



The 'Livestock Revolution': Rhetoric and Reality

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Abstract

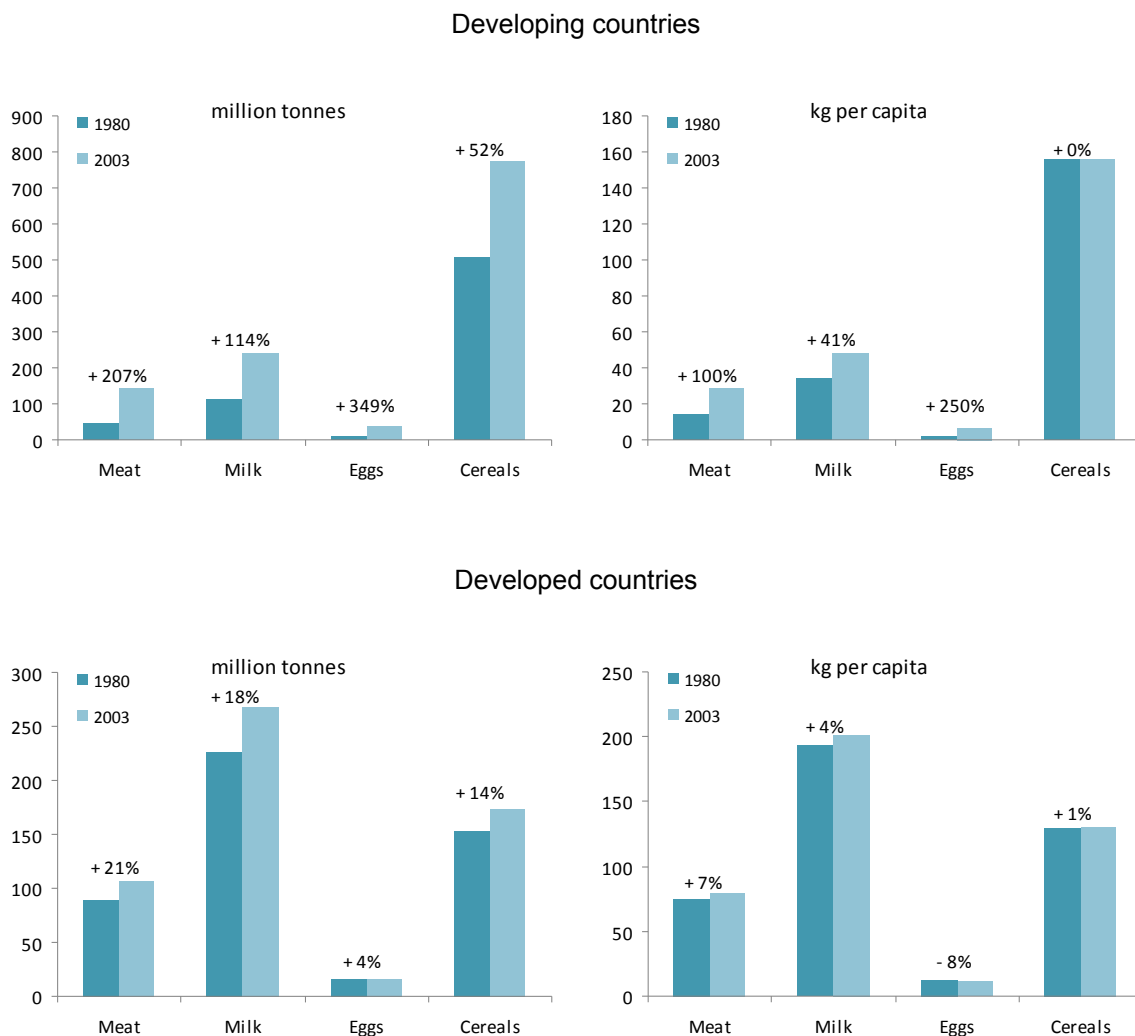
Since the term 'Livestock Revolution' was coined in an influential 1999 IFPRI publication, insinuating an analogy to the 'Green Revolution', it has become a dominant 'paradigm' in the narratives of development practitioners and policymakers engaged in the livestock and related sectors. The basic tenet of the 'Livestock Revolution' paradigm is that the combination of population growth, rising *per capita* incomes, and progressive urbanization are creating an unprecedented growth in demand for food of animal origin in developing countries, giving rise to major opportunities and threats for mankind. This global picture dominates the policy debate without due regard to regional and national specificities. This Research Report presents an explorative cross-country analysis of trends in consumption of animal source food in 88 developing countries over the period 1980-2003. Following the falsifiability criterion proposed by Karl Popper, the Report makes some falsifiable statements about the Livestock Revolution, and then looks for possible conflicting evidence at regional and country level. Both a macro- and a micro-perspective, focusing on country total and *per capita* consumption of animal source food, provides evidence that the Livestock Revolution has been, at least so far, a very circumscribed phenomenon affecting only few countries and some livestock commodities. However, given that a number of highly populated developing countries are fast-growing economies (including China, India, Indonesia and Brazil), a large share of the world's population lives in countries which are recording remarkable increases in the consumption of animal source food. The question remains, whether the term Livestock Revolution is appropriate to represent trends which have hitherto involved only a minority of developing countries.

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1. Introduction

The growing demand for food of animal origin (in the following termed animal source food, ASF) in developing countries, caused by the combination of population growth, rising *per capita* incomes, progressive urbanization, as well as other factors, has been dubbed 'The Livestock Revolution' (Delgado *et al.*, 1999). This trend is anticipated to continue well into the next decades and to severely impact on livestock and crop production systems, the environment, public health, trade flows and, more broadly, on the world food economy. The views have been expressed, that about half a billion of the world's 'extreme' poor, who depend on livestock for part of their livelihoods, may potentially benefit from the expanding market for ASF (Brown, 2003; Catley, 2008; Delgado, 2003; ILRI, 2008), and that an unregulated growth of the livestock sector may generate significant negative externalities, both on the environment and public health (Barrett, 2001; FAO, 2006a; World Bank, 2005; World Bank, 2009a).

Figure 1: Total and *per capita* consumption of meat, milk and eggs in developing and developed countries, 1980 and 2003



The global figures on consumption growth of ASF are indeed impressive: based on FAOSTAT (2009) data, between 1980 and 2003, the consumption of meat in developing countries increased from 47 to 143 million tonnes, that of milk from 112 to 239 million tonnes and that of eggs from 8 to 37 million tonnes; in *per capita* terms, annual meat consumption doubled from 14 to 28 kg, the consumption of milk increased from 34 to 48 litres and that of eggs from 2 to 7 kg.¹ Over the same period, the overall demand for cereal-based food in developing countries has increased from 510 to 775 million tons (that for feed from 113 to 241 million tons) while *per capita* consumption of cereals has remained more or less constant, at about 156 kg/year. The gap in consumption of ASF between developing and developed countries is thus narrowing (but still remains substantial), because the latter have recorded only marginal changes in the *per capita* consumption of ASF between 1980 and 2003 (see Figure 1 below and Table 1a in the appendix, which also includes a list of developing and developed countries).

Regional and country-specific trends in the demand for ASF are of course varied, notably faster growth being recorded in transforming and urbanized economies in Asia and Latin America than in agriculture-based sub-Saharan Africa (Delgado *et al.*, 1999; Dijkman, 2009). However, due to the scarcity of systematic cross-country analyses of trends in consumption of ASF in developing countries, global figures tend to dominate the development discourse² – despite Delgado *et al.* (1999) clearly stating that the Livestock Revolution is a geographically confined phenomenon.

This Research Report draws on the concept of falsifiability proposed by Karl Popper to investigate whether the confidence, which development practitioners and policymakers place in the basic tenets of the ‘Livestock Revolution’, is supported not only by global aggregate trends, but also by regional and country level evidence. Although the global picture clearly matters, the sound appreciation of national and regional developments in the demand and supply of ASF is the first step to design livestock sector policies, which are context-specific, a prerequisite for effectiveness.

¹ Throughout the paper, aggregated figures for meat consumption include meat from both monogastrics and ruminants, i.e. changes in the structure of the ‘meat basket’, wherein poultry meat is increasingly relevant, are not investigated

² The literature abounds with resounding titles such as: “*Rising consumption of meat and milk in developing countries has created a new food revolution*” (Delgado, 2003). “*The Livestock Revolution – devouring the planet?*” (New Agriculturalist, 2002). “*The Livestock Revolution: a pathway from poverty?*” (Brown, 2003). “*How can Africa benefit from the Livestock Revolution?*” (Babagana, 2008). “*Managing the Livestock Revolution – policy and technology to address the negative impact of a fast-growing sector*” (World Bank, 2005). “*Responding to the Livestock Revolution - the case for livestock public policies*” (FAO, 2005). “*The Livestock Revolution – a global veterinary mission*” (Steinfeld, 2004). “*Responding to the Livestock Revolution. The role of globalisation and implications for poverty alleviation*” (Owen *et al.*, 2004).

2. Methodology

In ‘The Logic of Scientific Discovery’, Karl Popper (1959) argued that theories and statements, in order to be ranked as scientific (and be relied upon by policymakers), must not only be supported by empirical evidence but must also be subjected to the test of falsifiability. In other words, inductive approaches, which draw general conclusions from a particular body of evidence, should not be substantiated by looking for additional evidence that confirms the conclusion or theory but by searching for possible conflicting evidence that, if found, would force rejection or modification of the conclusion / theory.³ Of course, Popper explicitly recognizes that a single counter-instance is not sufficient to falsify a theory, but he also warns that “*there are fashions in science, and some scientists climb on the band wagon almost as readily as do some painters and musicians. But although fashions and band wagons may attract the weak, they should be resisted rather than encouraged*” (Popper, 1979, pp.215-216).

Following Popper’s rationale, we formulate four assertions on the trends in total and *per capita* consumption of ASF in developing countries, derived from three influential publications on the Livestock Revolution: the IFPRI discussion paper by Delgado *et al.* (1999), who first theorized the Livestock Revolution; the 1999 ILRI Annual Report, which looks at the poverty dimensions of the Livestock Revolution (ILRI, 2000); and a 2001 World Bank Report on livestock sector development, which discusses the social, environmental and health repercussions of the Livestock Revolution (de Haan *et al.*, 2001). We then test whether these assertions can be proved false by empirical evidence. The evidence is derived from FAOSTAT country food consumption data for the period 1980 to 2003.⁴ The analysis is confined to this period of about two decades to focus on the ‘Revolution’ – which the Oxford English Dictionary defines as “*an instance of great change or alteration in affairs*” – and not on the long term evolution in food consumption patterns, and 2003 is the last year for which consolidated consumption data are available. Countries with a population of less than 1 million people in 2003, those with fewer than 15 data points, as well as some Middle East oil-exporting countries (Kuwait, Saudi Arabia and the United Arab Emirates) and South Korea – which are currently classified as high-income countries by the World Bank – were excluded from the sample dataset, which consists of 88 developing countries (out of 126 in FAOSTAT), accounting for about 96 percent of the population in the developing world.

³ In the psychological literature, the unconscious and unintentional tendency to search for information and evidence which confirm one’s expectations and hypotheses is termed confirmation or confirmatory bias (Raymond, 1998).

⁴ <http://faostat.fao.org>

3. Falsifiability Tests for the Livestock Revolution in Developing Countries

The Role of Income Growth and Urbanization

There is no question that “*population growth, urbanization, and income growth in developing countries are fuelling a massive global increase in demand for food of animal origin*” (Delgado *et al.*, 1999, p.1)⁵, as well as of cereals, fruits, vegetables, water and other food and non-food commodities. It is difficult to exactly quantify the contribution of each single factor to the growing demand for livestock products. For instance, there are different ways to calculate the responsiveness of food consumption to increased income / expenditure (the income / expenditure elasticity of demand), and it is all but clear how to quantify the overall contribution of urbanization to changing food consumption patterns.⁶ However, the contribution of population growth to total changes in the consumption for ASF can be estimated by comparing the actual demand for livestock products with today’s theoretical demand at base-period *per capita* consumption. The expectation is that a ‘Revolution’ will be only marginally accounted for by human population growth, which in the sample countries averaged 2.4 percent per year in 1980-2003 and has rarely exceeded 3 percent per year. We thus formulate the following assertion:

Assertion one: Urbanization, and income growth are fuelling a massive increase in demand for ASF in developing countries

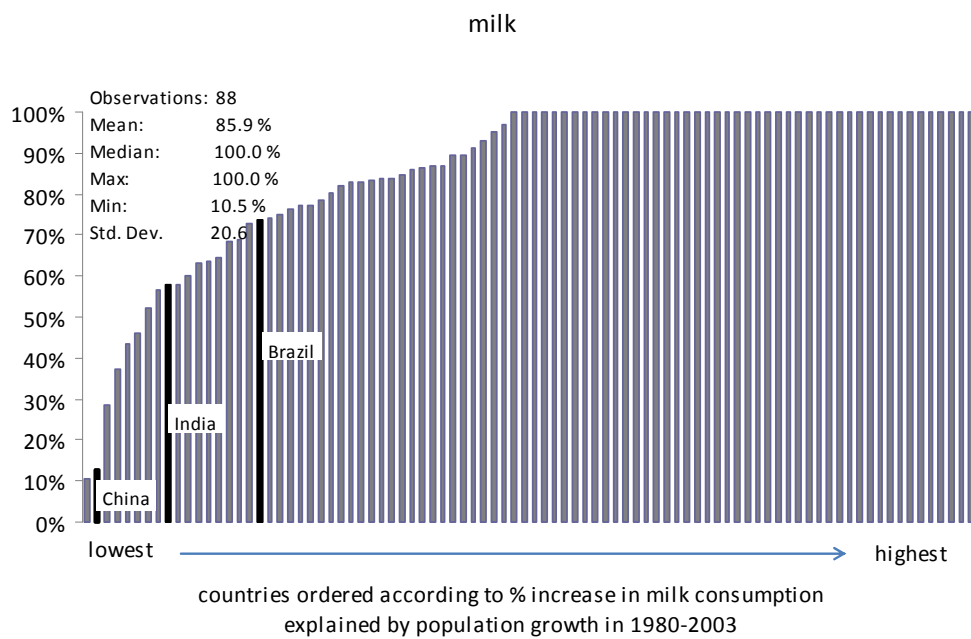
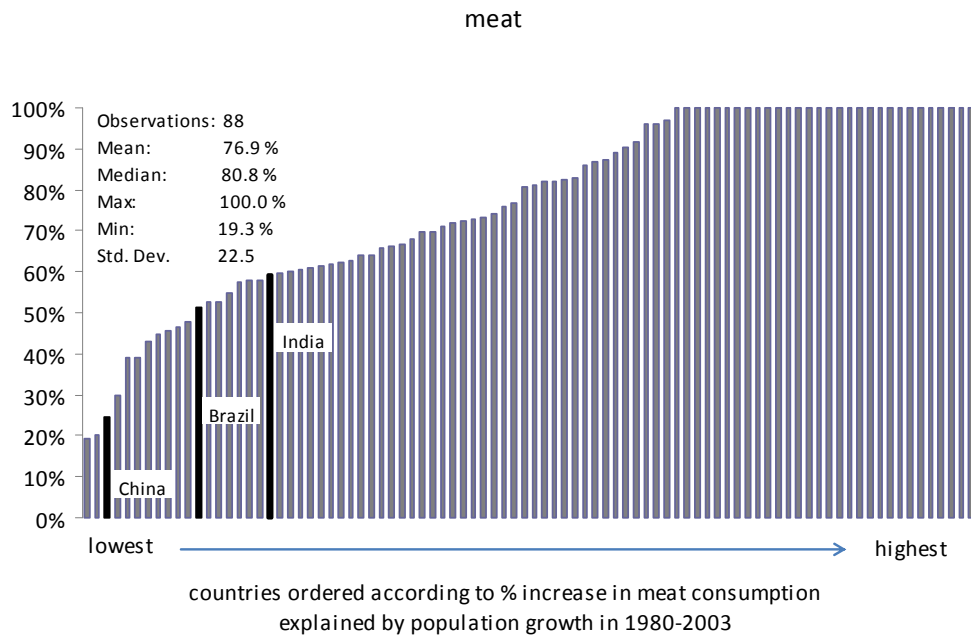
Figure 2 presents the proportional contribution of population growth to the increase in meat and milk consumption in 88 developing countries over the period 1980-2003, as well as some basic statistics.⁷

⁵ “*The forces fuelling the Revolution – income growth, urbanisation and population growth – show no signs of abating*” (ILRI, 2000, p.4). “*The growing, increasingly urban, and more affluent population in the developing world will most likely demand a richer, more diverse diet, with more meat and milk products*” (de Haan *et al.*, 2001, p.1).

⁶ A Report of a Joint WHO/FAO Expert Consultation on “Diet, Nutrition and the Prevention of Chronic Diseases” (WHO, 2003) notes that urbanization distances people from primary food production. The urban poor may thus have a less varied and nutritious diet than their rural counterpart, whereas better-off urban households can access the wider variety of foods which are available in urban markets.

⁷ The proportional contribution of population growth to the total increase in consumption of livestock products is rounded down to 100% in cases demographic changes are estimated to account for more than 100% of the changed consumption in ASF. This may happen, for instance, when countries record a decrease in *per capita* consumption of ASF or because of flawed data.

Figure 2: Increases (%) in total consumption (quantity) of meat and milk explained by population growth in 88 developing countries over the period 1980-2003



On average, population growth explains about 77 and 86 percent of the increase in consumption of meat and milk in developing countries over the period 1980 to 2003. Gains in real *per capita* income, urbanization and other factors, therefore, appear not the major elements underpinning the current trends in the demand for animal food in the ‘average’ developing country. With the exception of China, even in fast-growing and highly populated countries, such as Brazil, India or Indonesia, population growth ‘explains’ more than half of the increase in demand for meat and

milk.⁸ This demand growth is largely for wet and (relatively) low-processed ASF (despite the ‘Supermarket Revolution’), and will remain so for years to come, because of the relatively low *per capita* incomes in developing countries (almost 50 percent of the population in developing countries lives on <\$2 PPP/day) coupled with unequal distribution of wealth (particularly in Brazil and China⁹) (Otte *et al.*, 2008; World Bank, 2009b).

Overall, the assertion that “*urbanization, and income growth in developing countries are fuelling a massive global increase in demand for food of animal origin*” appears not to hold true for the majority of developing countries, the main driver behind growing demand for ASF in most countries being population growth. Income growth and urbanization are major determinants for increasing demand for meat and milk in a limited, but in some instances highly populated and rapidly growing economies.

The Role of Changing Diets

“Put simply, the Livestock Revolution is a fundamental change in the way people eat. As their incomes rise, people diversify their diets, giving up traditional staple cereals in favour of more milk, meat, fish and eggs” (ILRI, 2000, p.3).¹⁰ There is evidence that, over the last decades, population growth in developing countries has resulted in sustained increases in the global consumption of ASF. There is less evidence of significant changes in human diets (de Oliveira, 1997; Pingali, 2007), which is a major factor underpinning of the Livestock Revolution. It is, in fact, because of the growing (relative) relevance of ASF in human diets – and hence of the livestock sector in agriculture – that the livestock sector could present larger market and business opportunities as well as environmental and public health risks and threats for society than other sectors of agriculture. We thus formulate the following assertion:

Assertion two: People in developing countries have fundamentally changed their diets

Table 2a in the appendix presents the relative contribution of meat and milk to the national food basket in 88 developing countries in 1980 and 2003. Figure 3 below displays the proportional contribution of different food items (including cereals, roots and tubers, fruits and vegetables, meat, and milk) to the national food basket for the different developing regions in 1980 and in 2003.¹¹

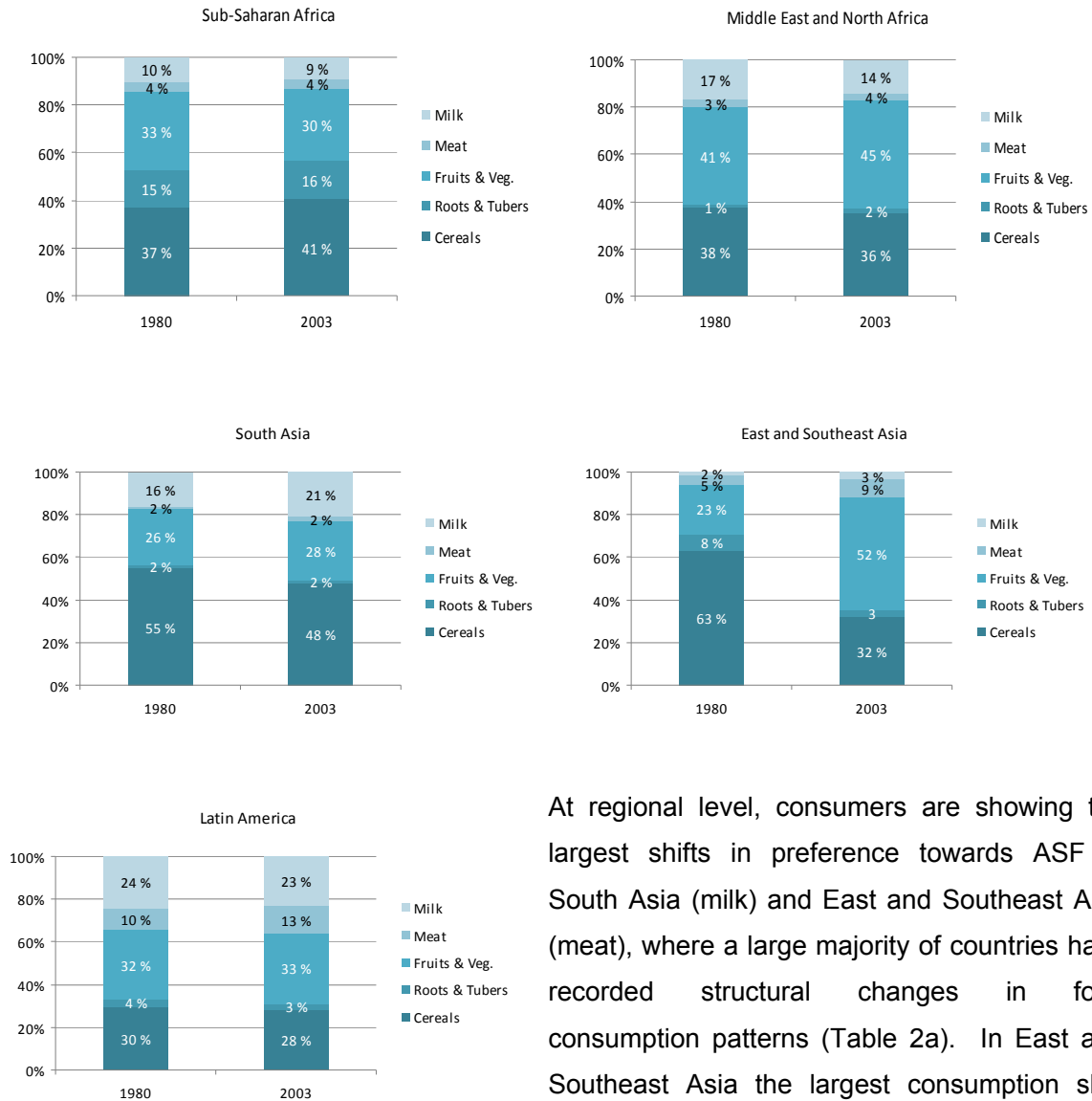
⁸ In 2003, Brazil had an estimated population of 182 million; China 1.3 billion; India, 1.1 billion; Indonesia, 214 million.

⁹ The Gini coefficient of income inequality – which ranges from 0 (perfect equality) to 1 (perfect inequality) – in 2005 was 0.37 in India, 0.39 in Indonesia, 0.42 in China and 0.56 in Brazil (www.worldbank.org/data).

¹⁰ “The structural shift in developing-country diets toward animal proteins is a given that must be dealt with” (Delgado *et al.*, 1999, p.3). “... changing consumer perspectives are likely to be major driving forces in the global livestock sector during the next two decades” (de Haan *et al.*, p.1).

¹¹ There are no differences in the composition of the food basket at national and *per capita* level, as FAOSTAT *per capita* consumption data are built by dividing total national consumption by population, i.e. *per capita* figures are derived from national

Figure 3: Proportional contribution of selected food groups to the national food basket by major developing country region, 1980 and 2003



At regional level, consumers are showing the largest shifts in preference towards ASF in South Asia (milk) and East and Southeast Asia (meat), where a large majority of countries have recorded structural changes in food consumption patterns (Table 2a). In East and Southeast Asia the largest consumption shift was seen for fruits and vegetables, rising from 23 to 52 percent of the food basket (by weight) – a little publicized ‘fruit and vegetable revolution’. No significant changes in food habits can however be detected in Latin America, Middle East and North Africa, and sub-Saharan Africa, where country-level data indicate wide within-region heterogeneity: for instance, meat and milk only accounted for a larger share of the food consumption basket in 2003 than in 1980 in 15 out of the 39 countries ($\approx 38\%$) in the sub-Saharan African sub-sample and in 10 out of 22 countries ($\approx 45\%$) in the Latin American sub-sample (Table 2a).

aggregates and not from household surveys or other sources of data, which take into consideration other variables influencing the size and variety of the food basket, such as *per capita* income and household composition.

Given the large between-region and between-country differences, it appears misleading to generically state that people in the developing world are significantly changing their diets. Similar differences are likely to exist between rural / urban areas and income strata within-countries.

The Pace of Change

Changes in the demand for animal foods offer “*one of the few rapidly growing markets that poor rural people can join even if they lack substantial amounts of land, training and capital*” (ILRI, 2000, p. 9) and present “*crucially important policy dilemmas that must be resolved for the well-being of both rural and urban people in developing countries*”¹² (Delgado *et al.*, 1999, p.4). Indeed, a rapid growth of the demand for ASF generates opportunities and challenges (which are independent of any shift in food consumption patterns), although it remains undefined what is meant by a “*rapid demand growth ... which propels the Livestock Revolution*” (Delgado *et al.*, 1999, p.59). Presumably, it is a growth rate which is considerably higher than the rate of population growth – which only ensures a ‘Revolution’ – thereby implying major growth in the *per capita* consumption of ASF. We thus formulate the following assertion:

Assertion three: *Per capita* consumption of ASF has increased rapidly (>2% per annum¹³) in developing countries

Table 1 and 2 display the least squares annual growth rates in *per capita* meat and milk consumption in major developing regions over the period 1980-2003, and group countries into three categories: negative growth of *per capita* consumption over the period, growth in the 0-2 percent range or growth above 2 percent per annum (see Table 3a in the appendix for individual country-level growth rates).

Over the period 1980 to 2003, trends in *per capita* meat and milk consumption have been positive in a total of 54 and 47 countries respectively, i.e. 61 and 53 percent of the countries in the sample, and negative in the remaining countries. Across countries, annual national growth of *per capita* consumption of meat averaged 0.93 percent and that of milk -0.14 percent, which turn into 3.72 and 1.57 percent respectively if population size is factored in. The median consumer has increased his/her intake of meat and milk by 0.76 and 0.09 percent per year.

¹² “*The global livestock sector is changing fast*” (de Haan *et al.*, 2001, p. vii). “*We call it a revolution to draw people’s attention to the fact that the change is happening rapidly and on a massive scale*” (ILRI, 2000, p. 3).

¹³ The threshold of 2 percent is arbitrary and possibly conservative, considering that, over the period 1980-2003, in the sample countries *per capita* consumption of meat and milk increased by 4 and 2 percent per year respectively. Note also that, in a seminal paper on ‘growth accelerations’, Hausmann *et al.* (2005) consider that a country’s growth rate is rapid when GDP *per capita* grows at 3 percent per year as a minimum. In particular, they define growth acceleration as an increase in GDP *per capita* of 2 percentage points or more, which is followed by a post-acceleration growth rate of at least 3.5 percent per annum in the following eight years.

Table 1: Annual growth rate in *per capita* meat consumption by developing regions, 1980 – 2003

Region	No. of countries	Annual <i>per capita</i> growth rate			No. of countries with <i>per capita</i> meat consumption annual growth rate		
		Cross-country mean	Pop. weighted mean	Median	< 0%	0% - 2%	> 2%
SSA	39	0.09	-0.44	-0.24	22	14	3
MENA	11	0.69	0.93	0.99	4	4	3
SA	5	1.90	1.69	1.57	0	3	2
ESEA	11	2.52	6.18	3.25	2	2	7
LA	22	1.51	3.71	1.46	6	7	9
All	88	0.93	3.72	0.76	34	30	24

Table 2: Annual growth rate in *per capita* milk consumption by developing regions, 1980 – 2003

Region	No. of countries	Annual <i>per capita</i> growth rate			No. of countries with <i>per capita</i> milk consumption annual growth rate		
		Cross-country mean	Pop. weighted mean	Median	< 0%	0% - 2%	> 2%
SSA	39	-1.46	-0.63	-0.77	24	14	1
MENA	11	-0.47	-0.77	-0.53	6	5	0
SA	5	1.23	2.23	1.26	1	2	2
ESEA	11	3.80	5.43	2.82	0	5	6
LA	22	0.09	0.77	0.17	10	9	3
All	88	-0.14	1.57	0.09	41	35	12

With the exception of East and Southeast Asia these average rates of growth do not appear 'rapid', and 'rapid' growth (>2% per annum) for meat and milk was only recorded in 24 and 12 of the 88 countries respectively. However, given that China and (in part) India as well as Indonesia and Brazil – which together account for almost 60 percent of the population in the developing world – are growing fast and witnessing rapid *per capita* increases in the consumption of livestock products (Table 3a), a large share of world's population lives in countries in which the *per capita* consumption of meat and milk is recording remarkable growth rates.

As overall only a limited proportion of developing countries have been recording a 'fast' growth in the consumption of ASF it would be accurate to say that "some regions and countries have witnessed extraordinarily rapid growth in consumption and production [of meat and dairy products], while others have fared less well and still others downright badly" (ILRI, 2000, p. 5).

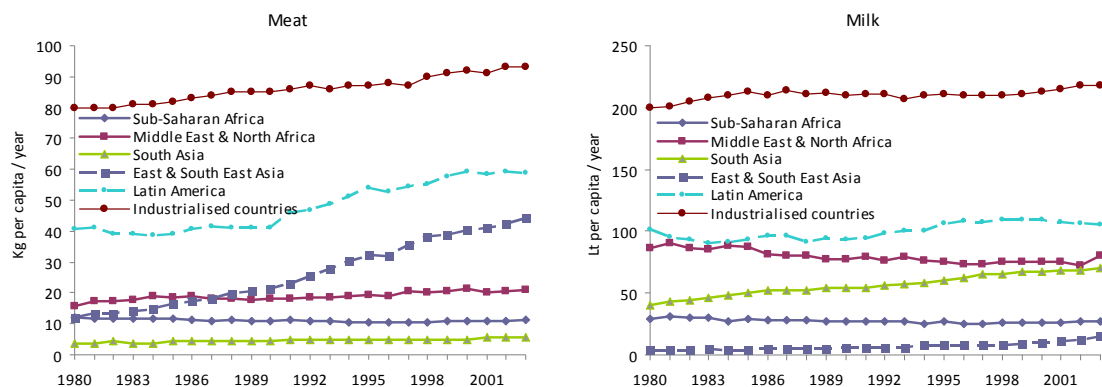
Industrialized Countries and the ‘Hotspots’ of the Livestock Revolution

Given that, over the period 1980-2003, in a ‘typical’ developing country (i) population growth explains a large share of the change in consumption of meat and milk; (ii) there is limited change in overall food consumption patterns; (iii) *per capita* consumption of ASF is not generally increasing rapidly, the question arises of how much *per capita* consumption of ASF – which, *ceteris paribus*, is possibly the simplest proxy for the Livestock Revolution – has grown in developing countries. In effect, opportunities and threats associated with the Livestock Revolution are ultimately linked to the quantity of additional meat and milk which have been (will be) effectively produced and consumed and produced, and not to growth rates *per se*. Since the Livestock Revolution is allegedly unfolding in developing countries, the demand for ASF in developed countries is only marginally growing, and the consumption gap between developing and developed countries can only narrow when absolute increases in *per capita* consumption of ASF are larger in the former than in the latter, we formulate the fourth assertion as follows:

Assertion four: Absolute changes in *per capita* consumption of ASF have been larger in the vast majority (>75%) of developing countries than in industrialised countries¹⁴

Figure 4 below depicts population-weighted trends in *per capita* consumption of meat and milk in industrialised countries and in five major developing regions, including sub-Saharan Africa, the Middle East and North Africa, South Asia, East and Southeast Asia, and Latin America.¹⁵

Figure 4: *Per capita* consumption of meat and milk in industrialised countries and the developing world, 1980-2003



¹⁴ Comparison is with the so-called industrialised countries and not with all developed countries because of significant data gaps in the latter group, mainly due to missing data for the 15 independent States that split off from the former Soviet Union. See table 1a for a list of developed countries. Industrialised countries include: Australia, Austria, Belgium-Luxembourg, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Japan, Malta, the Netherlands, New Zealand, Norway, Portugal, South Africa, Spain, Sweden, Switzerland, United Kingdom and United States of America.

¹⁵ Eggs are excluded from the analysis because FAOSTAT data include only kg consumed per year. Given that one egg weighs between 40 to 70 g, the data can only show very dramatic changes in annual *per capita* egg consumption.

The figure provides evidence that, in the last two decades, industrialised countries have recorded small but steady increases in the *per capita* consumption of both meat and dairy products, and reveals three other major trends: (i) in South Asia there has been an unambiguous rise in the *per capita* consumption of milk – but hardly any rise in *per capita* meat consumption; (ii) the Middle East and North Africa and sub-Saharan Africa display stagnant *per capita* consumption of both meat and milk, at least over the period 1980 to 2003; (iii) in Latin America and East and Southeast Asia there has been a significant increase in the *per capita* consumption of meat – but much less so for milk.

Regional trends, however, conceal significant differences within regions (see table 3a in the appendix). Tables 3 and 4 display the annual absolute changes in the *per capita* consumption of meat and milk in developing and industrialized countries between 2001-2003 and 1980-1982, and group countries by changes in consumption level: negative, in the 0-0.5 kg / lit range, or bigger than 0.5 kg / lit.

Table 3: Changes in annual *per capita* meat consumption (kg) in developing regions and industrialised countries, 1980-82 – 2001-03

Region	No. of countries	Annual <i>per capita</i> change in meat consumption (kg)			No. of countries with changes in <i>per capita</i> meat consumption		
		Cross-country mean	Pop. weighted mean	Median	< 0 kg	0–0.5 kg	>0.5 kg
SSA	39	0.04	-0.04	-0.01	20	17	2
MENA	11	0.10	0.17	0.17	3	8	0
SA	5	0.08	0.07	0.07	0	5	0
ESEA	11	0.40	1.19	0.32	2	5	4
LA	22	0.32	0.80	0.40	6	8	8
All	88	0.16	0.56	0.08	31	43	14
Industr. countries	25	0.55	0.51	0.47	3	10	12

Table 4: Changes in annual *per capita* milk consumption (lit) by developing regions and industrialised countries, 1980-82 – 2001-03

Region	No. of countries	Annual <i>per capita</i> change in milk consumption (lit)			No. of countries with changes in <i>per capita</i> milk consumption		
		Cross-country mean	Pop. weighted mean	Median	< 0 lit	0–0.5 lit	>0.5 lit
SSA	39	-0.08	-0.12	-0.10	22	11	6
MENA	11	-0.20	-0.38	-0.43	6	2	3
SA	5	0.76	1.05	0.40	1	2	2
ESEA	11	0.31	0.36	0.14	0	9	2
LA	22	-0.04	0.46	0.01	11	1	10
All	88	0.01	0.52	0.02	40	25	23
Industr. countries	25	0.21	0.63	0.23	10	5	10

Over the period 1980 to 2003, absolute changes in the yearly *per capita* consumption of ASF have not been impressive (this is hardly surprising, given small growth rates in *per capita* consumption), despite some countries having performed remarkably well. Across the sample of developing countries, the median consumer has increased his/her annual consumption of meat and milk by 80 grams and by 20 millilitres respectively while the ‘average’ increase in meat and milk consumption amounted to 560 grams and 520 millilitres. Ultimately, for the median consumer, over a year, these increases amount to one small piece of meat accompanied by a sip of milk. This is less than the corresponding *per capita* increase in consumption of ASF in industrialised countries. Overall, changes in the *per capita* consumption of meat and milk have been larger only in a minority of developing countries than in industrialised countries, namely in 38 and 33 developing countries respectively, i.e. 43 and 38 percent of the sample. Again, this highlights that population growth is the major determinant of the expansion of the demand for ASF in the developing world.

Given the heterogeneity within and between regions, it seems misleading to state that a ‘Livestock Revolution’ – as measured by absolute changes in *per capita* consumption of ASF – is indiscriminately occurring in the developing world, and differentiations should be made by commodity and region, if not even by country.

4. Conclusions

A massive increase in the consumption of ASF is occurring in the developing world and is expected to continue well into the next decades, because of population growth, as well as gains in real *per capita* income, urbanization and other factors. According to FAO (2006b), in 2050 *per capita* consumption of meat and milk in developing countries will be at 44 kg and 78 lit per year, up from 28 kg and 48 lit in 2003. In the long term, however, if the consumption patterns in industrialized countries are an indication of where the developing world is heading, *per capita* consumption of meat and milk in developing countries should grow from about 28-48 to 80-200 kg / lit per year (Table 1a in the appendix). These changes in food consumption patterns would have tremendous effects on the livestock sector and on agriculture as a whole.

Delgado *et al.* (1999) were the first to call attention to the opportunities and threats associated with the increased demand for ASF in developing countries, which they dubbed the 'Livestock Revolution'. However, although they clearly pointed at geographical and country differences in trends in the consumption of animal food in their paper, the current policy debate is largely dominated by the global figures.

This Research Report presented a systematic explorative cross-country analysis of trends in consumption of ASF in 88 developing countries over the period 1980 to 2003. Following the falsifiability criterion proposed by Karl Popper, we formulated four statements on the Livestock Revolution, and subsequently searched for possible conflicting evidence at regional and country level. Both a macro and a micro perspective – looking at country total and *per capita* changes in the consumption of ASF – suggest the Livestock Revolution has been, at least so far, a circumscribed phenomenon affecting a relatively small number of developing countries and that the global increase in the consumption of ASF is associated more with overall demographic trends than with changing food habits. (However, given that some highly populated developing countries are fast-growing – including China, India, Indonesia and Brazil – a large share of the world's population lives in countries which are recording notable shifts in food consumption patterns.) It follows that, *ceteris paribus*, there are currently not necessarily (relatively) larger global development opportunities and threats associated with the livestock sector than with other productive sectors, and that, given its regional and national specificities, the livestock sector development policy discourse needs to be linked to national and regional rather than to global trends.

The question remains, whether the term 'Livestock Revolution' is appropriate to represent trends which, at least so far, are to a large extent due to population growth and by-pass a large proportion of the developing world: "... world *per capita* meat consumption appears at first glance to have risen more slowly than the term 'revolution' would imply" (Rosegrant *et al.*, 2001, p.12).

Of course, in the years to come a veritable Livestock Revolution may possibly unfold, but policymakers and development practitioners should be cautious about generalizing global data and devise policies and strategies without first detailed country scrutiny and analyses, because livestock sector policies which (exclusively) build on a presumed existence of a fast growing demand for ASF are destined not to go far in supporting growth and poverty reduction in the majority of developing countries. In fact, the dominance of the paradigm of demand-led livestock sector development stands in the way of identifying where the potential exists for supply-driven livestock sector growth to act as important stimulus for rural development and poverty reduction. The latter often still is the case in agriculture-based economies, in which poverty is highest.

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6. Appendix

Table 1a: Food consumption of livestock products and cereals in developing and developed countries, 1980 and 2003

	Developing Countries*		Developed Countries**	
	1980	2003	1980	2003
Population (million)	3,256,894	4,998,864	1,175,743	1,334,295
Total meat consumption (million tons)	46.6	143.2	88.3	106.7
Total milk consumption (million tons)	111.9	239.7	226.9	268.0
Total egg consumption (million tons)	8.3	37.3	16.4	17.0
Total cereal consumption (million tons)	510.0	775.0	152.4	174.3
<i>Per capita</i> meat consumption (kg / year)	14	28	75	80
<i>Per capita</i> milk consumption (lit / year)	34	48	193	201
<i>Per capita</i> egg consumption (kg / year)	2	7	13	12
<i>Per capita</i> cereal consumption (kg / year)	156	156	130	131
% of livestock products in food basket	14.8	19.7	46.0	45.8
<i>meat</i>	4.2	6.7	12.2	12.4
<i>milk</i>	9.9	11.2	31.5	31.3
<i>eggs</i>	0.7	1.7	2.3	1.9

* Developing countries: Algeria, Angola, Antigua and Barbuda, Argentina, Bahamas, Bangladesh, Barbados, Belize, Benin, Bermuda, Bolivia, Botswana, Brazil, Brunei Darussalam, Burkina Faso, Burundi, Cambodia, Cameroon, Cape Verde, Central African Republic, Chad, Chile, China-Hong Kong, China-Macao, China, China-Province of Taiwan, Colombia, Comoros, Congo, Congo Democratic Republic, Costa Rica, Côte d'Ivoire, Cuba, Cyprus, Djibouti, Dominica, Dominican Republic, Ecuador, Egypt, El Salvador, Eritrea, Ethiopia, Fiji, French Polynesia, Gabon, Gambia, Ghana, Grenada, Guatemala, Guinea, Guinea-Bissau, Guyana, Haiti, Honduras, India, Indonesia, Iran Islamic Republic, Jamaica, Jordan, Kenya, Kiribati, Korea Democratic People's Republic, Korea Republic, Kuwait, Lao People's Democratic Republic, Lebanon, Lesotho, Liberia, Libyan Arab Jamahiriya, Madagascar, Malati, Malaysia, Maldives, Mali, Mauritania, Mauritius, Mexico, Mongolia, Morocco, Mozambique, Myanmar, Namibia, Nepal, Netherlands Antilles, New Caledonia, Nicaragua, Niger, Nigeria, Occupied Palestinian Territory, Pakistan, Panama, Paraguay, Peru, Philippines, Rwanda, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and Grenadines, Samoa, Sao Tome and Principe, Saudi Arabia, Senegal, Seychelles, Sierra Leone, Solomon Islands, Sri Lanka, Sudan, Suriname, Swaziland, Syrian Arab Republic, Tanzania United Republic, Thailand, Timor-Leste, Togo, Trinidad and Tobago, Tunisia, Turkey, Uganda, United Arab Emirates, Uruguay, Vanuatu, Venezuela, Bolivarian Republic, Viet Nam, Yemen, Zambia, Zimbabwe.

** Developed countries: Albania, Armenia, Australia, Austria, Azerbaijan, Belarus, Belgium, Bosnia and Herzegovina, Bulgaria, Canada, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Georgia, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Malta, Moldova, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Russian Federation, Serbia and Montenegro, Slovakia, Slovenia, South Africa, Spain, Sweden, Switzerland, Tajikistan, The former Yugoslav Republic of Macedonia, Turkmenistan, Ukraine, United Kingdom, United States of America, Uzbekistan.

Source: FAOSTAT (<http://faostat.fao.org>)

Table 2a: Contribution (%) of meat and milk to the national (or *per capita*) food basket (quantity), by major region and country; 1980 and 2003

Regions / countries	Meat		Milk		Meat & Milk	
	1980	2003	1980	2003	1980	2003
Sub-Saharan Africa	4.3	3.9	10.4	9.3	14.7	13.2
Angola	5.6	6.0	15.5	4.4	21.1	10.5
Benin	4.8	6.2	3.0	3.2	7.8	9.5
Botswana	5.2	7.3	36.5	28.7	41.7	36.0
Burkina Faso	3.5	3.9	13.1	8.0	16.6	11.9
Burundi	2.1	1.4	5.9	2.0	8.0	3.4
Cameroon	3.9	4.7	5.1	4.6	9.0	9.3
Cape Verde	2.5	7.8	16.0	20.5	18.5	28.2
Cent. African Rep.	7.0	14.2	4.5	7.5	11.5	21.8
Chad	6.5	6.6	15.9	12.4	22.1	19.0
Congo	5.1	7.4	3.4	6.2	8.5	13.6
Congo Dem. Rep.	2.5	2.7	0.9	0.8	3.3	3.5
Cote d'Ivoire	4.2	3.9	6.1	2.9	10.3	6.8
Gabon	12.3	9.5	6.2	5.3	18.5	14.8
Gambia	5.9	2.5	8.7	18.2	14.7	20.7
Ghana	4.4	2.9	1.3	1.9	5.7	4.8
Guinea	1.3	2.0	2.9	3.7	4.2	5.7
Guinea-Bissau	6.4	5.7	7.9	6.4	14.3	12.2
Kenya	5.7	4.4	21.1	29.0	26.7	33.4
Lesotho	6.1	5.0	12.4	5.0	18.5	10.1
Liberia	4.2	3.7	4.2	0.9	8.4	4.6
Madagascar	6.4	5.7	14.1	11.1	20.5	16.8
Malawi	1.8	1.9	3.3	1.7	5.1	3.6
Mali	7.4	7.0	25.2	16.6	32.5	23.6
Mauritania	9.6	9.1	49.2	37.7	58.8	46.7
Mauritius	5.2	8.7	30.4	28.2	35.7	36.9
Mozambique	2.8	2.3	4.0	1.9	6.8	4.2
Namibia	14.1	12.3	18.9	22.7	33.0	35.1
Niger	5.6	3.5	13.6	9.1	19.2	12.6
Nigeria	4.1	2.4	5.8	2.4	9.9	4.8
Rwanda	1.3	1.5	4.3	5.6	5.6	7.0
Senegal	4.5	6.0	14.0	10.0	18.5	15.9
Sierra Leone	2.2	2.7	7.5	3.5	9.6	6.2
Sudan	6.9	5.5	34.6	38.8	41.5	44.3
Swaziland	10.0	10.5	19.3	19.3	29.3	29.8
Tanzania	3.0	3.8	7.3	9.8	10.3	13.6
Togo	3.1	3.5	1.7	1.7	4.8	5.3
Uganda	3.3	2.8	7.7	7.0	11.0	9.8
Zambia	5.1	5.1	4.8	2.7	9.9	7.8
Zimbabwe	4.4	8.3	18.6	9.8	21.1	18.1
Middle East & North Africa	3.1	3.6	16.5	13.6	19.5	17.2
Algeria	2.8	3.7	20.9	21.0	23.8	24.7
Egypt	2.8	3.5	8.5	10.3	11.3	13.8
Iran	4.6	3.8	14.9	9.2	19.5	13.0
Jordan	6.0	6.8	20.1	20.1	26.1	27.0
Lebanon	7.2	7.7	21.7	16.4	28.9	24.0
Libya	7.1	4.4	15.1	13.6	22.2	18.0
Morocco	3.4	3.9	9.1	7.2	12.4	11.1
Syria	2.8	4.5	12.5	18.5	15.3	22.9
Tunisia	3.2	4.2	13.7	16.7	16.9	20.8
Turkey	2.0	2.9	23.1	17.2	25.1	20.1
Yemen	4.7	5.7	13.7	13.2	18.3	19.0

cont.

cont.

Regions / countries	Meat		Milk		Meat & Milk	
	1980	2003	1980	2003	1980	2003
South Asia	1.6	1.7	15.8	21.2	17.4	22.8
Bangladesh	1.2	1.3	5.7	5.8	6.8	7.1
India	1.4	1.5	14.8	19.8	16.2	21.3
Nepal	3.4	2.9	16.7	12.0	20.1	14.9
Pakistan	2.9	3.3	32.5	42.0	35.4	45.2
Sri Lanka	1.1	2.5	8.7	13.4	9.9	15.9
East & S.East Asia	4.5	8.6	1.5	2.9	6.0	11.6
Cambodia	1.6	6.2	3.0	1.4	4.6	7.5
China	4.9	9.5	0.8	2.8	5.7	12.3
Indonesia	1.9	3.3	3.1	2.6	5.0	5.9
Korea, Dem. Rep.	3.8	2.6	0.8	1.0	4.7	3.6
Laos	3.6	4.2	1.7	1.1	5.3	5.4
Malaysia	7.7	14.1	14.0	12.8	21.7	26.9
Mongolia	30.9	25.0	22.7	31.0	53.7	56.0
Myanmar	2.7	3.3	3.9	4.4	6.6	7.7
Philippines	4.4	8.3	5.3	5.1	9.7	13.4
Thailand	5.0	8.4	2.1	8.0	7.2	16.3
Viet Nam	3.5	8.2	0.6	2.6	4.1	10.8
Latin America	9.7	12.7	23.9	22.8	33.7	35.5
Argentina	18.2	14.9	29.3	29.7	47.5	44.6
Bolivia	11.7	13.4	12.4	9.0	24.0	22.5
Brazil	10.6	17.3	22.3	25.0	32.9	42.3
Chile	7.0	13.7	20.6	22.9	27.6	36.6
Colombia	8.5	8.3	19.1	26.6	27.6	34.9
Costa Rica	7.9	7.8	36.3	31.8	44.3	39.6
Cuba	7.8	5.2	34.9	15.8	42.7	21.1
Dominican Rep.	5.7	9.8	19.5	22.9	25.2	32.7
Ecuador	4.2	10.4	17.3	22.7	21.5	33.1
El Salvador	4.1	5.7	25.2	25.3	29.3	31.0
Guatemala	4.5	7.3	17.2	12.3	21.7	19.6
Haiti	3.6	6.0	5.2	5.4	8.8	11.4
Honduras	4.4	7.2	23.4	27.1	27.7	34.3
Jamaica	9.3	12.7	20.1	10.6	29.3	23.3
Mexico	7.8	11.0	27.7	21.7	35.5	32.7
Nicaragua	7.2	6.8	22.1	29.7	29.2	36.5
Panama	13.4	15.8	26.3	19.9	39.7	35.7
Paraguay	14.3	12.5	11.0	17.9	25.3	30.4
Peru	5.2	6.4	22.5	13.7	27.7	20.1
Trinidad & Tobago	8.8	10.1	29.5	28.3	38.4	38.3
Uruguay	18.3	12.9	34.7	32.3	52.9	45.2
Venezuela	9.4	12.9	29.8	19.7	39.2	32.5
All Dev.ing countries	4.5	6.7	11.0	11.4	15.5	18.1
excl. China	4.3	5.1	15.1	16.3	19.5	21.4
excl. India	5.2	7.9	10.1	9.5	15.3	17.3
excl. China & India	5.4	6.6	15.3	14.8	20.6	21.4

* Depending on the region, between 1980 and 2003 eggs accounted for between 0.5 and 2.8 percent of the total food basket (tons).

Source: FAOSTAT (<http://faostat.fao.org>)

Table 3a. *Per capita* consumption and least squares growth rate of *per capita* consumption of meat and milk in developing countries, 1980-82 to 2001-03 three year average

Region / country	<i>Per capita</i> meat consumption (kg/year)			<i>Per capita</i> milk consumption (lit/year)		
	1980 - 82	2001 - 03	Annual growth rate	1980 - 82	2001 - 03	Annual growth rate
Sub-Saharan Africa	12*	11*	-0.44*	30*	27*	-0.63*
Angola	15	18	0.31	47	15	-5.95
Benin	12	17	0.83	7	11	1.90
Botswana	15	23	2.57	98	128	1.05
Burkina Faso	7	10	1.37	25	20	-0.77
Burundi	4	3	-1.65	14	4	-5.41
Cameroon	12	15	0.31	16	15	-0.80
Cape Verde	7	28	6.73	65	86	1.56
Cent. African Rep.	20	31	1.82	12	16	1.00
Chad	14	14	0.54	33	26	-1.24
Congo	13	15	0.67	7	13	1.62
Congo Dem. Rep.	6	4	-2.25	2	1	-3.66
Cote d'Ivoire	14	11	-1.51	21	7	-5.46
Gabon	55	42	-1.19	25	27	0.88
Gambia	9	5	-2.75	23	28	-0.42
Ghana	10	9	-0.65	2	7	2.95
Guinea	4	6	2.46	9	11	0.96
Guinea-Bissau	14	13	-0.39	17	14	-1.08
Kenya	16	14	-0.60	63	95	0.95
Lesotho	18	15	-1.48	41	15	-5.79
Liberia	12	7	-2.33	10	1	-10.56
Madagascar	22	15	-1.37	48	30	-2.09
Malawi	5	4	-0.41	9	4	-5.24
Mali	17	18	0.25	59	45	-0.69
Mauritania	31	32	-0.10	164	135	-1.26
Mauritius	14	38	5.09	90	117	1.16
Mozambique	5	5	-0.13	8	4	-3.23
Namibia	35	35	-0.33	55	71	0.99
Niger	17	11	-1.32	42	29	-1.53
Nigeria	11	8	-1.56	17	7	-4.18
Rwanda	5	4	-0.38	16	19	0.71
Senegal	12	17	1.79	37	25	-2.34
Sierra Leone	5	5	0.75	16	7	-3.25
Sudan	22	21	0.11	127	149	1.26
Swaziland	34	30	-0.51	60	63	0.57
Tanzania	9	9	-0.25	24	25	0.03
Togo	8	8	-0.99	4	4	-0.06
Uganda	11	11	0.17	26	24	-0.77
Zambia	13	11	-0.24	13	6	-2.76
Zimbabwe	13	15	0.11	52	19	-5.98
Middle East & North Africa	17*	21*	0.93*	88*	76*	-0.77*
Algeria	12	18	2.01	89	114	0.69
Egypt	14	20	1.77	37	54	1.54
Iran	21	24	0.99	73	58	-1.69
Jordan	28	29	-0.36	74	63	-1.07

cont.

cont.

Region / country	<i>Per capita meat consumption</i> (kg)			<i>Per capita milk consumption</i> (lit)		
	1980 - 82	2001 - 03	Annual growth rate	1980 - 82	2001 - 03	Annual growth rate
Lebanon	38	50	1.08	115	116	0.15
Libya	49	28	-2.17	106	78	-2.29
Morocco	13	20	2.58	34	35	0.20
Syria	22	21	-0.22	100	87	-0.53
Tunisia	15	26	2.20	66	102	1.89
Turkey	14	19	0.77	161	110	-1.57
Yemen	15	14	-1.08	47	32	-2.93
South Asia	4*	6*	1.69*	42*	69*	2.23*
Bangladesh	2	3	2.41	11	13	0.57
India	3	5	1.57	41	66	2.11
Nepal	9	10	0.44	42	40	-0.36
Pakistan	8	11	1.50	96	153	2.60
Sri Lanka	3	6	3.58	24	34	1.26
East & S.East Asia	13*	43*	6.18*	4*	13*	5.43*
Cambodia	5	14	4.46	4	4	2.86
China	14	52	6.91	2	12	7.64
Indonesia	4	9	3.65	7	7	0.44
Korea, Dem. Rep.	14	10	-3.14	2	3	0.03
Laos	10	15	2.22	1	5	7.33
Malaysia	23	48	3.91	40	47	1.21
Mongolia	111	97	-0.35	73	108	2.82
Myanmar	7	10	0.76	11	14	0.51
Philippines	16	29	3.25	18	18	1.14
Thailand	19	27	1.90	7	22	6.14
Viet Nam	11	28	4.14	1	9	11.74
Latin America	40*	59*	2.20*	97*	107*	0.77*
Argentina	104	85	-0.60	166	183	1.17
Bolivia	39	50	1.39	38	34	0.37
Brazil	40	79	4.10	80	115	2.00
Chile	33	67	4.42	92	110	1.77
Colombia	27	33	1.25	67	109	2.74
Costa Rica	28	42	1.79	130	167	1.30
Cuba	34	31	-1.53	160	94	-3.18
Dominican Rep.	22	37	3.12	84	67	-0.88
Ecuador	20	43	3.74	83	98	1.22
El Salvador	12	22	2.60	73	93	2.11
Guatemala	11	23	3.95	42	40	0.00
Haiti	11	15	1.34	17	15	-0.75
Honduras	14	24	3.61	73	100	1.98
Jamaica	38	56	2.18	80	48	-3.35
Mexico	39	58	1.90	120	114	-0.07
Nicaragua	20	17	-1.06	64	77	-0.16
Panama	44	54	1.12	70	67	-0.11
Paraguay	67	50	-0.41	50	64	2.16
Peru	15	21	1.52	62	49	-0.99
Trinidad & Tobago	45	37	-1.28	149	106	-2.47
Uruguay	91	73	-0.24	185	187	0.35
Venezuela	48	53	0.36	151	76	-3.13

cont.

cont.

Region / country	<i>Per capita</i> meat consumption (kg)			<i>Per capita</i> milk consumption (lit)		
	1980 - 82	2001 - 03	Annual growth rate	1980 - 82	2001 - 03	Annual growth rate
All Dev.ing countries	13*	28*	3.72*	33*	46*	1.57*
excl. China	13*	18*	1.65*	60*	71*	1.02*
excl. India	16*	34*	3.87*	33*	41*	1.05*
excl. China & India	18*	25*	1.63*	70*	72*	0.18*

* weighted by population

Source: FAOSTAT (<http://faostat.fao.org>)