Livestock Production and Sustainable Resource Use

Putting Livestock on the Sustainability Agenda

One of the world’s greatest challenges is to feed a growing population while sustaining the global natural resource base. How the relationship between human needs and natural resource requirements will balance depends largely on livestock management and production practices. Livestock production has massive requirements for natural resources — livestock use one-third of the world’s land, including one-fifth of its cropping area.

This sector is one of the fastest growing in agriculture as demand in the developing world, particularly in Asia, skyrocket. In addition, livestock are the lifeline for millions of small subsistence farmers and herders in the developing world. They provide the power to till one-third of the world’s cropping area, produce nutrients for most of this land, and are intricately interwoven with the social fabric of many societies.

The effect of livestock on the natural resource base can be both positive and negative (see box, p. 2). Livestock integrated in a cropping system improve soil and vegetation and save chemical inputs and non-renewable resources. Grazing livestock can improve biodiversity, and industrial production probably reduces pressure on marginal lands and thus indirectly reduces soil degradation and preserves biodiversity. On the negative side, livestock contribute to land degradation, water pollution, erosion of biodiversity, and global warming.

Global livestock production is undergoing fundamental changes that have massive implications for natural resource requirements. Livestock production is becoming increasingly separated from its land base and assumes characteristics of industrial production. There is an irresistible trend to monogastrics (pigs, poultry) and grain feeding. These trends disrupt the past equilibrium when livestock were more land-based and less concentrated. Novel responses must be found to these major environmental challenges.

An overriding theme that has emerged from our work (see page 4 for source of this Note) is that livestock per se do not destroy the environment, but rather external factors (population pressure, income level and distribution, policies, institutions, regulations, lack of information and know-how) can cause livestock to shift from a positive to a negative force in sustainable agricultural production. This Note briefly describes how these factors affect the main "livestock-environment hot spots," and points to how livestock can contribute to development, but at the same time satisfy current and future human needs while maintaining the natural resource base.

Where and How It Happens

Mixed farming — Land and water quality and biodiversity are normally enhanced by blending crop and livestock production because waste products from one enterprise become inputs for the other. Use of crop residue helps maintain soil fertility and saves scarce non-renewable resources. Rotation between forage and arable crops
can replenish soil nutrients, maintain soil flora and fauna, minimize soil erosion, reduce dependence on chemical pesticides, and provide suitable habitats for birds. Rotation can help prevent agricultural systems from becoming too brittle by promoting greater biodiversity.

Mixed farming is not a panacea, however, because mixing crops and livestock alone does not generate new nutrients. As in all systems, there are considerable losses. Nutrient transfer from grazing to crop land is the main avenue to maintain food production in most systems. Increasing population pressure changes the crop/grazing land ratio, and if other nutrient sources are not available, gaps in fertility may begin a downward spiral of declining crop yields and increasing erosion.

Successful crop-livestock integration will depend largely on appropriate incentives. The availability of markets for livestock products is a key factor. Market pricing for grains, agricultural machinery, fuel, fertilizers, and concentrate feeds is necessary to put crops and livestock on a level playing field and make inputs produced on-farm attractive. Improving the security of land tenure is needed to provide an incentive to invest in long-term improvements such as use of inorganic fertilizers and inclusion of green manure and leguminous fodder in crop rotations.

**Arid and semi-arid rangelands** — These grazing areas are extremely resilient provided that herders have adequate mobility and flexibility — they must be able to spread climatic risks, use the sparse and erratic rainfall and biomass production efficiently, destock rapidly in times of drought, and restock when rains return. Degradation and increased vulnerability to drought occur when livestock movement is interrupted by crops encroaching onto rangeland, a move that breaks the ecologically sound cycle of alternating between wet- and dry-season grazing. Crop encroachment is encouraged by subsidies on crop inputs, fuel, and agricultural machinery. In semi-arid zones such as the Sahel, the fateful combination of poverty and rapid population growth encourages land degradation from overpopulation, which leads to a closely-related complex of factors such as crop encroachment, fuel wood collection, water development, and overgrazing.

Out-migration to align the human population with the carrying capacity of the land will be a top priority in most arid regions. To improve the effects of livestock on the land, flexible land tenure forms based on local empowerment are a first requirement. Necessary incentive changes include market pricing for the crop sector (to eliminate cropping from marginal areas), and the introduction of grazing fees for communal areas and full cost recovery for water and animal health services. Opening alternative investment opportunities outside the livestock sector is also of crucial importance.

**Tropical rain forests** — Infrastructure, land tenure, and credit policies played an important role in the encroachment of ranching into tropical rain forests. Road construction fueled land speculation, and in some countries, titling regulations requiring land to be used for agriculture before a title was granted encouraged deforestation. Incentive policies, which

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**Livestock affect the natural resource base in different ways**

Both positive and negative effects of livestock on the natural resource base are not well quantified. Some examples include:

**Non-renewable resources** — While global data are not available, it is estimated that livestock annually produce the value of about US$ 750 million in artificial fertilizer for tropical irrigated production in Asia, and help save another US$ 650 million in fossil fuels in that region.

**Greenhouse gases** — On a global basis, 17 percent of methane, 10 percent of nitrous oxide, and an insignificant share of carbon dioxide emissions originate from livestock.

**Desertification** — Land degradation in the most arid areas is limited; overgrazing causes about one-third of the land degradation in semi-arid areas.

**Deforestation** — Ranching was the main cause of deforestation in Latin America two decades ago, but now "slash and burn" subsistence farming and forest overexploitation are its principal causes. Worldwide, ranch encroachment plays only a minor role in deforestation (0 to 40 percent).

**Land and water pollution** — Regional nutrient surpluses as a result of excessive feed imports are important causes of water eutrophication in parts of northwestern Europe, the USA, and increasingly in East Asia.
provided subsidized interest rates with lenient reimbursement conditions and beef export subsidies, played an important role in ranch expansion in the 1960s and 1970s. These policies have now been phased out, which has stopped investment in large ranches by absentee owners. Current ranch-induced deforestation is mainly caused by smallholders who “slash and burn” new areas because current cropping and pasture systems are not sustainable. Taxation for pasture and cropland are attractive concepts for future implementation.

Industrial production and processing — Industrial systems (intensive pig, poultry, and dairy operations; feedlots) rely on massive imports of feed, thus transferring nutrients from deficit to surplus areas. This transfer depletes nutrients in feed-producing areas. Excess nitrogen and phosphorus from manure in areas of high livestock density “leaks” into surface or groundwater, damaging aquatic and wetland ecosystems and potable water. Surplus manure, with its high water content, is a problem because it can only be transported economically over short distances. In addition, mineral fertilizers are frequently cheaper and have nutrients more readily available.

These industrial systems, however, are expected to supply the lion’s share of future demand. If adequately distributed and used with appropriate technology, these systems seem to produce competitively, even if all environmental costs are internalized. The process to put the industrial system on a sustainable basis needs to start by eliminating its current advantage in many national policies by removing, for example, subsidies on inorganic fertilizers and concentrate feeds so that land-based systems are more competitive.

A further step to improve feed efficiency is to lower the waste load by promoting feed additives such as phosphate enzymes, amino acids, and other growth enhancers, as well as using better feed rationing equipment. But critical for future sustainability of this system is a gradual move to internalize all environmental costs by promoting better regional distribution between crop and livestock production, zoning (prescribing maximum number of livestock farms and livestock units on farms), incentives such as taxes on manure surpluses or phosphorous loads or systems of tradable manure quotas, and regulations such as on manure storage, application techniques, or season of application.

Biodiversity — While overgrazing, deforestation, and soil nutrient loading clearly destroy habitats and reduce plant and animal biodiversity in many parts of the world, there is increasing evidence that grazing by different species — cattle, small ruminants, camels, and wildlife — can be highly complementary and stimulate plant diversity on most temperate and tropical rangelands. The combination of wildlife and livestock increases biodiversity and increases the income of pastoralists and ranchers.

Establishing protected areas to preserve biodiversity has been a preferred option around the world. But with growing population pressure and under-paid and poorly-motivated government staff, only the most valuable areas can be effectively protected. The preferred solution, therefore, is to seek synergies between biodiversity and livestock by integrating livestock production in overall ecosystem management, including benefit sharing with the local population (as successfully accomplished in Kenya).

The need for uniform genotypes for industrial production systems leads to extinction of local livestock breeds and genetic erosion of others. About 600, or 20 percent of all livestock breeds, are currently at risk of extinction. Pig breeds in China, dairy breeds in India, and buffaloes are especially threatened. The low competitiveness of many indigenous breeds under current production and market conditions, policies favoring exotic breeds (subsidized imports and multiplication of exotic genetic material), and technologies (subsidized machinery, replacing traditional draft breeds) are the main culprits.

Concentrate feeds — The growing demand for concentrate feeds for pigs and poultry, and to a lesser extent for dairy and beef production, leads to area expansion and intensification with subsequent negative effects on forest habitats and biodiversity. This demand promotes a continuous transfer of nutrients from feed-producing areas to areas of high livestock concentration, particularly when associated with industrial production. Many technologies are available, however, that reduce the environmental impacts of cropping.

Greenhouse gases — Livestock and livestock wastes produce three gases that cause global warming: carbon dioxide, mostly through burning savannahs; methane, usually through fermentation of low quality feed by ruminants; and nitrous
What Can Be Done and What Is Needed

There are many opportunities to harmonize livestock production with sustainability through changes in incentives, regulations, and institutions. It is critical in this discussion, however, to acknowledge that the first priority for many farmers is household food security and family welfare, with future sustainability traded off against immediate food needs. Changes are easy when win-win situations are available, but with multiple objectives in play, win-win situations are not always possible, and difficult choices among production systems, agroecological zones or regions, and technological options are needed. The enabling environment will then define the relative cost of production, which in turn will determine the choice of technologies (see box, p. 3).

Enabling Environment

Informed decisionmaking, stronger institutions, and changes in perceptions, along with policy changes, provide the enabling environment that facilitates introduction of environmentally-friendly technologies (see box, at right).

Informed decisionmaking — Current decisionmaking about the role of livestock in sustainable agriculture is hampered by lack of information and awareness about the expected results of policy changes on livestock-environment interactions, and the complexity of livestock interactions with other sectors. In addition, the policy void that stems from the marginalization of some livestock producers (for example, poor pastoral peoples) or the strong influence of others (such as Latin American ranchers or dairy lobbies) complicates decisionmaking.

Strengthened institutions — Any sustainable livestock development strategy must have a legal basis with well-defined and enforceable rules and institutions for resource utilization. A legal framework, empowerment of formal and informal institutions, and use of participatory approaches are critical. Where institutions are weak and the polluter is difficult to identify, however, regulations are difficult to enforce and market incentives are more reliable. Regulations are preferable where the polluter can be unmistakably identified and where infrastructure and institutions are available to enforce environmental regulations.

Changed attitude — Most importantly, livestock can only be successfully positioned for a future successful role in global agriculture when accompanied by a change in attitude that removes conjecture, lack of objectivity, and oversimplification from the debate on livestock-environment relationships. The need to correct unsustainable livestock production systems is generally appreciated, but the evidence that livestock can contribute to sustainable agriculture, provided the appropriate enabling environment is created, must be accepted. Furthermore, dramatic changes transforming the global livestock sector need to be realized — from ruminants to monogastrics, from roughage and pastures to feed grains, and from rural to urban production. Enormous environmental challenges are growing rapidly and require that the relationships among land, feed, livestock, and associated socioeconomic factors become part of the debate on future global natural resources.

This Note is based on the results of a multi-donor study, Livestock and the Environment, which is being published in two different documents, one containing the full analysis and the other summarizing issues and options. The authors are C. de Haan (World Bank), H. Steinfeld (FAO), and H. Blackburn (USAID). These documents contain full lists of references.