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Livestock and climate change

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Livestock systems occupy 45% of the global surface area with a value of at least $1.4 trillion. Livestock industries and value chains employ at least 1.3 billion people globally and directly support the livelihoods of 800 million poor smallholders in the developing world.

Livestock are an important source of nourishment. Livestock products contribute 17% of calories and 33% of protein consumed globally. Consumption levels of milk and meat in the developed world are at least five times higher than in the developing world. However, in developing countries the demand for livestock products is rising rapidly, mainly due to increased human population and rapidly increasing incomes, mainly in Asia. Growth in poultry and pig production is projected to satisfy this demand, though growth in milk and beef production will be important in parts of Africa.

For the poor, increased consumption of livestock products reduces mortality and improves cognitive development of children. There is considerable potential to increase incomes of smallholders from the sale of livestock products. Keeping livestock is an important risk reduction strategy for vulnerable communities, and livestock are important providers of nutrients and traction for crop production.

Globally, livestock and livestock systems are a major cause of global warming; and climate change will have major impacts on poor livestock keepers and on the ecosystem goods and services on which they depend. Livestock contribute 18% of global anthropogenic greenhouse-gas (GHG) emissions (Steinfeld et al., 2006). The main greenhouse gases from livestock systems are methane from animals (25%), carbon dioxide from land use and its changes (32%), and nitrous oxide from manure and slurry (31%).

Who might be affected, and where?

From 2002 onwards, a series of ex-ante impact assessments and priority setting exercises included an initial attempt to map the distribution of livestock in the global tropics. These also linked livestock distribution to the distribution of the poor, indicating that hundreds of millions of poor people were dependent to some extent on livestock for their livelihoods. They were concentrated in South Asia and sub-Saharan Africa. This was not a surprise, but the spatial distribution of livestock's importance for poor people was quantified for the first time, albeit crudely.

The bottom line is that at least 90% of the planet's 1.3 billion poor are located in Asia and sub-Saharan Africa, and that 60% of them depend on livestock for some part of their livelihoods.

Livestock production systems are diverse

Livestock production systems are highly diverse, which results in large differences in associated GHG emissions per kg product in different regions and systems. The impacts of livestock production on GHG emissions have been widely highlighted, particularly those associated with rapidly expanding industrial livestock operations in Asia and those linked to deforestation in Latin America.

On the other hand, in smallholder crop-livestock and agro-pastoral and pastoral livestock systems, livestock are one of a limited number of options to increase incomes and sustain the livelihoods of people who have a limited environmental footprint. Livestock are particularly important to increase the resilience of vulnerable poor people by diversifying risk and increasing assets. Given that almost all human activity is associated with GHG emissions, those from livestock in these systems are relatively modest when compared to the contribution that livestock make to the livelihoods of this huge number of people.

This complex balancing act of resource use, GHG emissions and livelihoods needs to be taken into account when designing mitigation strategies. Farmers should be provided incentives or offset payments for adopting livestock systems that reduce emissions while maintaining their livelihoods.

GHG emitted by livestock systems can be significantly reduced

Ways to reduce GHG emissions from livestock systems through technologies, policies and incentives include:

Reduce the demand for livestock products: Consumption of livestock products per capita has increased in the developed world, and levels of consumption in some countries increase the risk of health problems. Here, demand is met by local production in very intensive systems or by import of livestock products. In both cases, this demand affects land use practices and use of resources in the developing world. Reducing the demand for livestock products in the developed world could lead to healthier people and reduce pressures on land and natural resources in developing countries.

Intensify the diets of ruminants: Feeding better quality diets to ruminants reduces the amount of methane produced per unit of animal product. This increased efficiency could be achieved through improved land use and practices like improved fodder technologies (fodder banks, improved pasture species, use of legumes) and supplementation with crop by-products and others. These practices are cost effective and available in many developing countries and can increase milk production and the efficiency of methane production (in terms of emissions per kg of product). Together with reductions in animal numbers, this can help mitigate methane emissions from ruminant systems.

Use more productive breeds or shift livestock species: In the developing world, many low producing animals could be replaced by fewer but better-fed animals of a higher potential to reduce total emissions while maintaining or increasing the supply of livestock products. This will require in most cases changes in breeds or cross-breeding schemes. Switching livestock species to better suit particular environments is a strategy that could yield higher productivity per animal for the resources available. At the same time, changes from cows, sheep and goats to pigs and poultry could lead to reduced methane emissions, it could also increase the demand for grains.

Introduce regulatory frameworks for manure management: These are required to reduce nitrous oxide emissions from manures. They are of particular importance to manage excreta in the developing world and for slurry and manure applications from cattle mainly in the developed world. In the developing world, regulatory frameworks for manure management in poultry and pig industrial units are required to reduce emissions.

Adopt grazing systems that enhance CO_2 removal from the environment: Carbon can be sequestered from the atmosphere via improved management. Any practice that increases the photosynthetic uptake of carbon or slows the return of stored carbon to CO_2 via respiration, fire or erosion increases carbon reserves. Significant amounts of soil carbon could be stored in rangelands or in silvo-pastoral systems. This could also be an important diversification option to sustain the livelihoods of smallholders and pastoralists through payments for ecosystems services.

Integrated crop-livestock systems can significantly help offset GHG emissions: Livestock are integrally linked to crop production in the developing world. Crops and residues are used to feed livestock, and manure is a crucial source of nutrients for crop growth or as fuel in crop-livestock systems. Crop residues can also be used as fuel, directly or after conversion to fuels such as ethanol or diesel. While these bio-energy feedstocks release CO_2 upon combustion, the carbon is of recent atmospheric origin (via photosynthesis), rather than from fossil carbon. The net benefit of these bio-energy sources to the atmosphere is equal to the fossil-derived emissions displaced, less any emissions from producing, transporting, and processing. Carbon dioxide emissions can also be avoided by practices that forestall the cultivation of new lands now under forest, grassland, or other non-agricultural vegetation.

An essential step towards a low-carbon economy is implementing policies (going far beyond livestock issues) that increase and/or manage carbon prices. Such price incentives are critical if synergies between adaptation and mitigation are to be exploited in the future.

Options for livestock keepers to adapt to climate change

The future trajectory of global GHG emissions is uncertain, but even if these are reduced substantially and quickly, the globe will continue to warm for several decades. Many options are available to help adapt to climate change and cope with increasing climate variability. These include technological (drought-tolerant fodder crops), behavioural (changes in dietary choice), managerial (different livestock management practices), and policy (market and infrastructural development). Some examples are:

Expanded use of weather information: rural communities need help to manage risks associated with rainfall variability. Several organisations provide information on weather conditions of rangelands and croplands in sub-Saharan Africa coupled with an outlook on future conditions. Such information can provide livestock keepers with short-term climate information to make better management decisions.

Livestock insurance schemes that are weather-indexed (that is, policy holders are paid in response to 'trigger events' such as abnormal rainfall or high local animal mortality rates). ILRI is piloting schemes in northern Kenya and southern Ethiopia among pastoralist communities that have never had access to formal insurance.

Changing the mix of livestock species: Some livestock keepers deal with drought by changing the mix of species they keep (such as including camels, or switching from cattle to goats) and the composition of their herds. The long term sustainability of these adaptations has not been critically examined, nor have possibilities to foster sustainable adaptation by smallholder livestock producers.

Enabling institutional environments for long term climate adaptation: Much of the research on adaptation to climate change emphasizes the need for supportive institutions and policies at local, national and international levels. People's choices are often constrained by institutions such as markets and land tenure, and limited by policies that encourage production that may not be climate compatible.

What for the future?

Progress has been made to better understand the impacts of climate change on livestock systems in developing countries, and to quantify the effects of different mitigation and adaptation options. Several challenges remain:

- A systems focus is key, not only to differentiate between systems with very different characteristics, but also to appropriately evaluate and implement appropriate mitigation and adaptation options at the household level. ILRI is working with partners on life-cycle analyses of household GHG emissions, test cases of different schemes that can provide income to farmers through payments for ecosystems goods and services, and development of household models that are able to evaluate risk and crop-livestock interactions and tradeoffs, but much remains to be done.

- There is widespread consensus that existing crop and livestock genetic resources will be critically important to help croppers and livestock keepers adapt to a changing climate. The genetic characterisation of indigenous animal genetic resources in tropical livestock systems is far behind that of major crops. Livestock genetic characterisation is urgently needed to broaden the range of animal genetic resources and options available to livestock keepers seeking to adapt to climate change.

- While risk management is an appropriate way to engage agriculturalists and pastoralists on climate change issues, much work is needed with government to take heed of forecasts and plan appropriate actions to deal more effectively with impending droughts and floods.

- The IPCC's Fourth Assessment Report of 2007 noted substantial barriers, limits, and costs to adaptation and mitigation in agriculture, also that many of these were not yet fully understood, let alone quantified. Much needs to be done, particularly to generate information that can be distilled to help people make decisions, and identifying thresholds in natural systems beyond which adaptation may be extremely difficult or impossible.

- There are considerable uncertainties surrounding the projections of climate models into the future, and climate science may only be partially successful in reducing these uncertainties in the next 10 years. Efforts to improve the communication of uncertainty, and how uncertainty can be better addressed in the future (without causing decision paralysis), could be very important.

Key readings

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Some of this brief is taken from: Herrero, M. and Thornton, P.K. 2009. Mitigating greenhouse gas emissions from livestock systems, IN: Agriculture and Climate Change: An Agenda for Negotiation in Copenhagen, edited by G. Nelson. International Food Policy Research Institute, Washington, DC.

On 9 and 10 November 2011, the ILRI Board of Trustees hosted a 2-day 'liveSTOCK Exchange' to discuss and reflect on livestock research for development.

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