Part 2

LIVESTOCK SECTOR TRENDS

Introduction

In the context of pre-industrial agriculture, livestock breeds had to be adapted to local environments, and fulfilled multiple functions, they were thus very diverse. However, driven by a growing demand for animal products, the livestock sector is rapidly moving towards intensive and specialized systems, in which the production environment is controlled and production traits are central criteria for the selection of species and breeds. The industrialized sector's demands for animal genetic resources (AnGR) have been met by a limited number of high-output breeds, and this has tended to narrow genetic diversity between and within breeds.

Despite the economic importance and rapid growth of intensive production systems, the world's livestock sector continues to be characterized by a high degree of diversity. Intensive and industrialized production systems contribute to meeting most of the growing demand for livestock-derived food. However, livestock keeping is also an important element in the livelihoods of many small-scale producers. Enabling poorer livestock keepers to improve their livelihoods remains an important objective. Achieving these food security and livelihood-related goals while also preserving natural resources, such as water, soil fertility and biodiversity, and addressing problems such as the emission of greenhouse gases, is a major challenge. This challenge demands a critical review of the current choice and use of AnGR, which may not always be optimal for the production conditions, and in which information deficits hinder the emergence of rational management strategies.

This section reviews drivers of change in the livestock sector and corresponding trends in production systems. It also introduces some of the most significant interactions between livestock keeping and the environment. Finally it highlights implications for the use of AnGR.

PART **2**

Box 19
The concept of productivity

When discussing the relative merits of particular breeds or production systems, the use of the term "productivity" can be misleading if it is not carefully defined. A distinction must be drawn between high productivity and high levels of production or output. Strictly speaking, "productivity" or "efficiency" is a measure of the output obtained per unit of input. For example, it can be defined in terms of the ratio of the output of a product such as milk relative to costs in monetary terms. Animals fed on crop residues like straws produce little, but as they do so at little cost, their productivity, so defined, is not necessarily low.

A broader view of the costs of production can yield very different results in terms of productivity estimates. For example, if environmental costs are counted, then the productivity of high-yielding animals kept under industrial production systems may not be as impressive as it otherwise appears.

A more comprehensive consideration of the outputs of livestock production is also relevant. Frequently overlooked functions of livestock include their role in the provision of financing and insurance. This is particularly important to livestock keepers who are unable to access these services from other sources. Several attempts have been made to quantify the value of financing and insurance functions and include them in calculations of the net benefits of livestock production. For example, studies have indicated that these functions account for 81 percent of net benefits from meat goat production in southwestern Nigeria (Bosman *et al.*, 1997), 23 percent in the case of cattle production in upland mixed farming systems Indonesia (Ifar, 1996), and 11 percent in smallholder dairy goat production in the Eastern Highlands of Ethiopia (Ayalew *et al.*, 2002). Manure is another important product in mixed farming systems that is often not accounted for in calculations of the total benefits derived from livestock. The Ethiopia study showed that manure production accounted for 39 percent of gross benefits derived from goat keeping in this system (ibid.). The significance of manure production is also highlighted by the findings of Abegaz (2005) which show that in mixed farming communities in the Northern Highlands of Ethiopia, animal manure and draught power are the major production targets, and account for the high livestock densities observed.

It is important to emphasize that it is not only in tropical and/or poorer societies that livestock have multiple values and costs. The arguments about productivity are also valid in wealthier societies (Van De Ven, 1996; Schiere *et al.*, 2006a). The fact that they are overlooked is the very reason for the environmental problems often encountered. This again underlines the need to assess the value of biodiversity in broader terms and not only with respect to potential milk or meat yield.

Provided by Hans Schiere.

Section A

Drivers of change in the livestock sector

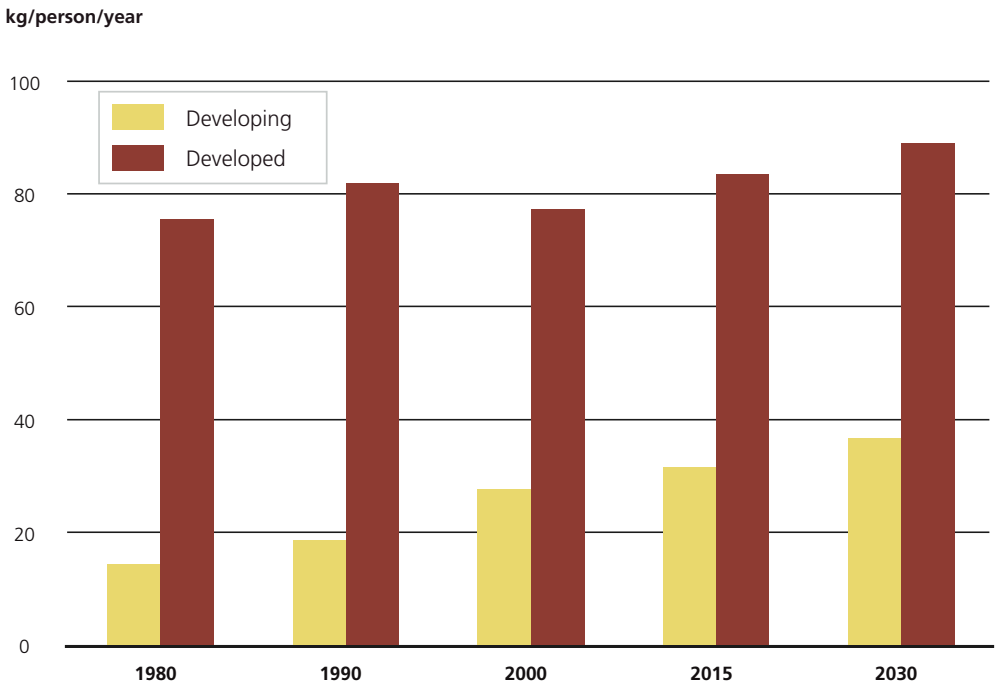
1 Changes in demand

Consumption of meat and milk worldwide has been rapidly growing since the early 1980s. Developing countries have accounted for a large share of this increase (Figure 37); growth in poultry and pork consumption in developing countries has been particularly striking. Between the early 1980s and the late 1990s, total meat and milk consumption in the developing world grew at 6 and 4 percent *per annum*, respectively.[1]

[1] Compound annual growth rates were estimated between 1983 and 1997.

In 1980, the human population of developing countries made up three-quarters of the world's population, and consumed one-third of the world's meat and milk (Tables 42 and 43). It is estimated that by 2030, developing countries may account for 85 percent of the world's population, and two-thirds of direct consumption of meat and milk. Increasing demand strongly stimulates production. For the 1999-2001 to 2030 period, FAO (2006a) estimates that production growth rates of meat and milk will be 2.4 percent *per annum* and

Figure 37
Changes in the meat consumption of developing and developed countries



Sources: 1980, 1990 and 2000 figures from FAOSTAT; 2015 and 2030 figures from FAO (2002a).

2.5 percent *per annum*, respectively, in developing countries; while the growth rates for the whole world will be 1.7 percent for meat and 1.4 percent for milk. Growth of per capita consumption is, however, predicted to be weaker, especially in sub-Saharan Africa, the Near and Middle East and North Africa, and in places where consumption is already high, such as developed countries or Latin America (particularly for meat). Except for Africa, consumption per capita is projected to grow at a lower pace after 2030, with consumers achieving better-balanced diets. This, in turn, may reduce production growth: over the 2030 to 2050 period, meat and milk production in developing countries are expected to develop at 1.3 percent *per annum* and 1.4 percent *per annum* respectively.

In developing countries, 70 percent of the additional meat consumption is of pork and poultry; in developed countries, the comparable figure is 81 percent. Poultry consumption in developing countries is projected to grow at 3.4 percent *per annum* to 2030, followed by beef at 2.2 percent and ovine meat at 2.1 percent. In the world as a whole, poultry consumption is projected to grow at 2.5 percent *per annum* to 2030, with other meats growing at 1.7 percent or less. Growth rates have been particularly high in China, India and Brazil, and the sheer size and vigour of these countries will mean that they will continue to increase their dominance of world markets for livestock products. High growth in consumption is spread throughout the developing world, but it is important to consider regional and between-country differences in the extent of the "livestock revolution". For example, consumption levels for meat, milk and eggs in sub-Saharan Africa have remained static over the last decade (FAO, 2006f). Furthermore, trends in demand for individual commodities will vary widely in different parts of the developing world, with China leading the way in meat, with a near doubling of the total quantity consumed – the increase being primarily in poultry and pork consumption. India and the other countries of South Asia will drive a large increase in total milk consumption.

TABLE 42
Projected trends in meat consumption from 2000 to 2050

Region	Production			Consumption per capita		
	1999-2001	Growth rate 1999-2001 to 2030	Growth rate 2030 to 2050	1999-2001	Growth rate 1999-2001 to 2030	Growth rate 2030 to 2050
	[1 000 tonnes p.a.]	[% p.a.]	[% p.a.]	[kg p.a.]	[% p.a.]	[% p.a.]
Sub-Saharan Africa	5 564	3.3	2.8	9.5	1.2	1.4
Near East/North Africa	7 382	3.3	2.1	21.9	1.6	1.1
Latin America & the Caribbean	31 608	2.2	1.1	59.5	0.9	0.7
South Asia	7 662	3.9	2.5	5.5	2.7	1.9
East Asia	73 251	2.1	0.9	39.8	1.5	0.9
Developing world	125 466	2.4	1.3	26.7	1.2	0.7
World	229 713	1.7	1.0	37.6	0.7	0.5

Source: FAO (2006a).

TABLE 43
Projected trends in milk consumption from 2000 to 2050

Region	Production			Consumption per capita		
	1999-2001	Growth rate 1999-2001 to 2030	Growth rate 2030 to 2050	1999-2001	Growth rate 1999-2001 to 2030	Growth rate 2030 to 2050
	[1 000 tonnes p.a.]	[% p.a.]	[% p.a.]	[kg p.a.]	[% p.a.]	[% p.a.]
Sub-Saharan Africa	16 722	2.6	2.1	30.6	0.5	0.6
Near East/North Africa	29 278	2.3	1.5	88.5	0.6	0.6
Latin America & the Caribbean	58 203	1.9	1	122.4	0.7	0.5
South Asia	109 533	2.8	1.5	82.3	1.5	0.9
East Asia	17 652	3.0	0.6	13.1	2.1	0.7
Developing world	231 385	2.5	1.4	53.1	1.3	0.7
World	577 494	1.4	0.9	94.2	0.4	0.4

Source: FAO (2006a).

The rationale on the basis of which people select their food is complex: it is multi-objective, and decisions are influenced by individual and societal capacity and preferences. Food preference is also changing rapidly. The pace of dietary change, both qualitative and quantitative, accelerates as countries become richer and populations become more urbanized.

1.1 Purchasing power

Among the various drivers of change in animal production, the literature concurs in identifying purchasing power as the most influential (Delgado *et al.*, 1999; Zhou *et al.*, 2003). Animal product consumption rises with purchasing power. However, the effect of increased income on diets is greatest among lower and middle-income populations (Delgado *et al.* 2002). This observation is true at individual level as well as at national level (Devine, 2003). Per capita consumption of animal-derived foods is, therefore, generally greatest among high-income groups, and most dynamic among lower and middle-income groups under conditions of strong economic growth. It goes without saying, that these groups are not evenly distributed across the globe – the former are concentrated in OECD countries, while the latter are mostly found in locations that have rapidly growing economies, such as Southeast Asia, costal provinces of China, the states of Kerala and Gujarat in India, and São Paolo State in Brazil. The two groups coincide in the urban centres of rapidly growing economies.

1.2 Urbanization

Urbanization is recognized to be the second main factor influencing per capita consumption of animal products (Rae, 1998; Delgado *et al.*, 1999). Urbanization is accompanied by changes in habitual food consumption patterns and dramatic lifestyle changes – including a marked reduction in levels of physical activity. In developing countries that are urbanizing, quantitative changes in dietary intake have been accompanied by qualitative changes in the diet. Changes include shifts from cereal-based diets to energy-dense diets with high animal protein and fat contents, as well as increased consumption of sugars and sugar-based products. Explanation for this trend may lie in the wider food choices and dietary influences found in urban centres, as well as a preference for convenience and taste (Delgado

Box 20
Sustainable utilization of the Iberian pig in Spain – a success story

The Iberian pig was once the most widely kept pig breed in Spain. The breed's hardiness, foraging abilities, capacity to endure periods without much food, and its tolerance of extreme temperatures, make it ideal for extensive production under local conditions. Traditional pig keeping contributes to the maintenance of the *dehesa*, a wooded pastureland ecosystem recognized as a Natural Habitat of Community Interest by the EU, part of which has been declared a Biosphere Reserve by UNESCO. Keeping the Iberian pig has long been of great economic and social importance in these areas.

However, from the 1960s onwards, the large-scale introduction of exotic breeds contributed to the decline of many Spanish livestock breeds including the Iberian pig. Traditional pig production systems declined as a result of low levels of yield, and problems related to disease control. By 1982, the number of sows of the Iberian breed had fallen to around 66 000.

Since that time, a very successful marketing infrastructure has been developed, focusing on the quality of meat from pigs fattened under the traditional system where the animals are free to forage for grass and acorns without any additional feeding. The resulting products are high in unsaturated fatty acids and are of excellent eating quality. The meat is in great demand: pigs fattened under the traditional system fetch prices up to 160 percent higher than conventionally raised animals, and dry cured hams fetch between 350 and 500 percent higher. Indeed, the main constraint to further increasing the output of these products is not lack of demand, but the limited range of the breed's traditional habitat.

Technological innovations have also been introduced to the traditional production systems – improvements to the quality of the pasture, and the more efficient use of crop residues. Many studies have been undertaken to increase knowledge of the breed's nutrition, handling, behaviour, morphology, genetic characteristics and meat quality.

By 2002 the number of sows had reached approximately 193 000. Most of this population increase has taken place under more intensive production conditions outside the breed's traditional home areas. However, 16.3 percent of the population is still being raised under the extensive system.

Provided by Manuel Luque Cuesta and Vicente Rodríguez-Estévez.

Photo credit: Vicente Rodríguez-Estévez

et al., 1999). The organization of food markets and the opportunity cost of the time of the main food preparers in the household both point to the consumption of more processed and pre-prepared foods, including street foods. Pre-packaged, pre-seasoned cooked meats, for example, tend to be appealing to urban consumers (King *et al.*, 2000).

Rae (1998) shows that in China, for a given level of expenditure, urbanization has a positive effect on per capita consumption levels, and also on the magnitude of the consumption response to a marginal increase in expenditure. Urbanization and income-increase effects coincide in the urban centres of rapidly growing

economies, creating hotspots of demand for animal products.

1.3 Consumer taste and preference

If purchasing power and urbanization are the most important factors contributing to patterns of per capita consumption, other factors are significant and can have great influence locally. For example, Brazil has a slightly higher income per capita than Thailand, and Thailand has a higher level of urbanization than Brazil, but animal product consumption in Brazil is roughly twice as high as it is in Thailand. Conversely, countries with contrasting per capita incomes can have similar levels of animal-derived food consumption (e.g. the Russian Federation and Japan).

A number of factors are at play, including natural endowment. Access to marine resources on the one hand, and to natural resources for livestock production on the other, have drawn consumption trends in opposite directions. Lactose-intolerance, found particularly in East Asia, has limited milk consumption. Cultural reasons, including religion, have further influenced consumption habits (Harris, 1985). This is, for example the case in South Asia, where meat consumption per capita is lower than income alone would predict. This influence is also seen in preferences for certain species and types of product. Examples include the exclusion of pork by Muslims, and the high preference for red meat among the Maasai. These various factors have given rise to a rich pattern of consumer preference, and also influence the way consumers assess the quality of animal products (Krystallis and Arvanitoyannis, 2006).

More recently, other institutional factors have influenced consumption trends. An example is the emergence of the "concerned consumer" (Harrington, 1994) in OECD countries. The consumption patterns of these consumers are influenced not only by market and taste factors, but by concerns about health, environmental, ethical, animal welfare and development issues. These consumers tend to reduce or even stop their consumption of particular animal products or to opt for certified products, such a free range or organic meat, milk or eggs (Krystallis and Arvanitoyannis, 2006). Government promotion campaigns are also identified as potential drivers of change in consumption patterns (Morrison *et al.*, 2003).

2 Trade and retailing

Increasing international trade as well as the rise of large retailers and integrated food chains are other important drivers of change in the livestock sector. More precisely, they influence the relative competitiveness of producers and production systems in supplying the rising demand for animal-derived foods.

2.1 Flows of livestock and their products

Livestock production traded across international borders has increased from 4 percent in the early 1980s to approximately 10 percent at the present time. A number of developing countries are among the top 20 exporters and importers in value terms (FAOSTAT). The main developing-country export products are live animals and the meat of cattle, sheep, goats, pigs, horses, chickens and ducks, fresh and condensed cow milk, as well as pig and cattle feed. Products imported in large quantities include the meat of cattle, sheep, chickens and ducks, fresh and dried cow milk, ghee, animal feeds, and live cattle, goats, sheep, buffaloes and chickens.

Four structural developments in livestock markets can be discerned (FAO, 2005b):

- International market chains: supplying livestock products from one country to retailers and consumers in another country. These chains are either controlled by large retailers, such as supermarkets, or by importing firms dealing with particular commodities.
- Chains created by foreign direct investment: vertically integrated market chains

supplying a domestic, mainly urban market. Typically, they are controlled by large retailers such as international or national supermarkets or fast food companies.

- Domestic markets affected by globalization: effects of globalization on consumer demand and behaviour have led to responses in domestic market chains other than vertically integrated chains. For example, dairy processors, fast food chains and restaurants have developed, and increased the diversity of products on the market, but are not part of vertically integrated chains.
- Increasing local markets: geographical concentration and intracountry specialization (see below) on the one hand, and urbanization on the other, lead to increasing livestock product (and feed resource) transfers at national level.

Box 21
Overcoming constraints to the development of small-scale market-oriented dairying

Demand for milk in developing countries is expected to increase by 25 percent by 2025 (Delgado *et al.*, 1999). Mobilizing the small-scale dairy sector to increase production has the potential to provide benefits such as increased incomes and food security for small-scale producers. Lack of regular income is a major problem for poor households. Both crop farming and meat production yield only periodic returns. Conversely, dairying, even on a very small scale, can provide modest but regular income.

One challenge to small-scale dairy development is posed by competition from rapidly increasing dairy imports to developing countries, which grew by 43 percent between 1998 and 2001, and is predicted to continue rising. However, there are some market developments that favour local producers. The National Dairy Development Board of India recently reported an increase of production in response to market demand for indigenous fermented milk products from 26 623 tonnes in 1999/2000 to 65 118 tonnes in 2003/2004, and a rise in the production of paneer from 2008 tonnes in 1999/2000 to 4496 tonnes in 2003/2004 (NDDB, 2005).

The entry of small-scale producers into the dairy sector is often constrained by a lack of capital to invest in animals, feed and equipment; a lack of water and power; a lack of knowledge regarding dairy husbandry and the requirements of the market; a lack of access to support services (health and AI); and a lack of access to production and processing technologies. Clearly, there are instances when the costs of milk production and the poor state of infrastructure render dairying uncompetitive for the small producer. However, a number of factors that enhance the prospects for successful small-scale dairy development can be identified.

The Market Oriented Dairy Enterprise (MODE) approach has been suggested as a template for development. Milk or producer groups are the essential entry point, and developments should be risk based, and move progressively to a market orientation, as group members become empowered to make well-informed decisions. The MODE approach consists of three steps: 1) groups are set up and operational; 2) a low level of activities is recorded with limited returns; and 3) a market-oriented approach is adopted. Other important considerations include the significance of local markets, which are often overlooked while export potential is overemphasized; the need for appropriate institutional development to ensure that milk collection, processing and marketing systems do not exclude the small producer; and a facilitative policy environment linking dairy development to national livestock development policy.

Provided by Tony Bennett.
For further information on the MODE approach see: FAO (2006e).

With globalization, international and domestic markets can become connected. Within poultry markets, for example, not all cuts are exported; those not required for export are sold in the domestic market. Pig producers in some Southeast Asian countries switch from national to regional markets depending on relative prices at different times of year. Although these markets are not identical, there are some common features in their requirements and their impacts.

Increased and long-distance trade requires standards and regulation to ensure safety and reduce transaction costs. Food control and certification systems must be of a high standard. In addition to the health and safety standards and regulations agreed by international bodies (such as the World Organisation for animal Health (OIE) and Codex Alimentarius), technical requirements may be imposed by retailers. These may include demands for particular meat cuts, carcass size and weight, leanness of meat, fat levels in milk, egg colour, or labelling with particular information or in specified languages. There may be demands for organic production or high animal welfare standards. In interconnected markets, the standards of the higher-value market may be adopted by the lower-value market, although in general they will be less strictly monitored.

Globalized markets have the potential to increase national income and create employment. For producers and traders, developing domestic markets can offer flexibility and a greater diversity of livelihood options. However, globalized markets are exclusive. Only some producers meet the requirements necessary to access them, and small producers can find it hard to acquire knowledge of these requirements or make the necessary investments. For example, many African-produced food products fail to meet international food safety and quality standards. This hampers the continent's efforts to increase agricultural trade both intraregionally and internationally, and locks many farmers out of a chance to improve their economic well-being (De Haen, 2005).

2.2 The rise of large retailers and vertical coordination along the food chain

The rapid expansion in supermarket penetration in developing countries is a fairly recent phenomenon. It has become significant only over the last five to ten years, and has proceeded at different rates in the various regions of the developing world. Reardon and Timmer (2005) describe the diffusion of supermarkets in developing countries as having occurred in three successive waves. The first, in the early 1990s, covered much of Latin America and East Asia (except China), north-central Europe, and South Africa, with supermarkets accounting for only 5 to 10 percent of agrifood retail sales on average these areas at that time. The second wave of supermarket diffusion took place in the mid-1990s, covering parts of Central America and Mexico, Southeast Asia, and south-central Europe, with the share of supermarkets in total food retail reaching about 30 to 50 percent by the early 2000s. The take-off of supermarkets in the third wave of diffusion started only in the late 1990s. Countries affected included China, India, the Russian Federation, and some countries in Central and South America, Southeast Asia and Africa. By the mid-2000s, supermarkets' share of food retail had already reached 10 to 20 percent in the countries included in the third wave.

The entry of transnationals into the agrifood chain in developing countries, particularly in the retail and processing sectors, has transformed the manner in which agrifood products are purchased from suppliers, processed into differentiated products, and distributed to consumers. As these large new distribution and retail units have to compete for market share, between themselves, and even with traditional suppliers and wholesalers in the domestic market, they must offer competitive prices. They can only maintain or expand market share by cutting costs. At the same time, they must compete in delivering the consistent product quality that is demanded by their main market. The concept of "quality" from the producers' perspective is complex, and its

TABLE 44
Standards in the livestock market and implications for small-scale producers

	Positive factors	Negative factors
Process standards		
UHT treatment of milk, government requirement.	Clearly specified process.	Administration costs of inspection. Investment in equipment and training may exclude smallholders.
Hazard Analysis Critical Control Point in abattoir, required by importers and supermarkets.	Clearly specified process.	Probably neutral for small producers.
Organic produce, standards set by certifying bodies.	Premium price. Can be carried out on a small scale. Favours labour-intensive systems.	Certifying bodies, harder to establish in developing countries. High costs of certification. Difficult to achieve by unorganized smallholders.
Performance standards		
Salmonella levels in meat, with financial penalty for poor performance.		Standards usually set to stringent developed-country consumer requirements. No guaranteed method to meet required standards. Cost of tests may be prohibitive unless subsidized.
Combined standards		
Contract farming requirements for timing of activities and quality of product.	Premium price. Support with investment and cash flow. May be assisted to overcome risk, e.g. restocking after HPAI outbreaks. Technical support.	Risk of total market loss if there is failure to produce the required quality. Not all producers meet requirements. Social stigma if there is failure to "make the grade".

Source: adapted from FAO (2006d).

attributes evolve over time. Its definition varies according to retailers' strategies on the one hand, and to cultural influences on the other. It includes food safety, nutrition, and attributes related to the commercial differentiation of the products (Farina *et al.*, 2005), as well as characteristics related to the mode of production (e.g. niche products). Large retailers require a reliable supply of agricultural products from their suppliers (producers) with consistency in volume and in quality.

In vertically integrated chains controlled by large retailers, procurement processes tend to shift towards centralized procurement systems, including the use of wholesalers specialized in a product category or dedicated to the market chain. Large supermarket chains may use preferred-supplier systems to select producers who meet quality and safety standards, and to reduce transaction costs.

Producers who become part of an integrated chain may face a change in contractual arrangements (e.g. becoming dedicated contract farmers) with increased levels of assistance and higher prices for quality products, but with increased risk if contracts are not met or the retailer closes down. This applies particularly where the farmer must specialize to satisfy volume, safety and quality requirements (Table 44). Typically, smallholders use enterprise diversity to hedge against risk, and make relatively small investments in several enterprises. This becomes harder if they are required to invest more heavily in one enterprise to meet the needs of a retailer. Globalized markets, with higher safety and quality requirements, are typically riskier, as the entire market can close down with the outbreak of a disease or the discovery of a quality problem. Smallholder producers and small traders have limited scope and ability to insure themselves against loss.

3 Changing natural environment

The Millennium Ecosystem Assessment[2] concludes that the degradation of ecosystems could become significantly worse during the first half of this century, and be a barrier to achieving the Millennium Development Goals. Recent changes in climate, especially warmer regional temperatures, have already affected biodiversity and ecosystems, particularly in dryland environments such as the African Sahel. Global climate change is likely to have significant impact on the world's environment. In general, the faster the changes, the greater will be the risk of adverse effects. Mean sea level is expected to rise by 9 to 88 cm by the year 2100, causing flooding of low-lying areas, and other damage. Climatic zones could shift towards the poles, and vertically – affecting forests, deserts, rangelands and other ecosystems. Many habitats will decline or become fragmented, and individual species could become extinct (IPCC, 2001). Climate change is taking place against the background of a natural environment that is already stressed by resource degradation – often exacerbated by existing agricultural practices.

Societies will face new risks and pressures. Food security is unlikely to be threatened at the global level, but some regions are likely to experience food shortages and hunger. Water resources will be affected as precipitation and evaporation patterns change around the world. Physical infrastructure will be damaged, particularly by rising sea levels and by extreme weather events. There will be many direct and indirect effects on economic activities, human settlements and human health. The poor and disadvantaged are the most vulnerable to the negative consequences of climate change.

A warming of more than 2.5°C could reduce global food supplies and contribute to higher food prices. Some agricultural regions will be threatened by climate change, while others may benefit. The impact on crop yields and productivity will vary considerably. The livestock sector will also be affected. Livestock products will become costlier if agricultural disruption leads to higher grain prices. In general, it seems that intensively managed livestock systems will more easily adapt to climate change than crop systems. This may not be the case for pastoral systems where livestock depend to a greater extent on the productivity and quality of the rangelands – which are predicted to decline and become more erratic. Extensive systems are also more susceptible to changes in the severity and distribution of livestock diseases and parasites. Negative effects of climate change on extensive systems in the drylands are therefore predicted to be substantial.

The effectiveness of adaptation to climate change will depend critically on regional resource endowments (IPCC, 2001). This has significant implications for the distribution of impacts within developing countries, as well as between more and less-developed countries. Developed countries will probably be more effective in adapting to climate change than developing countries and countries in transition, especially in the tropics and subtropics. Climate change is likely to have its greatest adverse effects on areas where resource endowments are poorest and the ability of farmers to respond and adapt is most limited (ibid.).

4 Advances in technology

Technological developments are another driver of change. Advances in transport and communication have promoted the expansion of global markets, and have facilitated the spread of production systems in which livestock are kept at a distance from sources of feed. Technological advances have also enabled increasing levels of control over the production environments in which animals are kept. Examples include improvements in building technology and cooling systems, but progress in breeding and nutrition have played the most critical roles.

[2] http://www.maweb.org/en/index.aspx

Feed

Advances in feed technology allowing the preparation of "near ideal" rations to match the nutritional demands of pigs, poultry and dairy cows at different stages in their lives/production cycles, have had an important effect on livestock production. In addition to technological developments, declining grain prices, a trend that has prevailed since the 1950s, has been one of the factors driving changes in livestock feeding practices. Despite growing demand over this period, supply has not lagged behind. The total supply of cereals increased by 46 percent over the 24 years from 1980 to 2004. In real terms (constant US$) international prices for grains have halved since 1961. Expanding supply at declining prices has been brought about predominantly by intensification of the existing cropped area, and to a lesser extent by area expansion in some regions (globally, the areas of cereal harvested shrank by 5.2 percent over the same period).

Genetics and reproductive and biotechnologies

New biotechnologies in combination with increased computing capacity enable rapid genetic advances, especially in the commercial pig and poultry sectors where AnGR are tailored to achieve high efficiency of feed conversion. Reproductive biotechnologies such as artificial insemination (AI) and embryo transfer (ET) greatly facilitate the dissemination of genetic material. These technologies are widely used in the developed world, and to a lesser extent in developing countries. Advances in molecular genetics have given rise to new techniques in animal breeding such as gene-based selection (mainly against diseases and genetic defects), and marker assisted selection and introgression of genes. Newer biotechnologies including cloning, transgenesis and transfer of somatic material may have significant impacts in the future. With regard to the application of biotechnologies, the scientific, political, economic and institutional basis to provide adequate safeguards and to ensure that potential benefits are realized is not yet in place in most countries. The main question to be addressed is not what is technically possible, but where and how life sciences and biotechnology can contribute to achieving a more sustainable agriculture.

5 Policy environment

Public policies can be seen as forces that add to the drivers described above, and influence changes in the sector with the aim of achieving a particular set of societal objectives. Policies are designed and adjusted, taking into account the state of markets, available technologies and natural resources (the drivers previously described), and the current status of the sector. Experience in both developed and developing countries confirms that a *laissez-faire* approach, simply standing back and allowing market forces to play out, is not a viable option[3]. In the absence of effective policies, many of the hidden costs of expanding livestock production – environmental degradation, disruption of the livelihoods of poor traditional livestock keepers, and threats to veterinary and human public health, are eventually borne by governments and the public. It is important that the attention of policy-makers is not exclusively focused on the role of large-scale production. Some systems remain little affected by trends towards industrialization. These systems do not account for the bulk of production growth. They do, however, affect the livelihoods of many people, and involve a wide range economic objectives and production practices. They are mostly oriented towards household consumption, local markets, niche markets or the delivery of environmental services.

Public policies are both drivers of, and responses to, changes in the livestock sector. At any point in time, policies that are in existence

[3] The following paragraphs of this section draw on the FAO Livestock Policy Brief *Responding to the livestock revolution – the case for livestock public policies*. http://www.fao.org/ag/againfo/resources/en/pubs_sap.html

and enforced are drivers of change, while policies in preparations are part of the public response to changes. This subchapter summarizes the broad policies that have affected the livestock sector.

Policies for institutional and technological change are initiated at both national and local levels, and not only by national governments. Other stakeholders, including farmer associations, development agencies and non-governmental organizations have often played an important role in strengthening institutions and promoting technologies that increase productivity, compliance with standards, or market access for small producers.

Policy-makers have generally utilized three main instruments to influence change in the sector: prices, institutions and promotion of technological change. Environmental objectives may be pursued using a combination of measures such as regulations, public support to extension and research, incentives or taxation, so as to make prices reflect real costs and encourage compliance with standards. In the absence of policy interventions and other measures, inputs such as land and water are often underpriced and the prices of livestock products often fail to reflect the cost of environmental damage.

The main regulatory and policy frameworks that have influenced the sector include:

- market regulation, regulation of foreign direct investment, regulation of property rights (including intellectual property), and regulations on credit that shape the "investment climate" in a country;
- institutional and regulatory frameworks affecting ownership and access to land and water resources;
- labour policy, including regulations affecting the cost of labour, the employment of migrant labourers, and working conditions;
- mobility, security and migration policies, which particularly affect mobile forms of livestock production such as pastoralism;

Box 22
Facts and trends in the emerging world food economy

Slowdown in population growth: The growth rate of 1.35 percent *per annum* in the second half of the 1990s is expected to decline to 1.1 percent in 2010–2015 and to 0.5 percent by 2045–2050 (UN Habitat, 2001).

Income growth and reductions in poverty*: Per capita income growth in developing countries is predicted to increase from 2.4 percent *per annum* for the period from 2001 to 2005 to 3.5 percent for the period between 2006 and 2015. The incidence of poverty is predicted to fall from 23.2 percent in 1999 to 13.3 percent in 2015.

Average food intake will increase but hunger will remain widespread: Daily per capita calorific intake in developing countries will increase from an average of 2 681 kcal in 1997-1999 to 2 850 in 2015. Under "business as usual", undernourishment will decline from 20 percent in 1992 to 11 percent in 2015, but reductions in absolute numbers of undernourished people will be modest – from 776 million in 1990-1992 to 610 million in 2015 – far from meeting the World Food Summit target.

Slower rate of agricultural production growth: Growth of demand for agricultural products, and therefore of production, will slow as a result of slower population growth and reduced scope for consumption increases in places where food consumption is already high. For developing countries, production growth will decline from an average of 3.9 percent *per annum* between 1989 and 1999 to 2.0 percent *per annum* between 1997-1999 and 2015 (FAO, 2002a).

* These figures are for developing countries as a whole. It should be acknowledged that reductions in the incidence of poverty will be geographically uneven with the greatest progress being made in East Asia and the least progress in sub-Saharan Africa (FAO, 2002b).

• *continues*

Box 22 *cont.*
Facts and trends in the emerging world food economy

Changes in product composition: Between 1997 and 2015, wheat and rice production in developing countries will grow modestly (by 28 and 21 percent respectively). However, significant increases are expected in coarse grains (45 percent), vegetable oils and oilseeds (61 percent), beef and veal (47 percent), mutton and lamb (51 percent), pig meat (41 percent), poultry meat (88 percent), and milk and dairy production (58 percent) (FAO, 2002a).

Production growth based mostly on yield growth: Yield improvements will account for about 70 percent of production growth, land expansion for 20 percent, and increased cropping intensity for the rest. Nevertheless, FAO projections show that the arable area in developing countries will increase by almost 13 percent (120 million ha) and water withdrawals for irrigation by 14 percent by 2030. One in five developing countries will face water shortages (FAO 2002a).

Growing agricultural trade deficits: Agricultural trade surpluses in developing countries are shrinking and by 2030 will have become a deficit of about US$31 billion, with a rapid rise in imports of cereals and livestock products, and a decline in surpluses in vegetable oils and sugar.

Urbanization: Virtually all of the world's anticipated population growth between 2000 and 2030 will be concentrated in urban areas (UN Habitat, 2001). At the present rate of urbanization, the urban population will equal the rural population as early as 2007 and will exceed it from that point on.

Diet transitions: The pace of dietary change, both qualitative and quantitative, accelerates as countries become richer and populations become increasingly urbanized, with a shift in diet structure towards a higher energy density diet in developing countries, and a dramatic increase in the contribution to food calories from livestock products (meat, milk and eggs), vegetable oils, and, to a lesser extent, sugar. Average developing-country per capita meat consumption increased from 11 kg *per annum* in the mid-1970s to around 26 kg in 2003, and oil-crop products from 5.3 kg to 9.9 kg. Increases in saturated fat intake from animal sources, a greater amount of added sugar in foods, reduced intakes of complex carbohydrates and fibre, and reduced fruit and vegetable intakes have been shown to be responsible for an increased incidence of non-communicable diseases (e.g. cardiovascular diseases and diabetes).

Market structures: Agrifood systems are evolving from an industry dominated by family-based farms and small-scale, relatively independent firms, to one of larger firms that are more tightly aligned across the production and distribution chain. Food retailing is increasingly customer responsive, more service focused and more global in ownership; in parallel, the input supply and product processing sectors are becoming more consolidated, more concentrated, and more integrated. Tangible evidence of this is the rise of supermarkets and changing patterns of food procurement in urban areas in many parts of the world, especially in Latin America (see Reardon and Berdegué, 2002).

Source: FAO (2005c).

- incentive frameworks, which shape relative competitiveness and production levels and practices – farm subsidies in OECD countries (US$257 billion in 2003) have, for example, substantially contributed to increased production levels;
- sanitary standards and trade policies, which have direct impacts on competitiveness and access to national and international markets; and
- environmental policies, which have affected farm practices and, to a limited extend, increased the relative competitiveness of production in countries where environmental regulations are less stringent or not enforced.