to pastoralists. Although many parts of the Horn of Africa are experiencing drier conditions, northeastern Kenya is predicted to be slightly wetter than present in the coming decades and will have a much higher vegetation cover index than present (Andresen et al., 2008). This would promote replacement of the vast open grasslands by bushy shrubs, which may be less valuable to grazers such as cows, the livestock type preferred by pastoralists. Indeed bush encroachment is already reported in some parts of northern Kenya, where invasive shrub species like *Prosopis juliflora* are becoming common in grazing lands, reducing the quality of pastures.

Even in years of normal rainfall, there are often anomalies in rain distribution: too much rain may occur within short periods of time, resulting in floods, whereas other periods are characterized by long spells of drought. These variations affect both the distribution and the

quality of pastures available for livestock in pastoral areas and other affected regions where farmers practice open grazing systems.

Market Liberalization and Global Policies

Livestock product markets in the Horn of Africa have become more and more open to global and regional markets. For example, in Kenya, liberalization of the milk and dairy market began in the mid-1980s and continued until the early 1990s. A number of measures were aimed at reducing or eliminating government control and regulations over breeding services, milk marketing, and dairy processing. Because Kenya's dairy farming had been overtaxed for decades, elimination of government intervention in 1992 had a significant impact in improving income at the farm and especially postfarm levels (Owango et al., 1998, Ngigi 2005). Ethiopia, Uganda, and Tanzania have conducted similar domestic and border policies that have led to a more open livestock market. The World Bank's Structural Adjustment Programmes have pushed for reduction in Kenyan government subsidies to agriculture and for privatization of many agricultural services. The privatization of veterinary services, however, has had serious negative impacts on the livestock sector in rural areas, often making such services unavailable except within the urban and periurban areas, where such negative effects were somewhat attenuated (FAO 1999).

In Ethiopia, an important recent change due to more open markets has been the development of capacity for exporting chilled and frozen meat to the Middle East. This involves the establishment of new, privately owned and operated abattoirs. This situation provides an opportunity for producers to directly supply animals for export. However, lack of education and experience may limit participation of pastoralists or other rural poor livestock producers in such opportunities.

In Somalia, livestock production and livestock exports have been the backbone of the economy, providing broad financial benefits to pastoral households as well as supporting livelihoods at the ports. Compared to other nomadic livestock systems the Somali system is relatively more market oriented. Despite political and economic crises, wars, and the absence of clear trade policies, Somalia has remained a major player in cross-border livestock trade in the Horn of Africa. Rough estimates from unofficial sources indicate that over 90% of Somalian livestock exports per year go to the Arab gulf countries, most of them to Saudi Arabia.

The opening up of markets in livestock products (meat and dairy) has spurred competition between local and outside firms. It has also increased product variety, thus enhancing consumers' choice and welfare. The rises in consumers' incomes in both regional and international markets, combined with the increasing availability of competing products, have induced a strong shift in consumer

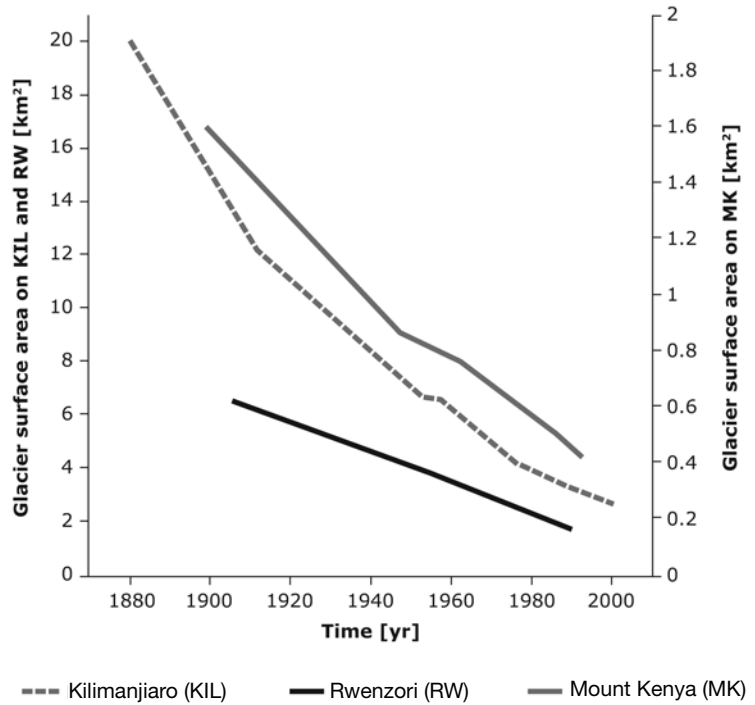


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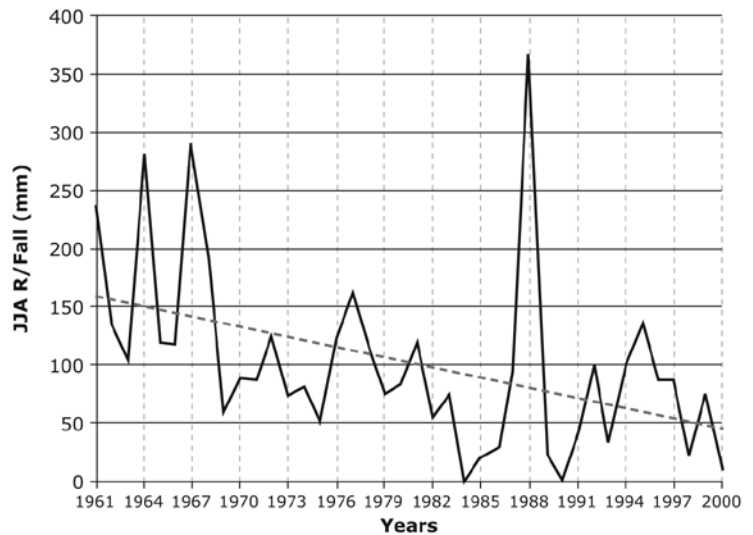


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demand and preference toward higher-quality products with a high level of accessibility. The needs to increase productivity and quality and to address shifting consumer preferences have promoted new market arrangements such as vertical integration and contract farming.

Increased trade openness (especially cross-border trade of live animals) has also had some drawbacks because it has increased exposure to animal diseases and accelerated the spread of these diseases in importing countries. The increased risk of animal diseases hampers the export of processed livestock products, especially under current tight sanitary requirements in major foreign markets. More importantly, although the livestock sector in the Horn of Africa region has been opened to

imported products, it suffers from limited access to regional and international export markets because of livestock policy distortions in developed countries. These distortions have depressed livestock producer prices in the Horn of Africa as producers try to compete in both domestic and international markets against developed countries' heavily subsidized livestock production and export.

Openness in the Horn of Africa has gone beyond trade in goods. It also includes financial openness that has brought inflows of capital investment, especially into Ethiopia, Kenya, Tanzania, and Sudan. For the livestock sector, these investments have both direct effects (e.g., improvement in livestock infrastructure in Sudan) and

indirect effects (e.g., credit access and improved communication networks).

Land Reform Policies

Issues of land tenure have dominated the Horn of Africa's political arena in livestock production. Whereas land tenure in almost all the crop–livestock mixed production systems is largely private, pastoral land is usually held under an access system of communal control. Land among the pastoralists is held by the community: landownership is a relationship between individuals and groups or tribes consisting of a series of rights and duties with respect to the use of land.

Where land reform policies have been introduced, they have become a major driver of change in livestock systems. For instance, transfer of land from large-scale to smallholder farmers has occurred during the postindependence period in countries such as Kenya and Uganda (Ngigi 2005). This transfer has increased the role of small-scale livestock keepers in livestock production. For instance, in a survey conducted in Kenya, 80% of smallholder respondents reported that they own their land.

High population growth in many countries in the Horn of Africa has created a scarcity of land within the high potential arable areas, resulting in migrations into the pastoral areas. Migrants move to wetter areas where they can practice crop farming. Introduction of croplands within the wetlands of the pastoral areas has created conflicts over access by livestock and wildlife to key resources such as water and pastures. These resources are critical for the survival of animals and humans, especially during periods of drought (Campbell et al., 2003).

Donors have also pushed for land tenure liberalization—in accordance with the World Bank's "security of property" paradigm. So far Ethiopia, Tanzania, and Uganda have resisted pressure for wholesale liberalization. However, all three found it necessary to move in that direction in order to foster an "enabling environment." Tanzania and Uganda enacted new land laws for this purpose, whereas Ethiopia modified its land policy (Fortin 2005, Harrison 2004).

Land reform policies have affected pastoralists' access to land in several ways:

1. Establishment of wildlife protection areas and private game and livestock ranches has denied pastoralists access to grazing lands, resulting in human–wildlife conflicts in many regions.
2. Land reform policies have tended to favor cropping and have ignored rangeland areas on the account that they have low productivity, especially of crops (Knips 2004).
3. Many governments promote sedentary livestock systems and fail to recognize pastoral livestock production as the best way to exploit rangeland resources.

4. Communal landownership, still practiced by pastoral communities, has denied individual legal rights of ownership, leaving land open for common use and overuse.
5. The traditional institutions and experiences of local communities in the management of grazing lands are rarely considered by central decision makers when they are creating policies and laws concerning resources that support livelihoods of local communities.

Animal Health

Livestock diseases have significant impacts on animal health and affect productivity, herd structure, and human health. Via product safety they also affect access to national and export markets. This section will review a few of these diseases in the Horn of Africa.

Rift Valley Fever

Rift Valley fever (RVF) is an acute febrile viral disease of cattle, buffalo, sheep, goats, camels, and humans caused by *Phlebovirus* (family Bunyaviridae). The disease causes livestock and human mortalities. The spread of the disease greatly affects pastoral livelihoods—in areas with RVF outbreaks, consumption of livestock products and animal movements are restricted to prevent transmission to humans. It is associated with climatic conditions of high rainfall following long periods of drought (Davies et al., 1985). These climatic conditions lead to high populations of *Aedes* and *Culex* mosquitoes, which spread the disease rapidly among livestock and humans (Linthicum et al., 1985).

Brucellosis

Brucellosis is a bacterial zoonosis caused by bacteria of the genus *Brucella*. The main hosts of *B. mellitensis*, *B. abortus*, and *B. suis* are goats, cattle, and pigs, respectively. Prevalence rates among cattle in Africa have been reported to range from 3 to 41% (Nakoune et al., 2004, Domingo 2000).

Drier environmental conditions found in most of the pastoral areas of the Horn of Africa tend to reduce infection and disease prevalence, whereas wetter conditions tend to protect the organism from the natural decontaminating effects of heat and sunlight. Movement of infected animals across borders, common in the Horn of Africa due to cattle rustling, interborder trade, and migration due to wars and insecurity increases the infection rate in susceptible herds. Animal management systems such as extensive pastoral grazing systems in Kenya (Omer et al., 2000); mixed breeds of cattle in Djibouti (Omer et al., 2000); and the practice of keeping sheep alongside goats in Uganda (Kabagambe et al., 2001), have been shown to contribute to the prevalence of disease. Once established in a herd, the disease leads to frequent abortions that affect herd structure, cause infertility, and affect

humans via consumption of animal products. By raising questions about product safety, it reduces market access and affects livelihoods.

Trypanosomiasis

Trypanosomiasis is a disease of cattle and humans caused by protozoan parasites of the genus *Trypanosoma*. *T. vivax* and *T. congolense* are important as cattle pathogens, whereas *T. brucei rhodesiense* and *T. brucei gambiense* cause acute and chronic human trypanosomiasis. The vectors for these trypanosomes are tsetse flies of the genus *Glossina*. *G. morsitans*, *G. austeni*, *G. pallidipes*, *G. swynnertoni*, and *G. longipennis* are classified as savanna species inhabiting grasslands where cattle are traditionally reared. However, they are capable of adapting to other ecological niches. The riverine *Glossina* species (*G. palpalis*, *G. tachnoides*, and *G. fuscipes*) are important vectors for bovine and porcine trypanosomiasis and chronic human disease due to *T. gambiense*. Asymptomatic infected wild ungulates serve as blood hosts, helping to maintain the trypanosomes and tsetse populations that transmit the disease to other animals and humans.

The disease in cattle causes economic losses due to low productivity (meat, milk, and traction power), treatment costs, and mortalities.

Bovine Tuberculosis

Bovine tuberculosis (TB) is caused by *Mycobacterium bovis*. Although cattle are considered to be the primary hosts of *M. bovis*, the disease has an exceptionally wide mammalian host range, which includes humans (O'Reilly and Daborn 1995).

M. bovis is a robust pathogen and may survive in the external environment in buildings, on transport vehicles, on pastures, and in slurry under certain climatic conditions for months and years (Wray 1975). Manure fertilization of arable land is a common practice in developing countries. *M. bovis* surviving in soil and slurry serves as a source of pasture and vegetation contamination and therefore a potential source of infection to animals and humans.

The losses caused by the disease derive from condemnation of infected carcasses, potential of transmission of disease to humans via consumption of meat and milk, and loss of external market access for export of live animals.

Contagious Bovine Pleuropneumonia and Contagious Caprine Pleuropneumonia (CCPP)

Contagious bovine pleuropneumonia (CBPP) is a highly infectious septicemic disease of cattle caused by *Mycoplasma mycoides* var. *mycoides* (small colony type). The agent is very susceptible to environmental temperatures. Transmission of the disease in the arid and subhumid tropics is from infected to susceptible animals by aerosol.

Frequent droughts in the Horn of Africa lead to pastoralists' movements in search of pasture and water. The stress of the movements may activate disease conditions in the carriers and convert them into active cases, causing spread of the disease in susceptible herds. International trade is another contributor to the spread of CBPP. Kouba (2003) reported that, of 117 Office International des Epizooties (OIE) List A disease cases communicated through international trade, CBPP accounted for 7.7%. This fraction would be higher if all countries fully reported their cases. Even where reporting is advanced incidence is probably much higher than reported.

The disease leads to loss of livelihood due to high mortalities and economic losses due to external trade embargo.

Rinderpest and Peste des Petits Ruminants

Rinderpest is an acute, highly contagious viral disease of ruminants and swine caused by *Morbillivirus* (family Paramyxoviridae). This occurs in many strains with considerable variation in virulence between them, but all are immunologically identical (Blood et al., 1994). In small ruminants, a disease similar to rinderpest, peste des petits ruminants (PPR), occurs. The disease is caused by a virus closely related to the rinderpest virus. The disease is more severe in goats than sheep, with case fatality rates of 55 to 85% in goats and 10% in sheep (Blood et al., 1994).

Herd migrations in search of pastures and water bring uninfected animals into contact with infected herds, and explosive outbreaks occur. Introduction of new animals into herds may serve as a source of infection. In cattle and small livestock, the disease leads to high mortalities causing losses to pastoral livelihoods. Exportation of animals and meat to external markets is prohibited from areas where the disease is thought to be endemic.

Tick-Borne Diseases (Theilerioses)

Theilerioses are tick-borne diseases caused by *Theileria* species occurring in cattle, sheep, and goats as well as in wild and captive ungulates. *Theileriae* are found throughout the world. Important pathogens of cattle are restricted to certain geographical areas of the world. *T. parva* is the most important member of the group occurring in East and Central Africa causing East Coast fever (ECF).

ECF is an acute disease of cattle caused by *T. parva* transmitted by the brown ear tick. ECF occurs in a less virulent form as corridor disease or January disease transmitted by *T. parva lawrencei* from buffaloes to cattle by *Rhipicephalus appendiculatus* and *R. zambeziensis*. Corridor disease occurs in eastern and southern Africa where there is contact between buffalo ticks and cattle. *T. velifera* is associated with mild theileriosis and is transmitted by *Amblyomma* ticks. The disease causes

economic and livelihood losses due to loss of production (milk), high treatment costs, and mortalities in susceptible herds.

Impacts of Changes on the Livestock Sector

Main Shifts in Production Systems

The livestock sector in the Horn of Africa has been influenced by economic, social, demographic, and environmental changes at regional and global levels. These changes bring opportunities for livestock keepers, but they have also had adverse impacts on production and marketing systems in the sector.

Population and income growth have increased demand for livestock products (Delgado et al., 1999, Simpkin 2005, Knips 2004) leading to higher production and profits for farmers, but they have also led to shrinking land parcels that can lead to land degradation, unless land management is improved. Moreover, urbanization and climate changes further reduce grazing areas and freshwater availability.

Countries in the Horn of Africa now experience a greater openness in livestock product markets along with innovations in production and distribution systems. These changes have led to new modes of livestock production and marketing characterized by contract farming, vertical integration, and the supermarket revolution (Simpkin 2005, Knips 2004). Harsh competition has also pushed toward higher productivity and quality. But open markets and increased standards raise the challenges for disease control, sanitary barriers, and intensification. They have also limited the access of resource-poor livestock keepers to these new production systems.

Another trend is that urbanization induces the development of periurban livestock production and creates new opportunities for farmers living at the edge of the cities. Moreover, the livestock manure from periurban centers is often used as organic fertilizer for greening some urban households and cities and for improving soil structure in rural areas. However, periurban livestock also increase water, noise, and air pollution.

Although the expansion of livestock rearing is often associated with land degradation, deforestation, and pollution of freshwater resources (de Leeuw and Tothill 1990), there is some evidence that well-managed grazed areas support higher biodiversity than cropped areas (Maitima et al., 2004, Pomeroy et al., 2003). Therefore, the impacts of the drivers of changes on livestock production systems in the Horn of Africa present some opportunities for improving the management of natural resources, especially toward a sustainable crop–livestock system.

Pastoral Systems

Approximately two thirds of the area of eastern Africa is inhabited by pastoral groups whose livelihoods depend

on rearing livestock in the pastoral production system. Many factors, including the following, affect the production capacity of pastoral systems and lead to insecurity of livelihoods:

- The changing agroecological conditions and physical characteristics of range resources
- Encroaching economic interests that seriously challenge the sustainable management of fragile rangelands
- Rights to access specific land resources at different times of need
- Political marginalization of pastoral interests in framing national policies
- Wars and civil unrests that create mass movements of livestock and people
- Transboundary diseases that threaten livestock populations

Insecurity is thus a permanent factor of life for pastoralists, and changes in their security situation can serve as a driver for changes in ranges, herd sizes and composition, and so on.

Since the 1900s the frequency and distances of herd movements have declined, and various forms and degrees of settlement have occurred among pastoralists. Spontaneous settlement is caused by a variety of factors: long droughts; encroachment of other land uses (Mkutu 2004, Leloup 1994); lack of infrastructure and social services; disease control policies (Morton 2001); shifting ownership; breakdown of customary pastoral social hierarchies; and insecurity. Governments sometimes promote settlement to intensify and commercialize animal production, to provide cheaper meat to urban areas, or to facilitate social control, administration, and delivery of social and livestock services (Pratt et al., 1997). Involuntary settlement of pastoralists by governments has also been reported in cases of dam construction, famine, and civil war (Larsen and Hassan 2003). In Kenya's Kajiado district and other Masai pastoral areas, there was a shift in the early 1970s from free grazing areas to group ranches with access rights limited to members of the group, but later most of the group ranches were subdivided into individual land holdings (Campbell et al., 2003).

The increasing role played by absentee investors/owners is another major trend. They contract pastoralists to herd their livestock, while often putting restrictions on livestock movements to facilitate control. For example, absentee livestock owners in the Sahel are increasing in numbers and are estimated to own 50% of livestock (Fafchamps and Gavian 1996).

Periurban Systems

A number of surveys have shown that livestock keeping is increasing in eastern African cities (Moshia 1991,

Lee-Smith and Lamba 1991, Egziabher 1994). The major reasons cited for livestock keeping in urban and periurban areas are provision of income, employment (direct and indirect), improved nutrition, food security, improved social capital, and financial security (access to credit and “bank on the hoof”). Land sizes where livestock is kept are diminishing; they average 0.75 hectares in Nairobi (Kang’ethe et al., 2005) and 0.42 ha in Addis Ababa (Tegegne et al., 2002). This has led to wide adoption of the stall-feeding system. The numbers of livestock kept vary, but the general trend in urban and periurban areas is that there are more chickens than cattle, sheep, and goats (Tegegne et al., 2002, Foeken 2005, Mlozi 2005, Owour 2003, Onim 2002, Kang’ethe et al., 2005). A species analysis of the market value of all the livestock in Kisumu and the Kibera district of Nairobi (Kang’ethe et al., 2007) showed that, although poultry are numerically the most common species kept, they constitute a much lower share of the market value of the livestock. In Kisumu, poultry accounted for only 9% of the total livestock market value compared to cattle, which constituted about 70%. In Kibera, where there were no cattle and pigs, poultry contributed 25% of total value, less than half of the contribution by goats, whereas the rest was contributed by sheep, ducks, geese, and rabbits.

Changes in Farming Practices

Nutrient Cycling, Land Use Practice, and Irrigation

For centuries, when population pressures were low in many parts of the region and availability of good arable land and grazing areas was high, farmers and herders in the Horn of Africa practiced nutrient cycling to sustain crop–livestock systems. During this time, land was used for cropping or grazing for an average of 2 to 4 years, followed by a period of rest (fallow) of 7 to 20 years, allowing soils to rebuild their fertility (Gachimbi et al., 2003). This land use practice was very efficient and required low inputs to sustain agricultural production.

Increasing population pressure and land subdivision have resulted in land use intensification and shortened fallow periods. Among the pastoral communities, grazing orbits have reduced, leading to keeping of smaller herds with more sheep and goats, whereas among the mixed crop–livestock systems more farmers are abandoning open grazing and adopting tethering or the more commercial dairy-based zero-grazing.

The increase in irrigation has led to increased cultivation in the drylands, reducing the amount of land available for grazing (Githaiga 2004, Olson et al., 2004, UNEP 2002). Large-scale irrigation has also resulted in environmental problems such as waterlogging and salinization, water pollution, eutrophication, and unsustainable exploitation of groundwater aquifers that degrade the drylands’ provision of environmental services. In such irrigation systems, rivers are often disconnected

from their floodplains and other inland water habitats, and groundwater recharge has been reduced. These human-induced changes have in turn had an impact on the traditional migratory patterns of wildlife and the species composition of riparian habitats. They have opened up paths for exotic species, changed coastal ecosystems, and contributed to an overall loss of freshwater biodiversity and inland fishery resources (UNEP 2002). Within the livestock sector, reduced availability of water has increased livestock–wildlife and human conflicts because humans, livestock, and wild animals now have to compete for water from fewer places. On the whole, there is a decline in biodiversity and services provided by inland water systems in drylands.

Fragmentation and Intensification

Changing land use policies have led to fragmentation of land and agricultural activity in the Horn of Africa as ownership shifted from groups to individuals. To make up for the lost revenue out of the shrinking land size, individual owners intensify their activities. Intensification of agriculture in these fragmented lands has promoted the type of livestock that do not need large spaces to grow, such as pigs and dairy cows. These policies have therefore encouraged the smallholders’ contribution to livestock production in the Horn of Africa. For instance, the share of smallholder dairies in Kenya’s milk sales rose from 35% in 1975 to 80% in 1995 (Knips 2004). Although most of the production from these smallholders still feeds into growing informal markets—as exemplified by the Kenya milk production where only 14% of milk production is processed (SDP 2004a, 2004b)—it has created revenues and employment within and outside the sector. These benefits from land reform policies have often not been balanced with better management practices for resources such as soil, pasture, and water.

Technology Adoption and Productivity

On average, livestock productivity in the Horn of Africa remains low, even by developing country standards (see Table 2.3), and this situation has not changed much in the last few years. The only exception is milk production in Kenya, where productivity has increased, in part because of the success of local projects such as the Smallholder Dairy Programme. The causes of slow growth in livestock productivity in the Horn include animal diseases, reduced grazing areas and lack of access to technology. Tribal and regional conflicts and lack of clear strategies on livestock production in some cases (Somalia) have also weakened livestock productivity.

Animal diseases reduce productivity through reduced fertility and degraded quality of livestock products, and especially animal mortality. A disease such as RVE, for example, can increase mortality by 10% in calves, causing a huge loss in productivity. CBPP increases mortality by 50 to 90% and morbidity by 75 to 90%. Saaed et al.

Table 2.3. Productivity for selected livestock products and countries 2005

Country	Beef Meat (carcass) Kg/animal	Milk Kg/animal
Ethiopia	108.4	200
Kenya	164	511
Somalia	110	348
Tanzania	107	174
Uganda	150	350
Canada	326	7596

→ Source: FAO 2005¹⁰

(2004) reported mortality rates of 21% in sheep caused by PPR in the northern state of Sudan. During the 1997 rinderpest outbreak among wildlife, Kock et al. (1999) estimated the mortality in buffaloes at 80%, whereas Abu Elzein (2004) reported 100% mortality rates in captive gazelles in Saudi Arabia, which had been imported from Sudan. Trypanosomiasis can decrease lambing and kidding rates by 37%, whereas brucellosis can reduce fertility due to large calving intervals and abortions (McDermott and Coleman 2001).

Moreover, the shrinking size of grazing areas has hampered the pastoral livestock access to required nutrition, and this has reduced their growth rates. Limited access to key resources such as feed grass and freshwater has further slowed animal growth. In addition, adoption of improved technologies and access to animal health services remain low in most communities. In the Amhara region of Ethiopia only 19 to 25% of households used purchased feed, whereas 33% used animal health services in 1991, rising to 55% in 1999. However, in 1999, returns to livestock were negative due to high mortality and loss of stock (Jabbar et al., 2003). Technology adoption in livestock production is lowest by far among pastoralists, especially in the fields of breed improvement, feeding, and processing of livestock products for markets. However, in the pastoral areas, there has been some significant improvement in technology adoption such as vaccination and control of epidemics for dealing with livestock diseases (UNEP 2002).

The quest to improve productivity in the Horn has induced the adoption of new production technologies such as artificial insemination to create more productive crossbreeds (Bebe et al., 2003). However, the levels of adoption remain low and vary widely between countries. For instance, 23% of Kenya's cattle herd are improved breeds, whereas the proportion in Uganda is only 4% (Knips 2004). Furthermore, changes in local and national government policies can greatly improve productivity levels in the Horn of Africa. The elimination of local and national taxation of livestock production and export has generated more revenues (Owango et al., 1998, Bebe et

al., 2003) allowing livestock keepers to access indispensable inputs to increase productivity and production.

Impacts On Natural Resources and Environment.

Increased Competition for Land and Livestock Feed Resources

Scarcity of livestock feed resources has been the major consequence of the changes in climate, social, and political scenarios described above. Reducing grazing orbits for most pastoralists has reduced availability of livestock grazing areas (Maitima et al., 2004, Olson et al., 2004, Reid et al., 2004). Climate variability and change have also resulted in changes in grass species composition. Within crop–livestock production systems, increase in land use intensification has also resulted in the shrinkage of grazing areas, forcing farmers to adopt new livestock feeding strategies like cut and carry of feed materials, tethering of animals around fruit trees, and setting aside certain areas (paddocks) for grazing (Bourn et al., 2005). Many farmers have been constrained to feed animals with weeds harvested from cropped areas and crop residues. Relatively rich farmers depend on industrially produced animal feeds. However, this requires high capital and is only economic when rearing exotic breeds (Canagasaby et al., 2005). As a result farmers in crop–livestock systems are changing their breeds from indigenous to exotic types, whose milk productivity fetches higher returns and can justify industrial feed products.

Urbanization and especially expansion of agriculture systems have reduced land availability. Moreover, government land reforms (e.g., in Kenya) have often changed land use from pastoral to agropastoral or in some cases to cropland (Olson et al., 2004). Since the 1920s, vast areas of natural rangelands in arid and semiarid regions have been taken over by cropping systems, private livestock and game ranches, nature reserves, and infrastructure. The rangelands most often encroached for these purposes include the best dry season grazing areas with the easiest access to water. As a result of encroachment, the total area and overall diversity and condition of the remaining rangelands have declined, while fragmentation (resulting from encroachment and land reform) has limited their accessibility.

Historically, communities in the pastoral areas have avoided cultivation of crops. However, over the last 25 years, they have rapidly converted semiarid grazing areas to agricultural croplands. The Masai in Kenya provide a useful example. Part of their motivation to turn to cultivation has been to protect the land from encroachment by other ethnic groups because farmers have more secure land tenure than livestock keepers (Campbell et al., 2003). The adoption of crop growing has also allowed them to capitalize on the cash market for grain, diversifying their income by growing maize and beans, while at the same time expanding their livestock herds.

Water Availability

Climate variability due to global warming, increased competition between crops and livestock, and increased irrigation have all contributed to reducing water availability. Reduced water availability leads to crop failures, lack of water and pasture for animals, and lack of food for humans and animals, leading to increased morbidity and mortality rates. Because these consequences are more severe in the arid and semiarid areas where pastoralists operate, climate variability and lack of water are responsible for loss of pastoral livelihoods and household assets, as well as increases in malnutrition and diseases for humans and animals.

Environmental Degradation and Pollution

Overgrazing has long been considered the primary cause of desertification in Africa. Overgrazing and land degradation can occur when livestock are forced to stay in a restricted area. However, under traditional mobile pastoralism, land degradation from overgrazing is often temporary. Because herds can visit different areas from one year to the next, stressed pastures get a chance to recover.

Recent work has shown that changing human activities are a major cause of land degradation (UNEP 2002). Increased population growth, privatization of rangeland, and encroachment of cropland have meant more frequent visits to the same pastures and less complete recovery. Because of the lack of natural feed resources and competition for land, farmers have cleared and burned forests and other dry vegetation on an increasing scale to extend pastoral lands and to stimulate fresh growth of grasses. Forest cutting for energy or for construction and craftsman use has also helped increase grazing land. These practices have not only aggravated land degradation but have also caused loss of biodiversity (UNEP 2002). The reduction of forest areas has also disturbed microclimates in livestock areas and increased runoff, helping to cause severe drought or flooding (Reid et al., 2000).

Expansion and intensification of livestock farming and processing have increased air pollution (odors, gas emissions) and noise pollution, especially in urban areas. Livestock activities can also cause water pollution (pathogenic microorganisms, eutrophication). Livestock depend on water from a variety of naturally occurring sources such as streams, springs, rivers and lakes, or human-made sources. Pollution occurs when animals concentrate around the water sources and contaminate with dung, urine, and soil from increased surface erosion, especially where those sources are shared by other users. Runoff from heavily manured fields and discharges from intensive production units, abattoirs, and processing plants into streams and rivers can have big impacts on aquatic systems, in particular eutrophication of water bodies and consequential algal blooms, composition of fish populations, ecological balance, and water quality (Bourn et al., 2005).

Demographic pressures including migration contribute to unsustainable development and food insecurity. The massive displacement and migration of millions of people from conflicts and/or environmental disruptions and their resettlement in concentrated densities in marginal areas are major contributors to land degradation and famine. These pressures are particularly pronounced in resource-poor areas.

Impacts On Food Security

The prevalence of malnutrition in the Horn of Africa remains high (Table 2.2). Livestock products play an important role in meeting food security, especially for the vulnerable (children and elderly) and for the low-income food insecure population—nearly 80% of Africa's population rely on agriculture for their income, and 75% of these farmers own livestock. But the rising demand for livestock products due to rapid population and income growth, coupled with the slow supply response to such high demand, has slowed improvements in food security in most countries. Per capita consumption of livestock products in the Horn of Africa has changed very little over the last 10 years, with the exception of milk consumption in Kenya, which had substantially declined during the 1990s and then rose to the original levels by the year 2000 (Figures 2.7a, 2.7b, and 2.7c). The consumption of livestock products in the Horn of Africa is in general far lower than consumption in developed countries. Moreover, these levels of consumption vary considerably by income level. The poor living in landlocked areas consume less livestock products.

Moreover, in areas where animals are important for draught power, reduced animal health leads to reduction in crop yields due to reduction in manure production and tillage. This tends to increase food insecurity and reliance on relief food (Mullins et al., 2000).

In times of severe drought, the typical emergency management response has been food and humanitarian aid to the affected areas. Unfortunately, resources allocated to caring for the symptoms have undoubtedly been larger than those directed toward addressing the root causes.

Impacts On Livelihoods and Poverty

Drivers of changes in and outside the livestock sector have enhanced the sector's direct role as provider of income and food among communities in the Horn of Africa. Moreover, livestock continue to form the basis for farmers' social and economic perspectives and can help make them less vulnerable to shocks. The increase in market opportunities arising from upward shifts in demand for live animals and processed livestock products has benefited some smallholder and landless livestock keepers, especially under local development projects.

At national and regional levels, poverty reduction is also affected by spillover effects of livestock sector

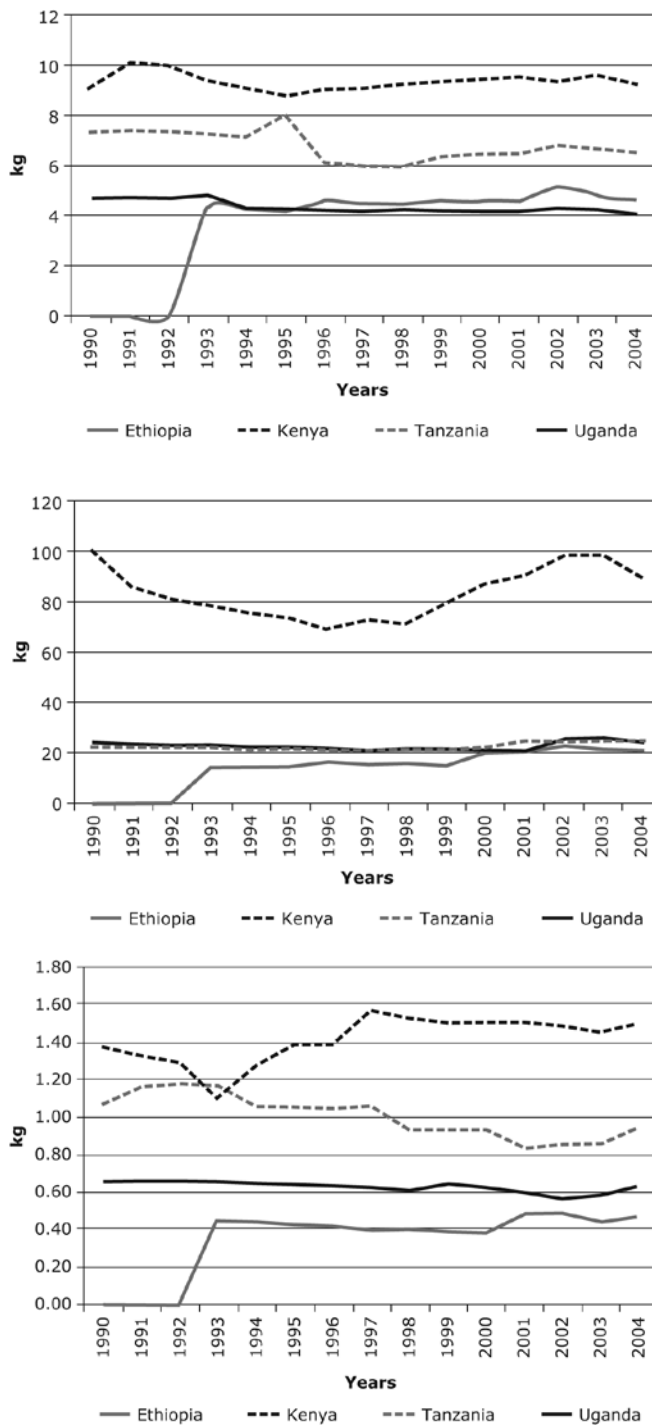


Figure 2.7a, b, c. AU: Provide caption for figure and figure source

Source:

development on other sectors such as transportation, feed production, and packaging industries. Indeed, development in the livestock sector has generated new employment and income for formerly unemployed youths in both rural and urban areas.

Concerns have remained over the continuing

overexploitation of land and natural resources accompanying urbanization, population growth, and economic growth. Deforestation, overgrazing, and abusive intensification have affected the availability and quality of land and freshwater. Land use policies and measures to mitigate the impacts of climate change (e.g., biofuel production) put even more pressure on these scarce resources. As a result, access to inputs has become more difficult, and input prices have risen, thus reducing profits for livestock keepers. Moreover, the resulting degradation of environment and resources affects the health and general well-being of inhabitants, including livestock keepers.

The burden of treatment costs for infected animals and people is a major constraint to livestock productivity and livelihoods. For instance, the evolution of multi-drug-resistant strains of *M. bovis* puts the resource poor, who are less able to afford vaccines or treatment, at a disadvantage. Where cost-recovery measures are introduced, charging for vaccines may damage rapport with communities and erode trust in government services. Farmers may see the loss of cattle and the costs of vaccine as severe burdens, which threaten their livelihoods and social well-being and even, in extreme cases, their survival.

Impacts on Input and Output Markets

The increased demand for quantity and quality of livestock products, due to growth in population, urbanization, income, and trade, has led to changes in livestock input and output markets. At the production level, contract farming and vertical integration have been more widely adopted because these structures facilitate both input and output deliveries and allow controls over productivity and product quality. This has been the case for dairy production in Kenya and Uganda. Urban and peri-urban livestock production has also grown to efficiently meet increasing urban demand. However, these changes, especially vertical integration, have left behind the more remotely located farmers who continue to produce and sell their products through informal channels. Changes in product delivery systems have also adapted to these needs, as witnessed by the rapid growth of supermarkets in the Horn of Africa. Urban consumers increasingly buy meat and especially dairy products from supermarket chains or independent supermarkets (Ayieko et al., 2006).

Livestock prices have trended upward internationally because demand for livestock products has grown faster than supply. In addition, the scarcity and high prices of input resources (especially feed grains) contribute highly to rising prices of livestock products. This trend can be seen in most of the major cities in the Horn of Africa for meat and dairy products. Precisely how much of the rise in consumer prices trickles back to farm prices remains unclear. Knips (2004) noted that high taxation of livestock products before reaching market outlets in

Ethiopia, Kenya, and Sudan has considerably reduced the producer share of livestock prices and margins.

Although there has been no specific study on livestock wages in the Horn, wage levels in the livestock sector are highly affected by the availability of labor, especially in rural areas. In pastoral areas, despite their high population growth, the migration of labor to growing urban centers within rural areas reduces labor availability and increases the opportunity costs of household labor. Ironically, the abundant labor in urban areas as a result of population growth and migration remains relatively unskilled to handle the increasingly technology-driven urban and periurban livestock sector (from production to processing). These constraints on the level and quality of labor may constrain supply, leading to increased farm prices of livestock products.

At the national level, the lack of infrastructure and inadequate processing facilities in the Horn of Africa still limit the commercialization of livestock products, especially meat and dairy from rural areas. Urbanization and changes in urban consumer preferences benefit mostly large livestock farmers and producers located near urban centers.

At the international level, most countries in the Horn of Africa are net exporters of live cattle. Intra-regional (or cross-border) trade is frequent—for example, between Ethiopia and Somalia or between Sudan and Uganda. For livestock *products*, however, subsidies on livestock production and export in rich countries have reduced income opportunities for pastoralists. Moreover, strict regulations and lack of technical support to control livestock product quality have impeded exports to international markets. The only exception is Sudan, which has increased its meat exports to Gulf countries.

Also, except for dairy products from Kenya and hides and skins from Ethiopia, the increase in local demand and the lack of infrastructure and quality and disease control has further limited the expansion of livestock product exports. The Horn of Africa, for instance, has remained a net importer of poultry meat and dry milk (Knips 2004, FAOSTAT 2007). The growth in productivity and production has not kept up with high domestic demand for live animals and processed livestock products and has constrained export growth. Moreover, market opportunities for livestock export are narrowed by occurrences of animal diseases (including rinderpest, RVF) that affect the product quality and safety and cast a negative reputation for some of the Horn of Africa's livestock export products.

Responses

This section deals with case studies of efforts made in response to the changes, as well as the consequences of those efforts for the benefit of the livestock sector. The case studies address responses to issues of animal diseases, land use and natural resource constraints, poverty

reduction, and competitiveness of the livestock sector in the Horn of Africa.

Animal Diseases

Animal health interventions have evolved from government and nongovernmental organization (NGO) treatment and vaccination campaigns, to community-based initiatives linked to the private sector. The speed with which these shifts are taking place varies from country to country. In areas under the jurisdiction of the governments (e.g., Eritrea) livestock vaccination is still largely carried out by government veterinarians. In Kenya, Ethiopia, and Djibouti, vaccination increasingly involves community-based animal health workers under the supervision of government veterinarians. In south Sudan and Somalia where there are few or no governmental services, vaccination is carried out by community animal health workers supported by NGOs. Animal health community workers play a very important role in remote areas and in areas affected by armed conflicts.

Most interventions to manage emergencies in animal health focus on internal and external parasite control. Anthelmintic drenches and acaricides are used to control ticks and manage tick-borne diseases in all livestock species because they are cheap and easy to administer. Some treatments have included injectable antibiotics for all species and trypanocidal injections, particularly for cattle and camels.

Lessons learned from the trends and evolution of animal health services include the following:

- Free provision of drugs or drug subsidies should be avoided because they create dependency on government assistance.
- Combining destocking programs with emergency veterinary programs enables livestock owners to pay for services.
- The private sector or existing community animal health workers should be involved in all veterinary services, including mass treatment during disease outbreaks.

It has been realized that linking community animal health workers to the private sector is the key to achieving sustainable animal health service delivery in most of the Horn of Africa. However, success has been observed only in the higher potential areas (e.g., Kenya's highlands). Within low potential areas the approach has not been so successful for several reasons, including insecurity and lack of sufficient private sector presence. Therefore most past interventions have aimed at building the capacity of private veterinarians to operate in pastoral regions.

A number of Pan-African livestock disease control programs have been implemented in the Horn of Africa over the last few decades, with variable success rates.

One of these initiatives was an attempt to control and eradicate rinderpest through the Inter-African Bureau of Epizootic Diseases, founded in 1950. The aim of this initiative was to vaccinate all cattle of all ages in phases every year for three successive years. Twenty-two countries were involved, of which 17 had rinderpest. By the end of 1979, only one country, Sudan, admitted to having the disease.

However, this initiative failed to completely eradicate rinderpest, opening the way to a subsequent pandemic of the disease. The Organization of African Unity (now the African Union) launched the Pan-African Rinderpest Campaign (PARC) in 1987 covering all the countries in the Horn of Africa. This initiative also faced difficulties because countries were unable to sustain high enough levels of immunity. It was evident to PARC's leadership that to achieve a continentwide success, a series of technology-based procedures had to be developed, standardized, and systematized for the village level.

After PARC ended, the Pan African Programme for the Control of Epizootics (PACE), overseen by the African Union with Global Rinderpest Eradication Programme (GREP) Secretariat hosted at the United Nations Food and Agriculture Organization (FAO), and the IAEA³ Technical Cooperation (TC) Programme helped to transfer technologies for reducing risk from trans-boundary livestock diseases and those of veterinary public health, with the Joint FAO/IAEA division of the IAEA providing technical expertise and assistance in the battle against rinderpest

Vaccine development to control theileriosis has been tried, using stabilized live sporozoites, followed by treatment. A number of sporozoite strains have been tried, including Marekebuni stock (Morzaria et al., 1985) and Mundali stock (Berkverns et al., 1992). The limitations of this approach are failure to produce protective immunity, problems in using live parasites, ensuring product safety for use in animals, and severe ECF reactions following immunization. Newer forms of recombinant vaccines are now being tried that could help to overcome some of the limitations of infection and treatment vaccines.

Land Use and Natural Resources Constraints: Sample Successes and Failures of Past Policies

Although the pressure on food availability for the region as a whole is growing, individual country analyses indicate that there is still considerable scope within the region for increases in productivity, and that regional trade can be a contributing factor in stimulating this production. In the short term, the Greater Horn region will require considerable assistance to raise production levels, but policies that promote sustained growth in agriculture through intensification and emphasize comparative advantages can contribute to increasing regional and national food security.

Responses to Problems of Drought and Regional Conflicts over Land Resources

The formation of IGAD was one response adopted by governments in the Horn of Africa to the problem of drought and famine. IGAD was established in 1986 by heads of the member states (Djibouti, Eritrea, Ethiopia, Kenya, Somalia, Sudan, and Uganda) with a mandate to address the severe drought and other natural disasters that cause widespread famine in the region. Initially, as a result of its limited role and focused program area, IGAD did not address conflict and related issues. In addition, some organizational and structural problems made the organization ineffective.

The many conflicts in the region made the efforts to address the problems of drought and famine more difficult. Internal conflicts in Sudan, the secession of Eritrea from Ethiopia, the civil war that led to the collapse of Somalia and other conflicts around border areas among neighboring countries all contributed to suffering and famine. Establishing an organization that could address the conflicts of the region was vital. Following this realization, IGAD was reconstituted to give it a mandate to address issues facing the Horn of Africa in a broader perspective (IGAD 2008).

The Conflict Early Warning and Response Mechanism (CEWARN) was born out of the reconstituted IGAD in 2002. Its objectives are to support member states in the following:

- Preventing cross-border pastoral conflicts
- Enabling local communities to play an important role in preventing violent conflicts
- Enabling the IGAD secretariat to pursue conflict prevention initiatives
- Providing members with technical and financial support.

So far, through CEWARN, IGAD is working on capacity building and awareness about early warning signs of conflict (IGAD 2008⁴).

The Famine Early Warning System Network (FEWS) (<http://www.fews.net>), of the United States Agency for International Development (USAID) is presently working in all the countries in the Horn of Africa. FEWS relies on secondary data produced by host governments for its analyses, with the exception of satellite imagery (NDVI⁵ and Meteosat/Rainfall Estimation), which it receives directly from the National Aeronautics and Space Administration (NASA) and the National Oceanic and Atmospheric Administration (NOAA) every 10 days. Geographic information systems (GISs) are used to do spatial analyses of available data that are included in the system's regular reporting. FEWS works closely with national Early Warning Systems and Market Information Systems (where these exist), and with Ministries of Rural Development or Agriculture, the World Food

Programme (WFP), and certain NGOs. The institution also undertakes frequent field trips to assess availability and access conditions affecting food security, often in tandem with WFP, host government partners, and NGOs. FEWS produces a widely disseminated monthly food security report.

FEWSNET has enabled governments and development agents to gain access to spatial information on climate and general environmental situations within the region and on how the region compares with other regions. FEWSNET, however, remains at regional IGAD level, whereas changes and responses to these changes are localized to individual productive systems. There is a need for FEWSNET to focus on individual productive systems at small localized scales.

The Livestock Early Warning System (LEWS) (<http://www.brc.tamus.edu/lews>), also operating in East Africa, is intended to provide an additional 6 to 8 weeks advanced notice ahead of the current early warning systems. The project combines predictive and spatial characterization technologies with the formation of a network of collection and measurement sites in East Africa. The system is based on near-infrared spectroscopy (NIRS) and fecal profiling technology supported by advanced grazing land and crop models. The foundational technology consists of the African GIS dataset used by the Spatial Characterization Tool, providing spatial analysis of weather, soils, terrain conditions, and human and livestock populations. LEWS involves the linkage of several new technologies capable of predicting the current nutritional status of free-ranging animals and the impact of weather on forage supply and crop production among carefully selected sets of households reflecting a variety of effective environments across diverse landscapes of East Africa.

LEWS has also been quite effective in informing pastoral communities on changes in spatial distribution of pastures for livestock within the pastoral areas. This needs to be institutionalized in the policy making process to regulate movement of livestock together with movement of wildlife to avoid seasonal conflicts of different users.

Policies to Regulate Landholding Sizes and Streamline Ownership to Maintain Productivity

Land tenure in the Horn of Africa is a sensitive and complex issue. At independence from colonial powers, the countries in the region established quite different tenure reforms, all aimed at improving productivity. For example, in Ethiopia, all land became public land, with leasing or sale of land being forbidden, whereas in Kenya, the government promoted private ownership (Bruce et al., 1996). In both Kenya and Ethiopia, fragmentation of land parcels through subdivision has reduced the average farm size to less than 1 ha in many areas. As a result, fallow periods have been reduced or are omitted

altogether, in order to produce sufficient quantities to meet the needs of the family. In spite of these policies, the countries of the subregion have all suffered impediments to large-scale agricultural development, and the majority of the populations are small-scale farmers (Bruce et al., 1996).

Subdivisions of land have made household productive units very small and hardly able to support livelihoods. Although this applies to all categories of land uses, it is more severe within the high-potential agricultural areas where land is individually owned. Due to scarcity of land for different uses (cultivation, herding, wildlife conservation, as well as land for urban growth) many policies have been developed to help in defining land use and user rights. In Kenya, for example, policies to govern land use started prior to independence. In 1940 the African Land Development policy (ALDEV) was introduced, confining Africans to the homelands and leaving vast tracts of land for white farmers. In 1980 the Arid and Semi-Arid Lands (ASAL) program focused on improvement of the arid and semiarid lands and may have contributed to the formation in 1990 of group ranches among Masai herders. However, in 2000 the group ranches were converted to individual holdings (Campbell et al., 2003).

The Constitution of the Federal Republic of Ethiopia of 1994 does recognize pastoralists' rights to free land for grazing and cultivation. In Eritrea, following the long war with Ethiopia, pastoralists have gradually adopted agropastoralism. In the highlands they practice rain-fed agriculture and in the plains irrigated agriculture. In Sudan, after independence the government began to establish large agricultural schemes on land traditionally used by nomads. Even though commercial ranchers were granted rights of passage through mechanized farms, pastoralists were denied this. Traditional patterns of movement were altered and traditional production systems changed. The system as it stands is bound to give rise to conflict between nomadic pastoralists and mechanized farmers but also between transhumant groups and tenants and between herders and other groups. Because the system rests on the expansion of mechanized farming, government policy favors large-scale producers. Legislation on land tenure reflects misconceptions about the pastoral system. New schemes are favoring large-scale irrigation usually taking up dry season grazing areas.

Governments are recognizing that central control of land and agricultural resources is limited by capacities and resources, and that land policy reform needs to encourage the formation of farms of viable size, for sustainability and growth of agricultural output (FAO 2001). In addition, just as state ownership has not yielded the anticipated growth in agricultural production; private ownership has also shown little benefit to increasing production, largely as a result of market failures. Therefore, market reform must go hand in hand with tenure reform (Bruce et. al 1996). Policy makers are also reforming

attitudes toward communal land tenure and access and realizing that, under certain conditions, communal systems can provide security of tenure, environmental and production sustainability, and conflict avoidance (Bruce et al., 1996). However, this transformation in attitudes has been slow and is still experiencing opposition in some countries. In Kenya, for example, individual titling is still regarded as the political and social ideal, and, therefore, claims to communally owned land are often thrown out of court. This has led to land grabbing or illegal occupancy in some areas, notably in urban areas and state forests (Warner et al., 1999). Means for strengthening the voice of community groups include the decentralization of political power and the formation of natural resource use councils consisting of community members (Warner et al., 1999). In Uganda, the new Land Act of 1998 combines the objectives of agricultural productivity and equity by promoting democratization and good governance with some redistribution of land rights. Implementation of the Land Act (1998) has been hindered by lack of an overall land policy and by insufficient strategic planning, limited resources and capacity, and widespread corruption (Warner et al., 1999).

Fencing of Wildlife Conservation Areas in Kenya

One intervention to reduce conflicts between herders and wildlife conservationists over land was the introduction of programs to fence areas used as national parks so that wildlife could be contained within the park. This solved the problem to some extent in some areas where fences were introduced. However, in other areas, especially where there were common resources shared by livestock and wildlife, fencing was perceived as a way of preventing herders from accessing these resources. On the other hand, it was realized that among the small parks most wildlife spend most of their time in human settlement areas outside the park boundaries. In some locations, wildlife utilization fees have been introduced to compensate agropastoralists for *not* cultivating their land, so that livestock and wildlife can share the land without crops. Classic examples of this are the Amboseli National Park and Masai Game Reserve in Kenya (Western et al., 1998).

Uganda's Decentralization Policy and Ethiopia's Land Privatization

Uganda has successfully implemented decentralization of governance, including formulation of policies, to districts and lower administrative units. These include policies to govern and regulate utilization of natural resources. In districts that are predominantly pastoralist, like those in or bordering the Karamojong area, decisions about using grazing lands and associated key resources are made by the local people through their local administrative bodies. If properly used, this move can reduce intertribal conflicts over use of natural resources. On the other

hand it can limit herd movements within tribal territorial boundaries, leading in some cases to overstocking and serious land degradation (Kisamba–Mugerwa 2001). In Ethiopia, following a change in governance to the present parliamentary system, landownership changed to allow individuals to own land. This change has attracted investors to make arrangements with local communities to utilize the land for economic purposes (Muduuli 2001).

Reducing Rural Poverty through the Livestock Sector

Policy Intervention and Aims

As in many countries in the developing world, changes in consumption and production patterns have mainly benefited large-scale livestock keepers and manufacturers but have so far eluded many small livestock keepers in rural areas. The widespread poverty in many livestock areas of the Horn is a reminder that the employment and revenues generated by the large-scale livestock keepers and growth in the sector have yet to reach these smallholders. A wide range of policy interventions have been put in place but these need to be reinforced for livestock production to become one of the key pathways to reduce poverty. These interventions include the following:

- Ensuring that the poorest and most vulnerable, especially children in rural areas, eat enough to survive and become active (e.g., school meal programs)
- Enabling the poorest to own and manage basic assets and to reduce their vulnerability, for instance by distribution of live animals (Heifer International) and land (land settlement schemes)
- Facilitating livestock keepers' access to essential inputs (including land) and financial credit and providing them with means to deal with production and marketing risks
- Encouraging research and extension to increase technology adoption (e.g., artificial insemination)
- Securing both domestic and foreign markets (including niche markets for small animals such as for rabbits or poultry) and eliminating price distortions that harmed small keepers

Regional Level Intervention

Numerous livestock-related projects define and apply regional strategies to help poor livestock keepers in the Horn of Africa to get out of poverty. Because of the regional dimension of animal health issues in the Horn, regional interventions are mainly centered on combating animal diseases. For instance, the Pro-Poor Livestock Policy Initiative (PPLI) run by FAO and funded by the United Kingdom's Department for International Development covers the world's most vulnerable regions, including

East Africa. In Uganda, for instance, the project focuses on the dairy sector and aims to build a stakeholder network that engages the poor as partners sharing rights and responsibilities as well as benefits from coordinated actions such as combating animal diseases. The African Union's Inter-African Bureau of Animal Resources (AU/IBAR), among its numerous projects coordinated with various donors, intervenes in eradicating rinderpest, reducing the risk of avian influenza, and providing support for sanitary standards for several countries in the Horn of Africa.

International or regional research institutions operating in the region, such as the International Livestock Research Institute or the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA), have also provided technical and policy support on many aspects of livestock development for poverty reduction. Supports include designing risk management tools, defining best soil management practices, and sharing genetic materials for some high-quality feed crops. Regional trading and marketing arrangements—such as the Common Market for Eastern and Southern Africa (COMESA), which includes countries in the Horn—have also been used as platforms to improve livestock for the benefit of the livestock sector.

Regional projects have made only small inroads in mitigating the negative impacts of climate changes in the Horn of Africa. This situation needs to be improved because the region's livestock production, which still relies greatly on pastoralism, remains vulnerable to the slightest changes in the ecosystem resources. There is also a need for regional responses to the flows of the informal or undocumented livestock traded across borders within the region, at least to contain the spread of animal diseases to small-scale keepers. All current and future regional projects will benefit from better coordination with local governments and especially communities, so that efforts yield significant gains for the Horn's poor livestock keepers.

National-Level Interventions

National planning for the development of the livestock sector to benefit the poor in the Horn of Africa tends to be specific to key subsectors. In Kenya, Uganda, and Ethiopia, for instance, policy responses have been mostly focused on dairy projects. In Kenya, the Smallholder Dairy Project (SDP), jointly initiated by the Government of Kenya and the Kenya Agricultural Research Institute, has enabled small farmers to diversify their income sources and to connect with the market (Staal et al., 2000, Ngigi 2005, Knips 2004). It has been achieved through a mixed system of dairy farming and cropping in the highlands of Kenya. The direct impacts of such a project on reducing poverty have been seen in the increase in income for small-scale producers involved (Ngigi 2005). Moreover, the project has also increased

employment opportunities in farming and manufacturing (SDP 2004b). The Dairy Development Authority of Ethiopia and Uganda and the Livestock Development Authority of Tanzania have conducted similar efforts and have significantly boosted small keepers' income.

Although the pro-poor policy responses focus on other livestock products such as bovine meat production, greater emphasis has lately been put on promoting the production of small animals (including poultry) in both rural and periurban areas. The main interventions consist of developing a network of assistance in animal health to encourage livestock keepers to meet the level and quality of products demanded in urban cities. These interventions were initially aimed to benefit the landless but have been expanded to poor small landowners to provide an additional source of income. But these efforts have so far lacked the risk management tools to deal with the resurgence of small animal diseases such as avian flu and Newcastle disease. This has significantly reduced the benefits of the development of small animal production among the poor keepers.

Increasing the Competitiveness of Livestock Products from the Horn of Africa

Improving Productivity and Product Quality

In the Horn of Africa, policy responses to the shortfall of domestic supply relative to demand consist mostly of finding ways to increase productivity and production levels. Actions to increase the level of productivity have focused on improving animal health care and access to technology. Liberalization of the veterinary services in some countries in the Horn has not solved the livestock production and animal health issues; the governments with help from private companies and various donors have now planned for accessible vaccination services to livestock keepers. There is a consensus, however, that research and extension on vaccines to protect animals from various diseases will be reinforced, and the governments will play a significant role in such a move.

The use of advanced technology, including biotechnology, is still limited but is starting to receive attention among donors and farmers. The success of the artificial insemination in Kenya in improving animal meat and milk productivity has yet to be reproduced (Bebe et al., 2003). With the spotlight that the donors, NGOs, and private companies put on the Horn of Africa, the problem is more about wider access than just the availability of technology.

One of the important policy responses to the awareness of the importance of competitiveness for the Horn of Africa in both domestic and foreign markets has been the promotion of quality control. Nearly all quality control policies are tied to animal health care. Various measures supported by government and donor projects have been put in place. The Kenya Meat Commission

since 1950, Tanzania's Livestock Development Authority since 1974, Ethiopia's Livestock Marketing Authority since 1998, and the Sudan's Live Animals and Meat Export Council since the mid-1980s are examples of the long-term efforts to foster high-quality standards for livestock products. In nearly all the countries in the Horn, however, these quality control services are still too centralized and do not yet reach out to provinces and communities where the bulk of the quality problems are found. Similarly, animal nutrition, especially feed quality in rural areas, needs to receive more attention in policy making because animal health and product quality and quantity depend on it.

Targeting Key Subsectors

The livestock sector in the Horn of Africa faces a dilemma between maintaining the usual, relatively stable export market of live animals and bovine meat on the one hand, and investing more in relatively risky but promising markets for small animals and advanced processed products (e.g., cheese, delicatessen) on the other. Most of the policy responses in the past have been to play safe and stick with the usual export products and destinations. This is justifiable for countries like Sudan, which has had long-lasting success in exporting of live animals (Knips 2004, Simpkin 2005). But growing efforts have been made recently to identify and try other important opportunities. For example, Sudan has become the leader in the Horn of Africa in bovine and especially ovine meat exports to the Gulf countries. Likewise, as Ugandan, Kenyan, and Ethiopian bovine meat exports decline these countries have started to promote pork and small animals and poultry meat production (Canagasaby et al., 2005). Several NGOs and international donors have backed these efforts, although their efficacy depends on other important conditions such as good infrastructure, strong market institutions, and undistorted market prices.

Building and Maintaining Basic Infrastructure (Roads, Ports, and Other Facilities)

The livestock sector in the Horn of Africa has a desperate need for improved infrastructure to make any effort a success. The prevalent situation at present is summed up in the image of tired animals traveling on long, rough roads under a hot sun before reaching the markets.

The competitiveness of Horn of Africa countries in domestic and international markets is hampered by the deterioration of basic infrastructure, from watering facilities, feeding areas, and shelters, to weighing scales for animals in market outlets. Moreover, exports of livestock and livestock products have been hampered by lack of adequate quarantine and storage facilities. Efforts such as the rehabilitation of holding ground facilities in Kenya were not enough to ensure high export capacity (Knips 2004). However, some recent initiatives, such as the Kadero and Port Sudan quarantine stations in Sudan, have

been successful in promoting livestock production and trade.

Investing in infrastructure from farm to harbor is key to an improved marketing system and would benefit all agents in the livestock sector including poor livestock keepers (Simpkin 2005). Better infrastructure to improve collection, storage, and delivery systems of livestock products needs to be built in remote areas so that poor livestock keepers living there can benefit from emerging markets.

Building and Strengthening of Institutions

Projects such as the Pro-Poor Livestock Policy Initiative have offered an institutional framework to empower poor livestock keepers to move toward a market-oriented and competitive livestock sector. There is therefore a need to establish advocacy strategy groups and regional fora to pursue the interests of pastoralists in general. Regional bodies like the African Union (AU) and IGAD are best placed to push forward the agenda of disadvantaged groups. In Kenya, the Pro-pastoralist Parliamentary Group, an initiative of the Kenya Pastoralists' Forum, is an ad hoc committee with advocacy on pastoral land rights as its main agenda. This example needs to be emulated across the region. PARC, Pan African Tsetse and Trypanosomiasis Eradication Campaign, PACE, Farming In Tsetse Controlled Areas, and GREP are other examples of international programs to strengthen local capacity and institutions to tackle transboundary diseases that need replication. All the success of these efforts to strengthen institutions are, however, bound to general economic and political reforms in the countries—such as combating corruption, enforcing the rule of law, empowerment of minority groups, and especially resolution of regional and internal conflicts.

Lessening Distortions in the World Market

Since international markets for livestock products (especially dairy products) remain highly distorted mainly because of developed countries' policies and sanitary barriers, some countries in the Horn have been active in various trade negotiations. But there is little the Horn countries can achieve, individually or as a region, to reverse these distortions in international markets. Renegotiating preferential access terms, especially to European markets under the Economic Partnership Agreement, would be a way forward, but such access may not last forever. Further liberalization of livestock product markets through regional trading arrangements (Common Market for East and Southern Africa, Cotonou Conventions, East African Community, SADC) could also benefit livestock sectors in the Horn of Africa. Trade within the region has been mainly informal, and this has to be addressed to minimize the risks of jeopardizing the quality and safety efforts within each country that damage its export sectors. Nontariff barriers to market access and

especially compliance with sanitary regulations among the trading countries need to be addressed.

Conclusions

Despite all the challenges described in this chapter, many significant achievements have been made in various sectors of livestock development ranging from animal health, environment, and livestock production interfaces, to marketing and political aspects. Community-private sector partnerships, for example, have proven to be a better option compared to governments being the sole agents in delivering livestock disease management. However, government participation still remains crucial in controlling disease outbreaks when they occur.

International markets for livestock products demand high sanitary standards, which are proving to be a big challenge, especially to small-scale producers. If the Horn of Africa is to gain and maintain access to foreign markets, especially in Europe, a greater effort needs to be put into containing livestock diseases. Creation of disease-free zones where livestock can be reared for export purposes is a good step toward addressing the problem. For the Horn of Africa to benefit from the increasing demand for livestock products, the challenges of declining land productivity, scarcity of land, and issues of climate variability and change, especially among pastoralists, must be addressed. Adoption of new technologies to improve animal breeds has for a long time been used as a viable way to increase productivity, but this has so far been applicable mainly in crop-livestock production systems.

The future of livestock production in the Horn of Africa will depend on how production systems will be able to cope or adapt to the challenges of climate change. Fortunately, many organizations are now making investments in developing strategies for climate change adaptations in Africa after the realization that the continent will be affected the most and the earliest compared to other regions. The Horn of Africa has been affected by droughts for a long time, and local communities have developed ways to cope with climate variability. If these indigenous knowledge systems are analyzed, to identify, strengthen, and upgrade some of the best practices, solutions or options may be found to reduce risks of livestock production to climate change.

Individuals, communities, governments, and international bodies need to be aware of both the positive and the negative impacts of animal husbandry and livestock production, so that appropriate measures can be taken to maximize benefits and minimize or mitigate adverse consequences. Because the livestock sector largely contributes to people's livelihood in the poorest areas of the Horn of Africa, its development, if well managed, remains a solid pathway to reduce poverty in a sustainable manner.

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Table queries

Table 2.1

1. FAO 2006 not in chapter reference list. Provide citation.

Table 2.2

1. Does "n.a." stand for not available? Spell out PPP and GNI.

Table 2.3

1. FAO 2005 not in reference list. Provide citation.

Text queries

1. What about environments? Clarify.
2. Contagious caprine pleuropneumonia is not mentioned in the paragraph that follows. Add mention to text or delete from subhead.
3. Spell out IAEA.
4. By *ibid* you were referring to IGAD 2008, correct?
5. Spell out NDVI.
6. Berkverns in text ref. Check spelling.
7. FAO 2008 not cited in text.
8. Larsen and Hassan, not Manal, cited in text. Fix as needed.
9. Is this a chapter in a book? A first volume in a multivolume set? Insert publisher info as needed.
10. Not cited in text. Add text ref or delete the two World Bank 2006, 2008 citations in refs.