2. Poverty, food security and livestock – a global overview

This chapter provides an overview of the global extent of poverty and its distribution among the six main continental blocks of countries: East Asia and the Pacific, Eastern Europe and Central Asia, Latin America and the Caribbean, the Near East and North Africa, South Asia, and sub-Saharan Africa. For each of these regions, structural features of the whole economy and the agriculture sector are examined to illustrate how they are linked to the extent of poverty. Interregional differences in livestock population densities, numbers of livestock keepers, levels and dynamics of development are reviewed. Following this, the role of livestock in food security and nutrition, the changing patterns of food consumption, and their implications for future demand for animal-source foods (ASFs) are analysed. The chapter ends by reviewing the negative impacts of livestock sector growth and intensified livestock production.

GLOBAL EXTENT AND DISTRIBUTION OF POVERTY

According to recent estimates by the World Bank, using data from the 2005 International Comparison Program (ICP), the extent of poverty is still high in the developing world. Of the 5.5 billion people in developing countries, about 1.4 billion live below the international absolute poverty line of $1.25 a day. Another 1.7 billion remain vulnerable to falling into poverty, which may be triggered by natural shocks, such as drought; economic shocks, such as food and fuel price rises; and financial shocks, such as unexpected health care expenditures. Tables 2.1 and 2.2 show the incidences of poverty and the absolute numbers of poor people in 1990 and 2005, using various poverty lines and based on the World Bank 2005 ICP.

Among the developing country regions, Eastern Europe and Central Asia (EECA), Latin America and the Caribbean (LAC) and the Near East and North Africa (NENA) had the lowest poverty incidences in both 1990 and 2005 (< 10 percent by 2005). All of the remaining regions had high poverty rates in 1990, and only East Asia and the Pacific (EAP) made significant advances in reducing these, from about 56 percent in 1990 (79 percent in 1981 [PovcalNet, 2010]), to just 18 percent by 2005. The number of extremely poor people declined from 893 million to 337 million over the same period. This decrease was largely influenced by the large improvement in China, from 60 percent poor in 1990 (84 percent in 1981) to 16 percent in 2005. East Asia and the Pacific is well on track to achieve MDG 1 of reducing poverty incidence by half by 2015.

In the sub-Saharan Africa (SSA) region, however, the incidence of poverty decreased only slightly, from 55 percent in 1990 to 50 percent in 2005, having worsened up to the mid-1990s before starting to improve. The absolute number of poor people increased from 284 million in 1990 (202 million in 1981) to 384 million by 2005. In South Asia, the number of poor declined, but progress was rather slow, with poverty incidence declining from about

Table 2.1
DEVELOPING COUNTRY POPULATIONS, BY REGION AND INCOME CATEGORY, 1990 (MILLIONS)

Region/country	<$1.25 /day	(%)	$1.25–< 2 /day	(%)	$2–<13 /day	(%)	$13+ /day	(%)	Total population
EAP	893.4	56.0	380.3	23.8	315.5	19.8	6.6	0.4	1 595.8
China	683.2	60.2	277.6	24.4	173.7	15.3	1.2	0.1	1 135.7
EECA	7.0	1.5	24.9	5.4	355.3	76.2	76.9	16.9	464.1
LAC	46.7	10.7	49.2	11.2	276.7	63.2	65.3	14.9	437.9
NENA	12.2	5.4	32.2	14.3	170.3	75.5	10.8	4.8	225.5
South Asia	574.4	51.3	351.6	31.4	192.6	17.2	1.1	0.1	1 119.7
India	435.5	51.3	266.1	31.3	146.7	17.3	1.0	0.1	849.3
SSA	283.7	54.9	109.2	21.2	117.7	22.7	5.9	1.2	516.5
All regions	1 817.5	41.7	947.4	21.7	1 428.1	32.7	169.1	3.9	4 362.1

< $1.25 = extremely poor.
< $2 = poor by developing country standards.
< $13 = poor by United States standards.
Sources: Chen and Ravallion, 2008; Ravallion, 2009.

Table 2.2
DEVELOPING COUNTRY POPULATIONS, BY REGION AND INCOME CATEGORY, 2005 (MILLIONS)

Region/country	<$1.25 /day	(%)	$1.25–< 2 /day	(%)	$2– <13 /day	(%)	$13+ /day	(%)	Total population
EAP	336.9	17.9	391.8	20.8	1 117.1	59.3	37.4	2.0	1 883.2
China	207.7	15.9	266.0	20.4	806.0	61.8	25.0	1.9	1 304.7
EECA	23.9	5.0	18.0	3.9	347.8	73.4	82.4	17.7	472.1
LAC	45.1	8.2	49.2	8.9	362.2	65.8	94.6	17.1	551.1
NENA	14.0	4.6	37.5	12.3	240.1	78.6	13.4	4.5	305.0
South Asia	595.8	40.4	495.7	33.5	380.2	25.8	4.9	0.3	1 476.6
India	455.8	41.6	371.9	34.0	263.7	24.1	3.4	0.3	1 094.8
SSA	384.2	50.4	171.7	22.5	197.1	25.8	9.7	1.3	762.7
All regions	1 399.8	25.7	1 164.1	21.3	2 644.3	48.5	246.2	4.5	5 454.4

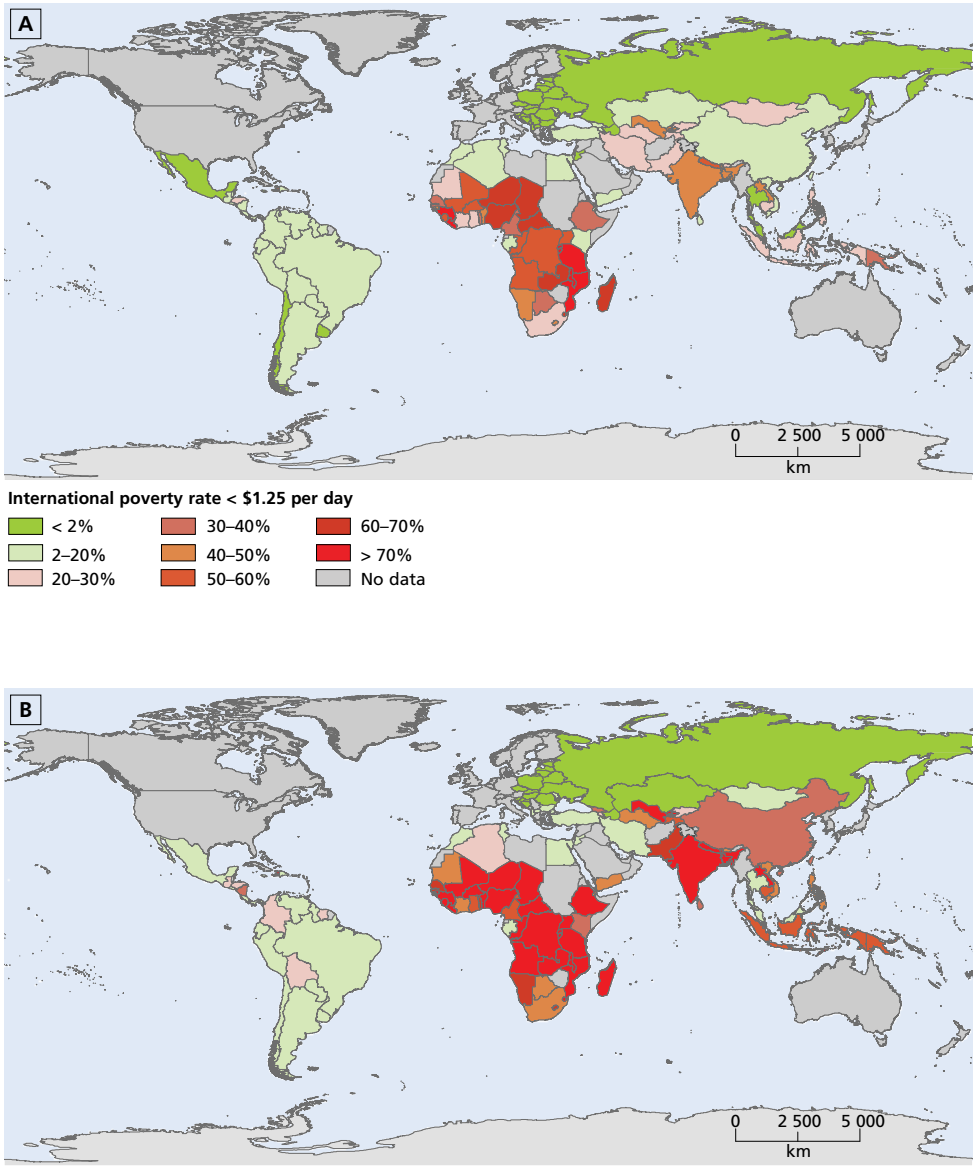
< $1.25 = extremely poor.
< $2 = poor by developing country standards.
< $13 = poor by United States standards.
Sources: Chen and Ravallion, 2008; Ravallion, 2009.

51 percent in 1990 to 40 percent in 2005. With this slow decrease, the absolute number of people living below the absolute poverty line in this region increased from 574 million in 1990 (548 million in 1981) to 595 million in 2005, of whom 456 million were in India.

Most of the approximately 1 billion extremely poor people living in rural areas (World Bank, 2008) depend directly or indirectly on agriculture for their livelihoods. Figure 2.1 maps poverty rates across much of the world, based on data in the 2008 World Devel-

FIGURE 2.1

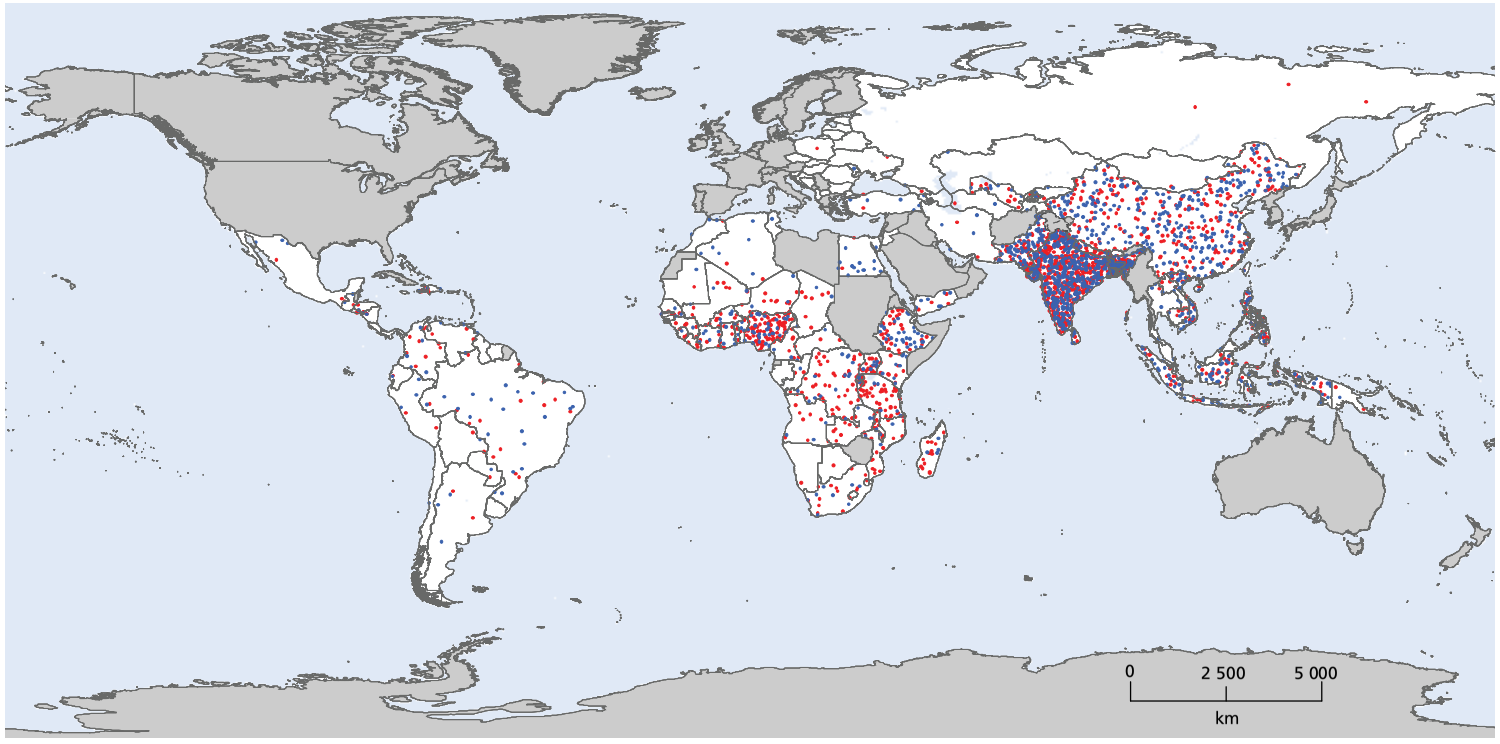
Poverty rates across the world based on (A) the revised international poverty line of $1.25/day and (B) the $2/day poverty line, estimated at 2005 purchasing power parity (PPP)



Source: Based on data from World Bank, 2008.

FIGURE 2.2

Poverty densities across the world based on two international poverty lines, $1.25 and $2 per day, applied to 2010 population estimates



Sources: Poverty rates from World Bank, 2008; population estimates for 2010 from FAOSTAT, 2010.

opment Report (World Bank, 2008). Figure 2.1A uses the revised absolute poverty line of $1.25/day – the current equivalent of the well-known "dollar-a-day" estimate for extreme poverty. Figure 2.1B uses the $2/day poverty line, which creates a far bleaker picture of global poverty, pushing a number of countries up into the "red zone" with more than 70 percent of their population classified as poor.

Figure 2.2 shows poverty densities for the same international poverty estimates, applied to 2010 population figures (FAOSTAT, 2010). Each red dot represents a million people living on less than $1.25/day and each blue dot a million additional people living on between $1.25 and $2/day. Large countries with high densities of poor people include India, Bangladesh and Nigeria.

FOOD AND NUTRITION SECURITY IN THE DEVELOPING WORLD

A rough indication of poor diets in the developing world, and hence of the need to improve food and nutrition security, can be derived from the average daily food energy intake, measured in calories per person (Table 2.3). In all developing country regions calorie intake is lower than it is in high-income countries. Regional average intakes are between an eighth, in the Near East and North Africa, and a third, in sub-Saharan Africa, lower than in high-income countries. The calorie intakes of the poor in each region are much lower than those of more affluent groups.

While developing country diets are poorer in quantitative terms than those in high-income countries, the difference in terms of quality is even more marked. The poorer quality of diets in developing countries is reflected by the low average levels of supply (and consumption per head) of meat and dairy products. In all regions but Latin America and the Caribbean, the average intake per person of meat and dairy products is a small fraction of that in high-income countries. At the rural poor's low levels of ASF consumptions even small increases in ASF intake provide nutritional benefits, which far outweigh any acute or chronic disease risks associated with the high consumption of ASFs of high-income countries or high-income households in developing countries (Randolph *et al*., 2007).

Low levels of consumption of livestock products such as meat, milk and eggs may be explained by the higher cost of production, and hence price per unit of food energy, than for staple crop products. To some extent, in providing food energy, higher levels of cereal consumption per person compensate for the low levels of meat, milk and egg consumption. However, many of the poor in developing countries suffer from not only low energy supply, but also micronutrient deficiencies, partly owing to their mainly cereal-based diets (Table 2.4).

The estimated disability-adjusted life years (DALYs)[1] that the World Health Organization (WHO) attributes to protein-energy malnutrition, vitamin A deficiency and iron-deficiency anaemia in the developing world are 17.4 million, 0.6 million and 15.6 million respectively (WHO, 2004), arising mostly from disability, while an estimated 460 000 people per year die from nutritional deficiencies. Given the high bioavailability of protein, iron and vitamin A in meat, eggs and milk, increasing the availability of ASFs for poor populations in developing countries could significantly reduce the burden of disease attributable to protein and micronutrient deficiencies.

[1] One DALY is equivalent to one year of healthy life lost to poor health or disability. DALYs are calculated as the sum of life years lost due to premature death, and years of disability.

Table 2.3
PER CAPITA CONSUMPTION OF CALORIES, PROTEIN, MEAT AND MILK, BY REGION, 2005

Region/country	Calories/ day	Calories from ASF/day (%)	Protein/day (g)	Protein from ASF/day (%)	Meat supply/day (g)	Milk[a] supply/day (g)
EAP	2 825	18.6	80	35.9	122	58
China	2 970	21.5	89	37.1	148	65
EECA	3 134	20.9	93	43.8	126	460
LAC	2 965	23.7	86	54.3	198	382
NENA	3 083	10.0	86	24.5	68	191
South Asia	2 337	9.0	55	21.0	16	190
India	2 348	8.3	55	19.0	14	179
SSA	2 068	6.9	52	19.9	40	78
All regions	2 634	14.5	71	31.3	86	169
High-income countries[b]	3 362	26.1	102	56.9	222	555

[a] Excluding butter.
[b] Based on 2010 World Bank classification (Annex 1).
Source: FAOSTAT, 2010.

Table 2.4
PREVALENCE OF PROTEIN-ENERGY MALNUTRITION, VITAMIN A DEFICIENCY AND IRON-DEFICIENCY ANAEMIA, BY REGION, 2004

Region	Protein-energy malnutrition		Vitamin A deficiency		Iron-deficiency anaemia	
	(%)	(thousands)	(%)	(thousands)	(%)	(thousands)
EAP	2.2	41 146	0.2	3 836	16.4	311 115
EECA	0.9	4 424	0.1	267	11.5	54 540
LAC	1.9	10 283	0.0	65	10.4	56 908
NENA	3.1	10 176	0.4	1 203	14.1	45 857
South Asia	6.9	102 496	0.6	9 245	29.3	437 824
SSA	9.2	68 669	0.9	6 613	26.6	199 373
All regions	4.3	237 194	0.4	21 229	20.2	1 105 617

Source: WHO, 2008.

THE ROLE OF LIVESTOCK IN FOOD SECURITY AND NUTRITION

Livestock directly contribute to human food security by transforming vegetation from non-arable drylands,[2] crop residues, by-products from food processing, and organic waste into human food that is of high nutrient density and nutritional quality. Livestock thus offer one of the most efficient means of utilizing resources that would otherwise go unexploited, in both rural and urban areas.

[2] Drylands comprise arid, semi-arid and dry sub-humid areas (other than polar and sub-polar regions) where the ratio of rainfall to mean annual potential evapotranspiration ranges from 0.05 to 0.65.

Livestock play a particularly important role in food security in dryland areas. A characteristic feature of drylands is low and highly variable rainfall, which makes much of them unsuitable for crop production. Drylands cover about 40 percent of the world's land surface and 54 percent of productive land,[3] and their exploitation through livestock grazing constitutes the largest land-use system on earth. It is estimated that more than 180 million people in the developing world depend on these systems for their livelihoods (Thornton *et al*., 2002), mainly through exploitation for grazing livestock. Drylands constitute a particularly large share of the land area of sub-Saharan Africa (60 to 70 percent); in East Africa an estimated 40 to 50 percent of ruminant meat is produced in drylands, while the equivalent figure for West Africa is between 30 and 40 percent (Rass, 2006). In addition, drylands complement and make possible other production systems, such as stratified beef production, which relies on a supply of calves for feeding by cow herds maintained on natural grasslands.

Livestock not only provide a means of exploiting drylands to support human livelihoods, they also add value to large amounts of plant materials associated with the production of food crops (e.g., straws, stovers) and to by-products of food and fibre processing (e.g., oilseed cakes, brewers' grains)[4] that are not edible for humans but can be used as animal feed. It has been estimated that in 1993, crop residues of wheat, rice, maize and barley provided more than 650 million tonnes of animal feedstuff, equivalent to 27 million tonnes of crude protein and 4 194 billion megajoules (MJ) of energy, while the feed energy produced from the global supply of by-products (excluding crop residues) would support the production of more than 500 million tonnes of milk (CAST, 1999). These figures are underestimates as they take into account only the main crop residues and by-products. Other low-value feed transformed into human-edible material by livestock includes organic kitchen and other wastes, which low-income households often feed to their animals, and a range of other organic materials consumed by animals through scavenging. Where livestock are largely fed from crop residues and by-products or wasteland, little or no cultivated land is devoted to fodder production. Improving the utilization and quality of crop residues, such as the treatment of straw, extends the livestock carrying capacity without reducing the production of crops for sale or human consumption.

Livestock also contribute indirectly to food security by increasing crop output through providing manure, which is a valuable source of organic plant nutrients and reduces the need for chemical fertilizers. Livestock enhance the flexibility and thus the stability of food production (Bradford, 1999). Because they can be kept for variable lengths of time and be maintained on a variety of diets they serve as a buffer to mitigate the impact of fluctuations in crop production on the availability of food for human consumption.

ASFs alone are unsuited to providing basic subsistence needs. Meat is rarely a staple diet item, even in pastoral societies, where the main livestock products consumed are milk and blood, which are complemented by purchased cereals. However, ASFs are energy-dense, contain high-quality protein and are good sources of a number of micronutrients. Animal pro-

[3] The world's productive lands include all areas except for hyper-arid lands with a ratio of mean annual precipitation to mean annual potential evapotranspiration of less than 0.05.

[4] Fadel (1999) estimates that every 100 kg of food produced yields 37 kg of animal feed by-product. The waste disposal function of livestock in utilizing these by-products represents a valuable service in itself and reduces the price of food for humans.

Table 2.5
MICRONUTRIENTS PROVIDED BY ANIMAL-SOURCE FOODS

Nutrient	Source	Consequences of deficiency
Calcium	Dairy products	Nutritional rickets
Zinc	Meats	Dermatitis, diarrhoea, growth faltering and stunting, impaired immune function and increased risk of infections
Iron	Meats	Children: impaired growth and cognitive development and reduced immune function Adults: lowered work capacity
Vitamin A	Dairy products, liver, egg-yolk	Night blindness, corneal ulceration, loss of vision, growth faltering, increased risk of infectious disease, morbidity and mortality
Vitamin B12	ASFs are only source	Anaemia, disorders of central nervous system
Vitamin B2 (riboflavin)	Dairy products, meats, eggs, organs	Skin lesions, angular stomatitis, glossitis, cheilosis

teins have higher digestibility (96 to 98 percent) than most plant proteins (65 to 70 percent), and the amino acid composition of animal proteins is superior to that of plants. The biological values for animal proteins range from 90 to 100 relative to egg protein (the reference protein conventionally set at 100), while values for plant proteins range from 50 to 70. The bioavailabilities of important minerals (calcium, phosphorous, iron, zinc, magnesium and manganese) and vitamins – thiamine (B1), riboflavin (B2), niacin, pyridoxine (B6) and B12 – are much higher in animal than in most plant products. These characteristics make ASFs important for population groups with limited food intake capacity relative to their needs, such as young children, pregnant and lactating women, and people with HIV/AIDS. For example, studies of children in various countries have shown that both their physical and their mental development are strongly and positively associated with the amounts of ASFs in their diet (Calloway, Murphy and Beaton, 1988, cited by Bradford, 1999). The benefits of ASFs appeared to be related more to micronutrient than to protein content (Allen *et al*., 1992; Murphy and Allen, 1996, cited by Bradford 1999).

THE ROLE OF AGRICULTURE IN POVERTY REDUCTION

Although the agriculture sector makes a relatively small contribution to gross national income (GNI) or gross domestic product (GDP), large proportions of national economically active labour forces are employed in agriculture (compare the fourth and fifth columns of Table 2.6).

The agricultural labour force's far smaller contribution to national income indicates that average incomes and productivities are lower in agriculture than in the rest of the economy, reinforcing the argument that poverty is more prevalent in the agriculture sector.

The second and third columns of Table 2.6 provide estimates of the average per capita incomes of each of the main continental blocks and two large individual countries, China and India (Annex 1 provides a list of the 2010 World Bank country groupings). Based on GNI per capita it is apparent that most developing regions and countries fall into the middle-income category, with average annual per capita incomes of between USD 976

Table 2.6
STRUCTURAL FEATURES OF DEVELOPING COUNTRY ECONOMIES AND THE RELATIVE IMPORTANCE OF AGRICULTURE AND THE AGRICULTURAL LABOUR FORCE, 2008

Region/country	GNI/capita *(USD)*	GNI/capita PPP *(international dollars)*	Agricultural value added *(% of GDP)*	Agricultural labour force *(% of total)*	Agricultural land *(% of total)**	Land/person in agriculture *(ha)**
EAP	2 631	5 399	12	56.9	50.8	1.3
China	2 940	6 020	11	62.0	59.6	1.2
EECA	7 418	12 220	7	15.2	28.2	20.5
LAC	6 780	10 309	6	15.6	35.7	17.0
NENA	3 242	7 308	12	22.6	22.4	7.9
South Asia	986	2 733	18	53.6	54.7	0.9
India	1 070	2 960	18	55.4	60.6	0.8
SSA	1 082	1 991	14	59.4	44.0	5.8
All regions	2 789	5 330	11	47.6	38.2	3.0

*Last two columns based on 2005 estimates of area of agricultural land.
Sources: World Bank, 2010b; FAOSTAT, 2010.

and USD 11 906 (as defined in World Bank, 2010a). Eastern Europe and Central Asia, and Latin America and the Caribbean are upper-middle-income regions with average annual per capita incomes of more than USD 3 856.

The alternative estimates of per capita incomes in PPP provide a better indication of the purchasing power. They are generally higher than the United States dollar values, but are closely correlated to these. There is considerable variation in average per capita PPP income levels among regions. These figures illustrate a familiar phenomenon: as per capita incomes rise, the proportion of the national labour force engaged in agriculture, and the value added as a proportion of national income diminish. Thus, the two upper-middle-income regions, unlike the others, employ less than 40 percent of their labour forces in agriculture, which yields less than 10 percent of national income.

There is far more available agricultural land per person employed in agriculture in the upper-middle-income regions than in the rest of the developing world. South Asia and East Asia and the Pacific have relatively small areas (about 1 ha) of land available per agricultural worker. However, although the agricultural resource base per person in agriculture is low in many developing countries (particularly in highly populated East and South Asia), and despite the poor remuneration of agricultural labour, the number of people depending on agriculture as part of their livelihoods has, in absolute terms, grown over the past 15 years (Table 2.7).

In general, in spite of continuing human migration to urban centres, populations in most countries will remain predominantly rural until 2020. In the two poorest regions, although urban populations are growing faster than rural ones in absolute terms, rural populations will continue to expand: for sub-Saharan Africa until 2045, and for South Asia until 2025 (FAOSTAT, 2010). In Latin America and the Caribbean, and the Near East and North Africa the majority of the labour force is engaged in non-agricultural employment. The same is

Table 2.7
NUMBERS AND PROPORTIONS OF ECONOMICALLY ACTIVE POPULATION ENGAGED IN AGRICULTURE, BY REGION, 1990 AND 2005 (MILLIONS)

Region/country	1990				2005			
	Agriculture		Non-agriculture		Agriculture		Non-agriculture	
	(no.)	*(%)*	*(no.)*	*(%)*	*(no.)*	*(%)*	*(no.)*	*(%)*
EAP	599.7	67.6	287.3	32.4	644.7	56.9	487.6	43.1
China	472.8	71.9	184.7	28.1	498.7	62.0	305.1	38.0
EECA	47.3	23.5	154.1	76.5	31.3	15.2	174.8	84.8
LAC	32.4	19.4	134.1	80.5	42.0	15.6	228.1	84.4
NENA	21.4	33.2	43.0	66.8	25.4	22.6	87.2	77.5
South Asia	269.9	62.8	159.8	37.2	342.9	53.6	297.4	46.5
India	207.4	63.4	119.2	36.5	261.6	55.4	210.8	44.6
SSA	132.8	67.9	62.6	32.0	194.5	59.4	133.2	40.6
All regions	1 103.5	56.8	840.8	43.2	1 280.8	47.6	1 408.1	52.4

Source: FAOSTAT, 2010.

true of Eastern Europe and Central Asia, but data for this region must be treated with caution, as the constituent countries changed dramatically between 1990 and 2005.

In most developing countries, the majority of the population continues to live in rural areas, poverty rates are higher among rural than urban households, and the rural poor constitute between 70 and 80 percent of the total number of poor. People employed in agriculture make up nearly half of the total labour force in all developing country regions and more than 60 percent in low-income countries (result not shown). This constitutes a large resource with potential for stimulating economic growth in agriculture and rural, non-farm economic activities.

There is consensus that to reduce poverty rapidly, interventions have to be directed to the rural areas of developing countries, where most of the population and most of the poor people live, and that they should target economic activities in rural areas, mainly agriculture, in which most of the poor are engaged (World Bank, 2008). The relative emphasis on interventions in agriculture will gradually decline as the structure of the economy transforms, moving towards other sectors (services and industry), but transformation of the economy has usually been driven by development of the agriculture sector (Tiffin and Irz, 2006). From a global perspective, the emphasis must remain on the rural population when poverty reduction is a main goal of economic development.

LIVESTOCK SECTOR TRENDS AND LIVESTOCK KEEPERS

Livestock's contribution to the total value of agricultural production can be estimated as the sum of price-weighted quantities of different agricultural commodities produced, after deducting the quantities used as seed and feed, weighted in a similar manner. Deduction of the agricultural inputs used gives a measure of the net production or output of each sector. Base prices are the average international commodity prices for the period 1999 to 2001.

Results obtained for the main regional groups of countries, China and India in 1990 and 2007 are presented in Table 2.8. Results for 2007 are the most recent figures available. The changing contribution of livestock to agricultural net output may be assessed either by comparing the percentage level in 2007 (seventh column) with that in 1990 (fourth column), or by comparing the growth rate of livestock net output with that of agriculture (last two columns).

In developing regions, it appears that livestock contribute about a third of total agricultural net output on average, but there is considerable variation, with sub-Saharan Africa having the lowest contribution in 2007. Between 1990 and 2007, the percentage contribution of livestock grew rapidly in East Asia and the Pacific, quite fast in South Asia, and moderately in the Near East and North Africa. However, the relative importance of net livestock output fell in Latin America and the Caribbean, sub-Saharan Africa, and developing countries as a whole. As there are substantial structural economic differences among these groups of countries, it is difficult to identify reasons for the decline in livestock's contribution to agricultural output. Again, changes over time recorded for Eastern Europe and Central Asia need to be treated with caution, as the constituent countries have changed.

Broad changes in the structure of regions' livestock sectors between 1990 and 2008 are shown in Table 2.9. The variation of tropical livestock units[5] (TLU) per person in agriculture is wide, in both years. Livestock density measured in TLU per square kilometre of agricultural land also varies substantially among regions. South Asia's 92 TLU/km^2 is more than twice that in any other region. Density is very low in Eastern Europe and Central Asia, at 12 TLU/km^2, moderate in the Near East and North Africa, and sub-Saharan Africa, at 23 TLU/km^2, and a relatively high 41 TLU/km^2 in East Asia and the Pacific.

The TLU per person employed in agriculture may be linked to average consumer incomes. It is currently highest in Latin America and the Caribbean, with nearly 7 TLU/person employed in agriculture, and exceeds 1 TLU/person in Eastern Europe and Central Asia, the Near East and North Africa, and sub-Saharan Africa. TLU/person in agriculture in East Asia and the Pacific, and South Asia is much lower. In East Asia and the Pacific, the majority of the TLUs are non-ruminants (pigs and poultry), while elsewhere ruminants account for most TLUs.

Over the 18-year period, the TLU per person employed in agriculture rose only in East Asia and the Pacific, and the Near East and North Africa. Numbers fell in Latin America and the Caribbean, and South Asia, and remained stable in sub-Saharan Africa, just keeping pace with expansion of the agricultural labour force. Again care is needed in assessing changes over time for Eastern Europe and Central Asia.

In all regions, the proportion of ruminants in the total TLU value declined between 1990 and 2008, while the proportion of non-ruminant livestock (pigs and poultry) rose. The last two columns of Table 2.9 give the average annual growth rates of the numbers of ruminant and non-ruminant livestock, independent of the changing agricultural labour force. Growth rates of ruminant numbers are relatively small, at less than 1 percent in all but the Near East and North Africa, and sub-Saharan Africa, and are even negative in India and Eastern Europe and Central Asia. Growth rates for the non-ruminant (pig and poultry) sectors are

[5] The TLU, equivalent to 250 kg live weight, standardizes live animals by species' mean live weight. The TLU conversion factors used are cattle 0.60, buffaloes 0.50, sheep and goats 0.10, pigs 0.25, and poultry 0.01. Livestock are aggregated into TLUs of 250 kg live weight, disregarding differences in breed, sex, age and health status.

Table 2.8
LIVESTOCK SECTOR'S CONTRIBUTION TO AGRICULTURAL GDP,* AND ANNUAL LIVESTOCK SECTOR GROWTH, BY REGION, 1990 AND 2007

Region/ country	1990			2007			Annual growth rate	
	Agricultural *(billion international dollars)*	**Livestock production** *(billion international dollars)*	**Livestock: agricultural GDP** *(%)*	**Agricultural production** *(billion international dollars)*	**Livestock production** *(billion international dollars)*	**Livestock: agricultural GDP** *(%)*	**Agriculture** *(%)*	**Livestock** *(%)*
EAP	244	58	23.7	478	145	30.3	4.0	5.6
China	173	45	25.8	355	120	33.9	4.3	6.0
EECA	142	95	67.0	120	53	44.5	-1.0	-3.3
LAC	111	49	43.8	190	81	42.7	3.2	3.0
NENA	36	12	33.7	60	22	36.7	3.1	3.6
South Asia	149	43	29.1	241	82	33.9	2.9	3.8
India	106	29	27.2	170	54	31.9	2.8	3.8
SSA	61	17	28.1	97	26	26.6	2.8	2.4
All regions	742	274	36.9	1,185	408	34.5	2.8	2.4

* Livestock sector GDP is frequently underestimated owing to accounting methods that do not (fully) include products such as manure and services such as draught power, the benefits of which are allocated to other sectors (for an example see Behnke, 2010).

Source: FAOSTAT, 2010.

Table 2.9
STRUCTURE AND GROWTH OF THE LIVESTOCK SECTOR, 1990 TO 2008

Region/ country	1990			2008			Annual growth rate	
	TLU/1 000 people in agriculture *(no.)*	**Ruminants** *(%)*	**Non-ruminants** *(%)*	**TLU/1 000 people in agriculture** *(no.)*	**Ruminants** *(%)*	**Non-ruminants** *(%)*	**Ruminants** *(%)*	**Non-ruminants** *(%)*
EAP	(No.)	46	54	539	39	61	0.8	2.4
China	412	41	59	518	35	65	0.7	2.1
EECA	3 393	73	27	2 747	69	32	-3.7	-2.6
LAC	7 470	87	13	6 766	82	18	0.6	2.6
NENA	1 579	83	17	1 894	77	23	1.6	3.7
South Asia	885	96	4	777	94	6	0.5	3.6
India	888	97	3	700	95	6	-0.2	2.8
SSA	1 145	93	7	1 147	93	7	2.1	2.3
All regions	980	78	22	980	74	26	0.5	1.9

Source: FAOSTAT, 2010.

far higher, at more than 3.5 percent per year in Eastern Europe and Central Asia, and South Asia. Between 2005 and 2008, poultry numbers increased by 10 percent a year in Eastern Europe and Central Asia and by nearly 8.75 percent in South Asia, particularly in India with 8.93 percent (FAOSTAT, 2010).

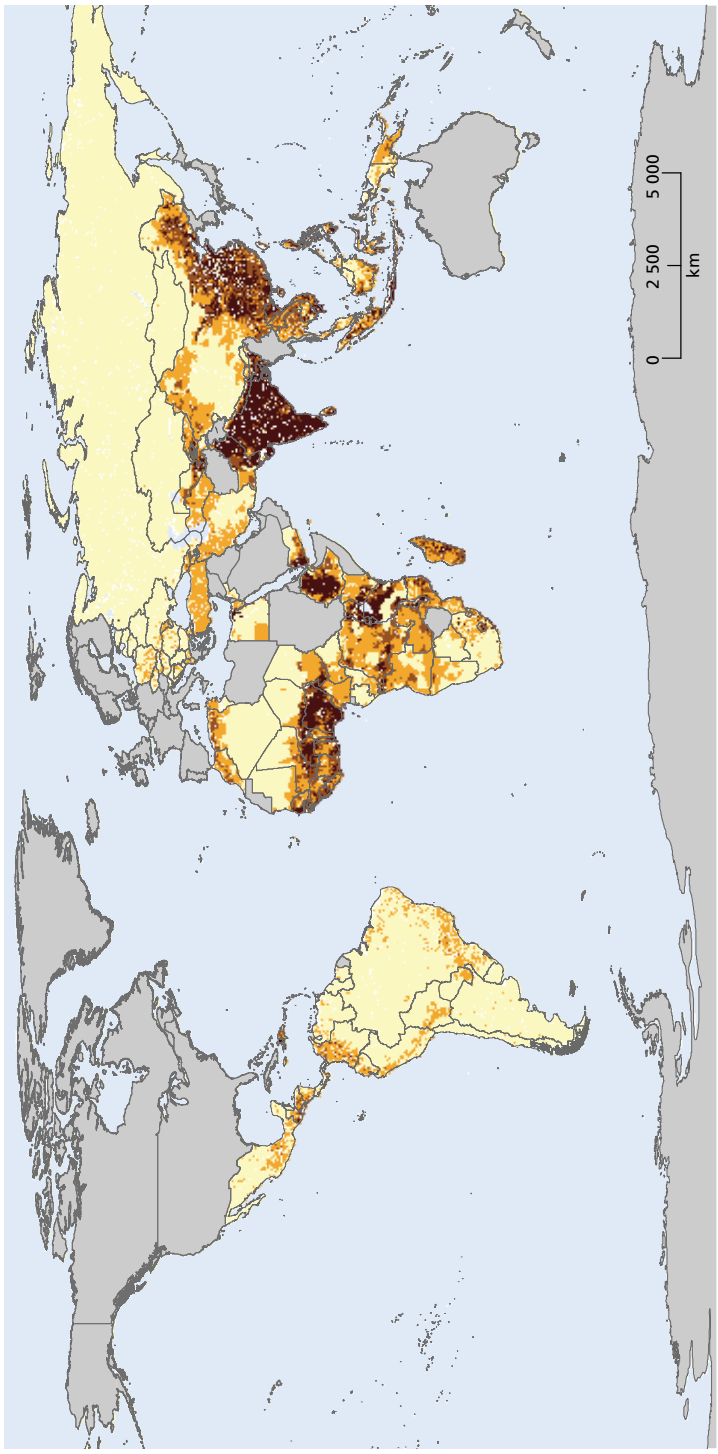
To locate poor livestock keepers for the targeting of research and development activities, the International Livestock Research Institute (ILRI) estimated the numbers of poor livestock keepers in the developing world (Thornton *et al*., 2002; 2003). These data have recently been updated using 2010 estimates of rural populations (FAOSTAT, 2010) and the more recent Version 5 of the Thornton *et al*. (2002) livestock production system maps (Robinson *et al*., 2011). The updated estimates of poor livestock keepers were based on national rural poverty lines[6] from the 2008 *World Development Report* (World Bank, 2008), updated using data from the World Bank (2011). This resulted in a collage of estimates of rural headcount indices based on surveys conducted between 1990 and 2006 and covering most developing countries. As the international poverty lines used in this chapter do not distinguish urban from rural poverty they are not ideal for estimating poor livestock keepers, because poverty rates usually differ greatly between urban and rural areas. However, to bring these latest estimates into line with other figures in this chapter, Table 2.10 compares the estimates of poor livestock keepers based on national rural poverty lines with those based on the international poverty lines for the poor (< $2.00/day) and the very poor (< $1.25/day). Table 2.10 includes the compounded, annualized rates of change in poor livestock keepers from 2000 to 2010, estimated using national rural poverty lines.

Estimates based on national poverty lines tend to be closer to those based on the $1.25/day line, but there are exceptions: national estimates for China are vastly lower than the international estimates; and those for Latin America and the Caribbean, and the Near East and North Africa are, respectively, about six and three times those based on the international $1.25/day poverty line. A striking finding from Table 2.10 is that shifting the poverty line from $1.25/day to $2/day more or less doubles the number of poor livestock keepers – showing the large numbers of people who fall into this marginal ground.

In terms of absolute numbers of poor livestock keepers (< $2/day), South Asia and sub-Saharan Africa dominate, with more than 45 and 25 percent of the world's estimated 752 million poor livestock keepers respectively. The depth of poverty among livestock keepers is particularly high in sub-Saharan Africa, where it is estimated that more than 85 percent of poor livestock keepers are extremely poor. Globally, the number of poor livestock keepers has been increasing by about 1.4 percent per year – reductions in the numbers in East Asia and the Pacific, and Latin America and the Caribbean being offset by considerable increases in all other regions. Numbers have been increasing particularly rapidly in Eastern Europe and Central Asia with 3.75 percent per year, the Near East and North Africa with 4.62 percent, and sub-Saharan Africa with 3.35 percent.

[6] National poverty lines reflect local perceptions of the level of consumption or income needed to avoid poverty. The perceived boundary between poor and not poor rises with the average income of a country, so does not provide a uniform measure for comparing poverty rates across countries. National poverty estimates are the appropriate measure for setting national policies for poverty reduction and monitoring their results. International poverty measurements provide a uniform standard for comparing poverty rates and numbers of people living in poverty across countries (World Bank, 2008).

FIGURE 2.3
Distribution (density) of poor livestock keepers, based on the international $2/day poverty line, 2010



Source: Data from Robinson *et al.*, 2011.

Table 2.10
ESTIMATES OF POOR LIVESTOCK KEEPERS BASED ON NATIONAL RURAL POVERTY LINES AND INTERNATIONAL POVERTY LINES, 2010, AND ANNUAL RATE OF CHANGE IN POOR LIVESTOCK KEEPERS BASED ON NATIONAL RURAL POVERTY LINES, 2000 TO 2010

Region/country	Poor livestock keepers in 2010 *(millions)*			Annual change in poor livestock keepers, 2000–2010
	National rural poverty line	International poverty lines		
		< $1.25/day	< $2/day	
EAP	50	70	170	-2.05%
China	7	46	105	-1.42%
EECA	17	7	12	3.75%
LAC	28	5	10	-1.48%
NENA	23	7	13	4.62%
South Asia	150	178	328	0.89%
India	106	142	258	0.41%
SSA	160	154	219	3.35%
All regions	428	421	752	1.40%

Source: Adapted from Robinson *et al.*, 2011.

Figure 2.3 shows the distribution of poor livestock keepers based on the international $2/day poverty line. The map shows that there are particularly high densities of poor livestock keepers throughout South Asia (India, Pakistan and Bangladesh) and in parts of sub-Saharan Africa (particularly Nigeria, Ethiopia, Uganda, Burundi, Rwanda, Malawi and areas of Kenya, South Africa and the Niger).

CURRENT AND FUTURE DEMAND FOR LIVESTOCK PRODUCTS

Comparison of regional average per capita incomes (Table 2.6) with average per capita supply or consumption of calories, protein and proportions derived from ASFs (Table 2.3) suggests there is a strong positive relationship between per capita income and consumption level. For instance, the relatively low-income regions of South Asia and sub-Saharan Africa have the lowest per capita consumptions of calories, protein and nutrients derived from ASFs, while the upper-middle-income regions of Eastern Europe and Central Asia, and Latin America and the Caribbean have the highest consumption levels. There is a case for further exploration of the association between total per capita expenditure level, determined by income, and the allocations to consumption of different food items (Table 2.11), by region.

These estimates show that in the poorer regions of East Asia and the Pacific, South Asia, and sub-Saharan Africa, more than 50 percent of total expenditure is allocated to food, with bread and cereals as the largest item. In contrast, the higher-income developing country regions of Eastern Europe and Central Asia, Latin America and the Caribbean, and the Near East and North Africa allocate between 26 and 42 percent of total expenditure to food, while the proportion in high-income countries is only about 13 percent. As the proportion of expenditure allocated to meat and dairy products increases, that allocated to bread and cereals decreases, among other dietary improvements.

Table 2.11
PROPORTIONS OF EXPENDITURE ALLOCATED TO DIFFERENT FOOD ITEMS, BY REGION (PERCENTAGES)

Region/country	Food expenditure as % of total	% of food expenditure					
		Bread and cereals	Meat	Dairy	Fish	Fruits and vegetables	Other food items
EAP	52.4	31.7	17.6	4.4	6.1	17.6	22.7
China	54.1	32.4	19.6	4.0	4.8	17.6	21.6
EECA	38.8	17.8	19.3	12.3	2.3	18.3	30.1
LAC	26.2	18.9	22.4	12.2	2.8	15.6	28.1
NENA	42.4	21.6	20.9	9.9	3.2	17.4	27.1
South Asia	52.5	32.1	8.2	16.9	5.1	14.1	23.6
India	52.5	30.8	9.0	17.8	5.2	14.0	23.2
SSA	60.9	31.4	12.8	5.6	9.3	18.8	22.1
All regions	48.9	28.8	15.1	10.1	5.2	16.5	24.3
High-income countries*	13.3	13.1	18.0	9.0	5.0	13.9	41.0

* Based on 2010 World Bank classification.
Sources: ICP 2005 dataset; data for India and China from Wu, 2005.

The impact of a change in per capita income on the quantity of a commodity demanded or consumed is measured by the income elasticity of demand.[7] For most commodities, income elasticities of demand are positive, although for a few "inferior" goods the quantity demanded falls as incomes rise, resulting in negative income elasticity. For necessities such as food, income elasticities are generally below unity, and Engel's Law states that as incomes rise, the income elasticity of demand for food falls (Norton, Alwang and Masters, 2006). However, while in high-income countries the income elasticity may be as low as 0.1, in very poor countries it may be as high as 0.8. There are also differences in income elasticities of demand for different food items. Higher-quality but more expensive items such as ASFs generally have higher income elasticities of demand than staple food crops. Table 2.12 translates income elasticities of demand into estimates of the additional expenditure on specific food items resulting from an additional $1 of total household expenditure.[8]

The figures in Table 2.12 support Engel's Law by showing a declining proportion of income spent on food as incomes rise. The proportion of the additional expenditure on food devoted to meat and dairy combined (ASFs) varies from 20 to 25 percent in the poorer regions of East Asia and the Pacific, South Asia, and sub-Saharan Africa. It is higher, at 30 to 35 percent, in the middle-income regions of Eastern Europe and Central Asia, Latin America and the Caribbean, and the Near East and North Africa, and reaches close to 40

[7] Estimated as the percentage change in quantity demanded, divided by the percentage change in per capita income.

[8] Estimates were obtained from the product of income elasticity of demand and current consumption level per $1 of expenditure (Table 2.11).

Table 2.12
PREDICTED EXPENDITURE ALLOCATIONS OF ADDITIONAL INCOME, BY REGION (PERCENTAGES)

Region/country	% allocated to food	% of additional food expenditure					
		Bread and cereals	Meat	Dairy	Fish	Fruits and vegetables	Other food items
EAP	40.0	26.2	18.5	1.9	7.6	20.4	25.3
China	43.5	27.7	19.6	0.7	6.3	21.6	24.1
EECA	24.3	13.3	20.1	14.2	2.6	16.4	33.4
LAC	16.0	12.1	24.0	13.9	3.4	13.7	32.9
NENA	27.2	14.9	21.9	11.1	4.3	14.5	33.4
South Asia	39.5	27.1	9.3	14.2	6.1	17.5	25.7
India	40.9	26.8	10.2	13.6	5.9	18.7	24.9
SSA	47.4	24.9	13.3	6.4	13.2	16.2	26.0
All regions	36.1	24.6	15.3	8.2	7.0	18.2	26.7
High-income countries*	3.8	6.7	18.6	10.4	7.5	11.3	45.5

* Based on 2010 World Bank classification.
Sources: ICP 2005 dataset; data for India and China from Wu, 2005.

percent for high-income countries. These results emphasize the expected relative growth in per capita ASF consumption as incomes rise. (A similar trend is observable for fruits and vegetables.)

In 2003, FAO published the report *World agriculture: towards 2015/2030* (Bruinsma, 2003), which presented prospective developments in food demand and consumption and the possible implications for nutrition and undernourishment. Since publication of this study, estimates of population growth have been considerably revised and world energy markets have become increasingly tight, resulting in increased costs for inputs and for transporting agricultural products, along with less direct effects such as increasing demand for agricultural land for producing biofuels. For these and other reasons, FAO has revised and extended the 2015/2030 estimates to 2030/2050 (Alexandratos *et al.*, 2006). Regional estimates of demand growth for livestock commodities based on these revisions are presented in Table 2.13.

The results shown in Table 2.13 reflect trends in both population and consumption patterns. Growth in poultry consumption outstrips that in other ASFs in all regions, and by far the most dramatic change is the projected increase in demand for poultry meat in South Asia. This is driven by growth in demand in India, where a staggering 850 percent increase is projected over the 30-year period, accompanied by a nearly 300 percent increase in egg consumption. In terms of volumes, the growth in consumption of milk products is impressive: in South Asia consumption will more than double, to 213 tonnes in 2030, 70 percent of which (146 million tonnes) will be in India. Because of its large and rapidly growing population, East Asia also has large projected increases in consumption, particularly of pork and poultry meat, and milk, most of which will be in China. The largest absolute and relative projected

Table 2.13
GROWTH IN DEMAND FOR LIVESTOCK PRODUCTS, 2000 TO 2030

Region/country	Beef		Mutton		Pork		Poultry		Eggs		Milk	
	Absolute *('000 tonnes)*	Proportion *(%)*	Absolute *('000 tonnes)*	Proportion *(%)*	Absolute *('000 tonnes)*	Proportion *(%)*	Absolute *('000 tonnes)*	Proportion *(%)*	Absolute *('000 tonnes)*	Proportion *(%)*	Absolute *('000 tonnes)*	Proportion *(%)*
EAP	8 798	130	1 669	58	28 075	63	22 522	143	10 188	45	23 765	132
China	6 888	132	1 537	56	22 050	54	14 609	121	6 810	34	15 936	143
EECA	290	11	204	40	112	5	2 310	108	684	28	4 364	15
LAC	7 302	58	239	54	4 405	100	14 434	126	3 246	78	39 818	72
NENA	1 929	112	1 287	103	9	52	6 296	243	1 799	148	17 913	111
South Asia	3 367	84	1 722	115	950	160	11 491	725	5 947	294	118 942	126
India	1 338	51	588	85	921	160	8 865	844	4 251	280	79 330	119
SSA	3 768	113	1 883	137	1 106	155	3 235	170	1 727	155	20 939	107
All regions	25 454	81	7 004	88	34 656	66	60 287	170	23 590	70	225 741	97

Source: Robinson and Pozzi, 2011.

increases in mutton consumption are for sub-Saharan Africa. Beef consumption is projected to increase most in East Asia and the Pacific, again driven by consumption in China.

Although the projections do not account for differential affluence and ASF consumption rates between urban and rural areas, separate population projections for urban and rural areas can be derived from United Nations (UN) estimates of urbanization (UN, 2008). This enables the mapping of projections that differentiate between urban and rural growth in demand. Robinson and Pozzi (2011) used the Global Rural and Urban Mapping Project (GRUMP) (CIESIN *et al*., 2004) population layer to map the UN estimates of rural and urban populations in 2000 and 2030 (UN, 2003; 2008) from which they mapped the growth in demand for ASFs (Figure 2.4).

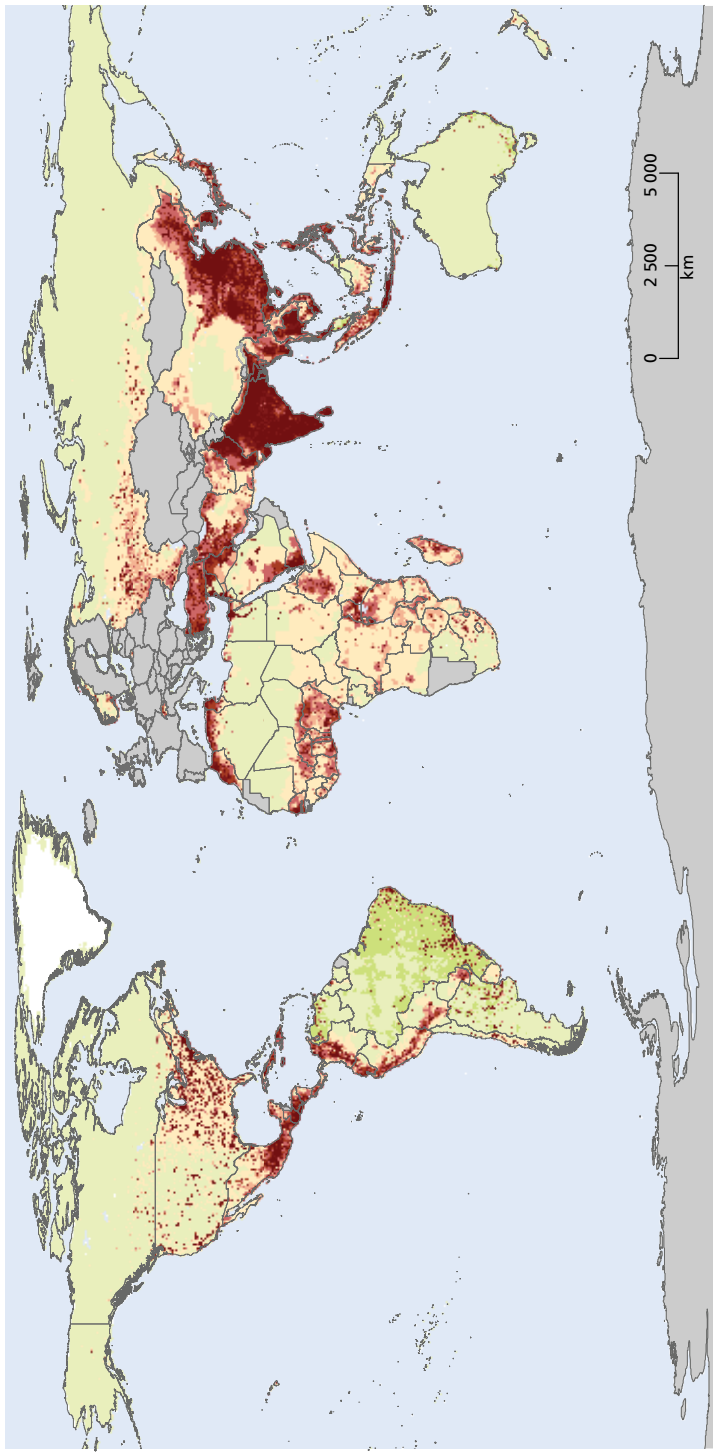
Figure 2.4 provides a global overview of projected demand for poultry meat, the ASF for which projected consumption increases are the greatest in all regions. Widespread increases are evident, particularly in South Asia, and East Asia and the Pacific. The apparent decline in Brazil reflects a net reduction of consumption in rural areas. Overall, the projected increase in annual poultry meat consumption is 3.8 million tonnes (77 percent), with a projected increase of 4.0 million tonnes (98 percent) in urban areas accompanied by a projected reduction of 200 000 tonnes (16.5 percent) in rural areas. This reflects high levels of urbanization leading to a reduction in the rural population.

The effect of urbanization on changing demand for ASFs is not clearly illustrated in Table 2.13, or in a map at the scale of Figure 2.4. For example, poultry meat consumption in India is projected to increase by about 8.8 million tonnes between 2000 and 2030, an 844 percent increase (Table 2.13). While most of this increase – 5.2 million tonnes – will occur in rural areas (compared with 3.7 million tonnes in urban areas), the relative increase in urban areas, at 1 288 percent, will be almost twice that in rural areas, at 676 percent. Similar patterns are seen in other commodities. For example, pork consumption in China is projected to increase by 22 million tonnes (54 percent) between 2000 and 2030 (Table 2.13). However, urban consumption is projected to increase by 23.5 million tonnes, or 160 percent, while rural consumption declines by 1.4 million tonnes, or 5 percent, again reflecting very high rates of urbanization.

This growth in demand for ASFs, particularly in the burgeoning urban areas of developing countries, presents potential opportunities for economic growth and poverty reduction. As long as daily per capita incomes remain below $5, quantity has preference over quality (McDermott *et al*., 2010) and most low-income consumers purchase their food in traditional live-animal or wet markets. Livestock producers who gain access to these urban markets benefit from the potential increased sales and higher prices that may be obtained. Many of these producers may be livestock-dependent poor, but even where production is in the hands of larger-scale commercial livestock owners, additional employment is generated for hired labour. The results represent an increase in the livestock sector's contribution to national GDP and the corresponding national income, while poor urban consumers derive the nutritional benefits associated with increased ASF dietary intake.

Expanded markets for ASFs have further benefits. Increases in livestock production are likely to necessitate increases in purchased inputs of young or breeding stock, genetic material, feeds and veterinary services. Some of these may be purchased from urban-based suppliers, resulting in financial flows from rural to urban locations. In addition, as shown in Table 2.12, less

FIGURE 2.4
Global growth in demand for poultry meat, 2000 to 2030



Sources: Robinson and Pozzi, 2011, based on data provided by J. Bruinsma.

than half of any additional income earned is likely to be spent on food, with the remainder being allocated to non-food consumer goods. It can be assumed that this applies to the income growth of livestock producers as much as to that of other members of society. The resultant growth in rural demand for non-food consumer goods might be met by purchases from urban suppliers. However, opportunities are also created for expanding local village-level manufacture and provision. In either case, growth of the livestock sector in response to increased urban demand can serve as the launch-pad for a self-generating process of economic growth and development (see Chapter 4).

NEGATIVE IMPACTS OF LIVESTOCK PRODUCTION

Although livestock sector growth in developing country regions can lead to a variety of positive social outcomes, there are also potential negative environmental and public health impacts, which need to be managed to minimize their consequences. The negative effects of livestock production include land degradation (e.g., from overgrazing), pollution from effluents, loss of biodiversity, emergence and spread of zoonotic pathogens, development of antimicrobial resistance, and GHG emissions, which drive climate change.

Recently there has been considerable debate about the contribution that livestock make to GHG emissions. GHGs comprise carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and gases with high global warming potential (GWP), mainly hydrofluorocarbons. In 2004, CO_2 from anthropogenic processes constituted about 77 percent of global GHG emissions, CH_4 constituted 14 percent, and N_2O 8 percent, the remainder being accounted for by GWP gases (IPCC, 2007). It has been estimated that agriculture generates about one-third of total global GHG emissions: 24 percent of CO_2, 52 percent of CH_4, and 84 percent of N_2O (USEPA, 2006). Agriculture's direct contributions to GHG emissions are dominated by N_2O from soils and CH_4 from enteric fermentation, which constituted 38 and 32 percent respectively of all agricultural non-CO_2 emissions in 2005 (USEPA, 2006).

Per capita GHG emissions and the contributions of different sources to total emissions vary significantly among regions (Table 2.14). Total per capita GHG emissions in high-income countries are about four times those of the rest of the world, and nearly ten times the amount estimated for low-income countries (result not reported). Regional estimates of per capita emissions of CO_2 – the main GHG – diverge even more, with a person in a high-income country emitting more than 50 times as much as one in a low-income country. For CH_4, with the exception of the two extremes, Latin America and the Caribbean (90 kg CO_2 equivalent) and the Near East and North Africa (18 kg CO_2 equivalent), per capita emissions from agriculture fall within a relatively narrow band of 40 to 55 kg CO_2 equivalent for all regions and for low- and high-income countries. Per capita emissions of N_2O from agriculture are lowest in South Asia, at less than 30 kg CO_2 equivalent, about 86 kg CO_2 equivalent in Latin America and the Caribbean and in high-income countries, and again between 40 and 55 kg CO_2 equivalent in all other regions.

Livestock account for an estimated 18 percent of global annual GHG emissions (FAO, 2006). These estimates include direct GHG emissions and, more important, the effect of deforestation and the GHG impacts of land-use change and feed crop production arising from increased livestock production (although these pose problems in attribution). Livestock's direct contributions to GHG emissions stem from enteric fermentation of

Table 2.14
ANNUAL PER CAPITA GHG EMISSIONS, BY GHG, SOURCE AND REGION, 2005 (KILOGRAMS OF CO_2 EQUIVALENT)

Region/country	Total GHGs	CO_2	CH_4	N_2O	CH_4 from agriculture	N_2O from agriculture
EAP	499.9	368.9	84.1	43.8	42.4	39.2
China	551.0	431.2	76.4	43.5	38.2	40.3
EECA	977.0	726.7	197.7	48.9	31.0	37.3
LAC	496.2	232.8	156.9	106.0	90.6	86.5
NENA	477.7	353.7	68.9	50.0	17.8	46.0
South Asia	207.0	109.2	66.3	29.5	43.7	27.6
India	222.5	130.0	65.1	27.5	42.2	25.5
SSA	264.2	84.9	86.5	69.4	42.8	54.5
All regions	426.3	268.2	96.1	51.0	46.3	43.6
High-income countries*	1 588.5	1 289.3	84.1	113.6	44.4	85.9

* Based on 2010 World Bank classification.
Source: World Bank, 2010b.

Table 2.15
ANNUAL CH_4 AND N_2O EMISSIONS IN DEVELOPING COUNTRIES, BY SOURCE, 1990 TO 2010 (MILLION TONNES CO_2 EQUIVALENT)

Region/country	1990		2000		2010		Annual growth
		(%)		(%)		(%)	
Total CH_4 and N_2O	6 060	100	6 741	100	7 986	100	1.4
Agriculture	3 877	64	4 447	66	5 162	65	1.4
Soils	1 357	22	1 524	23	1 833	23	1.5
Enteric fermentation	1 315	22	1 381	20	1 664	21	1.2
Rice	584	10	617	9	692	9	0.9
Manure	221	4	231	3	279	3	1.2
Other	401	7	694	10	694	9	2.8

Source: Authors' calculations based on USEPA, 2006.

ruminants (CH_4), and manure management (CH_4 and N_2O). Over the 20 years 1990 to 2010, emissions of both these non-CO_2 GHGs by livestock in developing regions grew by 1.2 percent per year (Table 2.15), which is half the annual livestock sector growth rate of 2.4 percent (Table 2.8), reflecting an increase in value generation per kilogram of non-CO_2 GHG emission. Livestock's share in direct contributions to non-CO_2 GHG emissions in developing countries has remained at 24 percent over the past two decades, despite

the sector's rapid growth, implying that emissions from other activities are growing at the same pace.

The emergence and spread of zoonotic pathogens and the development of antimicrobial resistance are other negative consequences of increasing livestock production that have received major public attention recently. Bovine spongiform encephalopathy, Nipah virus infection and highly pathogenic avian influenza (HPAI) are notable examples of pathogens causing infection in humans after massive propagation in livestock. Increasing livestock and human populations, coupled with changes in land use and agricultural practices have been identified as the main drivers for disease emergence (Woolhouse and Gowtage-Sequeria, 2005). Intensification – particularly the industrialization of livestock production, in which animals are often mass-reared under the prophylactic use of antibiotics[9] – is one of the causes of the increasing prevalence of antibiotic resistance in animal and human pathogens. Increasing livestock densities and higher animal turn-over also alter evolutionary trajectories by conferring selective advantages to fast-growing, early-transmitted and hence probably more virulent parasites (Mennerat *et al.*, 2010). Increasing livestock production will augment human health risks from pathogens associated with livestock unless livestock sector expansion is accompanied by proper safeguards. In addition to standard hygiene and biosecurity practices, these measures should include strategic interventions that slow down the "race" between the livestock industry and pathogens (Palumbi, 2001).

DISCUSSION AND CONCLUSIONS

Since establishment of the MDGs in the 1990s, global numbers of poor people defined by the low income limit of $1.25/day have declined. However, progress in poverty reduction has been very uneven among regions, with most gains being made in East Asia and the Pacific, where poverty incidence declined by 38 percentage points (from 56 to 18 percent), while in South Asia and sub-Saharan Africa it decreased by only 10 and 5 percent respectively.

It is worth noting that of the six main continental blocks of countries, three – Eastern Europe and Central Asia, Latin America and the Caribbean, and the Near East and North Africa – have low numbers and low proportions of the total population (at between 4.6 and 8.2 percent) with per capita daily incomes of less than $1.25. Some 94 percent of the world's extremely poor live in East Asia and the Pacific, South Asia and sub-Saharan Africa.

Although the agriculture sector makes a relatively small contribution to national income or GDP, large proportions of national economically active labour forces are employed in agriculture. Nearly three-quarters of the extremely poor live in rural areas (World Bank, 2008) and most depend on agriculture for their livelihoods. Average incomes and productivities are lower in agriculture than in the rest of the economy, reinforcing the argument that poverty is more prevalent in the agriculture sector. Although the agricultural resource base per person in agriculture is low in many developing countries (particularly in highly populated East and South Asia), and despite the poor remuneration of agricultural labour, the number of people dependent on agriculture has grown from 1.1 billion to 1.3 billion over the past 15 years. Low-income countries have the highest shares of labour employment in, and contributions to national income from, agriculture, at about 60 and 25 per-

[9] In the United States of America, 20 to 50 percent of antibiotic production goes into livestock feed for prophylactic purposes (Palumbi, 2001).

cent respectively. Rural populations will continue to expand in absolute numbers until 2045 in sub-Saharan Africa and until 2025 in South Asia.

In all regions, livestock make a substantial contribution to the total net output of agriculture. In the regions where most poor people live, livestock's contribution to net agricultural production rose from 23.7 to 30.3 percent in East Asia and the Pacific, and from 29.1 to 33.9 percent in South Asia. However, in sub-Saharan Africa, where there is more agricultural land per person, the equivalent figure fell from 28.1 to 26.6 percent in 2007. Also of interest is that the proportion of the livestock population (measured in TLUs) represented by non-ruminant poultry and pigs grew between 1990 and 2008, from 54 to 61 percent in East Asia and the Pacific, and from 4 to 7 percent in South Asia, while remaining constant in sub-Saharan Africa. The shift to increased relative reliance on poultry and pigs in East and South Asia may help to explain the growth in the relative net output of livestock in these regions.

Although ASFs alone are unsuitable for the provision of basic human subsistence needs, livestock contribute to food security by converting otherwise unusable plant material into human food. Arid and semi-arid rangelands, which are largely unsuited to arable cropping, account for 54 percent of the world's productive land, and an estimated 180 million people in the developing world depend on them for their livelihoods, mainly from grazing livestock. In sub-Saharan Africa, a third to a half of all ruminant meat is produced from rangelands: 40 to 50 percent in East Africa, and 30 to 40 percent in West Africa. Rangelands may also provide calves to be finished in more intensively managed production systems elsewhere.

Livestock also add value to crop residues such as straw and stovers, or processed by-products such as oilseed cakes or brewers' grains. It has been estimated that cereal crop residues provide more than 650 million tonnes of animal feed, while the global supply of by-products (excluding crop residues) would provide sufficient feed energy to produce more than 500 million tonnes of milk. In addition, many animals and poultry birds are fed from organic kitchen and other wastes through scavenging, at little or no feed cost. Increases in crop yields resulting from the application of animal manure contribute to food security. Livestock also provide a buffer against the risk of crop failure, thereby stabilizing food supply.

FAO forecasts of demand for livestock products in 2030 compared with demand in 2000 show the impacts of changes in population and consumption patterns. Growth in consumption of poultry meat is expected to outstrip that in all other ASFs in all regions, especially in India where a huge 850 percent increase is projected over the 30-year period; egg consumption in India is predicted to increase by nearly 300 percent over the same period. Expected growth in milk and dairy product consumption is impressive, with the quantity consumed in South Asia forecast to more than double by 2030. Large increases in consumption of ASFs, particularly pork, poultry meat, milk and beef, are also predicted for East Asia, mainly in China. The largest absolute and relative increases in mutton consumption are projected to occur in sub-Saharan Africa.

A major influence on the pattern of future demand for ASFs is the effect of urbanization. For instance, the predicted increase in poultry meat consumption in urban areas of India, at 1 288 percent, is more than 1.5 times that for rural areas, at 844 percent. A similar pattern emerges for pork consumption in China, which is projected to increase by 54 percent overall between 2000 and 2030. However, urban consumption is projected to

increase by 160 percent, while rural consumption declines by 5 percent, reflecting a very high rate of rural-urban migration.

Increased domestic livestock production can stimulate sustainable economic growth and development by increasing rural incomes and employment, which leads to higher spending on productive inputs and consumer goods, and greater trade for both urban and local rural suppliers.

The negative effects associated with livestock sector growth in developing country regions include the emergence and spread of infectious zoonotic and non-zoonotic diseases, and negative environmental impacts. The H5N1 avian influenza panzootic and the pandemic (H1N1) influenza A crisis demonstrate the potential magnitude of public health problems associated with rapidly expanding livestock production. Negative environmental effects include GHG emissions, land degradation (e.g., from overgrazing), loss of biodiversity, and pollution from effluents.

Most economic transformations have been driven by development of the agriculture sector (Tiffin and Irz, 2006), followed by a gradual shift in emphasis towards other sectors of the economy. However, for poverty reduction, the emphasis must remain on the rural population.

SUMMARY AND KEY POINTS

- Although the incidence of extreme poverty (< $1.25/day) in developing countries declined significantly, from 42 percent in 1990 to 26 percent in 2005, the absolute number of extremely poor people is still an alarming 1.4 billion (down from 1.8 billion in 1990). In South Asia and sub-Saharan Africa the numbers of extremely poor increased by 20 million and 100 million respectively.
- Diets in developing countries are deficient not only in quantitative terms, but even more so in terms of quality. The estimated DALYs attributed to protein-energy malnutrition, iron-deficiency anaemia and vitamin A deficiency in the developing world are 17.4 million, 15.6 million and 0.6 million respectively (WHO, 2004). Given the high bioavailability of protein, iron and vitamin A in meat, eggs and milk, increasing the availability of ASFs for poor populations in developing countries could significantly reduce the burden of disease attributable to protein and micronutrient deficiencies.
- Livestock contribute directly to human food and nutrition security by transforming vegetation from non-arable land, crop residues, food processing by-products and organic waste into human food of high nutrient density and nutritional quality. Livestock also contribute indirectly to food security by increasing crop output through providing manure, and serve as a buffer to mitigate the impact of fluctuations in crop production on the availability of food for human consumption, thereby stabilizing food supply.
- In most developing countries, the majority of the population lives in rural areas, poverty rates are higher among rural than urban households, and the rural poor constitute between 70 and 80 percent of the total number of poor people. In the two poorest regions, sub-Saharan Africa and South Asia, although urban populations are growing faster in absolute terms, rural populations will continue to expand until 2045 and 2025 respectively.
- There is consensus that to reduce poverty rapidly, interventions must be directed to the rural areas of developing countries, where most of the population and most of

the poor people live, and should target rural economic activities, as most of the poor are engaged in these (World Bank, 2008). Most of the world's poor depend directly or indirectly on agriculture for their livelihoods; the number of people involved has grown from 1.1 billion to 1.3 billion over the past 15 years.

- In all developing regions, livestock make a substantial contribution to the total net output of agriculture, averaging about 35 percent. Over the last 15 years, livestock value added has grown most rapidly in the lower-middle income regions of East Asia and the Pacific, and South Asia, where many of the extremely poor live. The contribution of livestock to agricultural net output in sub-Saharan Africa fell from 28.1 percent in 1990 to 26.6 percent in 2007.
- Globally, the number of poor livestock keepers (< $2/day) has been increasing by about 1.4 percent per year. In terms of absolute numbers, South Asia and sub-Saharan Africa dominate, with more than 45 and 25 percent of the world's estimated 752 million poor livestock keepers respectively. The depth of poverty among poor livestock keepers is particularly high in sub-Saharan Africa, where it is estimated that more than 85 percent of them are extremely poor.
- Growing populations and rising per capita incomes in developing countries will lead to major increases in the demand for ASFs in these regions. A large share of this growth will stem from rapidly expanding urban populations.
- Increases in domestic livestock production in response to urban demand growth, and the additional incomes generated, add to GDP and national income. Knock-on effects include increases in rural employment and in spending on productive inputs and consumer goods, generating additional trade with urban and/or local suppliers. As a result, growth of the livestock sector in response to increased urban demand can launch a self-perpetuating process of economic growth and development.
- In spite of the many positive social outcomes associated with livestock sector growth in developing country regions, there are also negative effects that need to be considered and managed. Two very significant effects are the emergence and subsequent spread of infectious diseases associated with livestock, and negative environmental impacts. The magnitude of negative environmental and public health externalities associated with livestock will be strongly influenced by the ways in which the livestock sector grows to meet the increasing demand.
- The relative emphasis on interventions in agriculture will gradually decline as the structure of the economy transforms, but economic transformations have usually been driven initially by development of the agriculture sector. From a global perspective, the emphasis must remain on the rural population if poverty reduction is a main goal of economic development.