Results

Maps of production, consumption and production surplus of bovine meat in 2000 are shown in Figure 1 for Africa, along with the growth in demand from 2000 to 2030. The full collection of maps is freely available to be downloaded from the GLW website[1] in graphic, Google Earth or ESRI format GIS file formats for each of six regional tiles: Africa, Asia, Australasia, Europe, North America and South America. The most interesting and useful of these maps are really the ones for demand growth. Some regional examples of these are given for poultry meat in Asia (Figure 2) and Central America (Figure 3), and for pig meat (Figure 4a) and milk (Figure 4b) in Latin America. Global maps of growth in demand for each of the six livestock commodities included in the supply and use analysis are shown in Annex B.

The maps speak for themselves. Figure 1b and Figure 1c clearly highlight the high population areas as those of high beef consumption (Figure 1b) with a negative production surplus (Figure 1c). Of particular note are the coastal areas of North Africa; the Nile delta in Egypt; the East African highlands and the shores of Lake Victoria; the irrigation schemes of Sudan; southern Nigeria; western Senegal; the south-east coastal areas and northern areas of South Africa; and the eastern parts of Madagascar. The pattern of high density urban settlements is evident across the continent. The production surplus map (Figure 1c) clearly shows these areas of net beef consumption in red, contrasting with the areas of excess production, which include the pastoralist areas of East, West and southern Africa.

These maps obviously reflect strongly the distribution of people, but it is in the absolute values, particularly for consumption growth (Figure 1e and Figure 1f), that their real value lies. The same applies to the global maps of demand growth that are shown in Annex B, though important regional differences are also evident. Projected demand growth for poultry meat is widespread in all regions and very high rates of increase are forecast to occur in Asia (Figure 2) and in Central America (Figure 3). Demand growth in areas with large rural populations, such as in India, is rather ubiquitous, whereas in more developed areas such as North America growth is much more focussed on the urban centres. Demand growth for milk and dairy products is also widespread. The pattern of growth seen in Latin America (Figure 4b) shows growth in Brazil to be focussed on the urban centres, in contrast to more broadcast growth in the Andean region, reflecting the more rural population in these countries. The global map of demand growth for pork clearly reflects food preferences determined by cultural and religious factors.

Because of the massive range of values in the maps – very high in densely populated cities and very low in remote rural areas – many of the differences, particularly at the high end of the scale, are difficult to visualise. Tabular data show these differences more clearly. Table 4 provides regional estimates of absolute and proportional growth in demand for the different livestock commodities from 2000 to 2030.

[5] www.fao.org/ag/AGAInfo/resources/en/glw/home.html

Figure 1. a) Production, b) consumption and c) production surplus of beef in 2000; d) consumption in 2030 and e) growth in demand from 2000 to 2030 in Africa, with f) a more detailed view of East Africa.

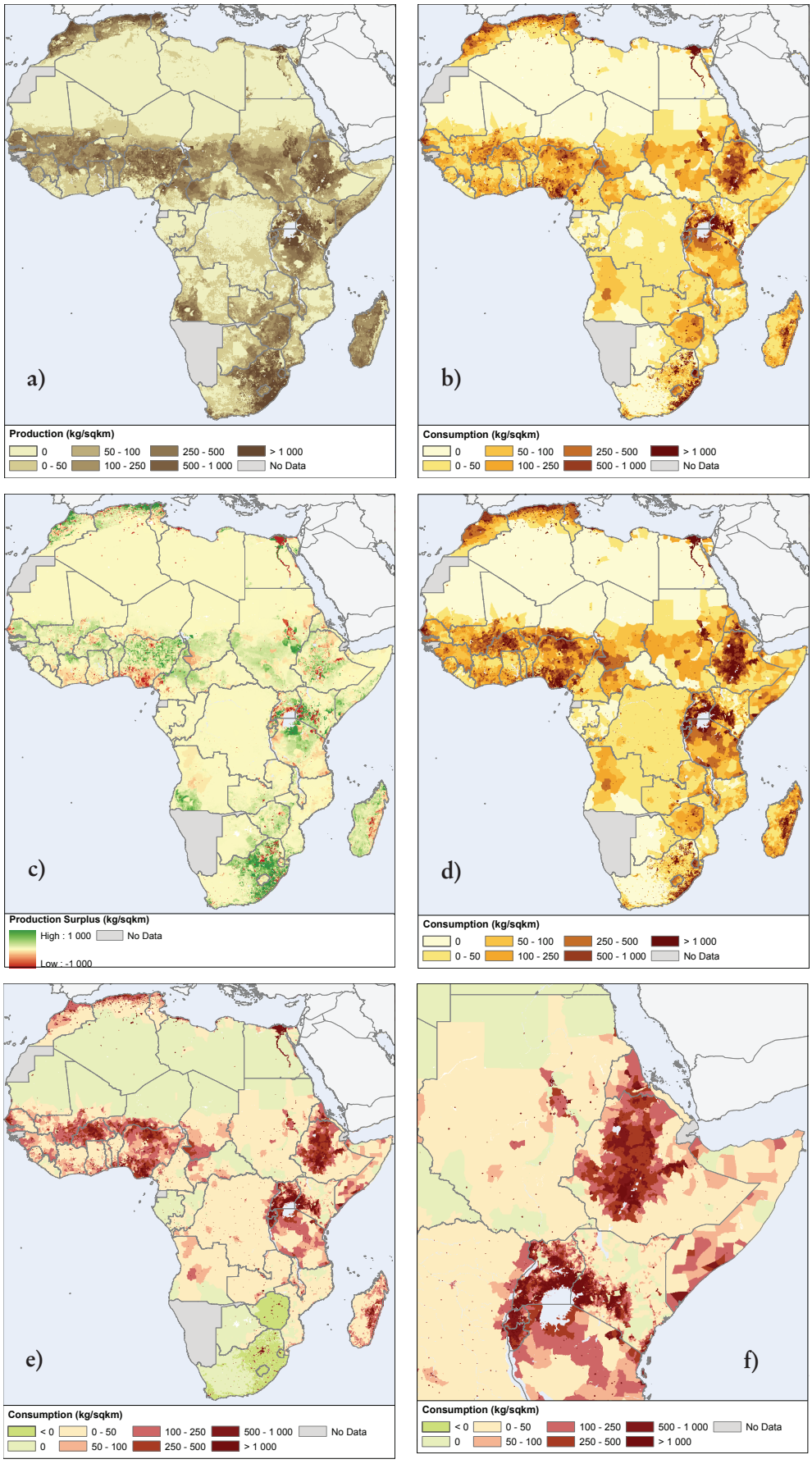


Figure 2. Growth in demand for poultry meat from 2000 to 2030 in Asia.

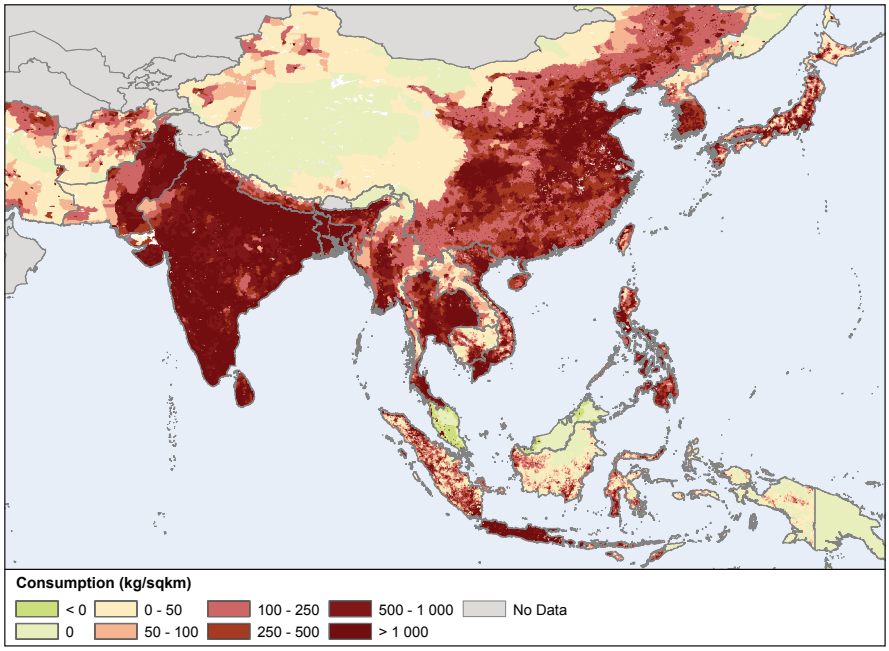


Figure 3. Growth in demand for poultry meat from 2000 to 2030 in Central America.

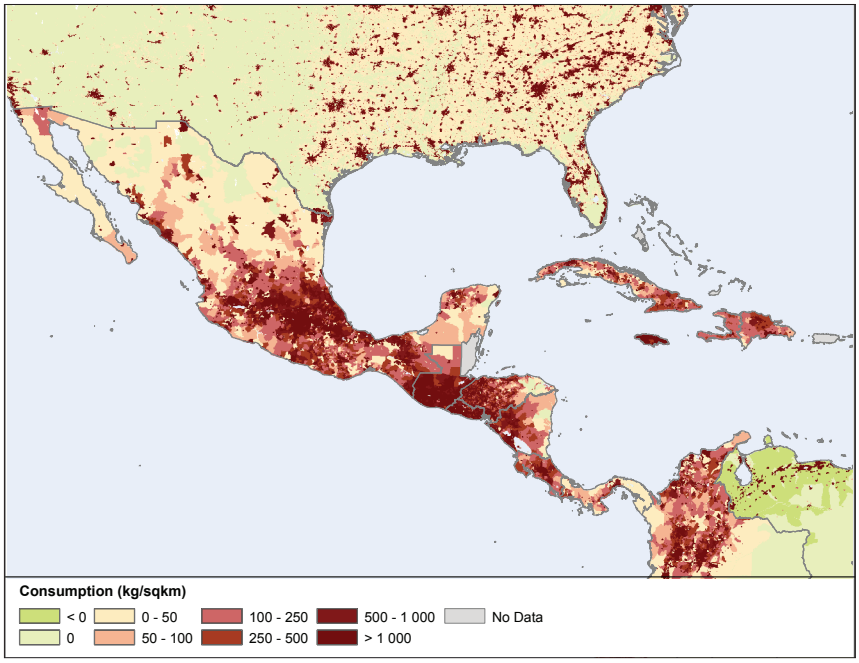
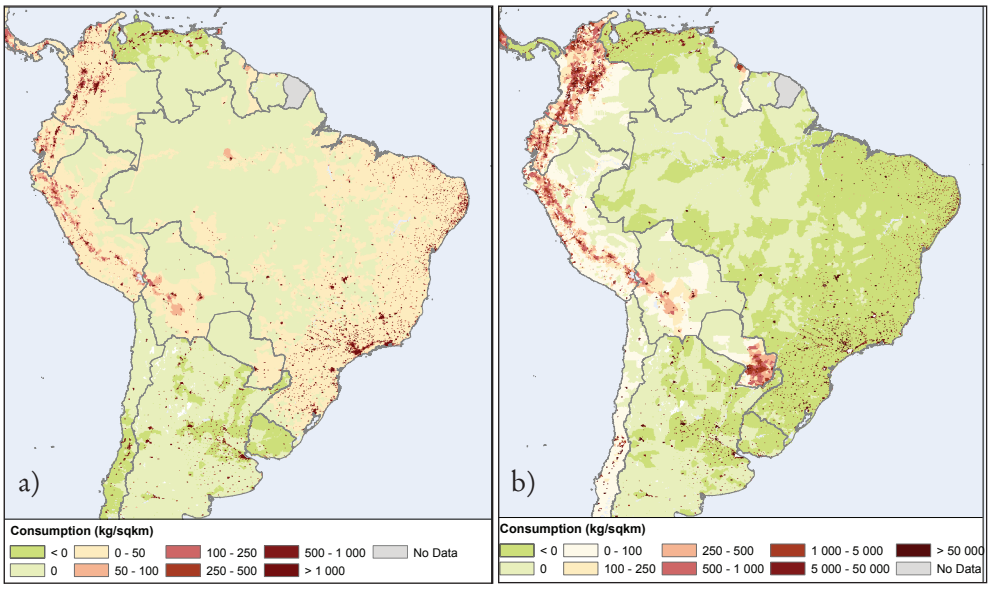


Figure 4. Growth in demand for a) pork and b) milk from 2000 to 2030 in Latin America.



The results presented in Table 4 reflect trends both in population and in consumption patterns. The most striking factor is that growth in poultry consumption outstrips growth in all other animal-source foods in all regions of the world. By far the most dramatic change is the projected increase in demand for poultry meat in South Asia; a 725 percent increase overall. This is driven by growth in demand in India where a staggering 850 percent increase is projected over the 30 year period.

The growth in poultry meat consumption in Asia is accompanied by a four-fold (about 300 percent) increase in egg consumption (280 percent in India alone). In terms of sheer volumes the growth of consumption in milk products is impressive, but very high absolute values for milk and dairy cannot be compared directly with the other livestock commodities since they refer to whole milk equivalent – which contains a large proportion of water in comparison to meat and eggs. In South Asia consumption of milk and dairy products will more than double (125 percent) to some 213 million metric tonnes in 2030. Seventy percent of that – 146 million metric tonnes – will be consumed in India. Because of its large and rapidly-growing population, East Asia is also projected to have large increases in consumption, particularly of pork, poultry meat and milk. Most of this is accounted for by China. The largest absolute and relative increases in mutton consumption are projected to occur in sub-Saharan Africa. Beef consumption is projected to increase most in East Asia and the Pacific, again driven by consumption in China.

Table 5 shows per-capita consumption of the same commodities for the same regions. Similar trends are evident, with the highest increases occurring in Asia, especially for pork, poultry and eggs.

Table 4. Growth in demand for livestock products from 2000 to 2030 ('Abs.' is the absolute increase in annual consumption from 2000 to 2030 in thousands of metric tonnes; 'Prop.' is the increase expressed as a percentage of consumption in 2000).

REGION	Beef		Milk		Mutton		Pork		Poultry		Eggs	
	Abs.	Prop.	Abs.	Prop.	Abs.	Prop.	Abs.	Prop.	Abs.	Prop.	Abs.	Prop.
East Asia and Pacific	8 798	130%	23 765	132%	1 669	58%	28 075	63%	22 522	143%	10 188	45%
China	6 888	132%	15 936	143%	1 537	56%	22 050	54%	14 609	121%	6 810	34%
Eastern Europe and Central Asia	290	11%	4 364	15%	204	40%	112	5%	2 310	108%	684	28%
Latin America and Caribbean	7 302	58%	39 818	72%	239	54%	4 405	100%	14 434	126%	3 246	78%
Middle East and North Africa	1 929	112%	17 913	111%	1 287	103%	9	52%	6 296	243%	1 799	148%
South Asia	3 367	84%	118942	126%	1 722	115%	950	160%	11 491	725%	5 947	294%
India	1 338	51%	79 330	119%	588	85%	921	160%	8 865	844%	4 251	280%
Sub-Saharan Africa	3 768	113%	20 939	107%	1 883	137%	1 106	155%	3 235	170%	1 727	155%
All Regions	**25 454**	**81%**	**225741**	**97%**	**7 004**	**88%**	**34 656**	**66%**	**60 287**	**170%**	**23 590**	**70%**
Low Income Countries	3 523	124%	22 440	136%	1 776	177%	3 481	167%	4 789	301%	1 972	208%
Lower Middle Income	14 642	114%	158467	124%	4 602	82%	26 861	61%	38 353	203%	17 470	68%
Upper Middle Income	7 289	47%	44 834	50%	625	46%	4 314	68%	17 145	115%	4 148	60%
High Income Countries	2 441	15%	31 312	31%	275	33%	2 935	22%	12 414	65%	1 911	24%

Note: The regions are defined according to the World Bank 2010 classification (World Bank, 2010). A full list of the countries included in the WB regions is provided in Annex A, along with their income ratings.

Tables 4 and 5 also highlight differences in consumption growth across low, middle, and high income countries. It is abundantly clear that growth in total and per-capita consumption of animal-source foods is much less in the high income countries compared to the low and middle income countries. This is partly because of a saturation effect – people already eat as much animal-source foods as they need and would like to – but also due to a trend towards reduced consumption of animal-source foods, particularly of beef, in many of these countries.

The effect that urbanisation will have on changing demand for animal-source foods is not illustrated in Table 4, nor does it come out clearly in the maps produced at the scales of those in Figures 1-4, or those in Annex B. Country-level estimates of demand, production, import and export of the different livestock commodities in 2000 and 2030 and their absolute and proportional changes are reported in Annex C. These tables include two important disaggregations: a) a breakdown of the growth attributable to changing consumption patterns, in comparison with that due to changing population numbers and b) the proportion of change projected to occur in urban areas, versus that projected to occur in rural areas.

Table 5. Growth in per-capita demand for livestock products from 2000 to 2030 ('Abs.' is the absolute increase in annual per-capita consumption from 2000 to 2030 in kg/person; 'Prop.' is the increase expressed as a percentage of consumption in 2000).

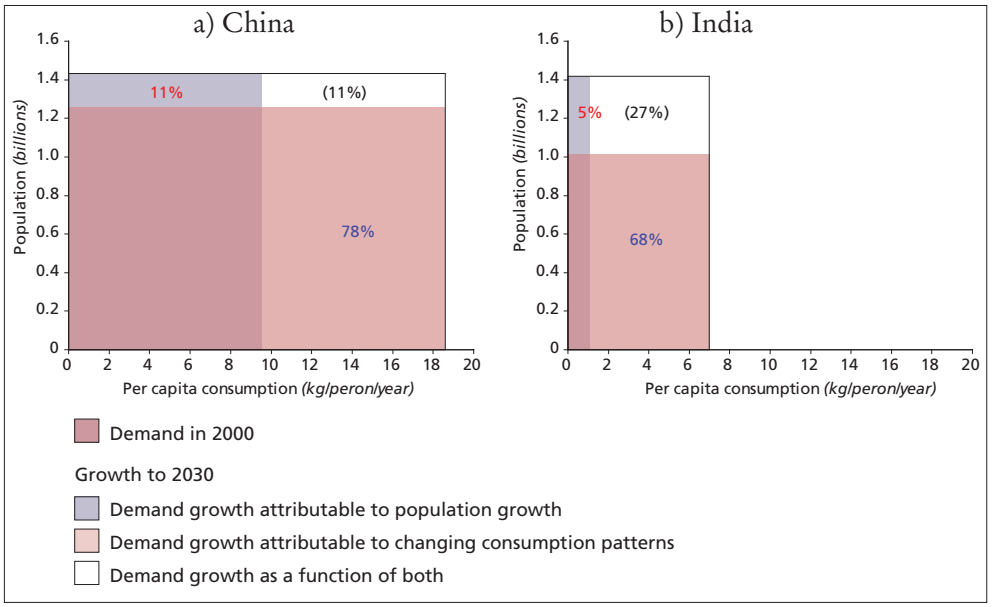
REGION	Beef		Milk		Mutton		Pork		Poultry		Eggs	
	Abs.	Prop.	Abs.	Prop.	Abs.	Prop.	Abs.	Prop.	Abs.	Prop.	Abs.	Prop.
East Asia and Pacific	3.8	61%	7.6	55%	0.2	39%	6.3	61%	7.7	91%	2.8	48%
China	4.3	103%	10.1	113%	0.8	37%	11.5	35%	9.1	94%	2.8	17%
Eastern Europe and Central Asia	10.7	25%	26.2	20%	0.5	15%	2.0	28%	11.4	116%	3.8	36%
Latin America and Caribbean	17.2	16%	24.7	27%	0.1	8%	2.5	34%	13.7	73%	2.6	45%
Middle East and North Africa	5.5	42%	20.9	31%	1.6	31%	0.0	12%	11.2	97%	2.6	49%
South Asia	4.2	24%	20.7	32%	1.0	45%	0.2	78%	4.1	271%	1.9	134%
India	0.2	8%	37.6	57%	0.2	33%	0.5	86%	6.0	577%	2.6	173%
Sub-Saharan Africa	5.3	25%	6.1	17%	0.7	30%	0.6	47%	2.6	73%	0.9	66%
All Regions	**7.8**	**26%**	**17.7**	**26%**	**0.7**	**28%**	**1.9**	**44%**	**8.5**	**94%**	**2.4**	**48%**
Low Income Countries	4.5	26%	4.3	16%	0.6	32%	1.3	70%	2.2	95%	0.9	73%
Lower Middle Income	7.2	32%	20.3	38%	0.7	32%	1.5	37%	9.0	109%	2.4	54%
Upper Middle Income	15.2	17%	21.8	22%	0.5	19%	2.3	37%	13.1	66%	2.8	43%
High Income Countries	21.0	-1%	6.1	3%	-0.7	-10%	2.0	11%	9.3	36%	0.9	9%

Note: The regions are defined according to the World Bank 2010 classification (World Bank, 2010). A full list of the countries included in the WB regions is provided in Annex A, along with their income ratings.

It is interesting to distinguish the proportion of overall growth attributable to changing consumption patterns, in comparison with that due to changing population numbers. Growth due mainly to increasing numbers of people is unlikely to require particular shifts in the structure of a given sector, if the proportion of the population who produce remains constant (though when population growth involves significant urbanisation this proportion is likely to decrease). When, however, growth is due to changing consumption patterns, it will require structural changes in the sector, through a combination of: a) an increase in the number of producers, relative to consumers; b) intensification of production; and c) importation of that commodity. By and large, the second change is the most likely to occur in order to meet this 'disproportionate' increase in demand.

This is illustrated in Figure 5, which shows how overall growth in demand for poultry meat in China and India is divided among population growth and changing consumption patterns (Table C.10). The percentages shown in Figure 5 indicate the proportion of the overall growth that is attributable to a) population growth

Figure 5. Demand growth for poultry meat in a) China and b) India, 2000 to 2030, disaggregated into that accounted for by population growth, versus that accounted for by changing consumption patterns.



(red) and b) increased consumption rates for poultry meat (blue). Looking at the diagram, though, it is quite clear that, if population numbers were to stay the same, consumption in China would slightly less than double, whereas that in India would increase seven-fold. The implications for the poultry sector in India are immense. The FAO projections do not anticipate this increase in demand to be met through imports, which remain at zero (Table C.9), but through an increase in production. This will require a massive, rapid intensification of the poultry sector.

Some dramatic details also become evident when growth is disaggregated in terms of urban versus rural areas. Looking again at poultry meat consumption in India, for example, which is projected to increase by about 8.8 million metric tonnes per year in 2030, compared to in 2000; an 844 percent increase (Table C.9). Whilst the greater share of this increase – 5.1 million tonnes – is to occur in the rural areas (compared to 3.7 million tonnes in urban areas), the relative increase in the urban areas – 1 277 percent – will be almost twice that in the rural areas – 677 percent. This contributes to the driving force behind the rapid intensification in the poultry sector that is ongoing in India (USDA, 2004).

Similar patterns are seen in other commodities. For example, pork consumption in China overall is projected to increase by 22 million metric tonnes between 2000 and 2030, a 55 percent increase (Table C.7). Urban consumption, however, is projected to increase by 20 million metric tonnes over this period, a 160 percent increase, whilst rural consumption is projected to increase only by 1 million metric tonnes (5 percent increase); reflecting very high rates of urbanisation.

For each of the cities considered in the GRUMP urban extents database, estimates of consumption in 2000 and 2030 and growth in demand from 2000 to 2030 have been extracted from the digital maps. The contribution made by each city to overall growth in demand for each country has also been estimated (expressed as

the percentage of overall national growth in demand accounted for by each city). For a selection of cities in each region (generally the most populous), data on consumption in 2000 and 2030, growth in demand from 2000 to 2030, and the contribution that makes to overall, national growth, are presented in Annex D.

Results show that the highest increases in consumption will occur, not surprisingly, in cities with the largest rates of increase in population. However, their contribution to the national growth can be fairly low, if they only account for a small proportion of the population as a whole. This is particularly striking if we look at consumption of poultry meat and eggs in India, for example, where the populations in the main cities are expected to double, more or less (from 2000 to 2030) and consumption of poultry meat is expected to increase thirteen-fold. Consumption growth in the three largest cities together, however, accounts for less than 10 percent of the total growth. This is in stark contrast to other countries, where growth in demand can be accounted for in large part by a single city. Sixty-four percent of overall growth in demand for beef in South Africa will, for example, be accounted for by Johannesburg (Table D.1). Figure 6 shows how growth in consumption of milk will be accounted for in Kenya: 32 percent of overall growth accounted for by Nairobi alone, completely dwarfing the four next largest cities.

If consumption estimates of commodities are standardised by expressing them in some common unit, it is possible: a) to combine them and b) to compare them, in meaningful ways. An example of each is shown. Figure 7a shows the global, projected consumption of protein from animal-source foods in 2030, per square kilometre, derived by combining the totals from the six commodity groups. This obviously reflects strongly the distribution of people in the world, highlighting, for example, the widespread, high-density populations of South and East Asia. If however, the effect of population is removed by expressing this as consumption of protein derived from animal-source foods, per person (Figure 7b), a very different picture emerges. Figure 7b shows the very high levels of protein derived from animal-source foods per person in the United States of America, Argentina and Australia, intermediate levels in much of North Africa, the Middle-East and Asia,

Figure 6. Demand growth for milk in Kenya, 2000 to 2030, disaggregated by rural and urban areas, with urban growth shown separately for the five largest cities.

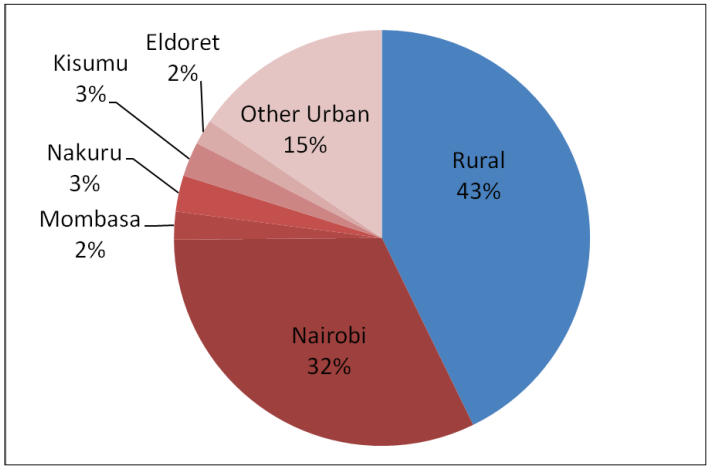
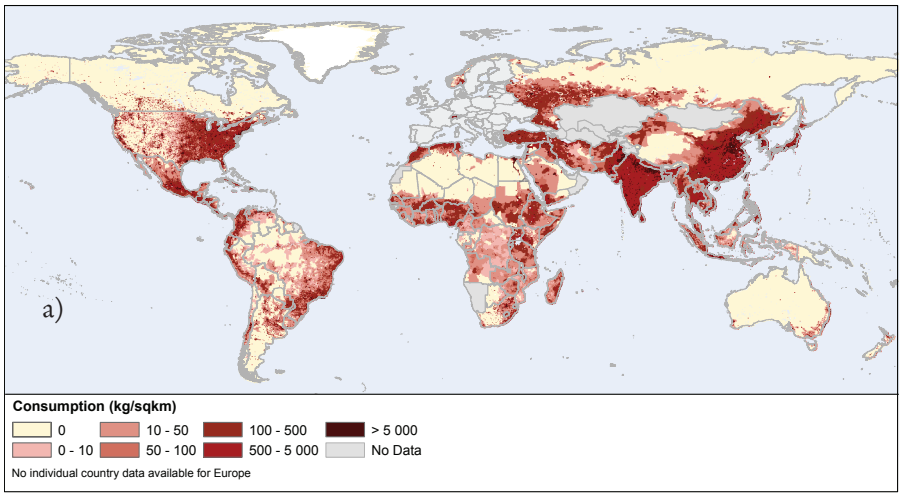
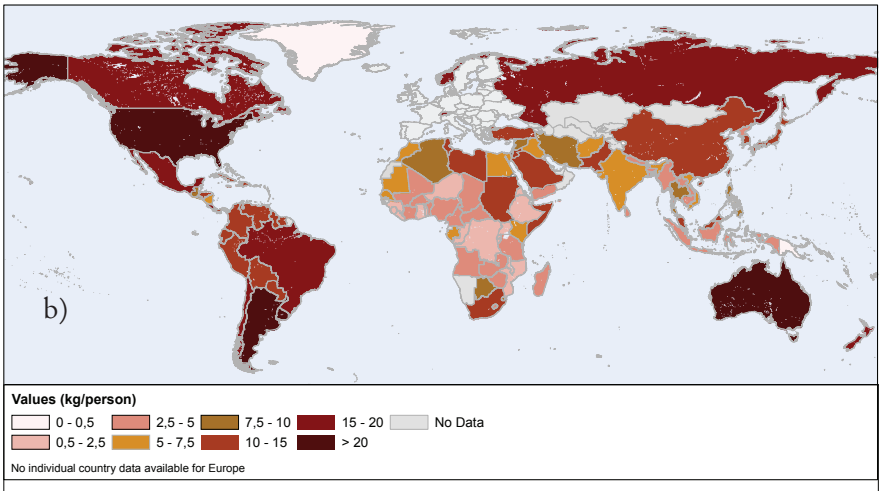


Figure 7. Global, projected consumption of protein from animal-source foods in 2030: (a) per square kilometre and (b) per person.





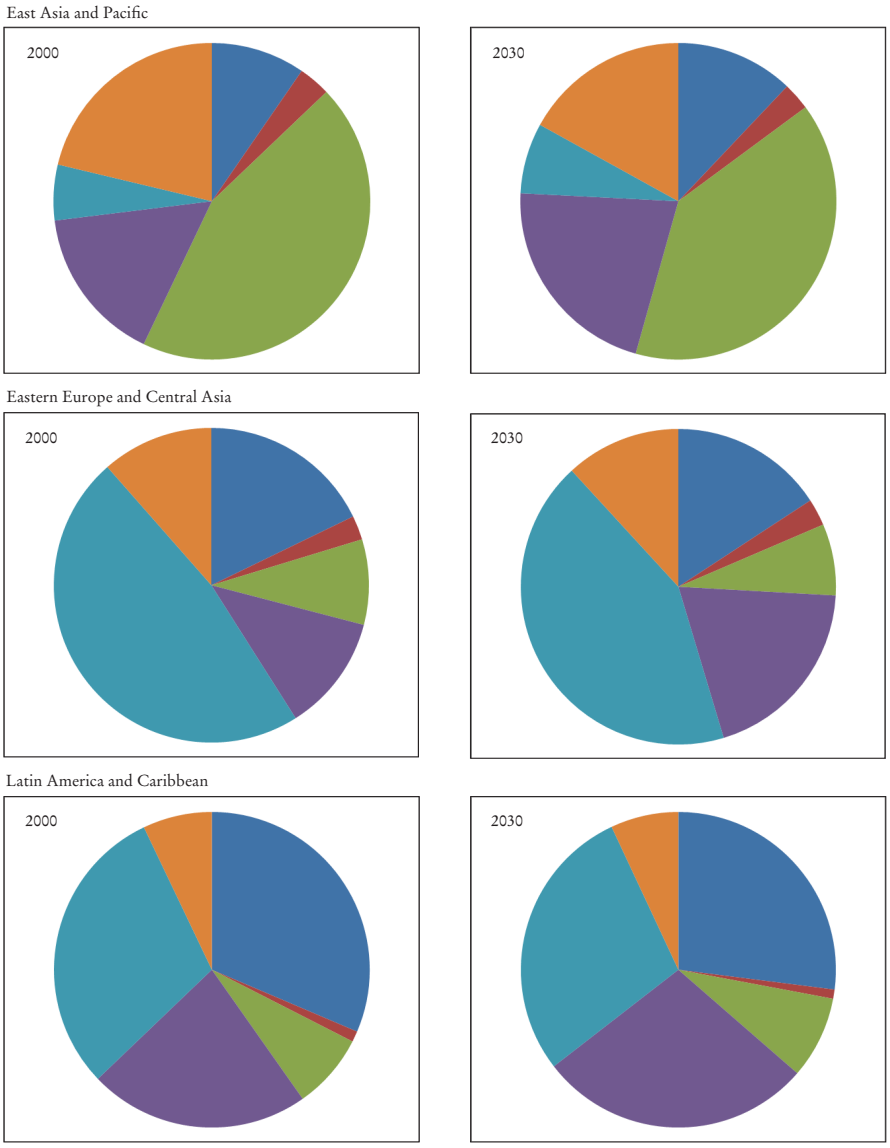
and very low values over most of sub-Saharan Africa and much of South and South-East Asia.

Expressing consumption in common units also allows commodities to be compared. Figure 8 shows the proportional intake of protein derived from animal-source foods for the major developing regions of the world in 2000 and in 2030, from each of the six major livestock commodity groups. Regional differences are very clear. East Asia and the Pacific is distinguished, not only by the large contribution of pork meat to overall protein derived from animal-source foods (almost half), but also by the large contribution made by eggs; both considerably larger than in any other region. Latin America and the Caribbean have a similar pattern of intake compared to the high income countries, though there is a smaller contribution from beef in the high income countries; the difference being made up by pork, largely. The Middle East and North Africa and sub-Saharan Africa are characterised by relatively large contributions from mutton, but poultry is quite important in the Middle East and North Africa, and beef more so in sub-Saharan Africa. The con-

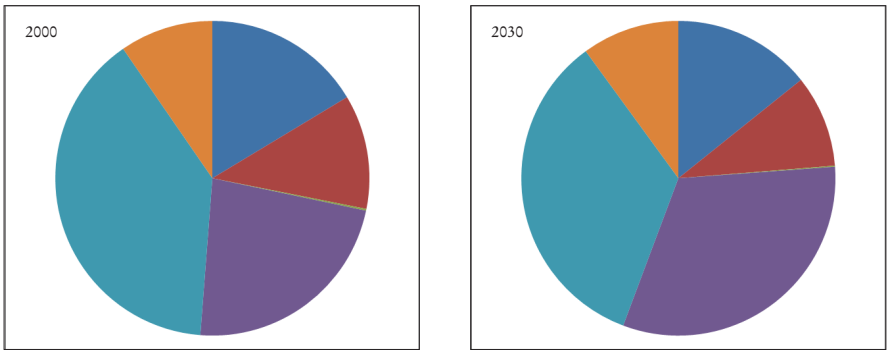
tribution made by pork is negligible in the Middle East and North Africa and very small in South Asia, reflecting its absence in Muslim areas. Beef makes the greatest contribution to dietary protein from animal-source foods in Latin America and the Caribbean and in sub-Saharan Africa. The most striking feature of all, though, is the massive contribution made by the dairy sector in South Asia, where almost 70 percent of dietary protein from animal-source foods comes from milk, and products thereof. This is in stark contrast to East Asia and the Pacific.

Projected changes in these patterns to 2030 are relatively small. The contribution made by poultry is predicted to increase in all regions of the world; by almost ten percentage points in Eastern Europe and Central Asia, the Middle East and North Africa and South Asia. The contributions made by beef and milk are projected to decline everywhere, with the exception of East Asia and the Pacific, where it is expected to increase by two percentage points.

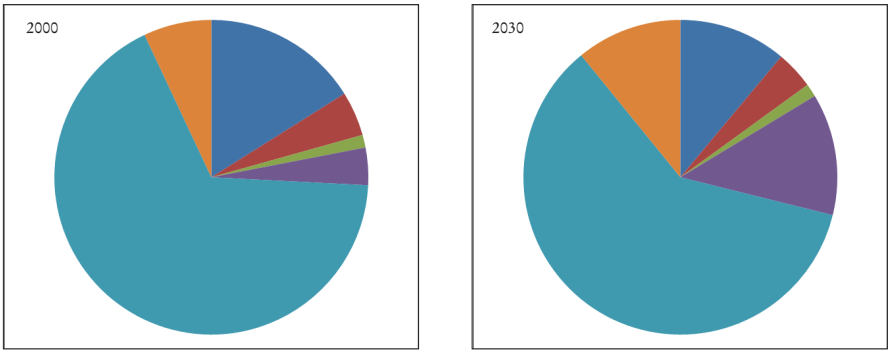
Figure 8. Proportional consumption of protein from animal-source foods, broken down by the six major livestock commodity groupings, in 2000 and 2030, for the major developing regions of the world, and for high income countries.



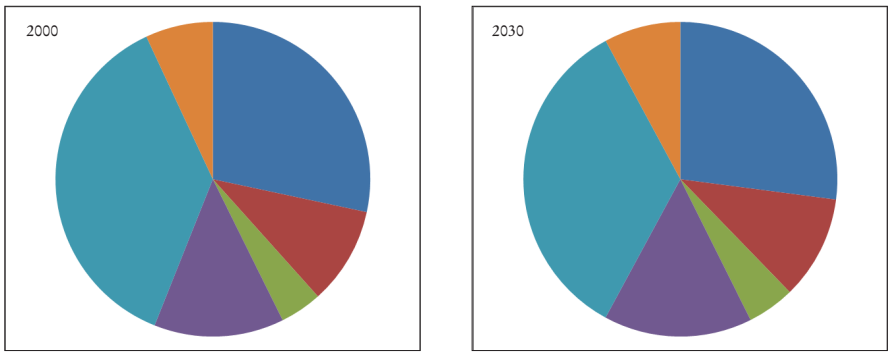
Middle East and North Africa



South Asia



Sub-Saharan Africa



High income countries