**Scale and structures of the poultry sector and factors inducing change: intercountry differences and expected trends**

*Martin Upton*
University of Reading, United Kingdom

**SUMMARY**
Rapid growth in consumer demand for livestock products in the developing countries is being met by corresponding growth in poultry meat and egg production and consumption. Comparison of five case-study countries, India, Egypt, China, Thailand and Brazil, shows a clear association between average per capita incomes and consumption of poultry meat. In India and China only, egg consumption has grown faster. Global meat export trade is dominated by Brazil, with contributions from Thailand and China, although the latter country’s imports exceed its exports. Quantities traded by India and Egypt are quite small.

Four main poultry production sectors are identified: 1, industrial and integrated; 2, commercial high biosecurity; 3, commercial low biosecurity; and 4, village or backyard. These are ranked in reverse order of scale of production, concentration of bird density, productivity per bird, contribution to total poultry meat production, market integration and adoption of formal biosecurity measures (the relative effectiveness of this biosecurity has been questioned). Sector 1 and 2 systems and poultry production are concentrated in particular limited areas of each of the case-study countries. Larger numbers of Sector 4, and possibly Sector 3, smaller-scale producers operate in all areas. Sectors 1, 2, and possibly 3, involve separation of the stages of production – breeding, growing, feed-milling, processing and distribution – allowing the benefits of increased scale and specialization. In Sector 1, the separate enterprises are vertically integrated, to reduce transaction costs and improve managerial control. The alternative of contract growing allows participation of small-scale growers and sharing of production and price risks.

Poultry breeding, feed milling and markets are seen as three drivers of change. The introduction of exotic strains and intensive breeding has led to rapid growth in productivity, particularly in India. Concentrate feed is the largest cost item. Global prices of the ingredients maize and soy meal have increased greatly this year (2007). Egypt suffers from high import dependency for both crops. India, China and Thailand, though self-sufficient in maize, are vulnerable to increasing demands and prices for feeds. Only Brazil is already a major exporter of both crops and has large areas of, as yet, underexploited cropland. Increase in poultry production and processing is linked with growth of commercial food and retailing and with globalization. Consumer preference for live-bird retailing, in Egypt and India, constrains growth of the sector.
Case-study countries differ in their comparative costs of poultry production, possibly lowest in Brazil. But prices are affected by trade, exchange-rate policies and producer support. Import duties (tariffs) imposed by importers benefit domestic producers, but raise costs for consumers and depress prices in exporting countries. Thus, tariffs on poultry meat and on feed grains affect producer prices and incentives. Devaluation of an overvalued currency has similar impacts, but (unlike tariffs) increases social welfare. The poultry industry has had relatively little direct government support. Public good and externalities associated with disease control justify government intervention. Outbreaks of highly pathogenic avian influenza (HPAI) in India, Egypt, China, Thailand and other countries (though not Brazil) have affected poultry production, consumption and trade. Policy issues arise in connection with compensation for birds culled, the use of vaccination and regulations some of which may disadvantage smallholder backyard producers.

Commercial production and consumption of poultry meat and eggs are expected to continue to expand. Possible constraints include global economic, environmental and social problems, domestic policy limitations, supplies and prices of feed grains and oilseeds, deficiencies in national infrastructure, and disease such as HPAI. Sector 4 production is likely to continue to serve a different market from that of the expanding commercial sector. The semi-commercial Sector 3 may be a transitional stage in the commercialization process and may eventually contract.

Key words: poultry, comparison, sectors

1 THE CONTRIBUTION OF POULTRY TO THE LIVESTOCK REVOLUTION
1.1 Increased production and consumption in developing countries

The rapid growth in developing-country demand for livestock products, known as the “livestock revolution”, is being satisfied, at least in part, by rapid expansion in poultry meat production (Delgado et al., 1999). The “revolution” has been fuelled by population growth, urbanization and income growth, as have the associated increases in the production and consumption of poultry meat. These changes have occurred at different rates in different countries, depending for instance on the current average per capita income levels. The World Bank classification of developing countries into low-income, lower middle-income and upper middle-income categories may be used for comparative purposes1 (Figure 1).

The most rapid expansion, in poultry meat production, has occurred in the lower middle-income group of countries, with average annual per capita incomes of between US$876 and US$3 456. In this group, poultry meat production has grown steadily, at an annual rate of over 8 percent, and has more than quadrupled over the last 20 years. Production in the low-income group of countries, and in the upper middle-income group, started from a lower base and has grown more slowly (Figure 1).

Egg production has grown at similar rates. In the lower middle-income countries, the “volume”, in tonnes, produced in 2004 was closely similar to the “volume” of poultry meat, but the value of egg production was more than double that of meat. The low-income

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1 The proportion of the total population, dwelling in urban areas, is positively associated with per capita incomes, rising from 30 percent in low-income countries to 77 percent in high-income countries. The proportion of national income derived from agriculture falls from 21.5 percent for low-income countries to 1.9 percent for high-income countries (see Annex A).
countries, as a group, produce similar quantities of poultry meat and eggs, in both volume and value terms. However, the upper middle-income countries produce a substantially lower volume and value of eggs than of poultry meat.

The impact of average per capita income on demand for poultry products is illustrated by comparing daily consumption of poultry meat and eggs in the different country-income groups, and changes over time (see Figure 2). Consumption levels of both poultry meat and eggs increased between 1990 and 2005 for all income groups except for high-income developed countries, where egg consumption fell. As average per capita incomes rose over the same period for all income groups, these changes give an indication of the impact of income growth on demand for poultry products. The decline in egg consumption in high-income countries suggests that the effect of income growth may have reached a peak and demand may be more strongly influenced by changes in consumer taste.

The contrasts in consumption of poultry meat and eggs between country-income groups in any one year are striking. Data for 2005 are presented in Table 1. These cross-country comparisons illustrate the relationship between individual incomes and consumption levels of poultry meat and eggs. It may be assumed that the average per capita consumption levels of countries with widely different average incomes provide an indication of the likely consumption behaviour of different income strata within countries. The poor, surviving on very low incomes and low levels of nutrition, can only afford to consume very small
amounts of poultry meat and eggs. As incomes increase, so too does the consumption of poultry products – rapidly at first, but at a diminishing rate.

A comparison of income and consumption levels in lower middle-income countries with those in low-income countries shows that a 1 percent increase in income is associated with a more than 1 percent increase in consumption of poultry products.2 A comparison of changes in average income and consumption levels between lower middle-income and

2 The “income elasticity of demand”, estimated as the percentage increase in quantity demanded for a 1 percent increase in income, is greater than unity over this range. The demand is said to be “elastic”. It becomes less elastic as incomes rise further.

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**TABLE 1**  
**Mean per capita incomes and consumption of poultry meat and eggs, by country income categories, 2005**

<table>
<thead>
<tr>
<th>Income group</th>
<th>Mean gross national income per capita (US$)</th>
<th>Mean per capita poultry meat consumption (kg per year)</th>
<th>Mean per capita egg consumption (kg per year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-income</td>
<td>585</td>
<td>2.81</td>
<td>1.30</td>
</tr>
<tr>
<td>Lower middle-income</td>
<td>1 923</td>
<td>14.04</td>
<td>5.70</td>
</tr>
<tr>
<td>Upper middle-income</td>
<td>5 634</td>
<td>30.06</td>
<td>8.64</td>
</tr>
<tr>
<td>High-income</td>
<td>35 264</td>
<td>27.80</td>
<td>10.71</td>
</tr>
</tbody>
</table>

Sources: FAOSTAT and World Bank data.
upper middle-income countries shows a smaller proportionate increase in consumption than in income. The differences in average consumption levels between high-income countries and upper middle-income countries are quite small. Indeed, consumption of poultry meat appears lower in the high-income countries. Consumption of poultry products in the upper middle- and high-income countries may be near to the desired maximum, and more expensive preferred sources of animal protein may be substituted in human diets.

1.2 The poultry industry in five case-study countries

The association between levels of income and consumption of poultry products may be illustrated by comparing the five case-study countries: India, Egypt, China, Thailand and Brazil (see Figure 3). The countries are ranked in increasing order of mean annual per capita income. While India is a low-income country, the other four are all lower middle-income countries (although Brazil is near the top of the income range). For more detailed information on the case-study countries, see Annex B.

The normal positive relationship between per capita income and consumption of poultry meat seems to apply both in the case of a very low level of consumption (India) and a very high level of consumption (Brazil). However, the pattern of egg consumption is rather different, with egg consumption in China much higher than in the other countries and more than twice as high as that of chicken meat. Egg consumption in Brazil, on the other hand, is much lower than might be expected. It appears that cultural differences affect choices regarding consumption of eggs.3

The relative importance of chicken and the meat of other bird species is also dependent on cultural differences. The consumption of duck is probably prevalent in irrigated areas of East Asia and Egypt, where duck rearing is a component of local farming systems.

Poultry meat makes up 18.4 percent of total meat consumption in China and 46.9 percent in Brazil. Poultry meat and eggs together contribute a larger percentage of total meat, eggs and fish consumption – 30.9 percent in China and 47.4 percent in Brazil. Although the proportions might differ slightly if measured in terms of units of animal protein, it is clear that poultry make a major contribution to human nutrition in these countries.

Growth in per capita incomes in the case-study countries over the last six years has contributed to the growth in consumer demand for poultry meat. For instance, in India, incomes have grown annually by 10.5 percent while chicken-meat consumption grew by 8.4 percent. The corresponding rates in China were 13.7 percent and 2.0 percent. Thailand is exceptional in that annual income growth of 7 percent was associated with a 4.25 percent fall in poultry meat consumption. In Egypt both income and poultry-meat consumption fell over the last six years.

Three of the case-study countries, India, China and Brazil, are very large in area, human population and poultry production. Statistics for these countries, therefore, dominate those for the respective income groups – India contributing 47 percent of the aggregate production of low-income countries, and China and Brazil together accounting for over 73 percent of total lower middle-income country production.

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3 These choices will affect the development of the poultry sector, and the relative emphasis on broilers and layers. These decisions will, in turn, affect the relative availability and, inversely, the relative prices of meat and eggs.
1.3 Poultry meat and egg production

There are large differences between case-study countries in terms of the size of the poultry sector and the contribution made to global poultry-meat production. Listed in diminishing size order, the percentage contributions made to global production are as follows: China 17.5; Brazil 11.9; India 2.4; Thailand 1.3; and Egypt 0.6. A visual comparison of the relative growth rates of poultry meat production, independently from overall size, is obtained by comparing indices of growth, with 1981 as the base year set at 100 (see Figure 4).

Poultry meat production has grown most rapidly in India, at over 11 percent annually over the last quarter century. The pace appears to have accelerated in the last decade. In China production grew even more rapidly up to the mid-1990s, but the rate of growth has slowed since then, giving an overall average rate of about 9 percent. Brazilian poultry-meat production has grown steadily since 1985, at a lower rate of just below 8 percent. The slackening in growth in the last two years may be a consequence of the impact of HPAI on demand.

In Egypt, after quite rapid growth to the mid-1980s, production expanded at a slower rate until the end of the century. Since the year 2000, production appears to have stagnated; it actually fell in 2006 as a result of HPAI. Thai production grew quite rapidly until the early 1990s, then quite slowly over the next ten years. Since 2002, production has fallen as a result of HPAI outbreaks, although recovery has started.

The overall growth in production is the result of changes in three key variables: first, the inventory or number of birds in the national flock; second, “productivity” – here measured as the number of birds produced and slaughtered per head of the national flock; and third, the carcass weight. All these variables have increased over the last quarter century in most
developing countries, and their relative contributions to the growth in poultry meat production may be assessed from published statistics. Results for all five case-study countries are given in Figure 5.

In India, the greatest gains have been made in the “productivity” measure; this is in contrast to the other four case-study countries where inventory change has contributed most to growth. This growth in productivity in India may reflect the technological change that has occurred in poultry breeding, from traditional, “desi” poultry to exotic hybrid chickens. In Thailand, the fall in productivity may be due to the large numbers of birds slaughtered for disease-control purposes and, therefore, removed from the market. The inventory of birds is not affected to the same extent, and has grown faster than total production.

Egg production has increased over the same period in all case-study countries, but less rapidly than meat production. This suggests that the overall growth of the poultry industry, in all cases, has been associated with a switch from egg production to broiler-meat production. However, there are big differences between countries with respect to the relative importance of poultry meat and eggs in volume terms. In India and China the volume of eggs produced exceeds the volume of poultry meat by 23 percent and 97 percent, respectively. In Thailand, Egypt and Brazil, the volume of egg production is less than that of poultry meat, at 65, 45 and 16 percent, respectively. For Thailand and Brazil, this may reflect the greater importance attributed to broiler production for the export market.

1.4 International trade in poultry produce
Trade in poultry products differs substantially between the five case-study countries, with Egypt and China being net importers of poultry meat, India close to self-sufficiency, and
Brazil and Thailand being net exporters. Changes in poultry meat trade over the last quarter century are shown in Figure 6. However, the situation differs somewhat with respect to trade in eggs and live birds – so each country is considered in a little more detail in the following paragraphs.

India is a net exporter of a small amount of poultry meat – a fraction of 1 percent of domestic production. In this respect, it differs from the majority of low-income countries, which are net importers of poultry meat. A small amount of export revenue is earned from canned poultry meat exports. Limited costs are incurred in importing live birds. However, eggs constitute a significant net export, earning nearly 80 times the export earnings from poultry meat.

Egypt is a net importer of poultry meat and eggs, but since 2003 has been a net exporter of live birds. Quantities and values are relatively small, and poultry meat imports only represent 4.5 percent of domestic utilization.

China, despite being a significant exporter of unprocessed poultry meat on the world stage, is a net importer, attracting 15 percent of global imports and supplying 8 percent of domestic consumption from imported produce. However, poultry meat is subjected to further processing in China, and some of the products are exported. If the value of canned chicken-meat exports is added to the value of primary chicken-meat exports, then China becomes a major net exporter of poultry-meat products, in value terms. Although China is a net importer of a small number of live poultry, the value of bird exports exceeds the value of bird imports by a small margin. The volume of eggs traded is only a small percentage of total production and consumption, but the balance between imports and exports

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4 The quantity is so small that the net export graph for India cannot be distinguished from the x axis in Figure 6.
changes from year to year. In 2005, China switched from being a marginal net exporter to a marginal net importer. However, in value terms, exports exceeded imports.

Thailand is a much smaller East Asian country which has encouraged the growth of the poultry meat export industry. Between 1980 and 2003, exports of poultry meat grew at a rate of 15 percent annually. In 2003, Thai exports represented 7 percent of the global total. Since then, exports have fallen as a result of HPAI outbreaks and have not yet recovered to the previous level. Nonetheless, exports currently account for over 40 percent of domestic production. However, like China, Thailand is earning revenue from exports of canned meat, which currently contribute considerably more to export earning than do exports of un-canned poultry meat. This emphasis on processed exports reflects a general switch from raw or frozen poultry exports to pre-cooked and processed exports, to avoid restrictions imposed following the HPAI outbreaks. Thailand is currently a net exporter of live birds, although imports were higher in 2004 after the first HPAI outbreak. Some eggs are also exported.

Brazil has rapidly expanded poultry-meat production and exports, and now supplies around 35 percent of global exports. This places the country ahead of the United States of America, which is the other major world exporter of poultry meat. Exports account for about 28 percent of domestic production. In fact, led by Brazil, the lower middle-income countries have in the twenty-first century become the main global net exporters, while net exports from the high-income countries have dwindled to a very low level. Since the mid-1990s the upper middle-income countries have become the main net importing group.

Canned poultry meat, live birds and eggs are also exported from Brazil, but in much smaller volumes and with much smaller values than the poultry meat exports.
2  THE RELATIVE IMPORTANCE OF DIFFERENT PRODUCTION SYSTEMS

2.1  The FAO four-system classification

The rapid expansion of poultry production, in all the case-study countries and globally, has been associated with technological change and increasing scale of production units. More specifically, the development has involved a switch in emphasis from traditional small-scale production using dual-purpose indigenous breeds to intensive commercial production systems using hybrid birds specially bred either for meat or for egg production. In practice, a range of commercial and semi-commercial systems may develop – so some further categories are needed.

### TABLE 2

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Sectors</th>
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<tbody>
<tr>
<td></td>
<td>1. Industrial and integrated</td>
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<tr>
<td></td>
<td>2. Commercial: high biosecurity</td>
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<td></td>
<td>3. Commercial: low biosecurity</td>
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<tr>
<td></td>
<td>4. Village or backyard</td>
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<tr>
<td>Biosecurity</td>
<td>High</td>
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<td></td>
<td>Moderately high</td>
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<td></td>
<td>Low</td>
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<td></td>
<td>Low</td>
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<td>Market outputs</td>
<td>Export and urban</td>
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<td>Urban/rural</td>
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<td></td>
<td>Live urban/rural</td>
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<td></td>
<td>Rural/urban</td>
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<tr>
<td>Dependence on market for inputs</td>
<td>High</td>
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<td>High</td>
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<td></td>
<td>High</td>
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<td></td>
<td>Low</td>
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<tr>
<td>Location</td>
<td>Near capital and major cities</td>
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<td></td>
<td>Near capital and major cities</td>
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<tr>
<td></td>
<td>Smaller towns and rural areas</td>
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<tr>
<td></td>
<td>Everywhere: dominates in remote areas</td>
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<tr>
<td>Housing</td>
<td>Indoors: closed</td>
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<tr>
<td></td>
<td>Indoors: closed</td>
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<tr>
<td></td>
<td>Indoors/part-time outdoors: closed/ open</td>
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<tr>
<td></td>
<td>Outdoors most of the day: open</td>
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<tr>
<td>Contact with other poultry, domestic birds and wildlife</td>
<td>None</td>
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<tr>
<td></td>
<td>None</td>
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<td></td>
<td>Yes</td>
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<td></td>
<td>Yes</td>
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<tr>
<td>Veterinary service</td>
<td>Own veterinarian</td>
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<td>Pays for veterinary service</td>
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<td></td>
<td>Pays for veterinary service</td>
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<td>Irregular, depends on government veterinary service</td>
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<td>Source of medicine and vaccine</td>
<td>Market</td>
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<td>Market</td>
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<td>Market</td>
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<td></td>
<td>Government and market</td>
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<tr>
<td>Source of technical information</td>
<td>Company and associates</td>
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<td></td>
<td>Sellers of inputs</td>
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<tr>
<td></td>
<td>Sellers of inputs</td>
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<td></td>
<td>Government extension service</td>
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<tr>
<td>Source of finance</td>
<td>Banks and company funds</td>
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<td>Banks and private informal</td>
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<td>Breed of poultry</td>
<td>Commercial</td>
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<td>Commercial</td>
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<td></td>
<td>Native</td>
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<td>Food security of owner</td>
<td>High</td>
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<td></td>
<td>OK</td>
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<td></td>
<td>OK</td>
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<td>From OK to bad</td>
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A set of characteristics used by FAO to distinguish between four main production sectors is presented in Table 2 (FAO, 2004). In effect, the commercial sector has been subdivided into three main categories, Sector 3 having the lowest levels of: i) scale and concentration of production; ii) intensity; iii) productivity; iv) commercialization; v) specialization; vi) market integration; and vii) formal biosecurity measures; and Sector 1 the highest. Attempts have been made to assess the distributions of poultry producers and birds between the four sectors in the case-study countries.

The four categories are better described as “sectors” than as “systems”, as increasing commercialization is associated with increased segmentation of different stages in the value chain from input supply through to retail delivery of the product. The production system is, then, only one stage in the chain.

Levels of biosecurity merit further comment. Although formal biosecurity may be higher in industrial/commercial systems, the greater bird population density may increase the probability of infection and the scale of disease outbreaks that occur in these concentrated production systems (Otte et al., in FAO, 2007a).

Increasing concentration of production is also associated with problems of waste disposal and soil, air and water pollution (Steinfeld et al., in FAO, 2006a). Within each sector there is a great deal of variation between individual types of production system and value chains, so further discussion is needed.

2.2 Sector 4: village or backyard production

The most basic and simple backyard production system involving a few hens and a cockerel is essentially a closed system. Home-produced fertile eggs are hatched to provide replacements, birds feed by scavenging or are provided with household scraps and crop by-products; there are virtually no veterinary inputs and the remaining eggs and meat produced are consumed within the household.

Such very simple subsistence poultry production systems are probably quite rare. Producers with even slightly larger flocks, generate cash income from the sale of eggs and birds within the local community. In the five case-study countries and in most parts of the developing world, live birds and eggs are traded in open-air or “wet” markets and in retail shops, where birds are slaughtered on sale. Transactions may take place directly between producers and consumers, but traders and other market intermediaries may be involved, selling on to other sectors of the poultry industry.

Sector 4 production systems are widely distributed and exist in both rural and urban areas. In most countries, the majority of producers fall into this category, but with development of the industry a growing proportion of both meat and egg production is derived from the commercial sectors. It is estimated that today in India, only 10 to 20 percent of total poultry output is derived from “backyard” production (Landes et al., 2004). Proportions may be higher in Egypt, at 22 percent of chicken meat and 30 percent of eggs, and China at over 60 percent of meat and nearly 70 percent of eggs, but are probably lower in Brazil and Thailand where the commercial sector is most developed. However, in all five case-study countries there is wide inter-regional variation in poultry population density, reflecting the localized concentration of commercial production. In areas that are less densely populated by poultry, “backyard” systems are likely to contribute a larger proportion of total poultry production.
In the village or backyard sector, production is generally based on traditional local, native breeds, producing both eggs and birds for meat. In India they are referred to as “desi” and in Egypt as “balady” poultry. Chickens are the main species kept, but in India, Egypt, China and Thailand significant numbers of ducks and other domesticated birds are kept. In China, ducks and other species make up nearly a fifth of the national poultry flock. Some are kept in mixed flocks, while others are kept separately from chickens.

Productivity of the traditional native breeds, whether measured by annual meat production per bird, feed conversion rate or eggs produced per bird, is comparatively low. For instance, in Egypt the balady chickens take two or three times as long as commercial birds to reach market weight, require almost twice as much feed per unit of weight gain, and the layers produce only two-thirds of the number of eggs per year (Taha, 2003). Nonetheless, village or backyard production can make a useful contribution to dietary protein intake and incomes of resource poor households (Acamovic et al., 2005). Furthermore, given the lower opportunity costs\(^5\) of resources and the higher market prices offered for local poultry, backyard systems are likely to yield a positive economic return, despite increasing competition from the commercial sectors.

2.3 Sector 3: low-biosecurity commercial poultry production

This sector is based on commercial production to generate cash income, but it retains some characteristics of the traditional, backyard systems, particularly in selling live birds in wet markets, to commercial intermediaries or directly to retail shops. Production units are generally intermediate in scale between backyard systems of up to 200 birds and commercial systems of over 2,000 birds. Some economies of scale may be derived in terms of scope for use of specialized equipment such as battery cages or semi-automatic feeders. Levels of biosecurity are thought to be low, in that birds are often not permanently housed, mixed flocks of chickens and waterfowl may be kept, birds are generally marketed live, and a range of different markets, un-monitored for health risks, are used for produce sales and input supplies.

Sector 3 flocks are generally devoted either to broiler meat production or to egg production. Specialized commercial hybrid chicks are generally purchased from external sources. Even where native breeds are used commercially, as in the “balady flocks” of Egypt, chicks are generally purchased from specialized hatcheries. Feeds must generally be purchased, either as premixed rations or as raw materials for home milling and mixing. Hence, the production and marketing process is segmented and the value chain may be analysed. However, for this sector in particular, there are so many alternative sources of chicks and feedstuffs and different potential market outlets, that it is difficult to establish a standard outline value chain applicable in all the case-study countries.

Sector 3 and 4 producers are not always clearly distinguished in national statistics. For instance, in China all flocks with up to 299 birds are classified as “backyard”, and these account for nearly all poultry producers and around 70 percent of poultry production. Arguably, some of these should be placed in the Sector 3 category. Similarly in Egypt, Sector

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\(^5\) The opportunity cost is the amount that could be earned from the most lucrative alternative use. For many poor households the opportunity cost of labour and other limited resources may be very small.
3 and 4 producers together account for nearly the total number of producers, but account for less than a third of total production. Similar proportions apply in Thailand. In India, the smaller independent commercial producers are of regional importance in the north and east of the country and particularly around Delhi, where integrated contract production has not become established as it has in the south. Even in Brazil, where the poultry sector is heavily industrialized, it is estimated that around 40 percent of poultry meat is produced on relatively small family farms of less than 100 hectares (Camargo-Barros, in FAO, 2003).

Sector 3 poultry production may originate with backyard producers who are able to generate sufficient income and savings to escape from the poverty trap and expand into somewhat larger-scale and more intensive production systems (Otte and Upton, 2005). However, there are many other small-scale investors, retired civil servants and the like, who establish moderate-sized semi-commercial poultry units as a means of generating supplementary income. In either case, Sector 3 production units are generally independently owned, relatively small-scale, enterprises.

The scale of production units is subject to capital limitations. For these relatively small-scale, independent investors, not only are private investment funds scarce, but so too is access to formal credit. Market limitations arise in countries, like India and Egypt, where there is a marked consumer preference for the purchase of live birds, rather than dressed, chilled or frozen carcasses. The transport of live birds is more difficult and costly, so producers need to be located near their markets. In India, it is suggested that relatively small-scale, Sector 3, producers are at a disadvantage in facing high feed and transport costs, limited access to vaccines and veterinary services, and shortage of credit.

2.4 Sector 2: large-scale commercial, high biosecurity

This sector consists of the generally larger-scale (over 2,000 bird) commercial flocks of broilers, layers or breeding birds. Only relatively wealthy individuals or commercial joint-stock companies have the necessary investment funds or can raise sufficient credit for these larger-scale investments. Biosecurity levels are defined as high, as birds are continuously housed, strictly preventing contact with other flocks or with wildlife. Despite this, many outbreaks of HPAI appear to have started in large-scale commercial flocks (Otte et al., in FAO, 2006b). Inputs are generally supplied and products marketed through formal market agencies. The production and marketing process is clearly segmented, and separate value chains for broilers and layers can be clearly identified (see Figure 7).

Figure 7 illustrates that in the non-integrated Sector 2, production of day-old chicks and feeds, broiler growing, processing and retail distribution of the final product are the responsibility of separate commercial enterprises. They are all “stakeholders” in the value chain, adding value to the product at each stage. The figure is simplified by showing a single enterprise at each stage of the chain. In practice, there may be a range of alternative partner agencies with which to transact business. Furthermore, links which are shown as “vertical coordination” might possibly be based on “arm’s length market relationships”, although reliance on the latter would be very risky. A similar value chain diagram could be drawn for the layer subsector, although the production cycle is longer and is subdivided into rearing and laying stages. Disposal of spent hens is another necessary activity. Eggs may be marketed without processing, although production from the larger flocks is likely to require egg packing.
The scale and intensity of production, reflected in both the level of purchased inputs and the output per bird, is substantially higher in the commercial and industrial sectors than in backyard systems. Advantages are derived from economies of scale, providing scope for specialization and division of labour between the different stages in the production process, leading to automation of operations and labour-cost savings. These advantages add to those derived from the use of highly productive commercial hybrid chicks and improved technologies such as the evaporative cooling or air-conditioning of poultry houses.

The need for vertical coordination of all stages in the production chain, particularly in the regular supply of chicks and the transfer of birds to slaughter or markets when ready, leads to concentration of commercial poultry production in particular areas of the country, generally near major urban markets. The available statistics on poultry production in the case-study countries do not clearly distinguish between commercial (Sector 2) and industrial (Sector 1) production. However, it is clear that these two sectors together produce most of the total national supplies of poultry meat and eggs, particularly in the areas of greatest poultry population density.⁶

In India, particularly around Coimbatore, in the south, large-scale commercial, though mainly Sector 1, producers account for 75 percent of poultry meat production. The four southern states, where poultry densities and flock sizes are high, together contribute 57 percent of the nation’s egg production. In the north, particularly around Delhi, non-integrated, Sector 2, producers contribute similarly large proportions of local production and consumption (Landes et al., 2004; Mehta, in FAO, 2007b). In Egypt, the commercial sector is estimated to contribute 87 percent of poultry meat production and 77 percent of eggs. As there are only two major integrators in Egypt, most of this production must come from the non-integrated commercial enterprises of Sector 2 (Otte et al. in FAO, 2007a).

⁶ For maps showing zonal variation in poultry density within countries, see Gerber (in FAO, 2007g) or GLiPHA (2007).
In China, poultry production is heavily concentrated in the Eastern Region, around Beijing, where commercial holdings with flocks of over 2,000 birds make up just over 5 percent of the total but contribute nearly 88 percent of total broiler meat production. A similar proportion of commercial layer farms, having flocks of over 500 birds, contribute 78 percent of the eggs. The four provinces making up the Eastern Region contribute more than half the national production of eggs. Proportions of large flocks are much lower in the Central and Western Regions, and as a result, their contributions to total production of poultry meat and eggs are much smaller.

The poultry industry in Thailand and Brazil is dominated by commercial and industrial production of broilers for export and for domestic consumption. This intensive production, about half the national total, is concentrated in the Central Region of Thailand, “a small but densely populated region” (Na Ranong, in FAO, 2007c). In Brazil, the main region of intensive production is in the south (50 percent of national broiler production) and southeast (27.5 percent) (OD Consultancy, in FAO, 2007d). Intensive production is now spreading westwards to locations more accessible to the main maize and soybean growing areas. In both Thailand and Brazil, although commercial production from Sector 2 exceeds that from Sectors 3 and 4, most of the poultry production is in the hands of the industrial, integrated production systems of Sector 1.

### 2.5 Sector 1: industrial and integrated production

This sector consists of the largest and most industrialized enterprises in the poultry industry. The various stages in the value chain are vertically integrated into a single industrial company. The broiler-growing or egg-laying components are either fully integrated as part of the parent company, or are separate production units operating under contract to the parent company, as shown in Figure 8.

For Figure 8 it has been assumed that although the whole process, from chick breeding and hatching through to distribution and retailing is integrated in a single organization, feed milling remains as a separate business enterprise. In many instances, the feed and poultry production activities are integrated, together with “horizontal” links to other sectors such as pig production. In other cases, vertical integration is partial – from breeder down to broiler grower, or from market distributor up to broiler producer.

Vertical integration yields financial benefits by reducing the “transaction costs” of exchanges at different stages of the value chain. In non-integrated poultry systems, transaction costs are likely to be high because of: first, the frequency and regularity of transactions resulting from the cyclical nature of poultry production; second, the risks of disease and market price fluctuations; and third, the investment in very specific types of assets, or “asset specificity”, involved in poultry production, processing and marketing (Williamson and Masten, 1995; Dorward et al., 1998). In these circumstances, the vertical integration of the different stages of the breeding, production, processing and marketing of poultry produce is a rational economic response, which should increase efficiency and reduce unit costs.

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7 These are the costs of obtaining information on the quality of the good being exchanged, negotiating a contract and enforcing the agreement.
In India, substantial numbers of integrated poultry production companies have been established, particularly in the four southern states and in western India around Mumbai (Landes et al., 2004). By contrast, in Egypt only one large-scale broiler farm is completely integrated (Otte et al., in FAO, 2007a). Information is currently lacking on the number of large-scale integrated producers in China, but it is apparent that some operate on a very large scale. The Beijing Dafa Chia Tai Company, which claims to be the third largest in China, raises batches of 2 million broilers from their own farms and 6 million from 2,300 contract farmers.

It is estimated that 70 percent of Thai broiler-meat production is derived from the large-scale integrated poultry sector (Rushton et al., 2005). A decade ago, the broiler sector was controlled by about a dozen large integrated firms (Tisdell et al., 1998). In Brazil, production of broilers for export, or about 30 percent of total broiler production, is in the hands of 20 major integrated production companies associated with the main exporters’ association, Associação Brasileira dos Productores e Exportadores de Frangos (ABEF).

3 STRUCTURE OF THE VALUE CHAIN
3.1 The introduction of commercial stock
The introduction of improved, exotic, genetic material is an important first step in the growth and development of the commercial poultry sector. Generally, the new strains are less hardy and less resistant to endemic diseases than indigenous birds. The greater productive potential cannot be attained without complementary inputs of specially compounded concentrate feeds, and improved housing, management, and veterinary care. Nonetheless, the introduction of new genetic material is the foundation on which other technological improvements are added.
Despite earlier attempts by field researchers and non-government organizations to improve the genetic potential of poultry, major advances only occurred with the introduction of exotic commercial stock. This was generally the result of private commercial activity, the importer needing sufficient capital to establish and maintain a breeding flock in a carefully controlled environment of the type required by exotic birds.

The Indian broiler industry is said to have been founded in the early 1980s by the Venkateshwar company of India in collaboration with the American poultry breeding company Cobb (now Cobb-Vantress). It is claimed that the Cobb 100 strain owned by Venkateshwar Hatcheries (VH) accounts for 60–70 percent of all broilers in India (Landes et al., 2004). The company distributes breeding stock and day-old chicks nationwide, and provides veterinary services to the growers. Until 1995, imports of grandparent stock were restricted to pure lines only, with the intention of protecting domestic broiler growers. This had the effect of giving VH some monopoly power. Since then, restrictions have been lifted and other integrators have been importing grandparent stock and developing their own strains. This concentration of poultry breeding activity in southern India appears to have resulted in a rapid increase in productivity per bird (Figure 5 above).

In Egypt, there are seven grandparent stock farms, largely originating from imported chicks or hatching eggs and serving over 400 commercial breeding flocks. One of the major integrated producers, the Cairo Poultry Company (CPC), is in partnership with the Hubbard chick company. However, there are a larger number of improved balady chicken type breeding farms. Egypt also exports breeding stock to other Middle Eastern and African countries.

The large integrated poultry companies in China generally use improved strains originally bred in the United States of America.

The Thai company Charoen Pokphand (CP), though originally a small feed company, introduced contract broiler production in 1976 as a joint venture with the United States of America-based Arbor Acres/Avigen Company, bringing improved grandparent stock into Thailand. This is seen as the start of the livestock revolution in Thailand. CP has subsequently grown into a vertically and horizontally integrated multinational corporation, with 100,000 employees in the mid-1990s and with interests in the food, poultry and pig meat and shrimp industries. In Brazil, about 95 percent of poultry meat is produced under contract to the large integrator companies. Most of the genetic strains in use originated, or were developed, from North American foundation stock.

Three general conclusions may be reached. First, poultry breeding and chick production is now a specialized activity for large-scale producers. Many intermediate and smaller broiler and egg producers cannot afford to maintain separate flocks of specially bred parent or grandparent birds. They must purchase chicks from the specialist breeders or become contract growers. Second, many of the specialist breeders are vertically integrated with poultry processors and distributors, and commonly with feed millers, together with reliance on contract growers. Finally, there is a continuing need for imports of exotic foundation stock from the United States of America or Europe. The primary breeders in these countries still export grandparent stock to Egypt, China, Thailand and Brazil, and still have partnership arrangements with poultry breeding companies in India. In some cases these links have led to the establishment of joint ventures involving foreign direct investment.

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8 The same large company supplies chicks to 85 percent of layer flocks.
3.2 Links with feed millers

The other key input for commercial and industrial broiler and egg producers is the supply of concentrate feeds. These generally account for about 60 percent of the costs of intensive poultry production, so the feed conversion ratio is an important measure of productive performance. In Figure 8, feed milling is shown as an independent commercial enterprise separate from the integrated poultry production sector, though with contractual arrangements for the supply of feeds to breeding, broiler and laying flocks. In the fully integrated poultry sector, feed milling is generally incorporated within the poultry production company. As concentrate feeds are needed for other (non-poultry) livestock enterprises, the feed milling enterprise readily forms the basis for horizontal integration into other types of productive activity.

Feed millers are, in turn, dependent on supplies of energy- and protein-rich raw materials, particularly cereals and pulses. Costs of feeds and hence of poultry production, are therefore dependent, in part, on the availability and cost of these raw materials. Maize is the main cereal used in livestock feeds in Latin America, and increasingly in Asia and the Middle East (Steinfeld et al., in FAO, 2006a).

Thus, it is reported that the CP Company of Thailand prepared for the expansion of the poultry industry by first developing and persuading farmers to adopt a high-yielding maize variety, in a joint venture with DeKalb. As a result, maize yields quadrupled over the fifteen years from 1970 to 1985, leading to a big reduction in the cost of poultry production (Anon, 1997).

Coordination of feed supplies and broiler or egg production is essential to ensure productive efficiency. Different feed mixes are required at different stages of the life of a flock, and must be delivered regularly at the right time. New technologies, such as pelleting of feeds, may be needed. In these circumstances, transaction costs of feed purchases are likely to be high. Formal delivery contracts are necessary to reduce transaction costs and risks of default. However, vertical integration should bring even greater savings in transaction costs and provide greater assurance of coordinated supplies. These savings help to explain why integration appears to be the preferred option in the highly commercialized large-scale sector, and why average variable costs of production are lower for this sector.

3.3 Production, trade and use of feed crops

Availability and the relative prices of concentrate feeds, particularly maize, vary substantially between countries. Comparisons of the production, trade and feed use of maize in the case-study countries, give an indication of differences in the availability of feed grains. Although there has been a long-term upward trend in maize production in most countries, there is considerable variation from year to year, and even bigger variation in quantities traded. Nonetheless, results for a single year, 2005, illustrate the key differences between the poultry meat exporting countries that are also maize exporters, and Egypt, which is a net importer of both poultry meat and maize (see Table 3).

It may be noted that in India and Egypt feed and seed use accounts for less than half the total domestic utilization, more is used for human consumption. However, in China, Thailand and Brazil, the bulk of the crop is used for feed and seed, while relatively small proportions of the total production are exported.
Soymeal, a by-product of the soybean oil industry, is of increasing importance as a protein-rich ingredient of concentrate feeds for poultry and other intensively produced livestock. Information on production and trade in the raw material – soybeans – gives an indication of the likely availability of soymeal (see Table 4).

Clearly, Brazil has a major advantage as a poultry producer in that it produces exportable surpluses of soybeans as well as maize. Furthermore, it is reported that there are large areas of underexploited potential arable land in the Cerrado Savanna of Central West Brazil. The other four countries import most of the soybean utilized domestically (almost all in the case of Egypt).

Today, countries like India, China, Thailand and Brazil that produce more than enough maize to meet domestic requirements are at an advantage over countries like Egypt that have to import maize to meet all their needs. The costs of transhipment, freight and insurance associated with imports are avoided. Nevertheless, domestic prices of feed grains and pulses in both importing and exporting countries are influenced by global markets. Over the past 12 months (to November 2007) poor harvests and growth in demand for feeds and biofuel production have led to a large increase – near 50 percent – in the price of maize on world markets (FAO, 2007e). The increase in cereal prices has influenced land allocation to other crops, so shortages and increased prices of soy products have also occurred. Hence, poultry producers in all countries are vulnerable to fluctuations in global feed prices.

Even where the main feed crops are produced domestically, delivery costs are affected by the distance from where the feed crops are produced to where the livestock are con-

<table>
<thead>
<tr>
<th>TABLE 3</th>
<th>Maize exports, imports and usage as feed in 2005</th>
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<tbody>
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<td></td>
<td>India</td>
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<tr>
<td>Maize exports as a proportion of home production (%)</td>
<td>2.8</td>
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<tr>
<td>Maize imports as proportion of home utilization (%)</td>
<td>-</td>
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<td>Feed and seed use as proportion of total utilization (%)</td>
<td>37</td>
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</tbody>
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Source: FAOSTAT.

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<th>TABLE 4</th>
<th>Soybean exports and imports in 2005</th>
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<tr>
<td></td>
<td>India</td>
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<tr>
<td>Soybean exports as a proportion of home production (%)</td>
<td>-</td>
</tr>
<tr>
<td>Soybean imports as proportion of home utilization (%)</td>
<td>58</td>
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</tbody>
</table>

Source: FAOSTAT.
centrated. Thus, in India, producers in the southern states are concerned to promote local production of maize and soymeal, most of which are currently purchased from producers in central and northern India. In Brazil, integrated poultry producers are expanding into central and western Brazil, where more land is available for maize and soybean production.

3.4 Links with processors and distributors

Vertical integration takes place as a consequence of the growth of firms in the context of the process of development of the food industry and the global economy. However, there are three primary motives for vertical integration in the poultry meat sector: i) increased control of markets and marketing margins; ii) greater biosecurity and quality-control management; and iii) economies of scale in production, processing and distribution (PBEC, 1999). It follows that processing and market distribution are essential elements of the integrated value chain.

Economies of scale and the benefits of automation lead to major cost savings in the slaughter, defeathering and evisceration of broilers. A standard modern abattoir has capacity to process 6,000 to 9,000 birds per hour or up to 20 million per year. Serious losses in efficiency and economic returns can arise where slaughter plants are operated below capacity, as may occur where demand varies on a seasonal basis, when there is a serious disease outbreak, or where regular supplies of birds are too small to justify the establishment of a modern abattoir.

These risks must be set against the cost savings achieved, and the benefits of easy storage and transport for domestic distribution or export of chilled or frozen dressed carcasses. In India and Egypt, consumer preference for the purchase of live birds limits the scope for industrial processing and, because of the higher costs of transporting live birds, restricts broiler markets to the area in which the birds are produced. In the major exporting countries Brazil and Thailand, most birds for both export and domestic use are processed in industrial-type abattoirs.

From the abattoir, poultry carcasses can go for further processing into chicken parts, with or without bones, or for the manufacture of other poultry dishes. Hence, poultry processing readily links into the commercial food industry, which is growing rapidly in all the case-study countries with the spread of supermarkets, fast-food chains and other retail outlets. Exports of canned poultry meat are of increasing importance for China and Thailand, possibly in response to export bans on un-canned products following HPAI outbreaks.

Many of the large-scale integrated poultry meat producers in Thailand and China, and probably Brazil and India, have become multinational agencies in the food industry, some with their own local retail outlets. The links between integrated poultry production and the retail food sector in China are emphasised in the suggestion that local outbreaks of HPAI have accelerated the switch from wet markets to supermarkets (Evans, 2006).

For egg producers, there are fewer economies of scale in processing and marketing. Hence, although there are large enterprises that may be integrated with a feed mill, and in some cases with a hatchery, they are less commonly integrated with the processing and marketing end of the chain. Some independent operators buy day-old chicks or point-of-lay pullets, purchase feeds and sell their own eggs, while egg marketing is sometimes organized on a cooperative basis. In general, the egg industry is less concentrated than the poultry meat sector.
3.5 Contract production

Broiler growing under contract is a common feature of the integrated and semi-integrated industrialized sectors of the global poultry-meat industry. This type of contractual agreement is widely used by large integrated companies in India, China, Thailand and Brazil. Less has been written about broiler growing under contract in Egypt, possibly because there are few large fully integrated poultry producers in the country.

Although there are some local variations, the standard contract adopted usually commits the “integrator” to: i) the supply of chicks, feeds and medicines; ii) the provision of technical, managerial and veterinary support; and iii) transport for the delivery of feeds and the collection of finished broilers. The grower then provides: a) the capital invested in buildings and equipment; b) the day-to-day management; and c) electricity and water services. Under the contract, the integrator agrees, in advance, to make a flat-rate payment of a given sum per kg live weight of harvested birds, plus a bonus for improved performance, usually related to low mortality and good feed conversion ratios. In some cases, a penalty may be incurred for poor performance.

Before a contract can be agreed, the grower must meet required standards for the buildings and other facilities offered, and demonstrate his/her knowledge and experience of poultry production. The payments are based on current market prices and average levels of productivity. Similar arrangements apply in the, less common, case of egg production under contract.

The grower’s contract is essentially a means of cost and risk sharing with the integrator. The grower avoids the transaction costs of organizing separate purchases of inputs and sales of products, and reduces the risks of large price fluctuations faced by an independent producer. There may be other benefits associated with the technical advice and support provided by the integrator. At the same time, there is a cost, in that independent producers generally earn larger margins per bird or per kg of meat produced. The integrator avoids the costs of establishing the necessary buildings and equipment and of day-to-day management, while excluding the risks of dealing at arm’s length with independent growers. Most studies show that the overall marketing margins are lower for integrated production systems than for independent growers.

Despite the fact that many broiler producers choose to adopt contract growing for large integrator companies, and remain loyal for extended periods, doubts are raised about the fairness of the system by both contract growers and independent growers in competition with the integrated producers. It is claimed that the integrators force producer prices and margins below competitive market levels.

Where, as is often the case, there are a small number of integrators dealing with a large number of potential contract growers, the integrators are in an oligopoly situation and have a measure of market power, which may be exploited, as it is they who generally write the contracts. In India, and probably other countries, there is no formal legal basis for the contractual agreements, which makes enforcement difficult. However, broiler growers always have the option of returning to an independent status if they become dissatisfied with the terms of the current contract. Integrators have an interest in maintaining grower loyalty. The system has functioned effectively in many situations.
4 GOVERNMENT POLICIES FOR THE POULTRY SECTOR

4.1 Comparative advantage

The global distribution of poultry production, and associated patterns of trade in poultry products, is dependent in part on differences in comparative advantage or the opportunity cost of production, and in part on past and present policies affecting trade, exchange rates, markets and prices, technology development and institutions. Comparative advantage depends, in turn, on endowments of natural resources, labour and capital, and the associated productive technology.

Given that India, China and Brazil are among the largest countries in the world, with huge internal, inter-regional differences, comparisons of national average data are of limited value in assessing comparative advantage. However, there are some fairly obvious differences. Brazil, with large areas of still not fully exploited fertile land, has a particularly favourable natural resource base for producing key feed crops (see Tables 3 and 4 above). Egypt appears to be disadvantaged in this respect, and is heavily dependent on imports of feed grains and oilseeds. Relative labour scarcity is reflected in wage rates which are higher in Thailand than in China and India. All these developing countries are constrained by capital limitations, with underdeveloped communications, physical, social and institutional services. However, international movements of capital are increasing in response to economic investment opportunities.

Comparison of average broiler farm-gate prices gives an indication of relative comparative advantage, although market prices may be affected by market distortions. Estimates, of average prices per kg live weight for 2001 are as follows: India US$0.48 to $US0.84; Thailand US$0.68; and Brazil US$0.48 (Landes et al., 2004). In comparison, the estimate for the United States of America is US$0.87. Production costs in China are likely to be lower than those in Thailand, as wages are lower. Market prices of commercial broilers in Egypt between 2004 and 2004 ranged from US$0.9 to US$1.2. Local “balady” chicken prices are 30 to 40 percent higher (Ibrahim et al., in FAO, 2007f).

4.2 Trade policies

Policy objectives, for agriculture and the poultry sector differ among the case-study countries. India and Egypt have historically pursued import substitution policies, with the aim of achieving a measure of self-sufficiency, although both are now opening up to more foreign trade with membership of the World Trade Organization (WTO).

China has undergone major change over the last 20 years, with reductions in government intervention and central planning. There is increased reliance on market forces, which is being accelerated with WTO membership. Large trade surpluses are being earned from manufactures, and there is less concern over the agricultural trade balance. The main goals for agriculture are to achieve food security for the huge population, to improve food safety and quality, to improve farmers’ incomes, and to protect the natural environment for sustainable agricultural and rural development. Brazil, as the world’s largest exporter of poultry meat, and Thailand, as the fourth largest, are concerned to protect and expand their export markets. Despite these differences, all the countries have imposed quantitative controls on imports in the past and have switched to the use of tariffs under WTO rules. Both kinds of trade barrier, if effective, restrict imports and therefore raise domestic prices — benefiting
domestic producers, but raising costs for consumers. In the case of feed crops, like maize and soybean, costs are increased for feed millers and poultry producers. Generally, the costs of trade barriers exceed the benefits. Tariffs are generally the preferred option, but WTO members are required to reduce tariff levels over time.

In India, quantitative import controls were applied to poultry meat, poultry preparations, eggs and egg products until April 2000, when they were replaced by tariffs of 30 percent on fresh, chilled or frozen chicken and 100 percent on processed products. Controls on imports of breeding stock and poultry feeds were lifted in 1997/98. However, an under-quota tariff on feeds of 15 percent, rising to 70 percent out of quota, was then introduced.

A ban on Egyptian imports of poultry meat introduced in the late 1980s caused domestic price rises and provided incentives for domestic producers. It was lifted in 1997, and replaced by an 80 percent tariff. Imports have remained at low levels. Further production incentives were provided by tariff-free imports of poultry feeds from July 2006.

Chinese tariffs on imports of poultry products were reduced from 20 percent to 10 percent between 2001 and 2004 as part of the trade liberalization process. Imports of poultry products provide materials for the growing processing sector from which some products are exported.

Agricultural exports from Thailand make a significant contribution to foreign-exchange earnings. Exports of agricultural and livestock products account for a large proportion of the total sector contribution to national income. However, Thailand is a net importer of some key agricultural products, including soybean and other oilseeds. In moves to promote trade liberalization, Thailand joined the ASEAN Free Trade Agreement (AFTA) and the Asia-Pacific Economic Cooperation (APEC) Group.

Tariff reforms were launched in 1994, aimed at the simplification of tariff structures and their gradual reduction over time. They were temporarily increased following Thailand's debt crisis of 1997, but now the in-quota tariff on maize and other feed crops is 20 percent. Currently, this has little effect on the maize market, as Thailand is a net exporter. However, imports of soybean are affected. The larger feed millers may benefit in being more-readily allocated low-rated tariff quota allotments. In this way the structures of the milling and poultry industries may be affected by the associated price discrimination.

Prior to the mid-1980s, Brazil like other Latin American countries pursued a policy of industrialization under protective trade barriers. Quite rapid economic growth had occurred, but this was accompanied by rapid inflation and the accumulation of a huge foreign debt. During the 1980s, measures were put in place to reduce the rate of inflation, with cuts in government spending and tighter monetary controls. Brazil joined with neighbouring countries to form MERCOSUR (Mercado Común del Sur) in 1991, which led to increased trade between members, but largely in capital intensive industries.

In 1994/5 the Real Economic Stabilization Plan was put in place, with effective currency devaluation and further liberalization, under the guidance of the WTO Agreement on Agriculture. Up to 2003, economic growth was slow and real wages fell under a series of domestic and international economic shocks. However, following a reform plan introduced in 2004/05, the government withdrew from agricultural markets, state enterprises were privatized and minimum support prices were eliminated. As a result, the Brazilian economy has strengthened, producing record current-account trade surpluses to which agricultural expansion has made a significant contribution.
4.3 Macroeconomic and exchange-rate policies

Government policies associated with taxation, spending, borrowing, interest rates, wage rates, the money supply and exchange rates, are together referred to as macroeconomic policies. Although they are applied to the whole economy, they can have a major impact on the development of a particular sector and trade in its products. For example, foreign exchange rates affect prices and quantities of exports and imports, and thus the prices of products and inputs. In the past, many governments have allowed their domestic currencies to become, and remain, overvalued. This situation may arise when the currency is “pegged” at a fixed rate against another currency such as the United States dollar while, as a result of changes in the global economic environment or poor macroeconomic management, rapid domestic inflation and growing foreign indebtedness, the real value of the domestic currency has fallen.

The benefits, of maintaining an overvalued exchange rate are derived in terms of cheap foreign exchange and low prices of imports, and possibly a decline in the prices of domestic produce as export quantities and revenues fall. The distortion may be maintained by the application of foreign exchange controls, together with trade quotas and tariffs, as outlined above. Losses are experienced by potential exporters faced by the artificially low domestic prices of exports. In effect they are taxed.

The main beneficiaries are thought to be urban dwellers for whom imported consumer goods and industrial raw materials are made cheaper. The situation can rarely be sustained, and macroeconomic reform strategies, usually involving currency devaluation, become necessary. Devaluation reverses the effects of an overvalued currency by raising the domestic prices for exports and imports, thereby providing incentives for domestic producers to substitute for imports and/or increase exports.

The development of the poultry sector in Brazil, Thailand and Egypt, has been affected by the international debt crises of the 1980s and 1990s. Brazil and other Latin American countries had borrowed heavily from banks in North America and elsewhere in the 1970s and early 1980s, but by 1982, debt servicing had become impossible and the problem had become a crisis. Thus, Brazil and other debtor countries were required to adopt unpopular reform policies. There followed a decade of cuts in government spending, currency depreciation associated with increasing domestic prices, and slowing economic growth. However, rising interest rates and market liberalization attracted foreign investment and poultry production started to expand.

With the introduction of the Real Economic Stabilization Plan in 1994, the Brazilian currency was changed from the cruzeiro to the real and pegged to the United States dollar. This was accompanied by trade liberalization, as outlined above. These policies stabilized the economy and brought about a consumer boom. Between 1999 and 2001 the real was devalued to about a third of its previous exchange value, leading to a major improvement in export prices, while reducing the profitability of imports. As a result there was a 20 percent expansion in the area planted to soybeans in the 2000/2001 crop year and a 35 percent increase in soybean exports (USDA, 2006). Capital inflows resumed, expansionary policies were adopted and economic growth recovered.

In the late 1990s, Thailand suffered a 40 percent devaluation of the baht which signalled the beginning of the Asian debt crisis, which spread to Malaysia, Indonesia, the
Republic of Korea and, less seriously, the Philippines. Serious capital losses experienced by foreign investors led to massive withdrawals of funds from these and other debtor countries. Interest rates rose and debtor problems were exacerbated in other countries. A further currency devaluation was needed in Brazil in 2001, while the Egyptian pound was devalued in 2002. In each case, the devaluation has raised the domestic prices of poultry products and of feed grains. The increases in poultry prices have benefited and provided incentives for domestic producers and exporters. However, rising prices of feed grains increase costs for feed millers and poultry growers. Serious problems may arise for countries like Egypt that are dependent on feed-grain imports.

4.4 Domestic support policies for the poultry industry
Public-sector investment in the development of the poultry industry has been limited in all the case-study countries. Development has been largely based on private domestic or foreign investment. Some schemes have been established to promote smallholder production and producer cooperatives in India. Poultry production has been subsidized to a limited extent by federal, state and local governments in Brazil and in Thailand. Rather more emphasis has been given to the promotion of crop production in general, and feed-grain producers may have benefited. The price of feed grains in Egypt remained low for a long period as a result of the overvalued currency.

More generally, governments are responsible for the provision of the social infrastructure of roads, telecommunications, water and electricity supplies, and other facilities. There is still much room for improvement in all developing countries. These limitations are seen as constraints to the future development of the poultry industry in all the case-study countries.

4.5 Poultry health and disease control
The maintenance of animal health and the control of livestock disease is an area where some sharing of public and private responsibility is likely to be necessary. Direct costs result from losses due to morbidity and mortality of birds, while indirect costs are incurred in the implementation of control measures.

The case for public-sector intervention in providing for specific disease control measures, such as border controls, surveillance, movement controls, quarantine services, food-safety and drug-quality control, has been argued on the basis that they yield public goods and externalities9 (Holden, 1999, Umali et al., 1992; Leonard, 1993). It is further generally agreed that where “stamping out” by compulsory slaughter is the chosen method of controlling a disease outbreak, the costs of slaughter and compensation should be met from public funds.10

These issues have come to the fore in recent years, with the spread of HPAI. Outbreaks of the disease, associated with a small number of human infections and deaths, have occurred in India, Egypt, China and Thailand. The disease and associated control measures

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9 Public goods are those from which no one can be excluded from the benefits and for which the cost does not depend directly on the number of beneficiaries. Hence, public goods are unlikely to be supplied adequately by private enterprise.

10 Hitherto, no satisfactory private insurance schemes have been developed to cover these costs.
have incurred major costs, both public and private, in terms of dead or culled birds and the associated financial losses. The impacts have been greater in China and Thailand, as the outbreaks began earlier in these countries, have recurred since, and have resulted in continuing import bans on unprocessed poultry products, thus damaging these countries’ major export industries.

In addition, loss of consumer confidence in the safety of eating poultry products caused a fall in demand and hence prices, which affected producers even in countries, like Brazil, where no outbreaks have occurred. However, this impact was largely temporary, as global consumer demand appears in 2007 to have recovered to its former growth path.

Governments have been forced to review their policies for control of the disease. Contingency plans have been prepared to strengthen the response if and when future outbreaks occur. Such plans include compulsory culling, with compensation as a means of “stamping out” the disease. A double “moral hazard” problem arises in determining compensation levels. If they are set too low, producers have little incentive for rapid reporting of an outbreak. If they are set too high, producers have little incentive for maintaining high biosecurity standards.

A vaccine has been developed in China and is distributed free of charge. Presumably it is intended for use in limiting the spread of outbreaks if and when they occur, rather than as a prophylactic. In Thailand, however, vaccination is banned, presumably because of its potential damaging impact on export markets. Both countries have switched most of their poultry export production to pre-cooked and processed products. This not only avoids the problem of import bans on their raw, uncooked poultry products, but also adds value to the commodity.

Other precautionary approaches aimed at limiting the risks of further outbreaks and their spread are being adopted. These include promoting improved surveillance and biosecurity, often by means of regulations that affect the structure of the industry. Regulations, such as the closure of live or wet-markets and the compulsory housing of birds, impose serious costs on smaller-scale, Sector 4 and possibly Sector 3 producers. These costs, together with a smaller capacity to cope with the costs of disease outbreaks, may drive small-scale producers out of the industry, although a small telephone survey in Thailand suggests that the majority have remained in poultry production after the trauma of the main outbreaks. These disproportionate impacts on different sectors of the poultry industry should be carefully considered by policy-makers.

5 EXPECTED TRENDS
5.1 Global expansion of the poultry industry
Commercial production and consumption of poultry meat and eggs are likely to continue to expand globally. This expansion will accompany general economic growth and industrial development, as demand for livestock products increases with growing per capita incomes and urban populations. Growth will continue at the intensive margin with increasing commercialization and industrialization of the poultry sector, and at the extensive margin as commercial poultry production spreads along with other industries.

Analysis of data for the case-study countries has shown large differences in average levels of per capita production and consumption of poultry meat and eggs, between countries
and between regions within countries. These are linked, at least in part, with differences in levels of industrial development and urbanization. Intensive, large-scale commercial production is concentrated in some of the more economically advanced areas. Further intensification and integration will occur in these areas, while concurrently, commercial production may become more widely dispersed.

Expansion of the poultry industry is most rapid in low- and middle-income countries where average incomes are increasing. At low income levels, a given proportionate increase in income results in a relatively large increase in poultry meat and egg consumption. As incomes increase, the impact of further growth on quantities demanded and consumed diminishes. At relatively high income levels the elasticity of demand falls to a very low level, so further increases may have little or no impact on consumption. Ultimately, in the long term, the growth in demand for poultry meat and eggs could slacken as average consumption levels approach the desired maximum. However, in global markets, this stage is quite remote, while if it occurs in individual countries, further expansion of the industry may be based upon opportunities for increasing exports.

5.2 Market and resource constraints on production

a) Constraints on the global economy. Growth in demand for livestock products, poultry meat and eggs is driven by growth in per capita incomes. Hence, threats to the global economy, posed by global warming, energy and mineral resource limitations, and political conflicts, could reduce the growth rate of consumer incomes and their demand for livestock products. Expansion of poultry production would have to slow, to avoid falling prices. The incidence and impacts of these constraints, on the poultry industry, are difficult to predict and depend upon the policy responses of the international community.

b) Macroeconomic, trade, exchange rate and investment policies. As outlined in Sections 4.2, 4.3 and 4.4, above, national economic policies can have significant impacts on income growth and distribution, and on resource and commodity prices. Policy distortions may have an adverse impact on the growth of demand for and supply of poultry products. It is widely recognized that market and trade liberalization and non-discrimination against agriculture, are desirable objectives to promote economic growth and development.

c) Supplies and prices of feed grains and oilseeds. General expansion of cropland is fast approaching the limit of available cultivable land, other than in Latin America. Competition for this resource with other crops and other forms of land use (e.g. for building and urban development) will increase. At the same time, demands for feed crops for other purposes, including human consumption and biofuel production, are increasing. These trends are likely to result in increasing feed prices and reduced margins for livestock producers. However, poultry have a competitive advantage over other species, as their feed conversion rate is better.

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11 The income elasticity of demand is high.
12 The quantity of feed used per kg of poultry product is lower.
d) **Deficiencies in the general transport and market infrastructure.** Poor communications, limitations of the road network, lack of marketing facilities and cold chains, inadequate information and other infrastructure deficiencies limit the spread of commercial poultry production in many developing countries. Governments have a role in overcoming some of these marketing constraints, for instance by building roads and disseminating information. However, this public-sector investment is a key component of general economic development, rather than a policy aimed at promoting increased poultry production.

### 5.3 Disease constraints

Development of the poultry industry may suffer fluctuations due to HPAI, with outbreaks causing loss of production and loss of export markets. Reductions in demand due to human health fears appear to be short lived. However, all this depends upon maintenance of a reasonable level of disease control and the non-occurrence of a human pandemic.

Exporting countries suffer most from epidemics of transboundary diseases like HPAI. Strict SPS (sanitary and phytosanitary) standards are likely to be maintained in future, with export bans being imposed on countries where outbreaks occur. Compartmentalization and regionalization have not been generally accepted. Although freezing, storage and processing allow some flexibility in adjusting to export bans, future outbreaks and the possible endemic state of the disease may cause changes in the main poultry-trading nations.

### 5.4 The future of Sector 4 production

There is some debate as to whether Sector 4, backyard producers are likely to be displaced in the face of competition from the lower-priced products of the highly productive commercial sectors. However, to some extent traditional and commercial poultry producers operate in different markets for products and key inputs. As commercial production tends to develop in specific regions within each country, often in the vicinity of urban conurbations, the traditional backyard systems may still dominate in remote rural areas.

Even in peri-urban areas, where commercial poultry production is well established, backyard and commercial systems may co-exist, operating in parallel but different markets. It is widely reported, for instance in India and Egypt, that traditional, local breeds of poultry are more highly priced than commercial broilers. The opportunity cost of family labour used in backyard systems is lower than that of hired labour used in commercial systems, while purchases of feed and veterinary inputs are minimal in Sector 4 production systems.

Some form of small-scale “backyard” or “hobby” production is likely to continue in all countries. Many backyard or hobby farmers still exist in Europe, with very little impact on aggregate supplies of poultry meat and eggs, though subject to monitoring and surveillance for disease-control purposes. In poor countries, backyard production maybe supported or promoted as a means of poverty relief. However, there are dangers that disease-control measures such as the closure of open, wet markets, or the requirement that all poultry be permanently housed, impose severe costs on small-scale producers, so that they are particularly disadvantaged in comparison with the commercial sector.
5.5 The role of Sector 3 producers

A question arises as to whether Sector 3 production is a transitory phase in the commercialization of the poultry industry that will largely disappear as Sectors 1 and 2 expand, or whether it will continue to function in filling niche markets for special products, such as duck and goose meat or organic produce. The apparent small size of Sector 3 in Brazil and Thailand suggests that the former outcome is the more likely.

Hence the growth and commercialization of the poultry industry may be illustrated as in Figure 9 which is adapted from Rushton et al. (in FAO, 2006c).

Figure 9 is based on the assumption that differences between countries in the structure of the poultry industry reflect different stages in development over time. However, as already noted, development of the industry is concentrated in particular regions within countries. Hence, different regions within countries may be at different stages in the development process. For instance, while northwestern Brazil and western China may be in the “early stage”, the south of Brazil and parts of eastern China have a well “developed” poultry sector.

Semi-commercial Sector 3 production may expand in the process of poultry commercialization, but eventually be displaced by larger-scale fully commercial systems. In fact, many Sector 3 producers may become contract farmers or their farms may become part of an integrated chain.

Arguably, this process of integration is required to improve overall biosecurity as contracts through the chain are strong and it is in the interests of all actors to avoid the spread of disease. Integrated systems are more likely to develop where consumer demand has shifted away from live-bird markets to those for mass-produced chilled products.

![Figure 9: Poultry sector development](source: adapted from Rushton et al. (in FAO, 2006c).)
REFERENCES


Scale and structures of the poultry sector and factors inducing change


Annexes
### ANNEX A

**Characteristics of developing countries, by income group (2006)**

<table>
<thead>
<tr>
<th>Region</th>
<th>Low-income</th>
<th>Lower middle-income</th>
<th>Upper middle-income</th>
<th>High-income developed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average GNI/capita (US$)</td>
<td>650</td>
<td>2,037</td>
<td>5,913</td>
<td>36,487</td>
</tr>
<tr>
<td>GDP growth (%)</td>
<td>8.0</td>
<td>5.7</td>
<td>8.9</td>
<td>4.3</td>
</tr>
<tr>
<td>Agriculture, value added (% of total GDP)</td>
<td>21.5</td>
<td>12.3</td>
<td>6.2</td>
<td>1.9</td>
</tr>
<tr>
<td>Urban population (% of total)</td>
<td>30</td>
<td>47</td>
<td>75</td>
<td>77</td>
</tr>
<tr>
<td>Population/km²</td>
<td>82.3</td>
<td>79.7</td>
<td>19.5</td>
<td>29.7</td>
</tr>
<tr>
<td>Poultry/head rural population</td>
<td>1.2</td>
<td>8.2</td>
<td>11.4</td>
<td>21.7</td>
</tr>
<tr>
<td>Poultry meat production (% of world total)</td>
<td>5</td>
<td>38</td>
<td>14</td>
<td>43</td>
</tr>
<tr>
<td>Poultry meat/head/year (kg)</td>
<td>1.7</td>
<td>17.1</td>
<td>23.2</td>
<td>33.7</td>
</tr>
<tr>
<td>Poultry meat exports (% of world total)</td>
<td>0.1</td>
<td>45.4</td>
<td>8.8</td>
<td>45.7</td>
</tr>
<tr>
<td>Poultry meat imports (% of world total)</td>
<td>4</td>
<td>25</td>
<td>30</td>
<td>41</td>
</tr>
</tbody>
</table>

*Sources: World Bank data and FAOSTAT.*

### ANNEX B

**Characteristics of case-study countries (2006)**

<table>
<thead>
<tr>
<th>Country</th>
<th>GNI/capita (US$)</th>
<th>GDP growth (%)</th>
<th>Agriculture, value added (% of total GDP)</th>
<th>Urban population (% of total)</th>
<th>Population/km²</th>
<th>Poultry/head rural population</th>
<th>Poultry meat production (% of world total)</th>
<th>Egg production (% of world total)</th>
<th>Poultry meat/head/yr (kg)</th>
<th>Eggs/head/year (kg)</th>
<th>Poultry meat exports (% of world total)</th>
<th>Poultry meat imports (% of world total)</th>
<th>Cereal yield (tonnes/ha)</th>
<th>Maize production (% of world total)</th>
<th>Soybean production (% of world total)</th>
</tr>
</thead>
<tbody>
<tr>
<td>India</td>
<td>730</td>
<td>9.2</td>
<td>18.3</td>
<td>29</td>
<td>368</td>
<td>0.6</td>
<td>2.4</td>
<td>3.9</td>
<td>1.8</td>
<td>1.9</td>
<td>0</td>
<td>2.4</td>
<td>2.4</td>
<td>2.1</td>
<td>2.9</td>
</tr>
<tr>
<td>Egypt</td>
<td>1,260</td>
<td>4.9</td>
<td>14.9</td>
<td>43</td>
<td>74</td>
<td>2.9</td>
<td>0.6</td>
<td>0.4</td>
<td>7.3</td>
<td>2.8</td>
<td>0</td>
<td>0.3</td>
<td>7.5</td>
<td>1.1</td>
<td>2.7</td>
</tr>
<tr>
<td>China</td>
<td>1,740</td>
<td>10.2</td>
<td>12.6</td>
<td>40</td>
<td>140</td>
<td>6.6</td>
<td>17.5</td>
<td>45.0</td>
<td>11.3</td>
<td>17.5</td>
<td>7.2</td>
<td>14.6</td>
<td>5.1</td>
<td>19.9</td>
<td>0.6</td>
</tr>
<tr>
<td>Thailand</td>
<td>2,720</td>
<td>4.5</td>
<td>9.9</td>
<td>32</td>
<td>126</td>
<td>6.6</td>
<td>1.3</td>
<td>1.1</td>
<td>10.0</td>
<td>8.5</td>
<td>5.4</td>
<td>0.1</td>
<td>2.7</td>
<td>0.6</td>
<td>5.0</td>
</tr>
<tr>
<td>Brazil</td>
<td>3,550</td>
<td>2.3</td>
<td>8.1</td>
<td>84</td>
<td>22</td>
<td>43.1</td>
<td>11.9</td>
<td>2.5</td>
<td>38.7</td>
<td>6.3</td>
<td>33.9</td>
<td>0</td>
<td>2.9</td>
<td>5.0</td>
<td>23.8</td>
</tr>
</tbody>
</table>

*Sources: World Bank data and FAOSTAT.*
ANNEX C. PRODUCTIVITY OF POULTRY IN MEAT PRODUCTION

A crude, but useful, measure of productivity in the poultry-meat sector is given by the ratio of the “number of birds produced and slaughtered per year”, to the “number of birds in stock, or inventory, at a single point in time”. Similar “productivity ratios” may be calculated for other livestock species, as the number produced per head of the national herd or flock. Despite the omission of other valuable products such as eggs, milk and wool, these ratios provide a crude indication of productive efficiency.

Interspecies comparisons, show poultry productivity to be substantially higher than that of other domestic livestock enterprises. For instance, “productivity ratios”, based on data averaged over all developing countries in 2005, are 0.2 for cattle, 0.5 for sheep and goats, 1.3 for pigs and 2.4 for poultry. (FAOSTAT, accessed 2006). Similar comparisons, using data for developed countries show higher “productivity ratios” for all species, but with the same inter-specific ranking. The high level of poultry productivity reflects both a higher reproductive rate and a faster rate of growth to maturity than those of other species. These factor together have allowed rapid genetic improvement, rapid growth of the poultry industry in many countries, rapid recovery and restocking after disease outbreaks, as well as the potential for economic gain.

National estimates of the poultry “productivity ratio” differ between countries, and have generally increased over time, as shown in the following table.

Differences between countries, in the productivity of poultry meat, may reflect differences in the relative emphasis given to egg production. In India and China, where in 1981 the ratios were rather low, there is more emphasis on egg production than there is in the other countries. However, in all the countries, except Thailand, the increase in productivity over the following 25 years is largely associated with increasing scale and commercialization of poultry production, and the introduction of specialized fast-growing broiler stock.

Thailand is a special case, in that in 1981, the average productivity ratio was already close to the levels then achieved in developed countries with largely commercial poultry sectors. The apparent decline in productivity by 2006 is largely due to the large numbers of birds lost or culled as a result of HPAI outbreaks from 2003 onwards. The very rapid growth of the productivity ratio for India, of over 7.5 percent annually over 25 years, is remarkable (see text Figure 5 and associated comments).

### TABLE C1
Poultry productivity ratios for case-study countries

<table>
<thead>
<tr>
<th></th>
<th>India</th>
<th>Egypt</th>
<th>China</th>
<th>Thailand</th>
<th>Brazil</th>
</tr>
</thead>
<tbody>
<tr>
<td>Productivity 1981</td>
<td>0.70</td>
<td>3.48</td>
<td>1.17</td>
<td>3.83</td>
<td>2.73</td>
</tr>
<tr>
<td>Productivity 2006</td>
<td>4.42</td>
<td>3.96</td>
<td>1.89</td>
<td>2.76</td>
<td>4.46</td>
</tr>
<tr>
<td>Average annual increase (%)</td>
<td>7.64</td>
<td>0.52</td>
<td>1.95</td>
<td>-1.30</td>
<td>1.98</td>
</tr>
</tbody>
</table>

*Source: FAOSTAT.*