

Briefing Notes

Production Systems Management

Livestock-Environment Interactions



A herder near Arusha National Park, Tanzania.

SYNOPSIS

LEAD (Livestock, Environment and Development initiative) is working to improve livestock development policies through incorporating environmental considerations in the policy-making process. To this end, LEAD has created a number of reports compiling the existing knowledge of livestock-environment interactions, classified by the major production systems of the world. Focusing on livestock production and processing, which often have been associated with negative environmental effects, these reports identify how to alleviate the negative and enhance the positive impact of livestock on the environment.

POLICY

The challenge for policy makers and environmental and livestock specialists is to fully capture the contribution of livestock in development that will satisfy current and future human needs while maintaining the natural resource base. The ecological footprint of livestock production can be shrunk substantially. The technologies exist but their successful adoption is often constrained by the difficulty in creating the right political and economic conditions in which environmentally friendly livestock production can take place. These complications stem from different interest spheres and complex links between livestock, the environment, the economy and society. Decision-makers in national governments, NGOs, at farming and community levels and in international and donor organizations, are the actors who must put their actions within the context of consistent strategies. With government support and willingness to act, there are sufficient mechanisms to keep adverse effects of livestock production within tolerable limits and to enhance the net contribution to human welfare.

THE ENVIRONMENTAL CHALLENGES

The balance between human needs and natural resource requirements will depend, to a significant extent, on what we do with animal production. Over the past 35 years, large land areas have become degraded. In many parts of the world, water resources have fallen to dangerously low levels or become unsafe to drink. Global temperatures have risen by about 0.50 Celsius since the beginning of the industrial revolution of the nineteenth century. It is estimated that more than 3,000 plant species and more than 500 animal species are in immediate danger of extinction.

Here are the main livestock-associated environmental problems:

- Land degradation of semi-arid lands in Africa and Asia, caused by a complex set of factors involving man and his stock, crop encroachment in marginal areas and fuelwood collection. Land tenure, settlement and incentive policies have undermined traditional land use practices and contributed to degradation through overgrazing.
- Livestock follows deforestation where ranching pushes into the remaining rainforest frontiers. This is the case in Central and South America, and, to a very limited extent, in Central Africa and South-East Asia. Policies in which the expedient use of ranching to obtain land titles and fiscal incentives have encouraged extensive grazing and large-scale clearance of forest. Significant biodiversity losses and gas emissions are associated with such deforestation.
- In northwestern Europe, northeastern USA, and in densely populated areas of East Asia, animal waste production exceeds the absorptive capacity of land and water. Continuous nutrient import results in over-saturation of nutrients with a series of negative implications on the environment, including biodiversity losses, groundwater contamination, and soil pollution.
- In many highland areas of the tropics, high human population densities are traditionally sustained by complex mixed farming systems. Continuing human population pressures lead to decreasing farm sizes. Livestock, often large ruminants, can no longer be maintained on the farm. The nutrient and farm power balance runs into a widening deficit and disinvestment occurs as natural resources degrade.

SCAPEGOATS AND MISSED OPPORTUNITIES

Perhaps the term “scapegoat” is no coincidence. Statements like: “Livestock have been criticised for damaging the environment in a number of ways” and “Livestock have been charged with wholesale devastation of African rangelands and irreversible destruction of soils – desertification.” It would appear as if livestock themselves go out and decide to destroy or not to destroy our environment; two centuries after the age of enlightenment we are still in need of a scapegoat, literally. Livestock do not move, produce or reproduce without our wanting it. They are completely dependent upon us and inseparable. Livestock do not degrade the environment – humans do. As a result of these misconceptions about livestock development, institutions and governments continue to miss opportunities which would permit the livestock sector to make its full contribution to human welfare and economic growth.

- Mainly in developing countries, slaughterhouses release large amounts of waste into the environment, polluting land and surface waters as well as posing a serious human health risk. Because of weak infrastructure, slaughterhouses often operate in urban settings where the discharge of blood, offal and other waste products is uncontrolled.

In these problem areas, livestock interact with the environment within the confines of a production system. Livestock and livestock waste emit large quantities of greenhouse gases such as methane and nitrous oxide, contributing to global warming.

Livestock can damage land and vegetation but livestock can also have beneficial effects on the environment. Livestock interact with land (which includes soil and vegetation), water, air, and plant and animal biodiversity. Well-managed grazing livestock can improve species wealth and the integration of livestock into mixed farming systems can improve water infiltration and recharge of groundwater reserves. The biggest contribution of livestock to the environment, however, is in providing for sustained intensification of mixed farming systems. Without this environmental function, the intensification of agriculture could not have taken place and current populations could not be sustained.

Attention to livestock-environment interactions is important in sustaining the world's resource base. Finding the balance between increased food production and the preservation of the world's natural resources remains a major challenge. It is clear that food will have to be produced at a much lower cost to the natural resource base than at present. Arguably, the environmental problems associated with livestock production would best be resolved by reducing consumption of their products, as many environmentalists suggest.

FAO believes that there is little chance of lowering the overall demand and that the billions of poor people have a right to improve their diet. The consumption of meat and other livestock products is in some countries and social classes excessive, causing medical problems such as cardiovascular diseases and high blood pressure. For the large majority of people, however, particularly in the developing countries, livestock products remain a desired food for nutritional value and taste.

Grazing and Overgrazing

About 34 million km² or 26 percent of the world's land area is used for grazing livestock. Grazing animals can improve soil cover by dispersing seeds with their hoofs and through manure, while controlling shrub growth, breaking up soil crusts and removing biomass which otherwise might provide fuel for bush fires. All these impacts stimulate grass tillering, improve seed germination and thus improve land and vegetation. On the other hand, heavy grazing causes soil compaction and contributes to erosion, and decreases soil fertility, organic matter content and water infiltration and storage.

The development of water points for human and livestock use in arid lands often causes land degradation. Around the water points, bare surfaces are caused by animal trampling. Severely degraded land typically accounts for 5 to 10 percent of the total area. Normally, soil fertility is quite high but normal vegetation patterns are impeded by the impact of hoofs, including soil compaction, and heavy grazing. Water development in arid areas might upset entire ecosystems by changing the relationship between traditional wet and dry season grazing areas, and converting traditional dry season grazing into year-round grazing.

Livestock and Deforestation

Tropical rainforests cover about 720 million hectares and contain approximately 50 percent of the world's biodiversity. Since 1950, more than 200 million hectares

of tropical rainforests were lost, with various contributing factors, including ranching, crop cultivation, and forest exploitation. Ranching-induced deforestation is one of the main causes of loss of some unique plant and animal species in the tropical rainforests of the Americas. Since 1950, the area in Central America under pasture has increased from 3.5 million to 9.5 million hectares, and cattle populations have more than doubled from 4.2 million to 9.6 million head over the same period. Crop expansion for animal feed also drives deforestation.

Livestock and Nutrient Surplus

Industrial and specialized livestock production systems emit large quantities of waste, resulting in excessive loading of manure on the limited land areas within reasonable distances of the producers, often in peri-urban contexts. Globally, pig and poultry industries produce 6.9 million tons of nitrogen per year, which is equivalent to 7 percent of the total inorganic nitrogen fertilizer production in the world.

The return of nutrients to land-based systems is often limited due to high water content and high transport cost. Transport beyond 5–15 kilometres is often uneconomical. In addition, mineral fertilizers, frequently a cheaper and more readily available source of nutrients, reduce demand for nutrients from manure even further, turning the latter into “waste”.

These nutrient surplus situations yield also excessive amounts of heavy metals, which are contained in feed as growth stimulants (copper and zinc mainly), or simple pollutants (cadmium). If the addition to the soil of heavy metals exceeds crop uptake, this may affect soil flora and fauna, ultimately posing human health risks. Regulations to reduce the heavy metal content of animal feed are now in place in most OECD member countries.

Direct drainage of manure into surface water and leaching from saturated soils is a feature associated with industrial systems in a context of weak environmental policies. Nutrients, organic water and pathogens contaminate surface water, leading to high algae growth, eutrophication and damage to the aquatic and wetland ecosystems.

GASEOUS EMISSIONS OF LIVESTOCK AND WASTE

Livestock are major sources of trace gases contributing to environmental problems at local to global scales. Ammonia volatilization can lead to nitrogen deposition, harming the natural ecosystem. In ruminant based systems, enteric fermentation and emissions from manure represent the bulk of emissions, whereas manure management and feed production represent the bulk of emissions associated with monogastrics.

Carbon Dioxide

There are two main sources of livestock-related carbon dioxide emissions related to climate change. First, carbon dioxide emissions result from biomass burning, part of which can be attributed to land clearing and bush fires for pasture and enhancing pasture growth. Second, carbon dioxide is released in relation to livestock-related consumption of fossil fuel for heating, manufacturing of machinery, and production of feed.

Methane

Methane gas is 23 times more aggressive in causing global climate change than carbon dioxide. Methane is the by-product of animal production and manure management, rice cultivation, production and distribution of oil and gas (pipelines), coal mining, and landfills. Every year, livestock and manure management are estimated to emit 80 teragrams of methane, representing 25% of man-made sources. Methane is produced as a by-product of the feed



Cattle on Silvopastoral system, Brasil.

FAO/R. M. Maurício

PASTORALISTS' RATIONALE

The perception that pastoralists maintain unproductive animals in their herds for “prestige” rather than economic reasons is still widespread. This, in the eyes of many, is one of the main reasons for overstocking and land degradation. However, almost all studies on pastoral and agro-pastoral systems show that there are very few unproductive animals in traditional herds. Animals are sold when they have their optimum market weight. Unproductive animals are sometimes found in “investments herds” owned by traders or civil servants who, in the absence of reliable and remunerative banking systems in sub-Saharan Africa, invest in livestock.



FAO/IS. Livestock

Cattle Farm in Uzbekistan.

CONCENTRATE FEED PRODUCTION

Cereals are the major component of livestock concentrate feed. Thirty-two percent of the world's cereal production is consumed by livestock. Growing demand for concentrate feed leads to area expansion and intensification, and thus potentially exerts a wide range of pressures on the environment. Increases in the areas of land used for crop production occur at the expense of other forms of land use, mainly pastures and forests, potentially placing greater pressures on these land resources, with subsequent threats to habitats and biodiversity. All cultivation results in soil loss and invariably depletes soil nutrients and organic matter. Excessive soil losses result in land degradation.

CREDITS

A group of donors and other organizations identified ways to help the livestock sector to satisfy future demands, while at the same time preserving the natural resource base. This group consists of the Commission of the European Union, DANIDA of Denmark, the Food and Agriculture Organization of the United Nations, the Ministère de la Coopération of France, BMZ through GTZ in Germany, the Directorate General of International Cooperation of the Netherlands, the Overseas Development Administration of the United Kingdom, the Environmental Protection Agency and the Agency for International Development of the United States, and the World Bank. Work done on Livestock and the Environment at FAO is led by Henning Steinfeld (Chief, AGAL), Mauricio Rosales (LEAD virtual center manager), and Pierre Gerber (Livestock policy officer – AGAL). The Production Systems Management Briefing Notes are produced by the Integrated Production Systems (PROD) Priority-Area of Inter-Disciplinary Action (PAIA).

digestion of mainly ruminants and, on average, about 6 percent of the feed energy is lost in methane. Methane emission is the direct result of the capacity of ruminants to digest large amounts of fibrous grasses and other feeds which cannot be used for human consumption. Pigs and poultry cannot digest these fibrous feeds and therefore emissions from these animals are relatively low.

Twenty percent of methane emanating from animal production comes from manure stored under anaerobic conditions. Here the picture is reversed: high levels of methane emissions from manure management are usually associated with high levels of productivity and intensity, as well as from large production units.

Despite growing livestock populations, global methane emissions from livestock remain static. One of the reasons for this is that monogastric production is growing at a faster pace than ruminant production. About 80 percent of the total growth of the livestock sector is attributed to pigs and poultry which emit comparatively small amounts of methane. Any reduction in methane production, however, is likely to result increased emission of other gases, notably carbon-dioxide and nitrous oxide, as fossil fuels and fertilizer will be required in the intensification process.

Nitrous Oxide

Nitrous oxide is the most aggressive greenhouse gas produced by livestock (296 times CO₂). It is produced from animal manure. Every year, livestock emit approximately 0.5 teragrams of nitrous oxide, representing 6% of man-made sources.

Reducing Greenhouse Emissions

Currently, the main policy constraint is the lack of appropriate incentives for the many existing technologies to reduce greenhouse emissions. The adoption of biogas technologies which convert methane from manure into energy is often hampered by the price of fossil fuels. In addition, there is still a lack of information on how to value the benefits accruing from reducing the losses in the global commons and on which mechanisms to use for distributing these benefits.

Countries which have ratified the Kyoto protocol have committed to reducing their greenhouse emissions. As a first step towards the reduction of greenhouse emissions, improving manure management seems to be the most cost-effective option, both in monogastric and ruminant based systems. Emissions at the various stages of manure management should be tackled: animal house (periodicity of manure collection, buildings' ventilation), storage (covering, temperature), processing (biogas production), and application/discharge (timing, mode of application).

RESOURCE

<http://www.virtualcentre.org/selector.htm>

FURTHER READING

Livestock – Environment Interactions – Issues and Options, Henning Steinfeld, Cees de Haan, Harvey Blackburn, FAO, 1997.

Livestock & the Environment – Finding a Balance, Cees de Haan, Henning Steinfeld, Harvey Blackburn, FAO, 1997.

Livestock and environment tool box

<http://www.virtualcentre.org/en/dec/toolbox/homepage.htm>

The LEAD virtual library at: <http://www.virtualcentre.org/en/library/default.asp>