



Cattle seek shade in Botswana

CHAPTER 14

Improving Food Production from Livestock

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Livestock herders and small-scale farmers who mix crop production with raising livestock are facing big challenges. Over the next 25 years, the growing populations and cities in the developing world will demand more and more animal-source foods—milk, meat, and eggs. At the same time, water scarcity, changes in climate, and new technologies are likely to drive big changes in small-scale farming. These smallholder systems are feeding most of the world’s poor today. And they will become increasingly

important to global food security in the future.¹

The world needs livestock food systems to meet the nutritional, economic, and environmental needs of a billion poor people. To this end, we must find ways to increase milk, meat, and egg production without hurting the environment. At the same time, the most vulnerable groups of livestock producers—including nomadic herders like the Maasai in Kenya and the Fulani in Niger—need help in coping with the increasing droughts, temperatures, and extreme weather events likely to occur due to

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climate change. A wide array of mechanisms—from better feeding strategies to healthier animals to new ways of coping with climate change—can help. Our challenge and that of the world’s small-scale livestock keepers is to make full use of these mechanisms and to continue bringing new options on stream, so that livestock enterprises increasingly reduce human and environmental poverty alike.

Why Livestock Matter

Farm animals are an ancient, vital, renewable natural resource. Throughout the developing world, up to 1 billion people rely on farm animals for their livelihoods. Livestock sustain most forms of agricultural intensification—from the Sahelian rangelands of West Africa to the mixed smallholdings in the highlands of East Africa to highly intensified rice production in Asia. And livestock production today is becoming agriculture’s most economically important subsector (see Table 14–1), with demand for animal foods in developing countries projected to double over the next 20 years.²

In herding societies, which largely live off ruminant animals raised on lands too marginal to support crop production, milk is a food staple. In mixed crop-and-livestock production systems, which remain the backbone of agriculture in developing countries, the high nutrient density of milk, meat, and eggs means that even small quantities of these foods make an important contribution to the nutrition of households subsisting largely on starchy grains.

Livestock are not just a source of meat, milk, or eggs in poor communities, however. For many rural people, livestock are above all an asset—like land, a house, or a bank account. Surplus income is used to buy animals, which are kept and sold to meet household expenses—with sales of smaller animals (chickens, goats, sheep) covering routine expenses and those of larger stock (cattle, water buffalo, camels) used for big investments or for coping

with a medical or other crisis. Typically, what spurs even poor farmers to increase their livestock productivity is not an ambition to produce more food for themselves but rather better access to agricultural markets, where they can sell more of their livestock and livestock products.

But things are changing—and changing fast in many regions. An ever-rising demand for livestock foods in the developing world as incomes rise and people move to cities is creating booming livestock markets. Technical and institutional changes in the non-livestock agriculture sector will reduce people’s reliance on livestock for their subsistence. Stronger financial institutions will reduce the need to store capital in livestock. More mechanized tillage operations will leave more feed for livestock producing milk and meat. Greater access to inorganic fertilizers could reduce the need for farmyard manure. Improvements in rural infrastructure, such as better roads and mobile phone connections, will bring markets closer to producers.

These changes will speed the intensification of livestock production in developing countries. Feeding strategies will increasingly focus on the production of milk and meat rather than the other functions of livestock, but this will depend on location. More regular and higher-quality feeds will be given to fewer, more productive animals. More animals on farms will be confined in stalls rather than allowed to graze freely on communal lands. Breeding strategies will combine the hardy traits of native livestock with the higher productivity of exotic animals. And more-specialized livestock producers will emerge to form commercial dairies and feedlots.

These developments will take more time in some places than others. But as they unfold, livestock technologies, policies, and investments aim either to enhance a benefit of livestock development—such as food, nutritional, economic, or environmental security—or to min-

Table 14–1. Livestock, Livelihoods, and the Environment

Sector or Resource	Contribution or Impact
Production	Developing countries produce 50 percent of the world's beef, 41 percent of the milk, 72 percent of the lamb, 59 percent of the pork, and 53 percent of the poultry. Mixed crop/livestock systems also produce close to 50 percent of the global cereal. Growth in the industrial pig and poultry sectors will account for 70 percent of production in South America and Asia. These systems will create the need for more grain as feed (which will account for more than 40 percent of global cereal use in 2050).
Value of production	Milk has the highest value of production of all commodities globally. Apart from rice (which is second), meat from cattle, pigs, and poultry is next in order of importance. In the least developed countries, the industry has around \$1.4 trillion in livestock assets, excluding the value of infrastructure or land.
Greenhouse gases (GHGs)	Livestock contribute 18 percent of global GHG emissions (25–30 percent of the methane and the nitrous oxide and 30–35 percent of the carbon dioxide).
Carbon sequestration	Due to the area occupied, rangelands can be a global sink of a roughly similar size to forests. However, there is a real need to research how this large potential can be tapped through technologies and policies.
Water	Some 31 percent of global water use for agriculture goes to livestock, but with projected demand for livestock products, agricultural water use may need to double due to the increased need for feed production. Rangelands could be the source of significant regional increases in water productivity.
Nutrients	Globally, manure contributes 14 percent of the nitrogen, 25 percent of the phosphorus, and 40 percent of the potassium of nutrient inputs to agricultural soils.
Deforestation	Extensive cattle enterprises have been responsible for 65–80 percent of the deforestation of the Amazon. Some 400,000–600,000 hectares of forest a year are also cleared for growing crops, like soybeans, mostly to feed pigs and poultry in industrial systems and to provide a high protein source for concentrates of dairy cattle. However, this is changing due to enforcement and incentives by the Brazilian government for farmers and the retail sector.

Source: See endnote 2.

imize a problem caused by livestock production—such as pollution of water sources with manure or emission of greenhouse gases. The increasing levels of livestock produced to meet the growing demand for products in developing regions need not increase the sector's environmental "hoofprint" at proportionately high levels. As production systems intensify, for example, and become more efficient, less feed

will be needed to produce a given unit of livestock product. On the other hand, the future is likely to involve more livestock production in urban areas and higher concentrations of livestock in dairies and feedlots, which will bring with them pollution problems in terms of the disposal of animal excreta.

It is also important to remember that any modifications to a livestock-based food sys-



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Cattle being herded toward a communal dipping facility in Surubu town, Tanzania

tem will affect outcomes beyond the environment. Improving feed, for instance, will not only lower greenhouse gas emissions but also, because it is usually more expensive, may increase the cost of livestock products.

Better Feeding Strategies

Feed is often cited as the primary constraint to improving livestock production in smallholder systems. This assumes that smallholders in developing countries, like larger farmers in industrial nations, keep livestock primarily for their meat and milk. But, as noted earlier, small-scale farmers may equally value livestock as a means of saving money, as traction for plowing or transporting goods, as a source of manure for fertilizing cropland, or as a source of milk for household consumption. Viewed in these terms, the widespread livestock herder practice of keeping many rather than a few

animals and the smallholder practice of maintaining livestock on minimal feed that cannot produce a marketable surplus of meat and milk are entirely rational. The Maasai of East Africa, for example, follow this strategy—cows are seen as walking banks that are sold for sending children to school, for marriages, and in times of crisis. For centuries, pastoralist peoples have traveled with their animals—cattle, goats, even camels—along well-established migration routes in East Africa. But that is changing due to conflict, water shortages, shrinking regional and international borders, and expanding crop production.³

The multiple functions of livestock in developing countries are usually supported by “opportunistic” feeding strategies, making use of whatever feed livestock keepers have at hand. These include the stalks, leaves, and other wastes of crops after their grain has been harvested; such crop residues play a key role in feeding farm animals throughout the developing world. Green fodder, not usually grown specifically for livestock feeding, is also used, along with thinnings from arable crops and material cut from roadsides. And grazing ruminant animals on communal lands is widely practiced. The little supplementary concentrate feed that is provided to smallholder stock is typically given to dairy cows and to other animals whose productivity depends on the better nutrition.

In Gomma District, in western Ethiopia, however, women have increased the productivity of their small animals by setting up and running sheep fattening cycles. Larger numbers of healthier animals are fetching higher prices when they (or their related products) are sold in markets. Farmers are using the increased income to expand and increase the number of animals in the fattening program and to purchase agricultural inputs like seeds, fertilizer, and farm tools. Household items, especially food, are also more accessible. And they can pay for their children’s education. Households

are making a profit of 2,250–4,500 birr (\$167–333) annually from the sale of fattened animals. Women in particular are benefiting, as they are traditionally responsible for fattening up the small-animal stock.⁴

In India, where feed shortages are common, farmers are trying to improve the quality of their feed to produce more milk with fewer animals—and indirectly reduce GHG emissions. A. K. Singh, a farmer in Andhra Pradesh, makes a living by keeping just three buffalo. He uses both the milk and the manure they produce. He takes good care of them, feeding them mostly on grass, sorghum stover, and brans. Each buffalo used to produce about 5 liters of milk a day until he started feeding them on stover from varieties of sorghum bred to produce both large amounts of grain (for human food) and more-nutritious stalks and other crop residues (for animal feed). Using this better feed doubled the amount of milk his buffalo produced. With his income from milk increased by 50 percent and with the sale of one animal, he was able to enroll another of his children in school. At the same time, the better feeding regime reduced by 30 percent the amount of methane (a potent greenhouse gas) his animals produced for each kilogram of milk. Stover (fodder) is the main source of feed for buffalo in India. Research centers and crop breeding companies have recognized the value of developing such crops for feed as well as food.⁵

Better feeding strategies for livestock in developing countries will come about largely through the application of existing nutritional principles. With livestock diets currently dominated by crop residues and other low-quality feeds, more energy-rich diets will have to be found to support higher levels of milk and meat production. There is likely to be greater use of milling byproducts, oilcakes, and other agro-industrial byproducts combined more effectively with basal diets to enhance the animals' use of the feed. Crop residues will be

chopped and made into feed blocks for easy transport and marketing. As demand for high-value livestock products continues to increase, the practice of growing crops specifically for animal feed will become economically competitive in certain areas. Better methods of processing and conserving feeds will allow them to be transported over longer distances. And there will be greater movements of feed from rural to urban producers.

Much of the knowledge about improved feeding practices already exists. The slow uptake of improved feeding practices has been mainly due to costs, including heavy labor requirements. Persistent attempts to promote feeding technologies in the smallholder livestock sector have failed to understand this.

Healthier Animals

The presence of animal disease in tropical countries greatly hinders trade in animals and animal products. Despite recent attempts at liberalization, sanitary and phytosanitary regulations still allow importing countries to take a precautionary “if in doubt, keep it out” approach. This denies livestock-rich but poor countries an opportunity to trade their way out of poverty while doing nothing to prevent unpredictable shocks from hitting some of the world's poorest nations.⁶

More than 70 percent of emerging diseases are zoonotic—that is, transmissible between people and livestock. In ecosystems that are relatively stable and whole, such as highly diversified smallholder agricultural systems, the coevolution of pathogens and their hosts (people and livestock) and vectors (ticks and tsetse flies) favors relatively low levels of pathogenicity and disease. But with increasing human incursions, agricultural and otherwise, into relatively virgin ecosystems, pathogens are encountering new hosts, with the result that new diseases are emerging, some of which, like HIV/AIDS, have the

potential to harm public health in incalculable ways.⁷

While intensive agriculture can produce cheap products, it also introduces new health risks for both animals and people. In particular, it selects pathogens hard to detect in animal populations (such as *Campylobacter* spp. in poultry or *Escherichia coli* in cattle) or that can survive conventional treatment (through the evolution of genetic resistance to antibiotics). The wide geographic scale and large volumes of modern consolidated food distribution systems mean that food-borne diseases can spread rapidly and affect large numbers of people greatly removed from the origin of the food.

Among the most important and successful animal health innovations of all time is the development of curative drugs for animal illnesses (such as antimicrobials, parasiticides, and acaricides). Official veterinary policies at national and global levels stipulate that health treatments be given only under the oversight of a veterinarian, with the result that many veterinary drugs have reached remote users not because of policies but in spite of them. In most poor countries, which have tens of millions of livestock and livestock keepers and only a few hundred veterinarians, informal and quasi-formal drug distribution systems have blossomed.⁸

This disconnect between veterinary policy and reality in poor countries makes it difficult for all those who are unofficially treating animals to get information on how to do this properly. The consequent improper treatments are a main reason that resistance to drugs is fast evolving in the organisms causing livestock diseases. Integrated disease control, which reduces reliance on therapeutic regimes by combining different methods of controlling disease, has succeeded where the scale and profitability of farming justify high managerial and technical inputs. The development of teams of community-based animal health workers is a promising innovation for

many poor livestock-keeping communities.⁹

Vaccines are the most cost-effective way of controlling most animal as well as human diseases. Among key innovations in vaccine development over the last few decades are DIVA vaccines; as the name indicates, these allow disease control officers to “differentiate infected from vaccinated animals.” This makes vaccination a much more attractive control option than culling animals, which is increasingly as unpopular in rich countries as it is unaffordable in poor ones. Development of thermostable vaccines was the key to the recent eradication of rinderpest and is helping to control Newcastle disease in village poultry. (See Box 14–1.)¹⁰

At the same time, health communities are shifting from technology-based solutions, which address the proximate causes of disease (such as lack of vaccines), to more holistic approaches, which focus more on the interconnections among human, animal, and environmental health. The convergence of these disciplines in “One Medicine–One Health” or “EcoHealth” approaches is likely to have profound implications for veterinary as well as medical care in the twenty-first century.

In some cases, traditional knowledge has improved disease surveillance. For example, Somali and Maasai herder early warning systems in East Africa were key in identifying the risk factors and symptoms of Rift Valley fever in an outbreak in 2006 and 2007. Rift Valley fever is an acute viral zoonosis spread by mosquitoes. It primarily affects domestic livestock such as cattle, camels, sheep, and goats, but it can also infect and kill people, especially those handling infected animals. In the 1970s, explosive outbreaks occurred among people throughout Africa, the Indian Ocean states, and the Arabian Peninsula. Epidemics in Egypt in 1977/78 and in Kenya in 1997/98 each killed several hundred people. Another outbreak in Kenya in 2006/07 killed more than 100 people.¹¹

Box 14–1. Controlling Newcastle Disease in Poultry in Mozambique

Newcastle disease, which can wipe out entire flocks of chickens and can spread from farm to farm, is especially devastating for rural farmers in sub-Saharan Africa. Vaccines for Newcastle used to be hard to come by in Africa. They were imported and usually expensive, putting them out of reach of small farmers. And even when they were available, they required refrigeration, which is not common in many rural villages.

Today, however, thanks to the work of the International Rural Poultry Center of the Kyeema Foundation in Mozambique, villages have access not only to vaccines but also to locally trained community vaccinators (or para-vets) who can help spot and treat Newcastle and other poultry diseases before they spread. With help from a grant from the Australian government's overseas aid program, Kyeema developed a thermostable vaccine that does not need to be refrigerated and is easier for rural farmers to administer to their birds.

Vaccinations take place three times a year and farmers are taught—with cleverly designed flip-charts and posters—how to apply the vaccines with eyedroppers. The community vaccinators try to link the control of Newcastle with efforts to address avian influenza because the symptoms of the two diseases—coughing, diarrhea, lethargy, runny eyes, mortality—are often similar. Community leaders help Kyeema identify people who are well respected in the community to be community vaccinators. Typically, women are chosen: not only do they tend to stay in the villages more than men, but the money they earn usually does much more to help the family because they use it to buy food or school-books for their children. Because more birds are surviving thanks to the vaccinations, Kyeema is also working with farmers to build better housing for their poultry and to find additional sources of feed.

—Danielle Nierenberg

Source: See endnote 10.

Somali pastoralists of northeastern Kenya accurately assessed the likelihood of the 2006/07 outbreak based on their assessments of key risk factors, and they did so long before veterinary and public health interventions began. They are particularly able to predict not only the symptoms of Rift Valley fever in their animals but also the likelihood of an outbreak of the disease. Indeed, observations by local communities in risk-prone areas were often more timely and definitive than the global early warning systems in use during the 2006/07 outbreak. Maasai herders of northern Tanzania accurately recognized symptoms such as high abortion rates as indicating the presence of the infection in their herds. These examples point out the important role that livestock keepers can play in early warning and veterinary surveillance.¹²

Coping with Climate Change

The impacts of livestock production on climate change have been discussed widely in the general as well as the scientific press. Yet each of the estimated 1 billion people who rely on small-scale livestock enterprises has a tiny environmental footprint compared with people in industrial countries. Set against the vital contributions that livestock make to the livelihoods of the poor, the greenhouse gases their animals produce are modest.¹³

The changing climate is already affecting the livelihoods and well-being of livestock keepers in developing countries, who face increasing water and feed scarcity, losses of livestock genetic diversity, and changing disease threats. As climate changes, climate variability is likely to increase—with more-frequent droughts and

floods putting at greater risk the food, economic, and environmental security of livestock communities practicing both pastoral and mixed crop-livestock production. The complicated trade-offs between desires to conserve water and other natural resources, to reduce GHG emissions, and to help poor people enhance their livelihoods and food security are even more complex when the possibility of increased biofuel production is included.

their agricultural cycles. Others are buying livestock insurance that is “weather-indexed.”¹⁴

Insurance is something of a holy grail for those working with African livestock, particularly for pastoralists who could use it both as a hedge against drought—a threat that will become more common in some regions as the climate changes—and to increase their earning potential. Fortunately, thousands of herders in Kenya’s arid and drought-stricken north can

now purchase insurance policies for their livestock, based on a new program that anticipates whether drought will put their camels, cows, goats, and sheep at risk of starvation. This “index-based” livestock insurance program uses satellite imagery of grass and other vegetation to determine potential losses of forage and to issue payouts to herders when drought is expected to occur. Insuring livestock of pastoral families had long had been considered impossible due to the formidable challenges of verifying deaths of animals that regularly are moved over vast tracts of land in search of food. This system works because getting compensation does not require verifying that an animal is actually dead. Payments kick in when the satellite images, available practically in real time, indicate that forage has

become so scarce that animals are likely to perish. Droughts are frequent in the region—there have been 28 in the last 100 years and 4 in the past decade alone—and the losses they inflict on herders can quickly push pastoralist families into poverty.¹⁵

In some regions, opportunities are arising for farmers both to mitigate their greenhouse gas emissions and to adapt to climate change. Management practices that increase the photosynthetic input of carbon or slow the return of stored carbon to carbon dioxide via respiration, fire, or erosion help sequester carbon. More effective storage and management of manure



Kenyan farmer with her healthy cow

The two main options for dealing with agriculturally related climate change are finding ways to reduce or mitigate emissions of greenhouse gases from agricultural production and helping farmers adapt to the changing climatic conditions. Adaptation options range from the technological (such as the use of drought-tolerant crops) and the behavioral (changes in diets) to the managerial (different farm management practices) and the policy-related (such as developing markets and infrastructure to ensure supplies of more-appropriate inputs and fairer producer prices). Some farmers are using seasonal weather forecasts to help them plan

can help reduce GHG emissions and increase the efficacy of the manure when applied to crops. Payments to livestock herders and others for the environmental services they provide, such as maintaining populations of wild animals and other forms of biodiversity or storing carbon, represent major opportunities to help poor households diversify their livelihoods and increase their income.

Conclusion

The speed of global changes in human demographics, technology, resource use, public perceptions, and other factors mean that food production systems, including livestock, will inevitably change too. There are good examples around the world of creative ways to adapt to the pace of these changes in a sus-

tainable manner. Whether strategies focus on diversification of income, sustainable intensification or expansion, or a mix of these, stories of success often combine a mixture of local entrepreneurship with public- and private-sector support for sound policy and investments in technology development, infrastructure, services, and market development. In some sectors, such as the smallholder dairy sector in Kenya and increasingly in other parts of East Africa, these factors have combined to create an enabling environment for increasing milk production in the region. Farmers now have access to better cows, feeds, and veterinary services, which together with national policy support have enabled incomes, food provision, and informal milk markets to flourish in the region.