



Science and the livestock revolution

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Globally, the livestock sector contributes 1.5 percent to GDP and is one of the few agricultural sub-sectors that keep pace with overall economic expansion. Growth is being driven by a radical process of industrialization in which scales of operation expand and livestock is separated from supporting land used for growing feed. At the other end of the scale, small-scale livestock provides critical livelihood support to some 400 million people living in extreme poverty.

In a world where a growing number of consumers and producers have instant access to relevant information and can voice their opinions, while others can barely feed their families, science has a moral mandate to guide the expanding and rapidly changing global livestock sector so as to minimize its negative impacts while maximizing the potential benefits. The challenges facing science today include "old" issues, such as increasing feed conversion efficiency and nutritive value of animal diets, which remain pertinent, but also a range of "new" issues that have broader social implications - such as the impact of livestock on the environment or the use of often hotly debated biotechnology applications.

► **Challenge: Livestock in an urbanizing world.** By the year 2010, half of the world's population is expected to be living in cities. Higher life expectancy and reduced birth rates in cities contribute to an aging population. Food consumption patterns are more varied in urban environments, with the emerging urban middle class consuming a richer diet. The urban poor, meanwhile, continue to face the challenge of finding enough food and of keeping, slaughtering and marketing animals under often unsanitary conditions.

How can animal science assist the urbanizing world? First, through intensification of production: continued research into animal nutrition and feeding and animal genetics still promises substantial gains in feed conversion efficiency. Intensification means industrialization of livestock systems, particularly for pigs and poultry. At the same time, we must avoid regional concentration of livestock production and design effective waste management systems to protect the environment from pollution.

Modern industrial animal production is based on a narrowing genetic base - especially in dairy animals, poultry and swine - which carries the risk of inbreeding depression over the long term. Using a



small number of genotypes may also lead to spreading recessive genes responsible for undesirable characteristics. Science can help improve methods for molecular characterization and identify the essential genetic variation so as to establish priorities for genetic conservation. Scientists can also help in responding to the increasingly sophisticated demands of the middle class consumer for low-fat, high-protein food and for preventing the growing tendency towards obesity, especially among the young.

Finally, the "animal welfare paradox": the demand for standardized, safe food may require management systems considered by some consumers to be unnatural or cruel. Animal welfare considerations must be based on sound science and objective research. Practical applications of science in animal welfare include designing environments that reduce disease, injury and death, management of animal social behaviour to reduce stress.

► **Challenge: Livestock in areas with weak links to markets.** Some parts of the world are still isolated, sparsely populated and poorly connected to markets. In these environments, livestock production is practiced by small-scale farmers reliant on rain-fed mixed agriculture or pastoralism - around 200 million people currently depend on mobile pastoralism, making use of natural pastures in dry-lands. The natural resource base in many marginal areas is degraded and human carrying capacity is close to its upper limit. As human populations are still increasing, alternative ways of income generation need to be

developed to allow some people to move out of livestock production. In areas where market signals are weak, livestock production is mainly resource-driven, and weather, disease and social conflict constitute major sources of risk for livestock keepers. Innovations that stabilize and safeguard production and enhance the resilience of livelihoods - e.g. through diversification - should have higher priority than interventions that simply increase production.

How can science assist? First, by improving temporal and spatial predictions of feed (and food) availability, and by promoting institutional mechanisms for timely de- and restocking, as well as novel livestock insurance schemes. Research can also help enhance the nutritional value for livestock of crop components not suited for human consumption, develop low-cost technologies to prolong shelf life of livestock products to allow them to be consumed or sold throughout the year, and integrate customary management of land and water with formal law.

► **Challenge: Protecting animal and human health.** Livestock is an important host of disease agents, which potentially threatens food security and human health. Some of these diseases spread rapidly across borders and continents as well as between species, especially if live animals move over large distances. Globalization is accelerating the frequency, speed and geographical scale of transboundary animal disease events and facilitating the establishment of pathogens in hitherto unaffected environments. The transboundary nature of these diseases and their potential to overcome species barriers and to affect humans poses serious challenges that extend beyond the livestock sector and demand international cooperation.

Science has a vital role to play in providing better understanding of infection and disease transmission, in developing fast, accurate and robust diagnostics, and in monitoring and remote sensing of ecological factors that encourage pathogens to emerge. Rapid communication of information about disease outbreaks, and education of field personnel are also important in international efforts to improve surveillance, detection and rapid response. Research is also needed to develop vaccines that are safe and have a long shelf life, and anti-viral drugs which, when incorporated in vaccines, provide almost immediate protection while the immune system responds.

An unwelcome offshoot of scientific developments in medicine and human health is the growing potential for bio-terrorism. While we should not be overly worried about this, the only way to deal with the potential threat is through transparency and international cooperation.

► **Challenge: Biotechnology in livestock development.** Public perception of "biotechnology" is strongly influenced by what is known or believed about genetically modified organisms (GMOs). Conflicting information - and real or perceived withholding of information - all lead to confusion about the differences between different biotechnologies and their long-term ecological and health effects. There is an urgent need for objective and informed public discussion on biotechnology, and science-based protocols to determine the level of safety or the level of danger arising from their use.

For biotechnology to be used well, a number of concerns must be addressed. For example, it is possible that loss of genetic diversity may occur as high yielding breeds are chosen over those with other genetic traits. This is an age-old feature of livestock selection, but biotechnology methods may hasten the process. While encouraging selection for high yield, countries should have in place a policy for genetic conservation. There is little evidence, so far, of gene flow between cultivated plants and their wild relatives, but the absence of evidence is not proof of the contrary. Careful monitoring is required when new breeds and varieties are introduced into new environments.

Consumers have also expressed concern about the direct effects on humans of eating animals that have been fed on GM feed. Trials to date suggest that this concern is unfounded for the products currently in use, but it will continue to be raised with each new change introduced. Long-term monitoring for positive and negative nutritional effects is essential. Ethical questions also arise in connection with stem cell research and "pharming", where animals are genetically modified to produce substances of use to science or medical application.

Science can facilitate sustainable, equitable, and safe development of the livestock sector through innovation in a wide range of fields. For society, one of the main challenges will be to find mechanisms for differentiating between technical feasibility and social desirability. As science advances, so do quality assurance and quality control standards which, if taken to the highest level possible, would eliminate large numbers of livestock keepers from the market. Given the growing interconnectedness of economies, we must recognize that national choices have international implications.

For science, perhaps the greatest challenge is to find ways to communicate with its clients, particularly those which do not offer strong economic incentives, and with the public at large.