CHAPTER 3

Prospects for aggregate agriculture and major commodity groups

This chapter deals with the trends and future outlook of world food and agriculture in terms of the main commodity sectors. A brief introduction to the subject is given first, presenting trends and prospects for total agriculture (the aggregates of all crops and livestock products).

3.1 Aggregate agriculture: Historical trends and prospects

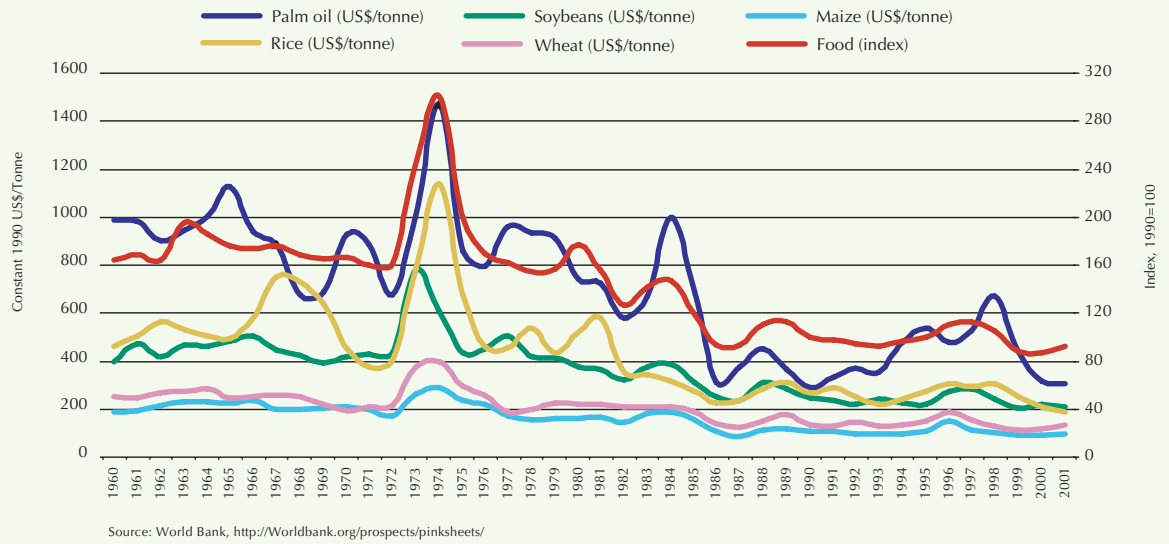
The historical evidence suggests that the growth of the productive potential of global agriculture has so far been more than sufficient to meet the growth of effective demand. This is what the long-term term decline in the real price of food suggests (Figure 3.1, see also World Bank, 2000a). In practice, world agriculture has been operating in a demand-constrained environment. This situation has coexisted with hundreds of millions of the world population not having enough food to eat. This situation of un-met demand[1] coexisting with actual or potential plenty is not, of course, specific to food and agriculture. It is found in other sectors as well, such as housing, sanitation and the health services.

Limits on the demand side at the global level reflected three main factors: (i) the slowdown in population growth from the late 1960s onwards (see Chapter 2); (ii) the fact that a growing share of the world population has been attaining fairly high levels of per capita food consumption, beyond which the scope for further increases is rather limited (Table 2.2); and (iii) the fact that those who did not have enough to eat were too poor to afford more food and cause it to be produced, or did not have the resources and other means to produce it themselves.

The first two factors will continue to operate in the future. Their influence will be expressed as lower growth rates than in the past of demand and, at the global level, also of production. The third factor will also continue to play a role, given that the overall economic outlook indicates that poverty will continue to be widespread in the future (see Chapter 2, Section 2.2.2). It follows that for a rather significant part of world population the *potential* demand for food will not be expressed fully as *effective* demand. Thus, the past trends of decelerating growth of demand will likely continue and perhaps intensify.

[1] The terms "demand" and "consumption" are used interchangeably. Both terms comprise all forms of use, i.e. food, feed, seed and industrial use as well as losses and waste (other than household waste). Demand for as well as supply from stocks, are disregarded. Given the 30-year time horizon of the study, a separate treatment of stock changes would unnecessarily complicate the analysis.

Figure 3.1 World market prices, 1960-2001 (constant 1990 US$)



Source: World Bank, http://Worldbank.org/prospects/pinksheets/

However, on the production side, there is no assurance that the past experience, when the world's production potential was more than sufficient to meet the growth of demand, will continue, even when demand growth will be much lower than in the past. The natural resources per head of the growing population (e.g. land or water resources per person) will certainly continue to decline and the yield growth potential is more limited than in the past. It remains to be seen whether advances in technology and related factors (e.g. investment, education, institutions and improved farm management) that underpinned the past growth of production will continue to more than make up for the declining resources per person. The future may be different if we are now nearer critical thresholds, e.g. yield ceilings imposed by plant physiology or availability of water resources for maintaining and/or expanding irrigation. On the positive side, there are those who think that biotechnology has the potential of helping to overcome constraints to further increases in production (Chapters 4 and 11, see also Evenson, 2002).

We present in this section a brief overview of what we can expect in terms of increases of aggregate demand for, and production of, agricultural products. The figures we use refer to the aggregate volume of demand and production of the crop and livestock sectors. They are obtained by multiplying physical quantities of demand or production times price for each commodity and summing up over all commodities (each commodity is valued at the same average international price[2] in all countries in all years). The resulting time series is an index of volume changes over time of aggregate demand and production. The movements in this aggregate indicator are rarely sufficient for us to analyse and understand the forces that shape the evolution of agricultural variables in their different dimensions. The commodities included (see list in Appendix 1) are very diverse from the standpoint of what determines their production, demand and trade. For this reason, the subsequent sections of this chapter analyse and present the historical experience and prospects of world agriculture in terms of the main commodity sectors. Sections 3.2-3.5 deal with the basic food commodities: cereals, livestock products, oilcrops and the roots, tubers and plantains group. Section 3.6 covers more summarily a selection of the main export commodities of the developing countries: sugar, bananas, coffee, cocoa and natural rubber. The commodities dealt with in sections 3.2-3.6 account for 79 percent of the world's aggregate agricultural output.

2 International dollar prices, averages for 1989/91, used for constructing the production index numbers in FAOSTAT.

Table 3.1 Growth rates of aggregate demand and production (percentage p.a.)

	1969-99	1979-99	1989-99	1997/99 -2015	2015-30	1997/99 -2030
				Demand		
World	2.2	2.1	2.0	1.6	1.4	1.5
Developing countries	3.7	3.7	4.0	2.2	1.7	2.0
idem, excl. China	3.2	3.0	3.0	2.4	2.0	2.2
Sub-Saharan Africa	2.8	3.1	3.2	2.9	2.8	2.9
idem, excl. Nigeria	2.5	2.4	2.5	3.1	2.9	3.0
Near East/North Africa	3.8	3.0	2.7	2.4	2.0	2.2
Latin America and the Caribbean	2.9	2.7	3.0	2.1	1.7	1.9
idem, excl. Brazil	2.4	2.1	2.8	2.2	1.8	2.0
South Asia	3.2	3.3	3.0	2.6	2.0	2.3
East Asia	4.5	4.7	5.2	1.8	1.3	1.6
idem, excl. China	3.5	3.2	2.8	2.0	1.7	1.9
Industrial countries	1.1	1.0	1.0	0.7	0.6	0.7
Transition countries	-0.2	-1.7	-4.4	0.5	0.4	0.5
				Production		
World	2.2	2.1	2.0	1.6	1.3	1.5
Developing countries	3.5	3.7	3.9	2.0	1.7	1.9
idem, excl. China	3.0	3.0	2.9	2.3	2.0	2.1
Sub-Saharan Africa	2.3	3.0	3.0	2.8	2.7	2.7
idem, excl. Nigeria	2.0	2.2	2.4	2.9	2.7	2.8
Near East/North Africa	3.1	3.0	2.9	2.1	1.9	2.0
Latin America and the Caribbean	2.8	2.6	3.1	2.1	1.7	1.9
idem, excl. Brazil	2.3	2.1	2.8	2.2	1.8	2.0
South Asia	3.1	3.4	2.9	2.5	2.0	2.2
East Asia	4.4	4.6	5.0	1.7	1.3	1.5
idem, excl. China	3.3	2.9	2.4	2.0	1.8	1.9
Industrial countries	1.3	1.0	1.4	0.8	0.6	0.7
Transition countries	-0.4	-1.7	-4.7	0.6	0.6	0.6
				Population		
World	1.7	1.6	1.5	1.2	0.9	1.1
Developing countries	2.0	1.9	1.7	1.4	1.1	1.3
idem, excl. China	2.3	2.2	2.0	1.7	1.3	1.5
Sub-Saharan Africa	2.9	2.9	2.7	2.6	2.2	2.4
idem, excl. Nigeria	2.9	2.9	2.7	2.6	2.3	2.4
Near East/North Africa	2.7	2.6	2.4	1.9	1.5	1.7
Latin America and the Caribbean	2.1	1.9	1.7	1.3	0.9	1.1
idem, excl. Brazil	2.1	1.9	1.8	1.4	1.0	1.2
South Asia	2.2	2.1	1.9	1.6	1.1	1.3
East Asia	1.6	1.5	1.2	0.9	0.5	0.7
idem, excl. China	2.0	1.8	1.6	1.2	0.9	1.0
Industrial countries	0.7	0.7	0.7	0.4	0.2	0.3
Transition countries	0.6	0.5	0.1	-0.2	-0.3	-0.2

The overall picture for total agriculture is presented in Table 3.1. At the world level, the growth of demand for all crop and livestock products is projected to be lower than in the past, 1.6 percent p.a. in the period 1997/99-2015 compared with 2.1 percent p.a. in the preceding 20 years 1979-99. The difference between the past and future growth rates of demand is nearly equal to the difference in the population growth rates. However, the past growth rates of demand had been depressed because of the collapse of production and consumption in the transition economies. We would have expected that the cessation of declines and eventual turnaround of demand in these countries (turning from negative to positive, Table 3.1) would have largely cancelled the effect of lower population growth rate at the global level, at least for the first subperiod of the projections. In practice, it is mainly the slowdown in the growth of demand in the developing countries, and in particular in China, that accounts for a large part of the global deceleration. Why this should be so is shown in the more detailed regional numbers of Table 3.1. They show that deceleration in the developing countries outside China (from 3.0 percent p.a. in 1979-99 to 2.4 percent p.a. in 1997/99-2015) is only a little more than the deceleration in their population growth (from 2.2 percent to 1.7 percent, respectively), an expected outcome given the operation of the factors mentioned earlier. However, a better idea about the roles of the above-mentioned factors making for deceleration (lower population growth and approaching saturation levels) can be had from the data and projections presented in Table 3.2. In it the developing countries are grouped into two sets: those that start in 1997/99 with fairly high per capita food consumption (over 2 700 kcal/person/day) and, therefore, face less scope than before for increasing consumption, and all the rest, that is those with 1997/99 kcal under 2 700.

China carries a large weight in the former group, so its example can be used to illustrate why a drastic deceleration is foreseen for the developing countries. China has already attained a fairly high level of per capita food consumption of the main commodities, a total of 3 040 kcal/person/day in 1997/99. In the projections, it increases further to 3 300 kcal by 2030. This is nearly the level of the industrial countries. Going from 3 040 to 3 300 kcal in 32 years is a growth rate of only 0.3 percent p.a. In contrast, in the preceding three decades the average growth rate of per capita kcal was 1.6 percent p.a. Therefore, the higher level from which China now starts imposes a limit on how fast per capita consumption may grow in the future. In addition, China's population growth in the past was 1.5 percent p.a., but in the projection period it will be only 0.5 percent p.a. These numbers vividly demonstrate the effect of slower population growth and near-saturation levels of per capita food consumption in depressing the aggregate growth of demand for food. This deceleration happened in the historical period in countries transiting from low to high per capita consumption and to low demographic growth. For example, the aggregate food demand growth rate of Japan was 4.7 percent p.a. in the 1960s and fell progressively to 2.2 percent in the 1970s, to 2.0 percent in the 1980s and to 0.8 percent in the 1990s.

When such deceleration occurs in China and in a few other large developing countries, the whole aggregate of the developing countries, and indeed the world, will be affected downwards. There are several other developing countries in situations roughly similar to those of China, i.e. they have fairly high levels of per capita consumption and are experiencing a significant slowdown in their population growth. As noted, the first group shown in Table 3.2 comprises the developing countries starting with over 2 700 kcal/person/day in 1997/99. There are 29 of them (including China) but they account for a half of the population of the developing countries, since the group includes many of the largest developing countries in terms of population.[3] They account for an even larger share of aggregate consumption of the developing countries, 66 percent in 1997/99. As in the case of China, this group of countries has much more limited scope than in the past for increasing per capita consumption, given that the group's average already stands at 3 030 kcal/person/day. We project this average to grow to 3 275 kcal/person/day by 2030. In parallel, the growth rate of their population is projected to be much slower than in the past, 0.9 percent p.a. compared with 1.8 percent p.a. in

[3] China, Indonesia, Brazil, Mexico, Nigeria, Egypt, the Islamic Republic of Iran and Turkey.

the preceding three decades. The net effect of these demand-limiting factors is that the group's aggregate demand is projected to decelerate drastically, from 4.2 percent per year between 1969 and 1999, to 1.9 percent p.a. in the period to 2015 and to 1.5 percent p.a. in the following 15 years to 2030.[4]

In contrast, the growth of demand in the other developing countries, those with under 2 700 kcal/person/day in 1997/99, is projected to decelerate less than their population: the growth rate of their demand falls from 2.9 percent p.a. in the preceding three decades to 2.5 percent p.a. in the period to 2030, while their population growth rate falls from 2.3 percent p.a. to 1.6 percent p.a. This group of countries includes India with its nearly one billion population out of the group's 2.2 billion. The prospect that India will not move much towards meat consumption (see Section 3.3 below) contributes to limit the growth rate of total demand for both food and feed. In the past, the aggregate demand of the developing countries was greatly influenced by the rapid growth of apparent meat consumption in China (see, however, Section 3.3 below for possible overestimation of meat

Table 3.2 Growth rates of demand and production in different country groups

	1969 -99	1979 -99	1989 -99	1997/99 -2015	2015 -2030	1997/99 -2030
			Demand (percentage p.a.)			
Developing countries	3.7	3.7	4.0	2.2	1.7	2.0
Countries with over 2 700 kcal/person/day*	4.2	4.2	4.6	1.9	1.5	1.7
Other developing countries	2.9	2.9	2.7	2.7	2.2	2.5
			Production (percentage p.a.)			
Developing countries	3.5	3.7	3.9	2.0	1.7	1.9
Countries with over 2 700 kcal/person/day*	4.0	4.2	4.6	1.8	1.4	1.6
Other developing countries	2.7	2.8	2.5	2.5	2.1	2.3
			Population (percentage p.a.)			
Developing countries	2.0	1.9	1.7	1.4	1.1	1.3
Countries with over 2 700 kcal/person/day*	1.8	1.6	1.4	1.0	0.7	0.9
Other developing countries	2.3	2.3	2.1	1.8	1.4	1.6
			Population (million)			
	1964/66	**1974/76**	**1984/86**	**1997/99**	**2015**	**2030**
Developing countries	2 295	2 925	3 597	4 572	5 827	6 869
Countries with over 2 700 kcal/person/day*	1 250	1 594	1 918	2 343	2 798	3 111
Other developing countries	1 045	1 331	1 679	2 229	3 029	3 758
			Kcal/person/day			
Developing countries	2 054	2 152	2 450	2 681	2 845	2 980
Countries with over 2 700 kcal/person/day*	2 075	2 243	2 669	3 027	3 155	3 275
Other developing countries	2 029	2 044	2 200	2 316	2 560	2 740

* In 1997/99.

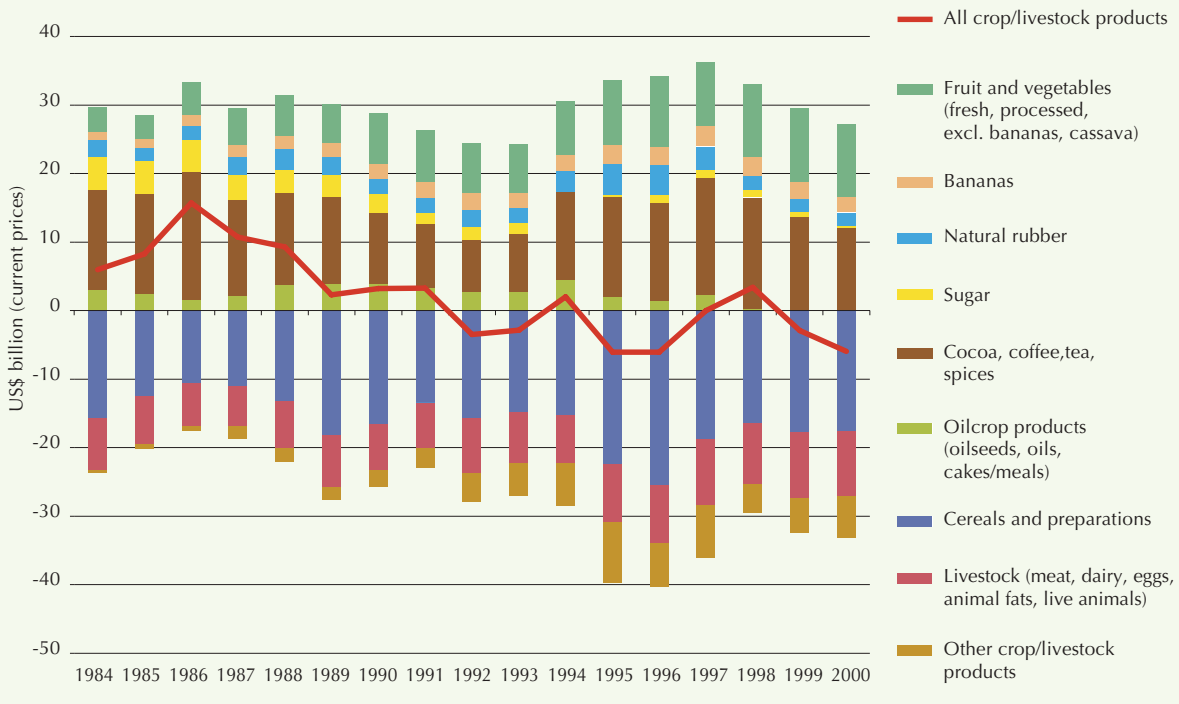
[4] Note that in China's projected 3 300 kcal/person/day in 2030 are included per capita annual meat consumption of 69 kg and 380 kg of cereals (for all uses). To have less deceleration than foreseen here in the growth of aggregate demand would require that these projected levels be even higher (see following commodity sections).

production and consumption in China). The prospect that China's influence will be much weaker in the future and that it will not be replaced by a similar boom in other large countries, is one of the major factors making for the projected deceleration in the aggregate demand of the developing countries.

At the world level, production equals consumption, so the preceding discussion about global demand growth prospects applies also to that of global production. For the individual countries and country groups, however, the two growth rates differ depending on movements in their net agricultural trade positions. In general, the growth rates of production in the developing regions have been below those of demand. As a result their agricultural imports have been growing faster than their exports, leading to gradual erosion of their traditional surplus in agricultural trade (crop and livestock products, primary and processed). The trend has been for this surplus to diminish and to turn into a net deficit in most years in the 1990s (Figure 3.2). In the last 15 years, the net balance reached a peak of US$16 billion surplus in 1986 and a trough of US$6 billion deficit ten years later, before some recovery in the subsequent years. The net deficit was still US$5.9 billion in 2000, the latest year for which we have data. This prospect had been foreshadowed in our earlier projections to 2010 from base year 1988/90 (Alexandratos, 1995, p. 121, see also Chapter 9).

Behind these trends in the value of the net trade balance of agriculture have been movements in both quantities and prices of the traded commodities and the policies that influenced them. Several factors, often widely differing among commodities, played a role in these developments. For example, the drastic decline in the developing countries' traditional net trade surplus in sugar is in part a result of the fact that several developing countries became major importers of sugar. In parallel, the reduction also reflects the effects of the heavy domestic support and trade protection in major sugar importing countries such as the United States and Japan, or in former net importing countries, such as the EU, which became a significant net exporter as a result of these policies (see Section 3.6 below and Figure 3.16). The emergence of several developing countries as major importers has also helped to cause the rapid declines in the net trade surplus of the developing countries as a whole in the oilcrops complex

Figure 3.2 Developing countries, net agricultural trade balances, 1984-2000



(vegetable oils, oilseeds and cakes/meals, see Section 3.4). In the case of the "non-competing" exportables of the developing countries, such as coffee, it has been the slow growth of demand in the main consuming and importing countries (the industrial ones) – in combination with falling prices – that kept the trade balance from growing.

The evolution of the overall net agricultural trade balance of the developing countries as a whole does not by itself denote overall improvement or deterioration from a developmental standpoint. The aggregate of the developing countries is a composite of very widely differing country and commodity situations. For some countries, a declining agricultural trade balance (or a growing deficit) is an indicator of progress towards improved welfare. This is the case of countries such as the Republic of Korea, in which the growing agricultural deficit has gone hand in hand with high rates of overall development and growing food consumption. The declining overall balance also reflects the rapid growth in such things as China's growing imports of vegetable oils (a positive development overall as they contribute to improve food consumption and are paid for by growing industrial export earnings); or cotton imports into several developing countries, which sustain their growing exports of textiles. However, a declining agricultural balance is a negative developmental outcome in countries that still depend heavily on export earnings from agriculture and/or have to divert scarce foreign exchange resources to pay for growing food imports (eventually building up unsustainable foreign debt). It is an even more negative indicator when such food imports are not associated with rising food consumption per capita and improved food security, but are necessary just to sustain minimum levels of food consumption – which is not an uncommon occurrence.

The projections indicate a continuing deepening of the net trade deficit of the developing countries. Their net imports of the main commodities in which they are deficit, mainly cereals and livestock products, will continue to rise fairly rapidly. In parallel, their net trade surplus in traditional exports (e.g. tropical beverages and bananas) will either rise less rapidly than their net imports of cereals and livestock or outright decline (e.g. vegetable oils and sugar). The particulars relating to future trade outcomes for these commodities are discussed in the following sections of this chapter. Trade policy issues are discussed in Chapter 9.

Concerning production, evaluation country by country and commodity by commodity suggests that the resource potential and productivity gains required to achieve the aggregate production growth rates shown in Tables 3.1 and 3.2 (and in the commodity sections of this chapter) are by and large feasible. This is based on the assumption that policies will favour rather than discriminate against agriculture. More information on the agronomic dimensions of this proposition is presented in Chapter 4. It is just worth mentioning here that the bulk of the increases in production will come, as they did in the past, from increases in yield and more intensive use of land.

This may sound odd in the light of the widely held view that the potential for further growth of yields is now much more limited than it was in the historical period, which included the heyday of the spread of the green revolution. The two propositions (that yield growth potential is less than in the past and that yield growth will continue to be the mainstay of the production increases) are not necessarily contradictory. What makes them compatible with each other is that in future slower growth in production is needed than in the past. The issue is not really whether the yield growth rates will be slower than in the past. They will. Rather the issue is if such slower growth is sufficient to deliver the required additional production. Naturally, even this slower yield growth may not happen unless we make it happen. This requires continued support to agricultural research and policies and other conditions (education, credit, infrastructure, etc.) to make it profitable and possible for farmers to exploit the yield growth potential.

At the global level sufficient production potential can be developed for meeting the expected increases in effective demand in the course of the next three decades. But this is not to say that all people will be food-secure in the future. Far from it, as Chapter 2 has shown. The interaction between food security and food production potential is very much a local problem in poor and agriculturally dependent societies. Many situations exist where production potential is limited (e.g. in the semi-arid areas, given existing and accessible technology and infrastructure) and a good part of the population

depends on such poor agricultural resources for food and more general livelihood. Unless local agriculture is developed and/or other income earning opportunities open up, the food insecurity determined by limited local production potential will persist, even in the middle of potential plenty at the world level. The need to develop local agriculture in such situations as the condition sine qua non for improved food security cannot be overemphasized.

3.2 Cereals

3.2.1 Past and present

Cereals continue to be overwhelmingly the major source of food supplies for direct human consumption. In addition, some 660 million tonnes, or 35 percent of world consumption, are being used as animal feed. Therefore, the growth of aggregate demand for cereals for all uses is a good (though far from perfect) proxy for monitoring trends in world food supplies.

Demand: general historical experience.
Historically, the growth rate of global demand for cereals (for all uses) has been in long-term decline. This is clearly seen in Tables 3.3 and 3.4 which show the historical developments in all major cereal sector variables for the world and the standard regions used in this report. To gain a better understanding of the main factors that led to the deceleration, we must distinguish between different country groups and historical periods. This is done in Figure 3.3 which plots the growth rates of aggregate demand for successive (moving) 15-year periods of different country groups over the time span 1961-99. The world growth rate declined progressively from 3.1 percent in the first 15-year period (1961-76) to 1.1 percent p.a. in the last 15-year period ending in 1999. We should not be surprised if our projections were to show further declines in the growth rates of world aggregate cereals demand (hence of global production) in the future.

The deceleration in population growth certainly played a role in this slowdown, as has the fact that a growing proportion of the world population has been gradually attaining levels of per capita food consumption that leave less scope than in the past for further increases. However, these two factors explain only part of the decline, given that there are still grossly unsatisfied nutritional needs affecting large parts of the world population. Other

Figure 3.3 Fifteen-year growth rates of aggregate cereal consumption

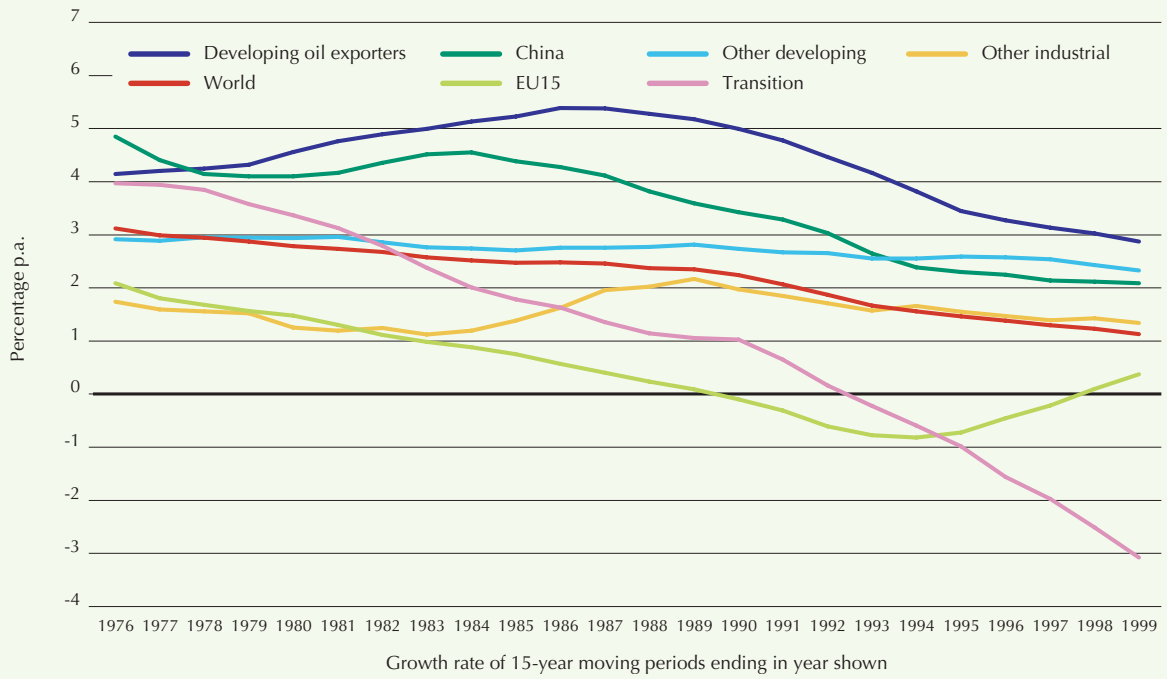


Table 3.3 Cereal balances, world and major country groups

	Demand				Production	Net trade	SSR[1]	Growth rates, percentage p.a.			
	Per capita (kg)		Total (million tonnes)		(million tonnes)		%		Demand	Production	Population
	Food	All uses	Food	All uses							
						World					
1964/66	147	283	489	941	940	4	100	1969-99	1.9	1.8	1.7
1974/76	151	304	612	1 233	1 268	1	103	1979-99	1.4	1.4	1.6
1984/86	168	334	810	1 608	1 659	2	103	1989-99	1.0	1.0	1.5
1997/99	171	317	1 003	1 864	1 889	9	101	1997/99-2015	1.4	1.4	1.2
2015	171	332	1 227	2 380	2 387	8	100	2015-30	1.2	1.2	0.9
2030	171	344	1 406	2 830	2 838	8	100	1997/99-2030	1.3	1.3	1.1
						Developing countries					
1964/66	141	183	324	419	399	-17	95	1969-99	3.0	2.8	2.0
1974/76	150	200	438	586	563	-39	96	1979-99	2.6	2.5	1.9
1984/86	172	234	618	840	779	-66	93	1989-99	2.2	2.1	1.7
1997/99	173	247	790	1 129	1 026	-103	91	1997/99-2015	1.9	1.6	1.4
2015	173	265	1 007	1 544	1 354	-190	88	2015-30	1.5	1.3	1.1
2030	172	279	1 185	1 917	1 652	-265	86	1997/99-2030	1.7	1.5	1.3
						Industrial countries					
1964/66	136	483	94	335	351	30	105	1969-99	1.0	1.5	0.7
1974/76	136	504	103	384	456	55	119	1979-99	1.0	0.8	0.7
1984/86	147	569	119	464	614	106	132	1989-99	1.7	1.4	0.7
1997/99	159	588	142	525	652	111	124	1997/99-2015	0.8	1.1	0.4
2015	158	630	150	600	785	187	131	2015-30	0.6	0.9	0.2
2030	159	667	155	652	900	247	138	1997/99-2030	0.7	1.0	0.3
						Transition countries					
1964/66	211	556	70	186	189	-9	102	1969-99	-0.2	-0.3	0.6
1974/76	191	719	70	263	249	-16	94	1979-99	-1.9	-1.1	0.5
1984/86	183	766	73	304	266	-37	87	1989-99	-4.9	-4.2	0.1
1997/99	173	510	72	211	210	1	100	1997/99-2015	0.7	1.0	-0.2
2015	176	596	70	237	247	10	104	2015-30	0.7	1.0	-0.3
2030	173	685	66	262	287	25	110	1997/99-2030	0.7	1.0	-0.2

Memo item 1. **Growth rates, percentage p.a.**

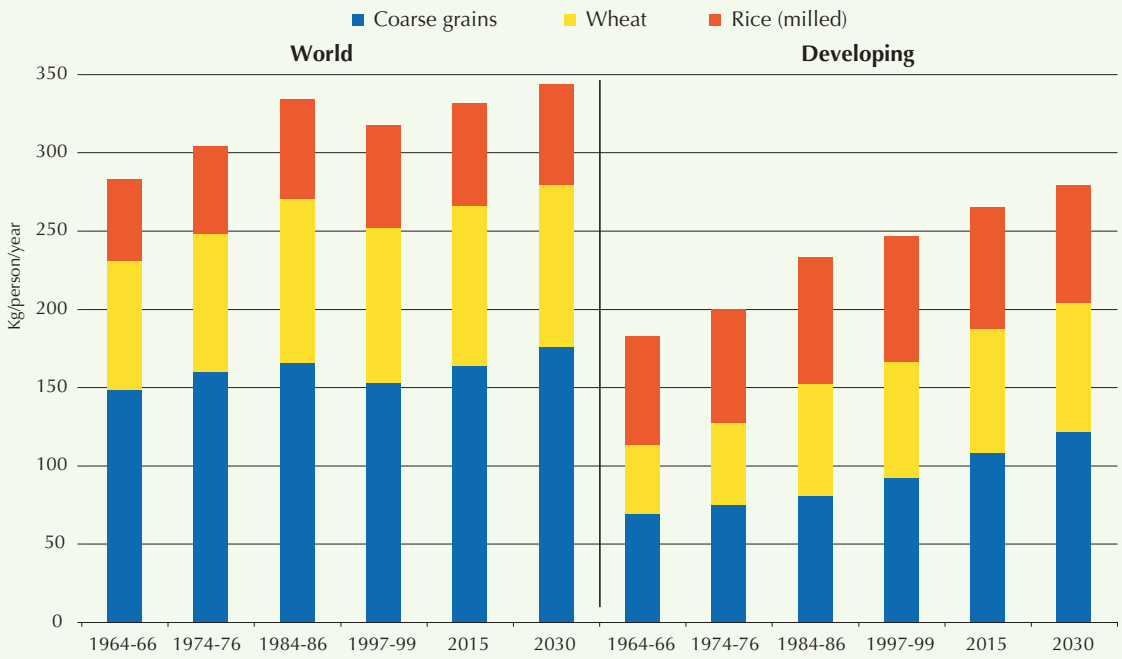
	Total demand – all cereals						Population				
	1969-99	1979-99	1989-99	1997/99-2015	2015-30	1997/99-2030	1979-99	1989-99	1997/99-2015	2015-30	1997/99-2030
Developing oil exporters[2]	4.2	3.4	2.7	2.1	1.8	1.9	2.4	2.1	1.7	1.3	1.5
China	3.2	2.3	2.1	1.3	0.9	1.1	1.3	1.0	0.7	0.3	0.5
Other developing countries	2.6	2.5	2.1	2.1	1.7	1.9	2.1	2.0	1.7	1.3	1.5
EU15	0.3	0.1	2.0	0.4	0.2	0.3	0.3	0.3	0.0	-0.2	-0.1
Other industrial countries	1.5	1.5	1.5	1.0	0.7	0.8	1.0	1.0	0.6	0.4	0.5

Memo item 2. **World demand (all uses) by commodity (million tonnes), food kg/capita and percentage p.a.**

	1964/66	1974/76	1984/86	1997/99	2015	2030	1979-99	1989-99	1997/99-2015	2015-30	1997/99-2030
Wheat, million tonnes	273	357	504	582	730	851	1.5	0.8	1.3	1.0	1.2
Rice (milled), million tonnes	174	229	308	386	472	533	2.1	1.6	1.2	0.8	1.0
Rice, per capita food only (kg)											
East Asia	84	93	109	106	100	96					
East Asia excl. China	110	125	130	132	129	124					
South Asia	73	69	75	79	84	81					
Coarse grains, million tonnes	493	648	796	896	1 177	1 446	1.0	1.0	1.6	1.4	1.5

[1] SSR = self-sufficiency rate = production/demand.
[2] Near East/North Africa (excl. Turkey, Morocco, Tunisia, Afghanistan, Jordan, Lebanon and Yemen) plus Mexico, Venezuela, Indonesia, Angola, Bolivia, the Congo, Ecuador, Gabon, Nigeria and Trinidad and Tobago.

Figure 3.4 Per capita consumption (all uses) of individual cereals



factors must be taken into account if we are to draw valid lessons from the historical experience for exploring the future. The forces that made for this decline may be summarized as follows:

- In developing countries, the past high growth rate was fuelled up to about the mid-1980s by the rapid growth in production and consumption of China, and of consumption in the developing oil-exporting countries.[5] In this group of countries, the rapid growth of demand was supported by quantum jumps in net cereal imports (see below). Growth of demand became much weaker in subsequent periods. This reflected partly the achievement of mid- to high per capita consumption levels in several countries, and partly changes in economic conditions, mainly the drastic slowdown in the growth of incomes and export earnings from oil. In contrast, the growth of aggregate demand in the remaining developing countries (which, among themselves, account for 30 percent of world consumption) slowed by much less – from a peak of 3.0 percent p.a. in 1966-81 (when population growth was 2.4 percent) to 2.3 percent in the latest 15-year period 1985-99 (population growth 2.1 percent).
- The collapse of feed use of cereals in the transition economies in the 1990s following the contraction of their livestock sectors (total use declined from 317 million tonnes in 1989/91 to 197 million tonnes in 1997/99) was a major factor in bringing down the growth of world demand in the 1990s.
- A third major factor was, up to the early 1990s, the decline in cereals used for animal feed (and their replacement by largely imported cereal substitutes – oilmeals, cassava, etc.) in the EU, following the high internal prices of the Common Agricultural Policy (CAP). This trend was reversed from 1993 onwards following the McSharry reform of the CAP.

Evolution of demand: commodities and categories of use. For *rice*, the characteristic feature of the historical evolution is that per capita consumption (for all uses, but overwhelmingly for direct food, although in some countries rice is also used as animal feed) has tended to level off (see Figure 3.4).

5 Countries with over 50 percent of their total merchandise exports coming from export of fuels in the 1980s (data from World Bank, 2001b). In this category belong the countries of the region Near East/North Africa (except Morocco, Tunisia, Afghanistan, Jordan, Lebanon, Turkey and Yemen) plus Angola, the Congo, Gabon, Nigeria, Bolivia, Ecuador, Mexico, Trinidad and Tobago, Venezuela and Indonesia.

This trend has been most evident in several countries of East Asia. Given their large weight in world rice consumption, developments in this region influence the totals for the world and the developing countries in a decisive way. Thus, the levelling off of average consumption in the developing countries since about the mid-1980s reflects essentially small declines in East Asia's per capita food consumption of rice (from 109 to 106 kg), although the average of South Asia kept increasing (from 75 to 79 kg, see Table 3.3, memo item 2). Absolute declines in per capita rice consumption because of diet diversification in Asia are not yet widespread, but the patterns established by the more advanced rice-eating countries (e.g. Japan, the Republic of Korea and Taiwan Province of China) have started appearing, although in much attenuated form, in other developing countries, e.g. China and Thailand. Despite these trends in per capita consumption, the aggregate world demand for rice grew faster than that of both wheat and coarse grains. This reflects essentially the fact that rice is used predominantly for food in the most populous region, Asia, while a good part of coarse grains, but also increasingly of wheat, are used for animal feed. Feed use suffered a severe setback in the last ten years or so because of the above factors (transition economies, the EU) and, to a lesser extent, other factors having to do with structural change in the livestock economy (shift of meat production from beef to poultry and pork, see Section 3.3).

The per capita consumption of *wheat* kept increasing in the developing countries albeit at a decelerating rate. In the industrial countries, a growing share of total wheat use went to animal feed (37 percent currently, 45 percent in the EU). Growing imports made possible the increases in consumption in the majority of developing countries. This is not evident from a first glance at the totals of the developing countries: their aggregate wheat consumption grew by 185 million tonnes and net imports by only 24 million tonnes between 1974/76 and 1997/99. However, the large weight in these aggregates of India, China, Pakistan and a few other countries (Argentina, Saudi Arabia, the Syrian Arab Republic, Turkey and Bangladesh), which increased production to match, or more than match, the growth of consumption masks the growing dependence of the great majority of the developing countries on wheat imports. In practice, the rest of the developing countries increased consumption by 54 million tonnes and

Figure 3.5 Increases in wheat consumption (all uses) and in net imports, 1974/76 to 1997/99, developing countries with over 500 thousand tonnes increase in consumption

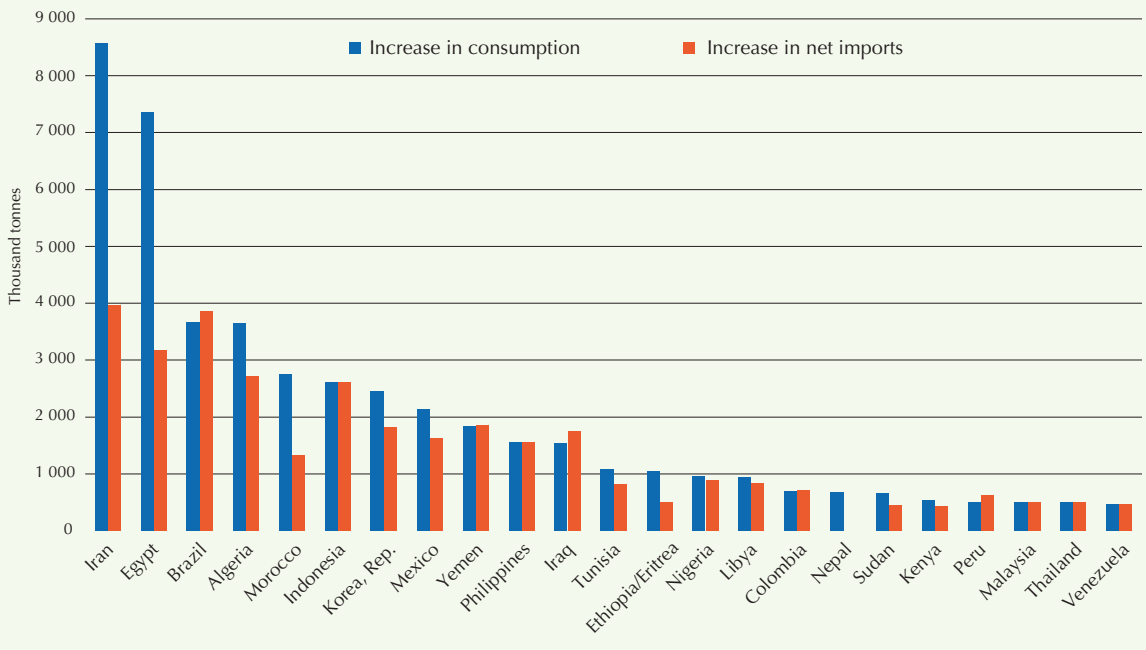
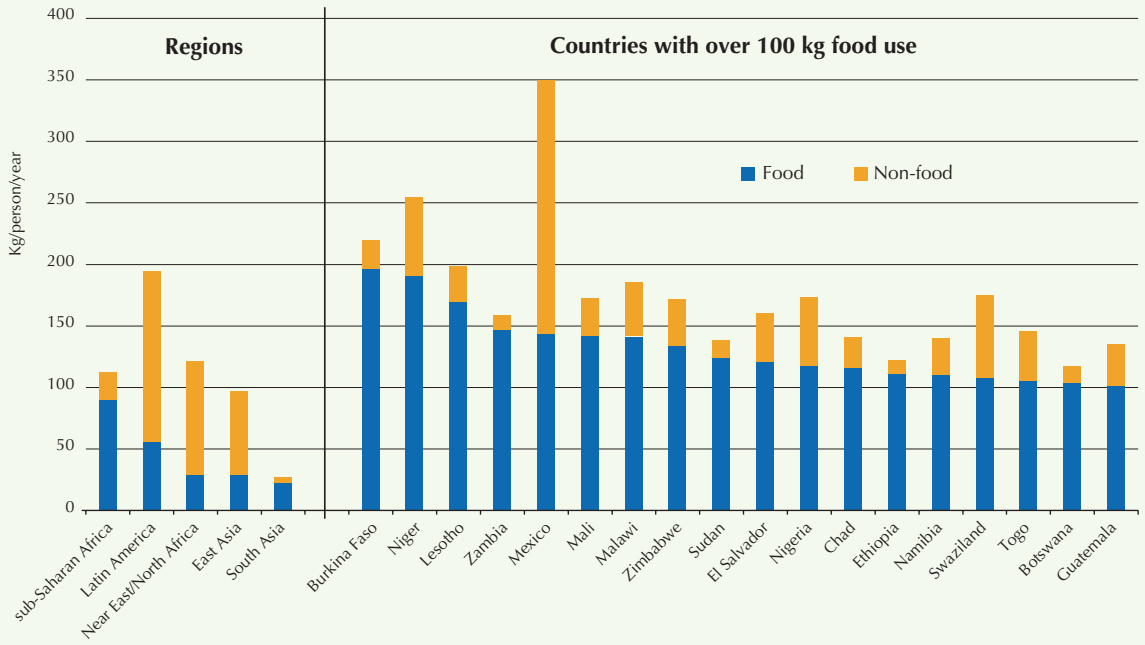


Table 3.4 Cereal balances by developing regions, all cereals (wheat, rice [milled], coarse grains)

	Demand				Production	Net trade	SSR[1]	Growth rates, percentage p.a.			
	Per capita (kg)		Total (million tonnes)		(million tonnes)		%		Demand	Production	Population
	Food	All uses	Food	All uses							
						Sub-Saharan Africa					
1964/66	115	143	26	33	32	-2	97	1969-99	3.1	2.6	2.9
1974/76	115	143	34	43	40	-4	94	1979-99	3.4	3.4	2.9
1984/86	118	142	47	57	48	-10	85	1989-99	3.1	2.7	2.7
1997/99	123	150	71	86	71	-14	82	1997/99-2015	2.9	2.8	2.6
2015	131	158	116	139	114	-25	82	2015-30	2.7	2.6	2.2
2030	141	170	173	208	168	-40	81	1997/99-2030	2.8	2.7	2.4
						Near East/North Africa					
1964/66	172	292	27	47	40	-5	86	1969-99	3.4	2.4	2.7
1974/76	189	309	39	64	55	-13	85	1979-99	2.7	2.4	2.6
1984/86	204	365	56	100	65	-38	65	1989-99	2.2	1.3	2.4
1997/99	209	352	79	133	83	-49	63	1997/99-2015	2.2	1.5	1.9
2015	206	368	107	192	107	-85	56	2015-30	1.8	1.5	1.5
2030	201	382	131	249	133	-116	54	1997/99-2030	2.0	1.5	1.7
						South Asia					
1964/66	146	162	92	102	88	-10	86	1969-99	2.6	2.8	2.2
1974/76	143	162	114	128	125	-10	98	1979-99	2.6	2.7	2.1
1984/86	156	175	154	173	173	-3	100	1989-99	1.8	2.0	1.9
1997/99	163	182	208	234	239	-3	102	1997/99-2015	2.1	1.8	1.6
2015	177	200	295	335	323	-12	97	2015-30	1.5	1.3	1.1
2030	183	211	360	416	393	-22	95	1997/99-2030	1.8	1.6	1.3
						East Asia					
1964/66	146	181	150	187	183	-5	98	1969-99	3.2	3.1	1.6
1974/76	162	211	212	275	266	-10	97	1979-99	2.5	2.5	1.5
1984/86	201	263	308	404	391	-12	97	1989-99	2.1	2.1	1.2
1997/99	199	290	366	534	507	-23	95	1997/99-2015	1.4	1.2	0.9
2015	190	317	404	675	622	-53	92	2015-30	1.0	0.9	0.5
2030	183	342	422	787	714	-73	91	1997/99-2030	1.2	1.1	0.7
						Latin America and the Caribbean					
1964/66	116	207	29	51	56	5	109	1969-99	2.9	2.2	2.1
1974/76	123	239	39	76	77	-2	101	1979-99	2.3	1.8	1.9
1984/86	132	267	52	106	101	-3	96	1989-99	2.8	3.1	1.7
1997/99	132	285	66	142	125	-14	88	1997/99-2015	2.1	2.4	1.3
2015	136	326	85	203	188	-16	92	2015-30	1.6	1.7	0.9
2030	139	358	99	257	244	-13	95	1997/99-2030	1.9	2.1	1.1

[1] SSR = Self-sufficiency rate = production/demand.

Figure 3.6 Food and non-food use of coarse grains, developing regions and selected countries, average 1997/99



net imports by 39 million tonnes. Figure 3.5 shows some major countries, other than the above-mentioned ones, which increased consumption by over 500 thousand tonnes. They include countries that are major producers themselves (Egypt, the Islamic Republic of Iran, countries of North Africa, Mexico and Brazil) as well as those that are minor or non-producers of wheat – Indonesia, the Philippines, Colombia and the Republic of Korea. In addition, numerous smaller countries in the tropics depend entirely on imports for their consumption of wheat.

Apparent consumption of *coarse grains* grew fairly fast, although the above factors made for significant declines in feed use in certain parts of the world and led to a decline in per capita use in the world as a whole (Figure 3.4). The driving force has been use for animal feed in the developing countries, particularly in the last ten years, with China being a major contributor to such developments. The increase in world consumption between 1984/86 and 1997/99 was 100 million tonnes. This was made up of a 131 million tonnes increase in the developing countries (out of which 77 million tonnes for feed – 43 of which in China); declines of 64 million tonnes in the transition economies; and an increase of 33 million tonnes in the industrial countries. Overall, the pattern of the world coarse grains economy has undergone drastic structural change in the location of consumption. The major export markets shifted increasingly to the developing countries: increases in net coarse grains imports of the developing countries outside China supplied some 30 percent of the increase in their consumption.

Coarse grains as food. About three-fifths of world consumption of coarse grains is used for animal feed, hence the term "feedgrains" often used to refer to them. However, in many countries (mainly in sub-Saharan Africa and Latin America) they play a very important role in the total supplies of food for direct human consumption. Indeed in several countries food consumption of cereals is synonymous with coarse grains. A sample is given in Figure 3.6. The majority of these countries face food security problems, which underlines the importance of coarse grains in food security. At the global level, about a quarter of aggregate consumption of coarse grains is devoted to food,[6] but the share rises to 80 percent in sub-Saharan Africa. Here maize, millet, sorghum

[6] Food consumption of coarse grains includes the quantities used to produce beverages (mainly beer) as well as other derived food products, e.g. corn syrup, widely used as a sweetener substitute for sugar.

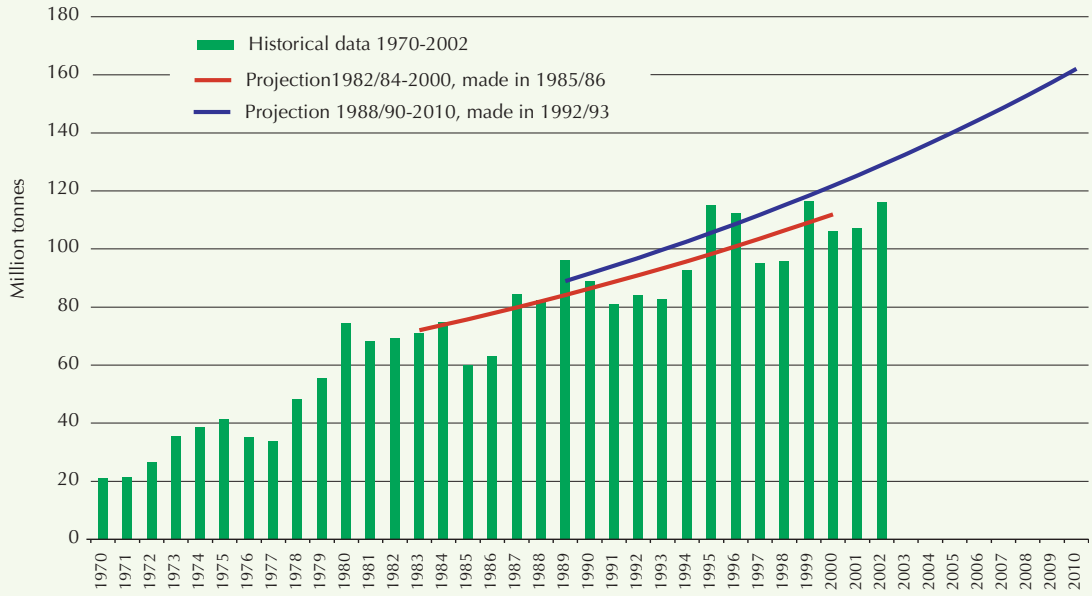
and other coarse grains (e.g. tef in Ethiopia) account for 3 out of every 4 kg of cereals consumed as food. Coarse grains are also used predominantly as food in South Asia (84 percent of aggregate consumption of coarse grains is for food), but there they account for only a minor part of cereal food consumption (1 out of every 7.5 kg). This share is rapidly declining (coarse grains represented 1 out of 4 kg in the mid-1970s), following the strong bias of cereal policies in the region, favouring rice and wheat.

Imports and exports. At the global level, production equals (roughly) consumption. Therefore what was said earlier concerning the factors that made for a steady decline in the growth rates of world cereal consumption, applies also to production.

However, this is not the case at the level of individual countries and country groups. Tables 3.3 and 3.4 show the extent to which production and consumption growth rates diverged from each other in the different regions, and how such divergences are associated with changes in net trade positions and self-sufficiency rates. In general, in the developing countries demand grew faster than production, so net imports increased from 39 million tonnes in the mid-1970s to 103 million tonnes in 1997/99 (Figure 3.7). Aggregate self-sufficiency (percentage of consumption covered by production) in these countries declined from 96 to 91 percent. If we exclude the three major developing cereal exporters (Argentina, Thailand and Viet Nam) net imports of the other developing countries increased from 51 million tonnes to 134 million tonnes and self-sufficiency fell from 93 to 88 percent.

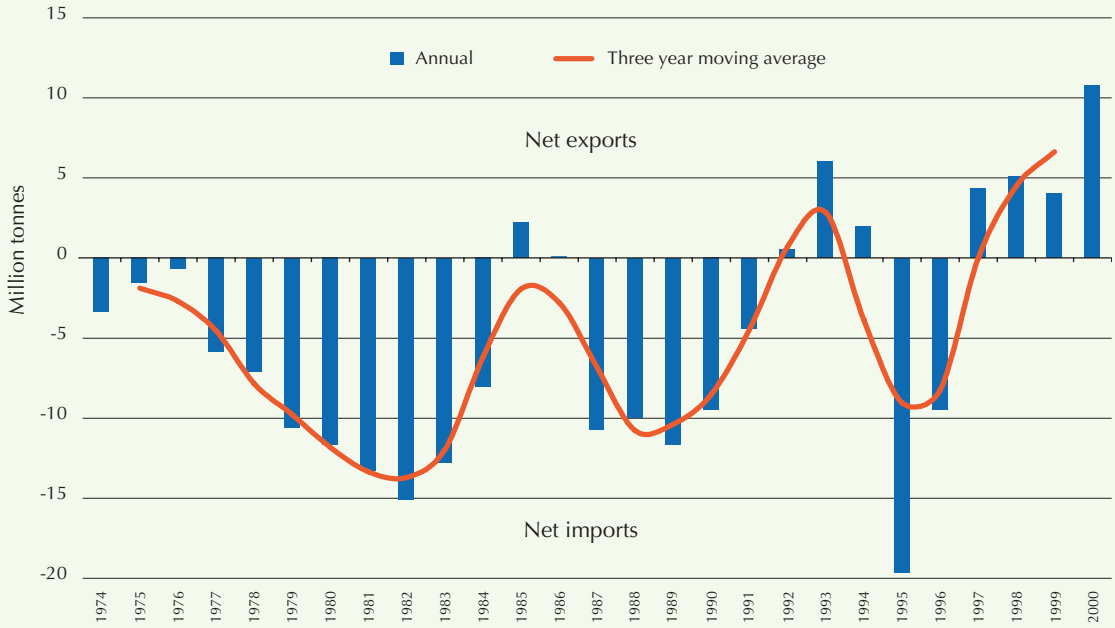
As noted, in the early period (the 1970s up to the mid-1980s) import growth was fuelled by the oil-exporting countries, particularly those of the Near East/North Africa region, and a few of the rapidly industrializing countries in East Asia (the Republic of Korea, Taiwan Province of China and Malaysia) and some in Latin America (Brazil, Mexico and Venezuela). In addition, the early period saw quantum jumps in the net imports of the former Soviet Union and Japan. In the subsequent years to the mid-1990s, net imports of oil exporters grew very little, reflecting, *inter alia*, the collapse of imports of Iraq, and the turnaround from net importer to net exporter status of the Syrian Arab Republic (all cereals) and Saudi Arabia (wheat). However, growth of net imports of the oil

Figure 3.7 Net cereal imports, developing countries: comparisons of old projections with actual outcomes



Projections 1988/90-2010 from Alexandratos (1995):145; 1982/84-2000 from Alexandratos (1988):106.
Data for 2002 refer to forecasts for July/June 2002/03 from Food Outlook, 3/02.

Figure 3.8 China's net trade of cereals



exporters resumed in the second half of the 1990s. The second major factor making for quasi stagnant world cereal trade in much of the 1990s has been the virtual disappearance of the transition economies as major net importers (and their transformation into small net exporters in some years), while the net imports of Japan stagnated, a development clearly associated with Japan's rapid growth of meat imports which substituted for imports of grains for feed (see Section 3.3).

However, other countries continued to expand net imports (the Republic of Korea, Taiwan Province of China, Malaysia and Brazil) and new ones were added to the list of growing net importers (the Philippines, Colombia, Peru and Chile). China must also be added to this list, as it became, albeit temporarily, a big importer in the mid-1990s (net imports of 20 million tonnes in 1995). However, such status of China did not last and the country turned into a small net exporter from 1997 onwards. Its net imports in the last quarter century are plotted in Figure 3.8. Taking smoothed three-year moving averages, its net trade status moved in the range from net imports of 14 million tonnes (early 1980s) to net exports of nearly 5 million tonnes in the three-year average 1997/99. This evidence does not point to China becoming a permanent large net importer in the future as some studies had indicated (with the knock-on effects on world market prices that would reduce the import capacity of the poor food-deficit countries) (Brown, 1995; for critique see Alexandratos, 1996, 1997). More important for world markets have been the large fluctuations in China's net trade status.

Another remarkable development has been the fact that South Asia has not moved in the direction of becoming the large importer that some commentators thought back in the 1960s it would have needed to become to feed its growing population. In the mid-1960s, the region was a net importer of 10 million tonnes of cereals. This represented a crucial 11 percent of its food consumption of cereals which was very low (146 kg per capita), given that consumption of all food provided only 2 000 kcal/person/day. Thirty-three years on, the region's population had doubled, per capita food consumption had increased to 163 kg and net imports had fallen to only 3.4 million tonnes. This was a result of the miracle of the green revolution but also, on the negative side, a result of the persistence of poverty that prevented demand from growing faster than it did. Finally, sub-Saharan Africa's net imports remained at very low levels, the result of both poverty (lack of effective demand) and import capacity limitations.

By and large, the traditional cereal exporters (North America, Australia, Argentina, Uruguay, Thailand and, in more recent years, also the EU and Viet Nam) coped quite well with spurts in import demand. As shown in Table 3.8, they export currently (average 1997/99) 176 million tonnes of cereals net annually. This is matched by the 135 million tonnes net imports of the developing countries other than Argentina, Uruguay, Thailand and Viet Nam, and 33 million tonnes of the net importing industrial countries (Japan, non-EU western Europe and Israel. A discrepancy of some 9 million tonnes at world level in the trade statistics remains unaccounted for.) This is about double their net exports of the mid-1970s and three times those of the mid-1960s. The data are given in Table 3.8. About a half of the total increment in these net exports in the period from the mid-1970s to 1997/99 was contributed by the EU. It is a very significant development for the world food system that this region turned from a net importer of 21 million tonnes in the mid-1970s to a net exporter. The transformation had been completed by the early 1980s. The EU's net exports reached a peak of 38 million tonnes in 1992 and it was exporting a net 24 million tonnes in 1997/99. In practice, the other traditional exporters have had to increase their net export surplus rather modestly, from 110 million tonnes in the mid-1970s to 151 million tonnes in 1997/99.

We do not have a counterfactual scenario to answer the question how the different variables of the world food system would have actually fared if the EU had not followed a policy of heavy support and protection of its agriculture (in particular prices, production, consumption and trade in the different countries and particularly the per person food availability of the poor countries and those that became heavy importers). This policy led to the region's import substitution and then subsidized exports.[7] The resulting lower world market prices (compared with what they would have been otherwise) are thought to have adversely affected the food security of the developing countries because of the negative effects on the incentives to their producers. However, the structurally import-dependent countries have a clear interest that world market prices should be lower rather than higher. Disincentives to own producers could have been counteracted by appropriate policies, at least in principle, although admittedly a very difficult task in practice (how does one keep domestic prices higher than import prices when a good part of the consumers are in the low-income, food-insecure category?). In looking at the impacts on food security, we should also consider the possible positive effects on the consumption of the poor of the lower import prices and increased availability of food aid. In the end, such policies of the EU resulted in the emergence of an additional major source of cereal export surpluses to the world markets and diversified the sources from which the importing countries could provision themselves. This is a structural change which is probably here to stay, even under the more liberal trade policy reforms of recent years and perhaps further reforms to come (see below).

It is worth noting that (for very different reasons) we are currently witnessing a similar transformation of the group of the transition economies from large net importer to a small one, and, as projected in this study, to a sizeable net exporter in the longer-term future. This group had emerged as a major net importer up to the late-1980s, but the drastic decline in its demand for cereals (no doubt aided by rapidly rising meat imports in the former Soviet Union) has by now led to drastic declines in net imports and occasional net exports, no matter that production also declined drastically.

3.2.2 Prospects for the cereal sector

The preceding discussion has highlighted the main forces that shaped the past. What changes can we expect in the future?

Aggregate demand. As already anticipated, the fundamental forces that made for slowdown in the growth of demand in the past – slower population

[7] In retrospect, it seems remarkable that this transformation of western Europe with the aid of heavy subsidies took place without significant trade conflict in its heyday. It is probably explained by the rapid expansion of the demand for cereal imports in that period (oil boom, transition economies becoming large importers), which provided sufficient market outlets for all. Conflict did appear with a vengeance after the mid-1980s when markets stopped expanding. It led to the Agreement on Agriculture under the Uruguay Round which imposed limits on the use of trade-distorting support and protection policies and export subsidies (see Chapter 9).

growth everywhere and the achievement of mid-high levels of per capita consumption in some countries – will continue to operate in the future and contribute to further deceleration in the growth of demand.

Are there any factors that will attenuate or reverse this trend? No major stimulus in this direction is likely to come from the countries and population groups with consumption needs that have still not been met. The overall economic growth outlook and its pattern (see Chapter 2) suggest there will be inadequate growth of incomes, and poverty will persist. However, the downward pressure on world demand exerted by more transient forces (systemic change in the transition economies and the high policy prices of the EU) has already been largely exhausted and will not be there in the future.[8] Indeed, the recovery in demand in these two country groups, already evident in the EU after the early 1990s, as well as eventually in the countries of East Asia, will likely more than compensate for the effects of the more fundamental sources of slowdown. The result will be that, for a time, the growth rate of world demand for cereals could be higher than in the recent past. This shows up in the projections (Table 3.3), where the growth rate of world demand for 1997/99-2015 is 1.4 percent p.a., compared with 1.0 percent p.a. in the preceding ten years.

In the longer term, however, the more fundamental sources of slowdown will predominate and the growth rate of world demand will be lower for the second part of the projection period 2015-30, to 1.2 percent p.a. Tables 3.3 and 3.4 present this information for the standard regions, while memo item 1 in Table 3.3 unfolds these projections in terms of the groups used in the preceding section to analyse deceleration in the historical period. The further slowdown in China's population growth (from 1.3 percent p.a. in the preceding 20 years to 0.7 percent p.a. in the period to 2015 and on to 0.3 percent p.a. in 2015-30), the levelling-off and eventual small decline in its per capita food consumption of rice as well as the growth of production and consumption of meat at rates well below the spectacular ones of the past (see Section 3.3) all contribute to further deceleration in its aggregate cereal demand. Given China's large weight, the effects are felt in terms of lower growth rates in the aggregates for the world and the developing countries. In conclusion, the role China played in slowing world demand for cereals after about the mid-1980s (Figure 3.3) will probably continue to operate, and so will the deceleration in world demand and trade that in the past was associated with the end of expansion in the oil-exporting countries.

Unless there is another event that will cause effects similar to those of the oil boom (spurt in the demand and imports of a significant number of countries with low levels in per capita food consumption of cereals and livestock products), we cannot expect reversals of the trend towards long-term deceleration in global demand.

Will any such event occur? It would be foolhardy to make predictions. The failure (of ourselves and others) to foresee the collapse of production, demand and trade in the transition economies is instructive. However, we can attempt to see what is implied by some available projections.

Concerning the issue of future commodity booms, or rather significant upward trends in world commodity prices, the following quotation from the World Bank (2000a) is telling: "On balance, we do not see compelling reasons why real commodity prices should rise during the early part of the twenty-first century, while we see reasons why they should continue to decline. Thus, commodity prices are expected to decline relative to manufactures as has been the case for the past century". More recent projections from the Bank to 2015 (World Bank, 2001c, Tables A2.12-14) confirm the view that no significant upwards movements of commodity prices are expected, although this does not exclude the possibility of short-lived cyclical price spikes nor the recovery for some commodities (such as coffee and rubber, see Section 3.6 below) from the very low prices of early 2002.

This leaves the other source of significant spurts in demand and trade that occurred in the past: rapid sustained economic growth (e.g. of the Asian-tiger type) in countries of the above-mentioned typology (low initial levels in per capita food consumption of cereals and livestock products). On this, the latest World Bank view presented in

[8] An additional factor that made for slow growth of demand in recent years has been the abrupt reversal of the trend towards growing feed use of cereals in the countries of East Asia hit by the economic crisis of 1998.

Chapter 2 (Figure 2.3) of what the future could hold in terms of economic growth and poverty reductions for the period to 2015 does not permit great optimism. Of the two regions with significant poverty only South Asia may be making progress while little progress is foreseen for sub-Saharan Africa. South Asia could indeed be a source of spurts in cereal demand if it were to behave like typical developing countries in other regions, i.e. undergoing considerable shifts in diets towards meat. However, the prospect that India will not shift in any significant way to meat consumption in the foreseeable future (see Section 3.3) militates against this prospect.

The decline in world per capita production and consumption of cereals that occurred in the decade following the mid-1980s was interpreted by some as foreshadowing an impending world food crisis (e.g. Brown, 1996). However, this trend will probably be reversed, and the reversal has already started. World per capita consumption (all uses) peaked at 334 kg in the mid-1980s (three-year averages) and has since declined to the current 317 kg (three-year average 1997/99).[9] The reasons why this happened were explained above. They certainly do not suggest that the world had run into constraints on the production side and had to live with durable declines in per capita output. In the projections, the declining trend is reversed and world per capita consumption rises again and reaches 332 kg in 2015 and 344 kg in 2030 (Table 3.3, Figure 3.4).[10] This reversal reflects, *inter alia*, the end of declines and some recovery in the per capita consumption of the transition economies.

Demand composition: categories of use. The projected evolution of future demand by commodity (wheat, rice and coarse grains) is given in Table 3.3 (aggregate demand, memo item 2), Figure 3.4 (per capita demand), and by category of use in Figure 3.9. At the world level aggregate consumption of all cereals should increase by 2030 by nearly one billion tonnes from the 1.86 billion tonnes of 1997/99 (Table 3.3). Of this increment, about a half will be for feed, and 42 percent for food, with the balance going to other uses (seed, industrial non-food[11] and waste). Feed use will revert to being the most dynamic element driving the world cereal economy, in the sense that it will account for an ever-growing share in aggregate demand for cereals. It had lost this role in the last decade following the above-mentioned factors that affected feed use in two major consuming regions, the transition economies and the EU. Feed use had contributed only 14 percent of the total increase in world cereal demand between the mid-1980s and 1997/99, down from the 37 percent it had contributed the decade before.

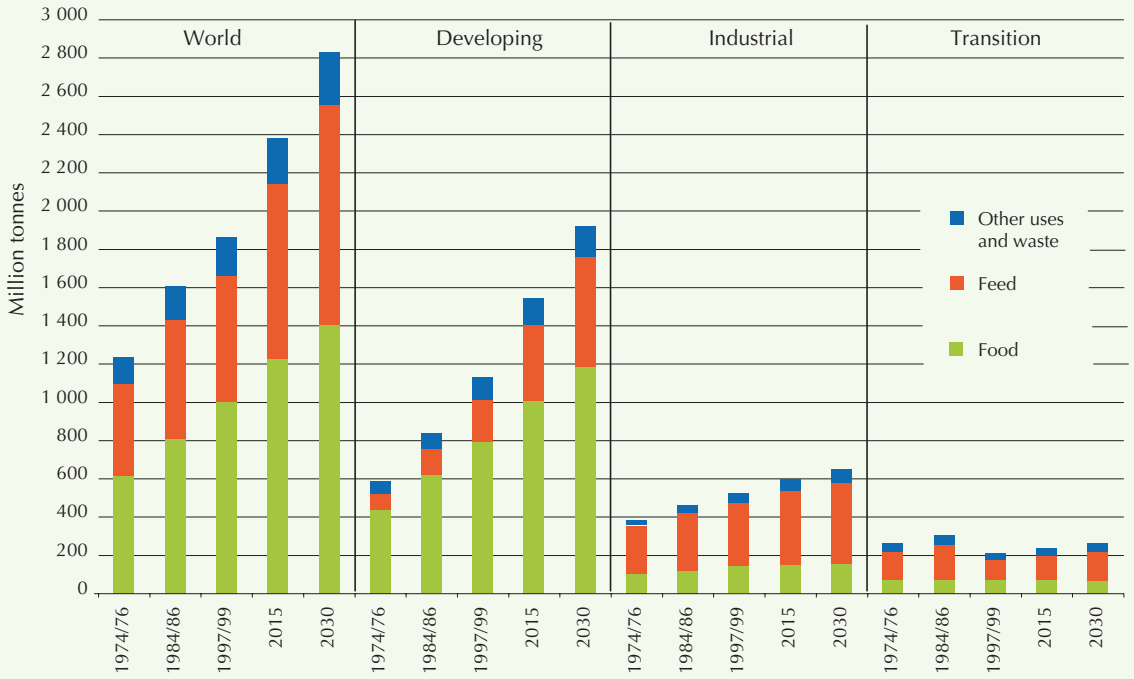
The turnaround of these two regions to growing feed use of cereals (already in full swing in the EU) or, in any case, the cessation of declines in the transition economies, tends to exaggerate the role of feed demand as a driving force in the long-term evolution of the structural relationships of the world cereal economy. With the rather drastic slowdown in the growth of the livestock sector (see Section 3.3), one would have expected that the role of feed demand as a driving force would be less strong than is indicated by the projected world totals in which the increase in feed use accounts for 51 percent of the increment in total cereal demand. As noted, it accounted for only 14 percent in the period from the mid-1980s to 1997/99. For the world without the transition economies and the EU, the jump in the shares is much less pronounced, which is far more representative of the long-term

9 Changes in production were much more pronounced (344 and 321 kg, respectively), and the effects on consumption were smoothed by changes in stocks.

10 Average per capita numbers for large aggregates comprising very dissimilar country situations (like the world per capita cereal consumption) have limited value as indicators of progress (or regress) and can be outright misleading. In practice, the world can get poorer on the average even though everyone is getting richer, simply because the share of the poor in the total grows over time. This can be illustrated as follows (example based on approximate relative magnitudes for the developing and the developed countries): in a population of four persons, one is rich, consuming 625 kg of grain, and three are poor, each consuming 225 kg. Total consumption is 1 300 kg and the overall average is 325 kg. Thirty years later, the poor have increased to five persons (high population growth rate of the poor) but they have also increased consumption to 265 kg each. There is still only one rich person (zero population growth rate of the rich), who continues to consume 625 kg. Aggregate consumption is 1 950 kg and the average of all six persons works out to 325 kg, the same as 30 years earlier. Therefore, real progress has been made even though the average did not increase. Obviously, progress could have been made even if the world average had actually declined. Thus, if the consumption of the poor had increased to only 250 kg (rather than to 265), world aggregate consumption would have risen to 1 875 kg but the world average would have fallen to 312.5 kg (footnote reproduced from Alexandratos, 1999).

11 Uses of maize for the production of sweeteners and of barley for beer are included in food, not in industrial use. The latter includes use of maize for the production of fuel ethanol.

Figure 3.9 Aggregate consumption of cereals, by category of use

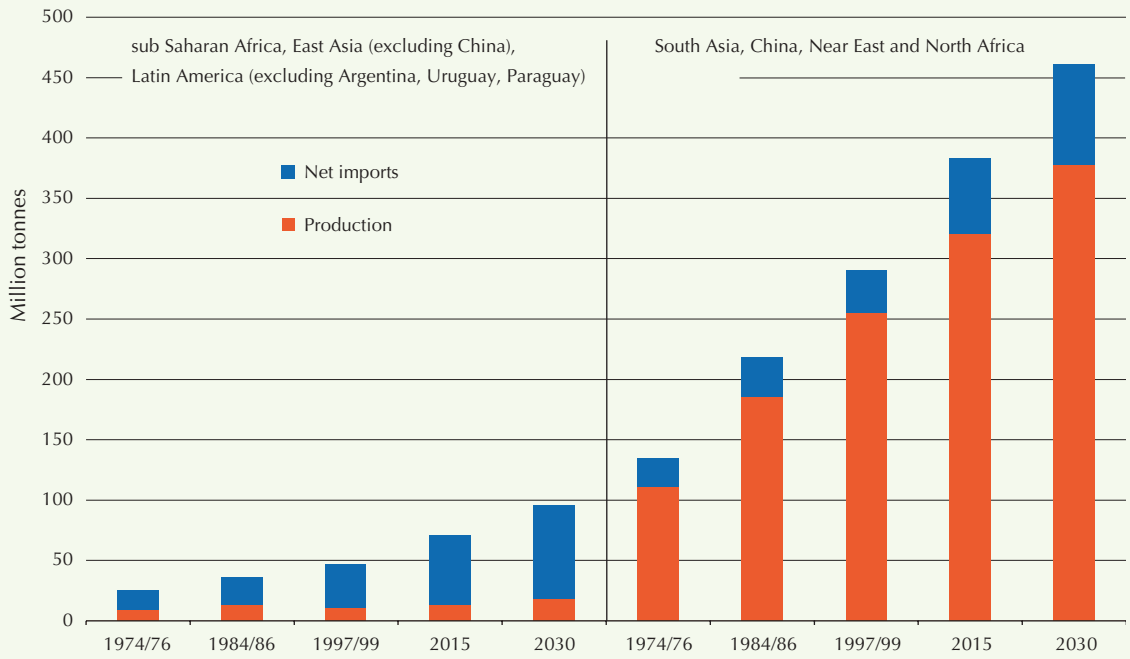


evolution of structural relationships than the global magnitudes would suggest. Such evolution increasingly depends on what happens in the developing countries. In these countries, feed accounted for 21 percent of the increment in total demand in the decade starting in the mid-1970s. It accounted for 29 percent in the period from the mid-1980s to 1997/99. In the projections, the share grows further to 45 percent of the increase in their total projected demand (see Section 3.3 for further discussion).

Commodity composition. The per capita consumption of *rice* will tend to level off in the first part of the projection period and decline somewhat in the second part. In the first subperiod the major factor is the slowdown in China and several other countries in East Asia, while per capita consumption in South Asia continues to increase. Slow declines will probably occur in South Asia after 2015. Here reference is made to the earlier discussion on food demand for all commodities and the related implications for total calories and nutrition: by 2030, East Asia will have moved close to 3 200 calories and South Asia to 2 900 (Chapter 2, Table 2.1). These levels suggest that per capita consumption of rice will not be as high as at present. The end result of these possible developments, together with the deceleration in population growth, is that the aggregate demand for rice will grow at a much slower rate than in the past, from 1.6 percent p.a. in the 1990s and 2.6 percent in the 1980s to 1.2 percent p.a. in the period to 2015 and on to 0.8 percent p.a. after 2015. Therefore, the pressure to increase production will also ease. With the slowdown in the growth of yields in recent years, maintaining growth even at much lower rates will be no mean task and may require no less effort (research, irrigation, policy, etc.) than in the past (see discussion in Chapter 4).

Wheat consumption per capita (all uses) will continue to increase in the developing countries as well as in the transition economies and the industrial countries, following the cessation of the factors that depressed demand in these two latter groups. In the developing countries, the increases in the consumption of wheat will be partly substituting for rice. The developing countries will continue to increase their dependence on imports. Their net imports would grow from 40 million tonnes in the mid-1970s and 72 million tonnes in 1997/99, to 120 million tonnes in 2015 and 160 million tonnes in 2030 (these numbers exclude Argentina and Uruguay that will be growing net exporters).

Figure 3.10 Wheat production and net imports



To appreciate why we project these rather significant increases in net imports of wheat, the relevant data and projections are plotted in Figure 3.10 in more disaggregated form. In the first place, in the regions that are not major producers themselves in relation to their consumption (roughly, sub-Saharan Africa, East Asia other than China, Latin America other than Argentina, Uruguay and Paraguay), consumption growth will be accompanied by increases in net imports, as in the past. For example, in these regions a consumption increase of 23 million tonnes between 1997/99 and 2015 will be accompanied by an increase in net imports of 21 million tonnes. In the preceding period (1984/86-1997/99) the comparable figures were 12 million tonnes increase in consumption and 14 million tonnes increase in net imports. Therefore, there is nothing new here. In contrast, what is new is that developments in the rest of the developing countries may diverge from past experience. As noted, production increases and declines in net imports and occasional generation of net exports in some of the major wheat-consuming countries (China, India, some countries in the Near East/North Africa region) masked the growing dependence of consumption growth in the developing countries on imported wheat. This factor will be much less important in the future. Some of the countries that had this role will probably turn around to be net importers again (e.g. India, Saudi Arabia and the Syrian Arab Republic) or larger net importers (e.g. China, Pakistan and Bangladesh) in the future.

World consumption of *coarse grains* should grow faster that of the other cereals (Table 3.3 and Figure 3.4), following the growth of the livestock sector. The shift of world consumption of coarse grains to the developing countries will continue and their share in world total use will rise from 47 percent at present (and 34 percent in the mid-1980s) to 54 percent in 2015 and 59 percent in 2030. Much of the increase (72 percent) in coarse grains use in developing countries will be for feed, a continuing trend in all regions except sub-Saharan Africa, where food use will continue to predominate. In sub-Saharan Africa, coarse grains will continue to constitute the mainstay of cereal food consumption. If sub-Saharan Africa's production growth rates of the past (3.3 percent p.a. in the past 20 years, 2.8 percent p.a. in the last ten) could be maintained, as is feasible in our evaluation (we project a growth rate of 2.8 percent p.a. to 2015), and given lower population growth, the region could raise per capita food consumption of coarse

grains by some 11 kg, to 101 kg by 2030 (Figure 3.11). This may not be impressive and certainly falls short of what is needed for food security, but we must recall that there was no increase in the last 20 years.

Production, imports and exports. World trade in cereals tended to slow down after the mid-1980s. Here we examine net imports and exports of the different country groups.

Our projections anticipate a revival of the net cereal imports of the developing countries and of the exports of the main cereal exporters. FAO's medium-term projections to 2010 (FAO, 2001b) had already anticipated this revival and had net cereals imports of the developing countries growing to 150 million tonnes in 2010. Our own projections to 2010 made in the early 1990s from base year 1988/90 indicated 162 million tonnes in 2010 (Alexandratos, 1995, p. 145). This projection to 2010 remains largely valid in the current work – we now have 190 million tonnes in 2015 and 265 million tonnes in 2030.

The commodity structure (wheat, coarse grains and rice) of the net trade balances is shown in Table 3.5. Net imports of the developing countries are projected to increase by 162 million tonnes between 1997/99 and 2030, roughly 80 million tonnes each of wheat and coarse grains, while they should increase their net rice exports by some 2 million tonnes (Table 3.5). The latest International Food Policy Research Institute (IFPRI) projections to 2020 paint a somewhat less buoyant outlook for the net imports of the developing countries: they project them at 202 million tonnes for the year 2020 (Rosegrant *et al.*, 2001, Table D.10) compared to our 190 million tonnes in 2015 and 265 million tonnes in 2030.

The quantities of cereals that will need to be traded in the future are certainly large, but the rates of change in the net trade position of the developing countries are not really revolutionary; a 158 percent increase over 32 years is somewhat less than the increase that occurred in a period of 23 years from the mid-1970s to 1997/99. However, these quantities may appear large in the light of the factors discussed above that made for deceleration in the world cereal trade in recent years. How reliable are these projections? We cannot tell in any scientific way, but a comparison of our earlier projections of the cereal deficits of the developing countries to 2000 (made in the mid-1980s from base year 1982/84), and to 2010 (referred to above) with actual outcomes is encouraging. As Figure 3.7 shows, the mid-1980s projection indicated 112 million net imports of the

Figure 3.11 Sub-Saharan Africa, cereal food per capita

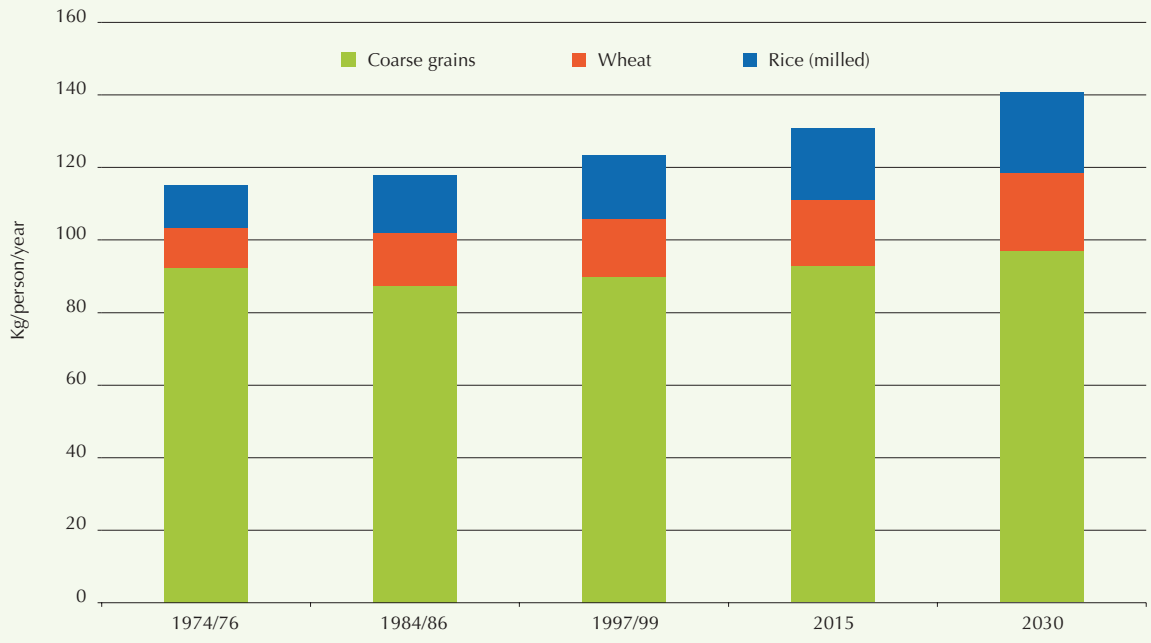


Table 3.5 Net trade balances of wheat, coarse grains and rice

	1974/76	1984/86	1997/99	2015	2030
			Million tonnes		
			Developing countries		
All cereals	-38.8	-66.4	-102.5	-190	-265
Wheat	-37.9	-48.8	-61.8	-104	-141
Coarse grains	-0.2	-17.6	-43.2	-89	-128
Rice (milled)	-0.7	0.0	2.5	3	5
			Industrial countries		
All cereals	55.1	105.9	110.7	187	247
Wheat	41.4	70.8	66.0	104	133
Coarse grains	12.1	33.7	43.4	83	115
Rice (milled)	1.6	1.4	1.4	0	-1
			Transition countries		
All cereals	-15.7	-37.3	0.9	10	25
Wheat	-4.8	-20.2	-0.3	4	12
Coarse grains	-10.4	-16.5	2.1	8	15
Rice (milled)	-0.5	-0.6	-0.9	-1	-1
Memo item.			**Developing excl. net exporters**[1]		
All cereals	-51.4	-91.5	-134.6	-238	-330
Wheat	-39.5	-55.6	-70.9	-118	-157
Coarse grains	-10.1	-31.3	-54.6	-107	-154
Rice (milled)	-1.8	-4.5	-9.2	-13	-19

[1] Developing net exporters: those with net cereal exports over 1 million tonnes in 1997/99 (Argentina, Thailand and Viet Nam). India and China, although they met this criterion, are not included in the net exporter category as they are only occasional net exporters.

developing countries for 2000 (Alexandratos, 1988, p.106). The actual outcome is 111 million tonnes (three-year average 1999/2001, see Figure 3.7).

To appreciate why this "revival" in the growth of imports may come about, reference is made to the preceding discussion of the factors underlying the growth in the wheat imports of the developing countries in the projections. In practice, explaining the growth of import requirements means explaining the factors that will cause the growth rates of demand and production (given in Table 3.4) to diverge from each other in the different countries and regions, given that net trade balances are by definition the difference between demand and production. The main arguments affecting demand were amply discussed above, while the (mainly agronomic) factors in projecting production are examined in Chapter 4. A brief discussion of trends, or breaks in trends, in production will help to explain why deficits of the developing countries could continue to grow despite ever-decelerating demand.

Two examples illustrate what is involved: wheat in South Asia and wheat and coarse grains in the region Near East/North Africa.

South Asia now produces 89 million tonnes of wheat, consumes 89 million tonnes and has net imports of 7 million tonnes (the difference going to increase stocks in 1997/99), down from net imports of 10 million tonnes in the mid-1970s. For 2015, demand (all uses) is projected to be 138 million tonnes (going from 69 kg to 82 kg in per capita terms). The growth rate of 2.6 percent p.a. is lower than the 3.3 percent p.a. of the preceding two decades (1979-99). So why should imports be increasing? The reason is that production is

Table 3.6 South Asia, land-yield combinations of wheat production

	Rainfed land			Irrigated land			Total		
	Area '000 ha	Yield tonnes/ha	Production '000 tonnes	Area '000 ha	Yield tonnes/ha	Production '000 tonnes	Area '000 ha	Yield tonnes/ha	Production '000 tonnes
1974/76				25 459	1.31	33 398			
1984/86				32 129	1.85	59 529			
1997/99	7 450	1.21	9 013	28 889	2.78	80 357	36 339	2.46	89 370
2015	7 437	1.38	10 270	32 763	3.52	115 210	40 200	3.12	125 480
2030	7 416	1.56	11 540	36 434	4.22	153 890	43 850	3.77	165 430

Note: Land refers to harvested area and therefore includes area expansion under wheat from increased double cropping.

unlikely to keep the high growth rates of the past. Much of the wheat is now irrigated and the boost given in the past from expansion of wheat into irrigated areas and the spread of new varieties is becoming much weaker (Mohanty, Alexandratos and Bruinsma, 1998). In addition there are problems in maintaining the productivity of irrigated land, particularly in Pakistan. The growth rate of wheat production in the region has been on the decline: it was 3.2 percent p.a. in the latest ten years (1989-99), down from 4.0 percent in the preceding decade and 5.1 percent in the one before. We project an average production growth rate of 2.0 percent p.a. up to 2015, and 1.9 percent p.a. in 2015-2030. These growth rates are slower than those of demand, hence the growing import requirements even to meet a demand growth much below that of the past. The land-yield combinations underlying these production projections are shown in Table 3.6.

IFPRI projects a turnaround of South Asia to a growing net importer of cereals at higher levels than we project in Table 3.4. In contrast, the latest ten-year projections by the United States Department of Agriculture (USDA) consider that India would continue to be a small net exporter of wheat until the year 2011 (USDA, 2002).[12] The Food and Agricultural Policy Research Institute (FAPRI) 2002 projections for the same year have India as a small net importer (one million tonnes), but the underlying consumption projections are very low (an increase in per capita consumption of only 1 kg in ten years) while production growth is also well below past trends. The small growth in consumption (and hence of import requirements) may be an underestimate, given India's projected relatively high growth of incomes and the prospect that increased food demand will not be diverted to meat in the foreseeable future (see section on livestock below).

Similar considerations apply to wheat and coarse grains in the Near East/North Africa region and, of course, to other regions and crops. Net imports of wheat and coarse grains into Near East/North Africa are projected to grow from 45 million tonnes in 1997/99 to 80 million tonnes in 2015 and to 108 million tonnes in 2030. After a quantum jump in the 1970s up to the mid-1980s, imports stagnated up to the mid-1990s, before resuming rapid growth in the second half of the decade. The projected continuation in the recovery of import growth factors in, among other things, the assumption that the decline in the imports of Iraq will have been reversed by 2015. On the demand side, the region's population growth rate will remain relatively high for some time (1.9 percent p.a. to 2015). Some countries in the region are among the fastest growing in the world. The example of Yemen is instructive: the country had a population of 17 million in the base year 1997/99, but it is projected to be a really large country with 57 million in 2030. Its present consumption of cereals amounts to 180 kg/person (all uses) or some 3 million tonnes p.a. of which only 0.7 million tonnes comes from local produc-

[12] "The surpluses of mostly low-quality wheat are generally not exportable without subsidy, but low levels of exports to neighbouring South Asian and Middle Eastern countries are expected to continue" (USDA, 2002, p.103)

tion. No quantum jumps in production are foreseen. Therefore, even without increases in per capita consumption, aggregate demand will be over 10 million tonnes in 2030, more if we factor in some modest increase in per capita consumption. For the whole Near East/North Africa region, the aggregate demand is bound to grow at 2.0 percent p.a. (see Table 3.4), even with a modest increase in per capita consumption of cereals for all uses (under 10 percent over the whole projection period).

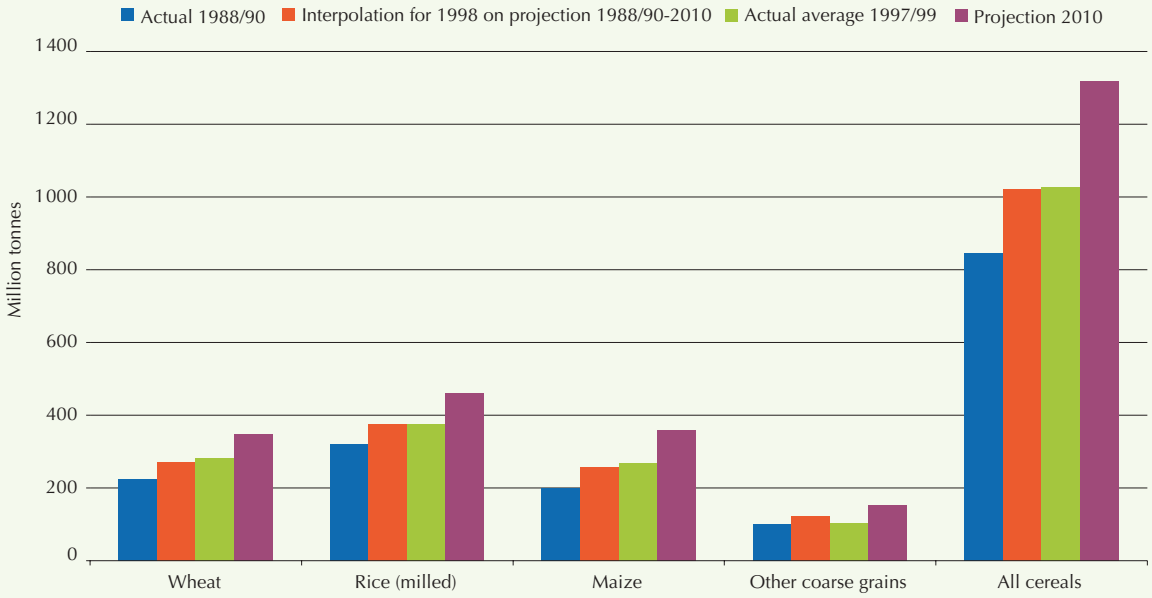
The projected growth in Near East/North Africa deficits reflects the prospect that production of wheat and coarse grains may not keep up even with this lower growth of demand. Production, which grew fairly fast in the past (3 percent p.a. in the 1970s and the 1980s) has shown no consistent trend since then; the average growth rate of the latest ten-year period (1991-2001) was -1.7 percent p.a. and production was 67 million tonnes in the latest three-year average 1999/2001, down from the 73 million tonnes at the beginning of the decade (average 1989/91). Among the major producers, Saudi Arabia's production of wheat and coarse grains declined by 46 percent, and that of North Africa (outside Egypt) by 30 percent. Among the major producers of the region, only Egypt and the Syrian Arab Republic had higher production in 1999/2001 than at the beginning of the decade. The evaluation of the possible land-yield combinations in the future (shown in Table 3.7), as well as the prospect that there will be no return to the heavy production subsidies some countries provided in the past, do not permit optimism concerning the possibility that growth of aggregate wheat and coarse grains production of the region could exceed 1.5 percent p.a. in the projection period. Hence the need for growing net imports to support the modest increase in per capita consumption.

As noted, the production projections that give rise to the import requirements presented here are derived from a fairly detailed analysis of the production prospects of individual developing countries commodity by commodity. The method

Table 3.7 Near East/North Africa: areas and yields of wheat, maize and barley

	Rainfed land			Irrigated land			Total		
	Area '000 ha	Yield tonnes/ha	Production '000 tonnes	Area '000 ha	Yield tonnes/ha	Production '000 tonnes	Area '000 ha	Yield tonnes/ha	Production '000 tonnes
					Wheat				
1974/76							26 668	1.20	31 947
1984/86							25 023	1.52	38 090
1997/99	19 201	1.28	25 550	8 008	3.15	24 231	27 210	1.83	49 781
2015	18 965	1.48	28 080	8 980	3.76	33 720	27 945	2.21	61 800
2030	19 065	1.65	31 435	9 935	4.31	42 855	29 000	2.56	74 290
					Maize				
1974/76							2 410	2.26	5 450
1984/86							2 205	3.01	6 644
1997/99	655	2.30	1 506	1 563	5.65	8 826	2 218	4.66	10 331
2015	604	2.45	1 482	2 005	6.15	12 333	2 610	5.29	13 815
2030	552	2.69	1 482	2 673	7.15	19 108	3 225	6.39	20 590
					Barley				
1974/76							9 585	1.11	10 675
1984/86							12 585	1.20	15 135
1997/99	9 793	1.22	11 906	1 777	1.84	3 266	11 570	1.31	15 172
2015	10 728	1.49	15 942	1 885	2.28	4 304	12 610	1.61	20 245
2030	11 375	1.72	19 577	1 975	2.66	5 243	13 350	1.86	24 820

Figure 3.12 Cereal production, all developing countries: comparison of actual outcomes average 1997/99 with projections to 2010 made in 1993 from base year 1988/90[1]



Interpolations from projected values by Alexandratos (1995, p. 145).

is described in Appendix 2. It is the same approach we used in earlier studies. In 1992-93, we had projected total cereal production in the developing countries to grow from 847 million tonnes in 1988/90 to 1318 million tonnes in 2010 (Alexandratos, 1995, p. 145). The interpolation for 1998 on the trajectory 1988/90-2010 (separately for each of the main cereals, see Figure 3.12) is 1 023 million tonnes. The actual outcome for the three-year average 1997/99 is 1 027 million tonnes (data as of February 2002).

Producing the export surplus. To explore how the growing import requirements may be matched by increases on the part of the exporters we need some rearrangement and more detailed setting out of the data and projections. This is attempted in Table 3.8. The following comments refer mainly to the contents of this table.

In the period from the mid-1970s to 1997/99, the net imports of the developing importers (developing countries not including the net exporters Argentina, Uruguay, Thailand and Viet Nam), plus those of the transition economies and the industrial importers (industrial countries minus the EU, North America and Australia) went from 89 million tonnes to 167 million tonnes, an increment of 78 million tonnes (subtotal 2 in Table 3.8). It was met by increases of the net trade balances of the following country groups which were traditional exporters or became such during that period: the EU 45 million tonnes (from net imports of 21 million tonnes to net exports of 24 million tonnes); North America 10 million tonnes; Australia 12 million tonnes; and combined Argentina, Uruguay, Thailand and Viet Nam 20 million tonnes.[13]

In the projections, the net import requirements of the developing importers and the industrial importers rise from 168 million tonnes in 1997/99 to 275 million tonnes in 2015 and to 368 million tonnes in 2030 (subtotal 1 in Table 3.8), an increase of 107 million tonnes to 2015 and another 93 million tonnes by 2030. These quantities must be generated as additional export surplus by the rest of the world. Where will they come from? The novel element in the projections is that part of the required increase may come from the transition economies, while the rest should come from the traditional exporters, developing and industrial.

[13] There is a large statistical discrepancy of 9 million tonnes in 1997/99 in the trade statistics.

Table 3.8 World cereal trade: matching net balances of importers and exporters

	Net imports (-) or exports (+)				Increment		
	1974/76	1997/99	2015	2030	1974/76 -1997/99	1997/99 -2015	2015 -2030
	Million tonnes				Million tonnes		
1 Developing importers[1]	-51	-135	-238	-330	-83	-104	-91
2 Industrial importers	-22	-33	-37	-38	-12	-4	-2
3 Subtotal 1 (=1+2)	-73	-168	-275	-368	-95	-107	-93
4 Transition countries	-16	1	10	25	17	10	15
5 Subtotal 2 (=3+4)	-89	-167	-265	-343	-78	-98	-78
6 Argentina +Uruguay + Thailand +Viet Nam	13	32	49	65	20	17	16
7 World imbalance	1	9	8	8	9	-1	0
8 Balance for industrial exporters[2] (=-5-6+7)	77	144	224	286	67	80	62
Memo item. **Production of industrial exporters**							
	Million tonnes				Percentage p.a.		
Total	430	629	758	871	1.1	1.1	0.9

[1] Developing countries excl. Argentina, Uruguay, Thailand and Viet Nam.
[2] North America, Australia and EU15.

The transition economies (not included in the net importing regions in the projections) could be net exporters of 10 million tonnes by 2015, a rather modest outcome given their resource potential which could put them in a position to produce even larger surpluses under the right policies. The reasons why this group of countries may eventually turn from the large net importer it was up to the late 1980s into a net exporter in the longer-term future are as follows: per capita consumption or – more correctly – domestic disappearance, will not revert to the very high pre-reform levels following the reduction of the high rates of food losses; the more efficient use of grain in animal feed; and the continued reliance, at least for the medium term, on imports of livestock products to cover part of domestic consumption. On the production side, land resources in several countries in this group are relatively plentiful and yields are well below those achieved in other countries with similar agro-ecological conditions (see Chapter 4 for comparisons with those obtainable under high-input technologies). The eventual integration of some Eastern European countries into the EU has the potential of contributing to this process, mainly in favour of coarse grains (USDA, 1999a).

These considerations suggest that the eventual recovery of production in the transition economies will result in export surpluses. We are rather conservative in our projections, as the production growth rate of cereals required to meet the growth of domestic demand and produce the 10 million tonnes net exports in 2015 is 1.0 percent p.a. This is modest, seeing that they start from the depressed levels to which production had fallen by the late 1990s. Other studies are much more optimistic about this potential. For example the latest IFPRI projections (Rosegrant *et al.*, 2001, Figure 4.9) suggest over 25 million tonnes net exports from Eastern Europe and the countries of the former Soviet Union in 2020. The latest FAPRI (2002) projections foresee 15 million tonnes for the year 2011 (the sum of wheat, barley and maize) as does the most recent USDA study (USDA, 2002, Tables 36-40), while Dyson (1996) has much larger numbers.

The net exports of the developing exporters (Argentina, Uruguay, Thailand and Viet Nam) are projected to rise from 32 million tonnes to some

50 million tonnes by 2015. Thailand and Viet Nam are projected to remain net exporters of cereals because of rice, although they will be growing net importers of the other cereals, mainly wheat. It follows that the more "traditional" industrial country exporters (North America, the EU and Australia) would need to increase net exports by 80 million tonnes by 2015 and another 62 million tonnes by 2030, i.e. by amounts roughly comparable to the increase of 67 million tonnes they recorded in the period 1974/76-1997/99 (Row 8 in Table 3.8).

The question is often raised as to whether these countries have sufficient production potential to continue generating an ever-growing export surplus. Concern with adverse environmental impacts of intensive agriculture is among the reasons for this question. The answer depends, *inter alia*, on how much more these countries must produce over how many years. Production growth requirements are derived by adding the above increments in net exports to the increments in their own domestic demand, including demand for cereals to produce livestock products for export.[14] The resulting projected production is shown in the lower part of Table 3.8. These countries are required to increase their collective production from the 629 million tonnes of 1997/99 to 758 million tonnes in 2015 and 871 million tonnes in 2030, an increment of 242 million tonnes over the entire period, of which about 80 million tonnes are wheat and the balance largely coarse grains. The annual growth rate is 1.1 percent p.a. in the period to 2015 and 0.9 percent p.a. in the subsequent 15 years, an average of 1.0 percent p.a. for the entire 32-year projection period. This is lower than the average growth rate of 1.6 percent p.a. of the past 32 years (1967-99), although the historical growth rate has fluctuated widely, mostly as a function of the ups and downs of export demand, associated policy changes and occasional weather shocks. The annual growth rates of any ten-year period in the past 35 years moved in the range from 3.4 percent (decade ending in 1982) to minus 0.1 percent (decade to mid-1990s), with the latest being 1.5 percent in 1989-99. The overall lesson of the historical experience seems to be that the production system responds flexibly to meet increases in demand within reasonable limits.

Of the three traditional industrial exporters, the EU faces the additional constraint that it can increase production for export only if it can export without subsidies. A key question is, therefore, whether market conditions will be such as to make possible unsubsidized exports. The relevant variables are the policy prices of the EU, the prices in world markets and the exchange rate €/US$. We have not gone into modelling explicitly these variables, but we project that the EU will be a growing net exporter of wheat and barley without subsidies. There seems to be a fair degree of consensus on this matter. The European Commission's latest projections to 2008 point in the same direction: "total cereal exports would stand substantially above the annual limit for subsidized exports set by the URAA limits (i.e. 25.4 million tonnes for total cereals) as durum wheat, some common wheat and barley/malt would be exported without subsidies" (European Commission, 2001, p. 37).[15]

Other studies agree in their findings that the EU will be a growing net exporter of cereals, at levels exceeding the limits for exports with subsidies[16] as defined under the Uruguay Round Agreement on Agriculture (URAA). The 2002 USDA baseline projection to 2011 concludes that "due to the declines in intervention prices and the weak euro, projected domestic and world prices indicate that EU wheat and barley can be exported without subsidy throughout the baseline period" (USDA,

[14] The term "domestic demand" can be misleading if it gives the impression that the inhabitants of the country actually "consume", directly or indirectly, the amounts used domestically. This can be especially misleading when a significant proportion of the cereals consumed goes to produce livestock products for export. For example, Denmark is given in the statistics as having the highest per capita consumption of cereals (all uses) in the world, 1 450 kg. But the country exports net two-thirds of its meat production and over 50 percent of production of milk and dairy products. It is also a net exporter of beer, which uses barley as input.

[15] Last-minute addition (June 2002): the Commission has just published the 2002 edition of its projections to 2009. It has the same projected exports of wheat and coarse grains as in the 2001 edition, i.e. exceeding the URAA limits, but adds: "These projections for cereal exports remain conditional upon an export policy that ensures the full use of the URAA limits" (European Commission, 2002, p.13). Somehow, this could imply the development of dual markets within the EU, if some exports will be with subsidies and others without. However, this need not be so if the non-subsidized cereals (e.g. durum wheat and malting barley) are different from the subsidized ones, e.g. feed barley and soft wheat.

[16] The UR limits for EU exports with subsidies are, roughly, 25 million tonnes. These limits refer to gross exports, while imports will be about 5-7 million tonnes, including those under the UR commitments. It follows that any projection study showing net EU exports over 18-20 million tonnes must assume (implicitly or explicitly) that in the future the right combination of domestic and foreign prices and exchange rates will prevail.

2002, p. 90).[17] It projects net EU exports of wheat and coarse grains of some 35 million tonnes net for the year 2011 (USDA, 2002, Tables 36-40). The FAPRI projections have net exports of 29 million tonnes for the same year (FAPRI, 2002). Longer-term studies point in the same direction: the most recent IFPRI assessment is more conservative with a projection of about 30 million tonnes net EU exports in 2020 (Rosegrant *et al.*, 2001, Table D.10).

When speaking of the need for the traditional industrial food exporters to increase their production for export further, the issue of the environmental effects of more intensification of their agricultures becomes relevant. For example, the EU study's net export outcomes are based on cereal yields rising at an annual rate of 1.3 percent to 2008. This is lower than the historical trend, but still raises the issue of the environmental risks associated with rising yields in the intensively farmed areas that produce much of the EU export surplus, e.g. France. Such risks are mainly related to the excessive use of fertilizer and other chemicals. The risk would be certainly increased if the pursuit of higher yields were to be accompanied by inappropriate use of fertilizer leading to increases in the nitrogen balance in the soil (difference between nitrogen inputs into the soil and uptake by crops). Empirical evidence suggests that this need not be so. OECD work on environmental indicators finds that the nitrogen balance in the EU declined from 69 kg/ha to 58 kg/ha of agricultural land between 1985/87 and 1995/97 (OECD, 2000a, Annex Table 1). Over the same period, the yield of wheat increased from 4.7 tonnes/ha to 5.5 tonnes/ha, and that of total cereals from 4.5 tonnes/ha to 5.2 tonnes/ha. Changes in the structure of incentives (e.g. reduced support prices), advances in technology (precision agriculture, etc.) and imposition of tighter management regimes concerning use of manure, probably explain much of this phenomenon.

Some environmental considerations.[18] It is important that eventual environmental risks associated with the growth of production for export be viewed in a global context, and the associated trade-offs recognized. How do such risks compare with those faced by other countries that would also be raising their production? And how does enhanced production for export contribute to, or detract from, world food security by making world agriculture as a whole more sustainable (or less unsustainable)?

This issue can be addressed schematically with the aid of a simple classification of natural resource/technology combinations used in grain production, on the one hand, and development levels, on the other. The former determines the extent to which the growth of production enhances the risk of adverse environmental impacts (e.g. soil erosion, salinization of irrigated areas, nitrate pollution of water bodies). The latter determines the value people place on resource conservation and on the environment, relative to the more conventional benefits from increased production, e.g. food security, farm incomes, export earnings, etc. This classification is as follows (from FAO, 1996d):

- Intensive high-income systems: for example, the Brie area in the Paris basin of France, characterized by very high grain yields obtained with substantial inputs of fertilizers and pesticides. Main environmental problem: water pollution from fertilizers and other chemicals.
- Extensive high-income systems: for example, Australia and western Canada, characterized by moderate to low grain yields and little or no use of fertilizers. Main environmental problem: soil erosion, mainly caused by wind and occasional intense rainfall.
- Intensive low-income systems: for example, areas of intensive grain cultivation under irrigation in India (Punjab, Haryana and Uttar Pradesh), characterized by medium-high yields and fertilizer applications. Main environmental problem: salinization, but also waterlogging and water scarcities.
- Extensive low-income systems: for example, Côte d'Ivoire, coarse grain production in areas expanding under population pressure (often in slash-and-burn mode), very low yields, virtually no fertilizer. Main environmental problem: deforestation and soil mining, leading to declining yields, abandonment and further expansion into new areas.

[17] In the USDA study: "The euro is assumed to strengthen slightly against the dollar in 2002 through 2004, and then to weaken somewhat through the remainder of the projections" (USDA, 2002, p. 89). The FAPRI assumptions are more optimistic about the euro: it reaches parity with the US dollar in 2006 and remains there until 2011.

[18] This section draws heavily on Alexandratos and Bruinsma (1998).

As noted (Table 3.3), in the 32-year period from 1997/99 to 2030, the world will need to increase annual production of cereals (including rice in milled form) by nearly another billion tonnes. This is roughly the amount by which world production increased in the preceding 32 years (1967-1999), a process which led to a better fed world but also brought with it the resource and environmental problems we are facing today.[19] The preceding rough classification shows the very wide diversity of natural and socio-economic conditions and the associated threats to the resource base and the environment, under which humanity will have to extract the additional billion tonnes from the earth. Although sweeping generalizations must be avoided, it would appear that it will be extremely difficult to produce so much more than currently, without putting additional pressure on the environment.

It is conceivable that under the right policies (for incentives, institutions, technology development and adoption) this additional pressure could be minimized or even reversed for some time. However, here we are speaking of very substantial increases in production and, although these are to be achieved over a period of 32 years, it is difficult to visualize how enhanced pressures on the environmental resources can be avoided entirely. In addition, the stark fact has to be faced that, for the world as a whole, adoption of measures to minimize impact will be a slow process, and will perhaps remain for some time beyond the capability of those societies that most need to increase production. These are precisely the countries whose very survival is threatened by the deterioration of their agricultural resources, given the high dependence of their economies on agriculture (Schelling, 1992). It is the high-income countries, in principle those that least need to increase production for their own consumption and food security, that place a high value on minimizing the adverse environmental impacts of agriculture and that also have the means to take action (for the EU, see Brouwer and van Berkum, 1996). These considerations provide a framework for thinking about the role of traditional exporters as suppliers of growing export surpluses in a world that has to accept the trade-offs between more food and the environment and must seek ways to optimize them (see Chapter 12).

3.3 Livestock commodities

3.3.1 Past and present

Livestock, a major factor in the growth of world agriculture. The world food economy is being increasingly driven by the shift of diets and food consumption patterns towards livestock products. Some use the term "food revolution" to refer to these trends (Delgado *et al.*, 1999). In the developing countries, where almost all world population increases take place, consumption of meat has been growing at 5-6 percent p.a. and that of milk and dairy products at 3.4-3.8 percent p.a. in the last few decades. Aggregate agricultural output is being affected by these trends, not only through the growth of livestock production proper, but also through the linkages of livestock production to the crop sector which supplies the feeding stuffs (mainly cereals and oilseeds), and benefits from the important crop-livestock synergies prevailing in mixed farming systems (de Haan *et al.*, 1998).

On the negative side, and in association with policy distortions or market failures, there are environmental implications associated with the expansion of livestock production. For example, through the expansion of land for livestock development, livestock sector growth has been a prime force in deforestation in some countries such as Brazil, and in overgrazing in other countries. Intensive livestock operations on an industrial scale, mostly in the industrial countries but increasingly in the developing ones, are a major source of environmental problems through the production of point-source pollution (effluents, etc.).[20] In parallel, growth in

[19] There are those who hold that the choices made in the past to achieve the increases in production (in essence the pursuit of high yields), although far from perfect, have, on balance, contributed to prevent more serious environmental problems from emerging. The standard example is the amount of additional land that would have been deforested and converted to crops if the additional output had been produced with little growth in yields (Avery, 1997). Naturally, this counterfactual proposition is not always appropriate given the fact that land expansion could not have substituted for intensification in many parts of the world where there was no spare land. Perhaps the trade-off should be conceived between the "bads" of intensification and human suffering (e.g. higher mortality) from reduced food security.

[20] A recent study puts the problem as follows: "In 1964, half of all beef cows in the United States were on lots of fewer than 50 animals. By 1996, nearly 90 percent of direct cattle feeding was occurring on lots of 1 000 head or more, with some 300 lots averaging 16 000-20 000 head and nearly 100 lots in excess of 30 thousand head. These feedlots represent waste management challenges equal to small cities, and most are regulated as point-source pollution sites under the authority of the US Environmental Protection Agency (EPA)" (Commission for Environmental Cooperation-NAFTA, 1999, p. 202).

Table 3.9 Milk and dairy products, production and use: past and projected

	1964/66	1974/76	1984/86	1994/96	1997/99	2015	2030
	Food per capita (kg, whole milk equivalent)						
World	74	75	78	77	78	83	90
Developing	28	30	37	42	45	55	66
Sub-Saharan Africa	28	28	32	29	29	31	34
Near East/North Africa	69	72	83	71	72	81	90
Latin America and the Caribbean	80	93	94	106	110	125	140
South Asia	37	38	51	62	68	88	107
East Asia	4	4	6	10	10	14	18
Industrial countries	186	191	212	212	212	217	221
Transition economies	157	192	181	155	159	169	179
Memo item							
World excl. transition economies	65	64	69	71	72	78	85

	'000 tonnes	Growth rates, % p.a.					
	1997/99	1969-99	1979-99	1989-99	1992-99	1997/99 -2015	2015 -30
	Aggregate consumption (all uses, whole milk equivalent)						
World	559 399	1.3	0.9	0.5	1.1	1.4	1.3
Developing	239 068	3.6	3.4	3.8	4.0	2.7	2.2
Sub-Saharan Africa	18 134	2.7	1.7	2.1	2.8	2.9	2.7
Near East/North Africa	32 979	2.6	1.6	2.0	2.6	2.4	2.2
Latin America and the Caribbean	61 954	2.7	2.6	3.5	3.5	2.0	1.7
South Asia	104 552	4.5	4.8	4.8	5.0	3.1	2.4
East Asia	21 450	5.8	5.6	4.9	4.1	2.7	2.2
Industrial countries	225 797	0.7	0.3	0.3	0.5	0.4	0.3
Transition economies	94 534	-0.4	-1.7	-4.8	-3.6	0.1	0.1
Memo item							
World excl. transition economies	464 865	1.9	1.7	2.0	2.2	1.7	1.5
	Production (whole milk equivalent)						
World	561 729	1.3	0.9	0.6	1.2	1.4	1.3
Developing	219 317	3.6	3.8	4.1	4.3	2.7	2.3
Sub-Saharan Africa	15 752	2.7	2.3	1.9	2.5	3.0	2.8
Near East/North Africa	28 186	2.3	2.2	3.1	3.4	2.2	2.1
Latin America and the Caribbean	56 551	2.6	2.8	3.9	4.1	2.1	1.8
South Asia	103 748	4.5	4.9	4.9	5.0	3.1	2.4
East Asia	15 081	6.9	6.9	4.5	4.4	2.9	2.2
Industrial countries	245 766	0.7	0.3	0.5	0.8	0.5	0.4
Transition economies	96 647	-0.3	-1.6	-4.6	-3.7	0.2	0.2
Memo item							
World excl. transition economies	465 083	1.8	1.7	2.1	2.4	1.7	1.5

the ruminant sector contributes to greenhouse gas concentrations in the atmosphere through methane emissions and nitrous oxide from the waste of grazing animals (see Chapters 12 and 13).

Important exceptions and qualifications. The strength of the livestock sector as the major driving force of global agriculture can be easily exaggerated. Many developing countries and regions, where the need to increase protein consumption is the greatest, are not participating in the process. In 40 developing countries, among those covered individually in this study, per capita consumption of meat was lower in the mid-1990s than ten years earlier. In this category are the regions of sub-Saharan Africa, with very low consumption per capita reflecting quasi-perennial economic stagnation. Also the Near East/North Africa, where the

Table 3.10 Food consumption of meat

	1964/66	1974/76	1984/86	1994/96	1997/99	2015	2030
	kg per capita, carcass weight equivalent						
World	**24.2**	**27.4**	**30.7**	**34.6**	**36.4**	**41.3**	**45.3**
Developing countries	10.2	11.4	15.5	22.7	25.5	31.6	36.7
excl. China	11.0	12.1	14.5	17.5	18.2	22.7	28.0
excl. China and Brazil	10.1	11.0	13.1	14.9	15.5	19.8	25.1
Sub-Saharan Africa	9.9	9.6	10.2	9.3	9.4	10.9	13.4
Near East/North Africa	11.9	13.8	20.4	19.7	21.2	28.6	35.0
Latin America and the Caribbean	31.7	35.6	39.7	50.1	53.8	65.3	76.6
excl. Brazil	34.1	37.5	39.6	42.4	45.4	56.4	67.7
South Asia	3.9	3.9	4.4	5.4	5.3	7.6	11.7
East Asia	8.7	10.0	16.9	31.7	37.7	50.0	58.5
excl. China	9.4	10.9	14.7	21.9	22.7	31.0	40.9
Industrial countries	61.5	73.5	80.7	86.2	88.2	95.7	100.1
Transition countries	42.5	60.0	65.8	50.5	46.2	53.8	60.7
Memo item							
World excl. China	28.5	32.6	34.3	34.1	34.2	36.9	40.3
World excl. China and transition countries	26.5	29.0	30.6	32.4	33.0	35.6	39.1
	Meat consumption by type (kg per capita, carcass weight equivalent)						
World							
Bovine meat	10.0	11	10.5	9.8	9.8	10.1	10.6
Ovine and caprine meat	1.8	1.6	1.7	1.8	1.8	2.1	2.4
Pig meat	9.1	10.2	12.1	13.7	14.6	15.3	15.1
excl. China	9.7	10.8	11.3	10.4	10.3	9.9	9.7
Poultry meat	3.2	4.6	6.4	9.3	10.2	13.8	17.2
Developing countries							
Bovine meat	4.2	4.3	4.8	5.7	6.1	7.1	8.1
Ovine and caprine meat	1.2	1.1	1.3	1.6	1.7	2.0	2.4
Pig meat	3.6	4.1	6.4	9.6	10.8	12	12.2
excl. China	2.1	2.4	2.8	3.3	3.4	4.0	4.7
Poultry meat	1.2	1.8	2.9	5.8	6.9	10.5	14.0
excl. China and Brazil	1.2	1.9	3.2	4.8	5.2	8.1	11.6

rapid progress of the period to the late 1980s (oil boom) was interrupted and slightly reversed in the subsequent years, helped by the collapse of consumption in Iraq. Similar considerations apply to developments in per capita consumption of milk and dairy products (Table 3.9). In the great majority of countries failing to participate in the upsurge of the livestock products consumption, the reason has simply been lack of development and income growth (including failures to develop agriculture and production of these products) that would translate their considerable latent demand for what are still luxury items into effective demand. Cultural and religious factors have also stood in the way of wider diffusion of consumption of meat in general in some countries (such as India) or of particular meats (such as beef in India and pork in Muslim countries).

The second major factor limiting the growth of world meat consumption is the fact that such consumption is heavily and disproportionately concentrated in the industrial countries. They account for 15 percent of world population but for 37 percent of world meat consumption and 40 percent of that of milk. Their average per capita consumption is fairly high – that of meat is 88 kg compared with 25 kg in developing countries. This leaves rather limited scope for further increases in their per capita consumption, while their population grows very slowly at 0.6 percent p.a. currently and 0.4 percent p.a. in the coming two decades. These characteristics of the industrial countries have meant that a good part of world demand has been growing only slowly. The aggregate meat consumption of the industrial countries grew at 1.3 percent p.a. in the last ten years (0.3 percent p.a. for milk), compared with 6.1 percent (3.8 percent for milk) in developing countries. This slow growth in the industrial countries has partly offset the accelerating growth in several developing countries that have been rapidly emerging as major meat consumers, such as China, Brazil and the Republic of Korea. The net effect of these contrasting trends has been a deceleration in the growth of world average per capita consumption of meat, going from 24 kg in the mid-1960s to 36 kg at present (Table 3.10). This deceleration is clearly seen in the growth rates of world aggregate consumption of meat (Table 3.11). The deceleration has been even more pronounced in the case of milk (Table 3.9), mostly because of developments in the transition economies (see below).

World averages conceal as much as they reveal. In the case of meat the strong growth in production and implied apparent consumption of pig meat in China in the 1980s and 1990s (which many observers believe to be grossly overstated in the country's statistics),[21] has shifted world meat consumption averages upwards rather significantly, from 30.7 kg in the mid-1980s to 36.4 kg at present. Without China, the average for the rest of the world would have actually stagnated in the same period (see memo item in Table 3.10). Again, this stagnation reflects the other extraordinary event of the 1990s, the collapse of consumption in the transition economies which went from 73 kg in the pre-reform period (late 1980s, when it had been boosted by heavy subsidies) to an estimated 46 kg in 1997/99. Excluding also the transition economies and the downward bias they impart to world totals, the per capita meat consumption in the rest of the world has been growing at a much slower, but always decelerating, pace: by 2.5 kg in the first decade (mid-1960s to mid-1970s), and by 1.6 kg in the second and third decades (see memo item in Table 3.10). Meat sector trends in the developing countries as a whole have been decisively influenced not only by China's rapid growth in the last two decades, but also by a similar performance in Brazil (from 32 kg in the mid-1970s to 71 kg at present). Including these two countries, the per capita meat consumption in the developing countries went over the same period from 11.4 to 25.5 kg. Excluding them, it went from 11 kg to only 15.5 kg (Table 3.10).

[21] According to its production and trade statistics, China's per capita meat consumption, resulting from the food balance sheets, was 45 kg in 1997/99. Independent consumption statistics show per capita consumption of "pork, beef, mutton" for 1997 of 19.04 kg for urban residents and 12.72 kg for the rural ones (UNDP, 2000a). The food balance sheet data we use here show for 1997/99 36.5 kg for the same meats plus another 8.5 kg for poultry meat. For a discussion of discrepancies see Feng Lu (1998); Fuller, Hayes and Smith (2000); and Colby, Zhong and Giordano (1998). It is indicative of the reservations with which the official production (and implied consumption) statistics are received by those concerned with world trade in livestock products, feedgrains and soybeans, that in FAPRI's latest projection study the data for per capita consumption of meat in China have been revised downwards drastically, to 31.5 kg in 1997/99 (FAPRI, 2002, livestock tables).

Table 3.11 Meat, aggregate production and demand: past and projected

	Production						Consumption				
	1997/99	1969 -1999	1979 -1999	1989 -1999	1997/99 -2015	2015 -2030	1997/99	1969 -1999	1979 -1999	1989 -1999	1997/99 -2015	2015 -2030
	'000 tonnes	Growth rates, % p.a.					'000 tonnes	Growth rates, % p.a.				
World												
Bovine	58 682	1.4	1.2	0.8	1.4	1.2	57 888	1.4	1.2	0.7	1.4	1.2
Ovine	10 825	1.9	2.2	1.4	2.1	1.8	10 706	1.9	2.2	1.4	2.1	1.8
Pig meat	86 541	3.2	2.9	2.7	1.4	0.8	86 392	3.2	2.9	2.7	1.4	0.8
Poultry meat	61 849	5.2	5.1	5.4	2.9	2.4	60 809	5.2	5.0	5.2	2.9	2.4
Total meat	217 898	2.9	2.8	2.7	1.9	1.5	215 795	2.9	2.8	2.7	1.9	1.5
Developing countries												
Bovine	27 981	3.0	3.4	3.8	2.3	2.0	28 074	3.4	3.5	4.1	2.3	2.0
Ovine	7 360	3.4	3.9	3.7	2.5	2.1	7 625	3.5	3.8	3.7	2.7	2.2
Pig meat	49 348	6.1	6	5.7	2.0	1.2	49 522	6.1	6.0	5.8	2.1	1.2
excl. China	10 892	3.7	3.3	3.4	2.7	2.4	11 393	3.6	3.2	3.7	2.7	2.4
Poultry meat	31 250	7.9	8.3	9.4	3.8	3.1	31 920	7.8	8.0	9.4	3.9	3.1
Total meat	115 938	5.2	5.5	5.9	2.7	2.1	117 141	5.3	5.6	6.1	2.7	2.1
excl. China	59 896	3.8	3.8	3.9	3.0	2.7	61 591	4.0	3.8	4.1	3.0	2.7
excl. China and Brazil	47 122	3.5	3.4	3.3	3.1	2.9	49 845	3.8	3.4	3.6	3.2	2.9
Total meat by region												
Sub-Saharan Africa	5 320	2.3	2.0	2.2	3.3	3.5	5 408	2.6	2.1	2.1	3.4	3.7
Near East/North Africa	6 956	4.4	4.4	3.8	3.6	2.9	8 164	4.7	3.3	3.3	3.6	2.9
Latin America and the Caribbean	27 954	3.5	3.4	4.5	2.6	2.1	27 296	3.8	3.7	4.8	2.4	2.0
excl. Brazil	15 180	2.5	2.2	3.1	2.7	2.3	15 551	3.0	2.6	4.0	2.6	2.2
South Asia	6 974	3.7	3.9	2.8	3.6	3.9	6 801	3.6	3.8	2.7	3.8	4.0
East Asia	68 734	7.1	7.6	7.6	2.4	1.6	69 472	7.1	7.7	7.8	2.5	1.6
excl. China	12 692	5.1	5.1	4.1	3.0	2.8	13 923	5.1	5.1	4.6	3.0	2.7
Memo items												
World livestock production (meat, milk, eggs)[1]		2.2	2.1	2.0	1.7	1.5						
World cereal feed demand (million tonnes)	657	1.3	0.6	0.6	1.9	1.5						
Population (million)												
World							5 878	1.7	1.6	1.5	1.2	0.9
Developing countries							4 572	2.0	1.9	1.7	1.4	1.1
excl. China							3 340	2.3	2.2	2.0	1.7	1.3
excl. China and Brazil							3 174	2.3	2.2	2.1	1.7	1.3

[1] Growth rates from aggregate production derived by valuing all products at 1989/91 international prices.

For milk and dairy products, there has been no "China effect" on world totals (given the small weight of these products in China's food consumption), but a very strong negative one on account of the transition economies, leading to a sharp slowdown in the growth rate of world production and consumption. Without them, there has been no deceleration in world production and consumption (Table 3.9, memo items).

In conclusion, the modest and decelerating growth in world per capita consumption of meat has been taking place for a wide variety of reasons. For the high-income countries, the reasons include the near saturation of consumption (e.g. in the EU and Australia), policies of high domestic meat prices and/or preference for fish (Japan and Norway), and health and food safety reasons everywhere. However, by far the most important reasons have been the above-mentioned failure of many low-income countries to raise incomes and create effective demand, as well as the cultural and religious factors affecting the growth of meat consumption in some major countries.

Rapid growth of the poultry sector. Perhaps the perception of revolutionary change in the meat sector reflects the extraordinary performance of world production and consumption of poultry meat. Its share in world meat production increased from 13 percent in the mid-1960s to 28 percent currently. Per capita consumption increased more than threefold over the same period. That of pork also increased from 9.1 kg to 14.6 kg (China's statistics helping, but from 9.7 kg to only 10.3 kg for the world without China, Table 3.10). In contrast, per capita consumption of ruminant meat (from cattle, sheep and goats) actually declined a little. The most radical shifts in consumption in favour of poultry meat took place in countries that were the traditional producers, and often major exporters, of bovine meat: Latin America, North America and Oceania (accompanied in the latter two by deep cuts in the consumption of beef), as well as in the mutton-eating region of the Near East/North Africa. Significant increases in beef consumption were rare. They occurred in the Republic of Korea, Japan, Malaysia, Kuwait, Saudi

Table 3.12 World exports of livestock products and percentage of world consumption

	1964/66	1974/76	1984/86	1997/99
Total meat				
Exports ('000 tonnes)	5 996	8 869	14 011	27 440
% of consumption	7.4	7.9	9.4	12.7
Bovine				
Exports ('000 tonnes)	3 134	4 626	6 225	9 505
% of consumption	9.4	10.3	12.2	16.4
Pig meat				
Exports ('000 tonnes)	1 734	2 522	4 665	8 270
% of consumption	5.7	6.0	7.9	9.6
Poultry meat				
Exports ('000 tonnes)	436	887	1 973	8 465
% of consumption	4.0	4.7	6.3	13.9
Ovine				
Exports ('000 tonnes)	691	835	1 148	1 200
% of consumption	11.1	12.6	14.1	11.2
Milk and dairy (liquid milk equivalent)				
Exports ('000 tonnes)	21 606	31 769	57 004	71 364
% of consumption	6.0	7.6	11.1	12.8

Note: Meat exports include meat equivalent of live animal exports.

Table 3.13 Net trade positions of the major importers and exporters of livestock products ('000 tonnes)

	Major meat importers			
	1964/66	1974/76	1984/86	1997/99
Japan				
Beef	-12	-85	-221	-867
Mutton	-69	-119	-78	-34
Pig meat	-1	-118	-214	-862
Poultry meat	-9	-28	-130	-666
Total meat	-91	-350	-643	-2 430
Milk/dairy products[1]	-847	-1 351	-2 129	-2 137
Former Soviet Union				
Beef	-101	-407	-470	-704
Pig meat	-4	-4	-333	-694
Poultry meat	-15	-61	-143	-956
Total meat	-95	-489	-1 036	-2 366
Milk/dairy products[1]	-79	70	-502	529
Mexico				
Beef	106	44	32	-141
Pig meat	0	1	-1	-112
Poultry meat	0	-1	-17	-297
Total meat	105	41	7	-586
Milk/dairy products[1]	-254	-684	-1 951	-2 231
Republic of Korea				
Beef	0	0	-13	-181
Pig meat	1	6	0	-5
Poultry meat	0	0	0	-40
Total meat	0	-1	-17	-231
Milk/dairy products[1]	-68	-30	-67	-205
Saudi Arabia				
Beef	-3	-10	-70	-52
Mutton	-6	-6	-47	-89
Poultry meat	-3	-47	-169	-292
Total meat	-12	-62	-286	-433
Milk/dairy products[1]	-62	-213	-1 169	-877

	Major meat exporters			
	1964/66	1974/76	1984/86	1997/99
United States				
Beef	-563	-887	-854	-475
Pig meat	-116	-125	-493	-159
Poultry meat	101	100	247	2 548
Total meat	-602	-916	-1 109	1 895
Milk/dairy products[1]	2 547	-2 040	-719	-2 909
EU-15				
Beef	-879	-220	552	504
Mutton	-377	-290	-233	-219
Pig meat	-46	-17	476	1 243
Poultry meat	-79	59	253	915
Total meat	-1 381	-468	1 048	2 444
Milk/dairy products[1]	-396	5 846	11 821	10 408
Australia and New Zealand				
Beef	558	989	918	1 959
Mutton	469	524	713	716
Total meat	1 033	1 523	1 637	2 681
Milk/dairy products[1]	4 729	5 584	7 764	13 302
Brazil				
Beef	57	83	263	302
Pig meat	1	6	-6	113
Poultry meat	0	7	266	621
Total meat	58	97	518	1 028
Milk/dairy products[1]	-230	-224	-1 044	-1 913
Argentina				
Beef	583	348	280	376
Total meat	620	380	282	267
Milk/dairy products[1]	59	444	36	1 217
Eastern Europe				
Beef	217	327	310	78
Mutton	17	51	74	24
Pig meat	211	287	398	215
Poultry meat	59	169	287	38
Total meat	504	833	1 069	355
Milk/dairy products[1]	214	828	2 388	1 683

Note: Data include the meat equivalent of trade in live animals.
[1] In liquid milk equivalent (excludes butter).

Arabia, Mexico and Taiwan Province of China (all of them somehow linked to increased beef imports, often the result of more liberal trade policies), while Brazil is an example of fast growth in both production and consumption of beef.

Buoyancy of meat trade in recent years. The rapid growth in consumption of several countries was supported by even faster growth in trade. Some drastic changes occurred in the sources of exports and destination of imports, particularly in the last ten years or so. For example, Japan increased per capita meat consumption from 32.6 kg in 1984/86 to 41.5 kg in 1997/99, while its net imports quadrupled and self-sufficiency fell from 84 to 56 percent. At the global level, trade (world exports, including the meat equivalent of live animal exports) increased from 9.4 percent of world consumption in the mid-1980s to 12.7 percent in 1997/99, with poultry increasing from 12.2 to 16.4 percent and beef from 6.3 to 13.9 percent (Table 3.12). The major actors in this expansion of the meat trade are shown in Table 3.13. Japan tops the list of importers. Recent surges in the poultry meat (and to a lesser extent pig meat) imports of the countries of the former Soviet Union (overwhelmingly the Russian Federation), put this group of countries second in the league of importers, with its net imports rivalling those of Japan. On the export side, the combined exports of beef and mutton of Australia and New Zealand put them at the top of world meat exporters. However, the really extraordinary development of the 1990s has been the turnaround of the United States from a sizeable net importer of meat to a sizeable net exporter, a result reflecting its declining net imports of beef and pig meat and skyrocketing exports of poultry meat. In a sense, although the policies are different, the United States is replicating the earlier experience of the EU, which turned from a big net importer of meat up to the late 1970s to a large and growing net exporter.

The developing countries did not participate as much as the developed countries in this buoyancy of the world meat trade, although there have been some notable exceptions on both the import and the export side. In *poultry meat*, Brazil and Thailand became significant exporters, while Mexico became a large importer together with the more traditional importers of the Near East region (Saudi Arabia, Kuwait and the United Arab Emirates) and Hong Kong SAR. In *pig meat*, the largest developing net exporter continued to be China (mainland, including trade in live animals), although this has declined in recent years. China was rivalled in recent years by growing net exports from Brazil. Taiwan Province of China became a major exporter (mostly to Japan) in the decade to the mid-1990s before turning into a net importer after 1997[22] following the outbreak of foot-and-mouth disease (Fuller, Fabiosa and Premakumar, 1997).

On the import side, Hong Kong SAR has continued to be the predominant developing importer, while Mexico and Argentina became fast-growing net importers of pig meat in recent years. Overall, the pig meat trade has not been buoyant in the developing countries, an outcome that has partly reflected the lack of consumption in the major meat importers of the Near East/North Africa region. In *bovine meat*, India joined the more traditional developing exporters of South America as a significant exporter (mostly buffalo meat). The Republic of Korea became the largest developing net importer, surpassing Egypt. Several other developing countries became significant importers of bovine meat in recent years, including some countries of Southeast Asia (the Philippines, Malaysia and Indonesia) as well as Chile. Most recently, Mexico turned from net exporter to net importer of beef (including the meat equivalent of trade in live animals – on this latter point, see USDA, 2001a). Finally, only a few of the traditional importers of the Near East/North Africa region (Saudi Arabia, the United Arab Emirates and Kuwait) continued to be significant net importers of *mutton* (including live animals), but the imports of other countries collapsed (the Islamic Republic of Iran, Iraq and the Libyan Arab Jamahiriya) so that net imports of the region as a whole declined.

Slow growth in the dairy trade. In contrast to the buoyancy of the meat trade in recent years, trade in dairy products virtually stagnated. There was no growth in net imports of the developing countries. Increases in East Asia and modest ones in Latin America just compensated for declines in the other

[22] In the latest FAPRI projections, the net, and growing, net importer status of Taiwan Province of China continues to 2011 (FAPRI, 2002).

regions. There was no boost from increased imports on the part of the transition economies as was the case with meat. On the contrary, the former Soviet Union turned from net importer to net exporter. The decline of production of subsidized surpluses and the associated decline in food aid shipments on the side of the major exporters were an integral part of these trade outcomes.

Growth of livestock output achieved with modest increases in the feed use of cereals. We referred earlier to the importance of the livestock sector in creating demand for grains and oilseeds. Feed demand for cereals is often considered as the dynamic element that conditions the growth of the cereal sector. Occasionally, such use of cereals is viewed as a threat to food security, allegedly because it "subtracts" cereal supplies (or the resources going into their production) that would otherwise be available to food-insecure countries and population groups. We have argued elsewhere that this way of viewing things is not entirely appropriate, although, where economies are closed to trade, negative effects on food supplies available to food-insecure population groups can be produced (Alexandratos, 1995, p. 91-92).

Estimates put the total feed use of cereals at 657 million tonnes, or 35 percent of world total cereal use. Demand for feed in recent years has been a much less dynamic component of aggregate demand for cereals than commonly believed. The main reasons for these developments in the 1990s were discussed in the preceding section on cereals: the collapse of the livestock sector in the transition economies and high policy prices for cereals in the EU that favoured use of non-cereal feedstuffs (see also the discussion on cassava in Section 3.5 below). An additional factor that slowed down the growth of cereal use as feed has been the shift of meat production away from beef and towards poultry meat and pork, particularly in the industrial countries, the major users of cereals for feed. Pigs and poultry are much more efficient converters of feed to meat than cattle (see Smil, 2000, Chapter 5). World totals have been decisively influenced by developments in the United States where the shift was most pronounced (poultry now accounts for 44 percent of total meat output, up from 30 percent in the mid-1980s, with the share of beef declining from 43 to 33 percent). Given the predominance of the feedlot system in the United States for producing bovine meat with high feedgrain conversion rates (5-7 kg of grain per kg of beef are the numbers usually given in the literature), it is easy to see why the shift to poultry has had such a pronounced impact on the average meat/grain ratios. Finally, productivity increases (reduction of the amount of feed required to produce 1 kg of meat), resulting from animal genetic improvements and better management, also played a role, at least in the major industrial countries.

3.3.2 Prospects for the livestock sector

Slower growth in world meat consumption. The forces that shaped the rapid growth of meat demand in the past are expected to weaken considerably in the future. Slower population growth compared with the past is an important factor. Perhaps more important is the natural deceleration of growth because fairly high consumption levels have already been attained in the few major countries that dominated past increases. As noted, China went from 10 kg in the mid-1970s to 45 kg currently, according to its statistics. If it were to continue at the same rate, it would soon surpass the industrial countries in per capita consumption of meat, an unreasonable prospect given that China will still be a middle-income country with significant parts of its population rural and in the low-income category for some time to come.[23] These characteristics suggest that further growth leading to about 60 kg in 2015 and 69 kg in 2030 as a national average for China is a more reasonable prospect than the much higher levels that would result from a quasi continuation of past trends (see also Alexandratos, 1997).[24] As another example and for similar reasons, Brazil's current average

[23] The poverty projections of the World Bank (see Chapter 2), suggest that despite the expected rapid decline in poverty in China, the country may still have some 200 million persons in the "under US$2 a day" poverty line (source as given in Table 2.5).

[24] The latest global food projections study of IFPRI projects China's per capita meat consumption to reach 64.4 kg in 2020 (Rosegrant *et al.*, 2001, p. 131). A higher estimate of 71 kg in 2020 is used in another IFPRI study (Delgado, Rosegrant and Meijer, 2001, Table 7). FAPRI, starting from the radical downward revisions of the historical meat production/consumption data (which bring the consumption per capita to 31 kg in 1997/99), projects 41 kg in 2011.

meat consumption of 71 kg suggests that the scope for the rapid increases of the past to continue unabated through the coming decades is rather limited.

The next question is whether any new major developing countries with present low meat consumption will emerge as major growth poles in the world meat economy.

The countries of South Asia come readily to mind. India has the potential to dominate developments in this region and indeed the world as a whole. It should be recalled that India is expected to rival China in population size by 2030 (1.41 billion versus 1.46 billion) and indeed surpass it ten years later, reaching 1.5 billion by 2040. It is also recalled that South Asia's projected growth rate of GDP per capita (overwhelmingly reflecting that for India) is, in the latest World Bank assessment, a respectable 3.5 percent p.a. for 2000-2004 and 4.0 percent p.a. after that until 2015. These rates are higher than those achieved in the 1990s (World Bank, 2001c, Table 1.7). India's meat consumption is very low – currently 4.5 kg per capita – and it has grown by only 1 kg in the last 20 years.

Can India play the role China has had so far in raising world meat demand? On this point, there are widely differing views. The first viewpoint, downplaying this prospect (Mohanty, Alexandratos and Bruinsma, 1998), is essentially based on the analysis of the differences in meat consumption among different income groups of Indian society. They show that high-income Indians, whether urban or rural, do not consume significantly more meat than low-income ones, although the differences in milk consumption are wide. Tomorrow's middle- and high-income population groups are likely to behave in a similar fashion. This would seem to preclude significant increases in national meat consumption because of income growth. Some support for this view is provided by recent marketing studies indicating that traditional consumption habits in Indian society are more resistant to change than one would expect from macroeconomic indicators (Luce, 2002). Other studies disagree, pointing to changing tastes and the prospect that the rapidly emerging middle classes will tend to adopt diets with higher meat content. For example, Bhalla, Hazell and Kerr (1999, Table 3) use "best guess" higher demand elasticities and project per capita food consumption of meat and eggs to increase from 5.8 kg in 1993 to 15 kg in 2020, in a scenario with 3.7 percent p.a. growth of per capita income. The latest IFPRI study of global food projections expects per capita meat consumption of 7.4 kg in 2020 (baseline scenario) or, in a rather improbable "India high-meat scenario", 18.0 kg (Rosegrant *et al.*, 2001, Table 6.23). Yet another IFPRI study has 7.0 kg for India in 2020 (Delgado, Rosegrant and Meijer, 2001, Table 7)

The only generalization we can make with some confidence is that the recent high-growth rates of per capita consumption of poultry meat in India (admittedly from the very low base of 0.2 kg in the mid-1980s to 0.6 kg in 1997/99) is bound to continue unabated in the coming decades. That is, India's participation in the global upsurge of the poultry sector, being at its incipient stage, still has still a long way to go. Consumption of other meats will probably grow by much less, with beef and pork subject to cultural constraints for significant parts of the population of India and indeed the whole of South Asia. In parallel, consumption of the preferred mutton/goat meat faces production constraints, implying rising real relative prices compared with poultry meat. Overall, the force of the growth of poultry meat consumption has the potential of raising India's average consumption of all meat by 2 kg in the period to 2015 (compared with 1 kg in the preceding two decades) and by another 4 kg in the subsequent 15 years to 10 kg in 2030 (meat plus eggs: 15 kg). This kind of growth will perhaps be viewed as revolutionary in a national context, since it would raise the very low intake of animal protein in the structure of the country's diet. However, it will be far from having an impact on world averages and those of the developing countries anywhere near that exerted in the historical period by developments in China.

Other countries or regional groups that played a role in raising global consumption of meat in the past are those of *East Asia other than China* (mainland). Some countries in this group have attained mid- to high consumption per capita, e.g. Hong Kong SAR, Taiwan Province of China, Malaysia and the Republic of Korea. However, in the most populous country of the region, Indonesia, as well as in several others (Thailand, Malaysia, Korea, Rep., Taiwan Province of China) the process of rapid growth in

meat consumption came to an abrupt end, often followed by reversals, in the late 1990s because of the economic crisis. The recent food crisis in the Democratic People's Republic of Korea accentuated the regional slowdown. A period of slow growth in the per capita consumption of this region (East Asia excluding China) may ensue before rapid growth resumes to reach the levels indicated in Table 3.10. This is an additional factor militating against the continuation of the rapid growth in world meat consumption at the high rates of the past.

Of the other regions, *Latin America and the Caribbean*, excluding Brazil, is still in a middling position as regards per capita consumption of meat (45 kg per capita), with only the traditional meat producers and exporters (Argentina and Uruguay) having levels comparable to those of the industrial countries. The swing to poultry consumption has been fairly strong, often substituting other meats. Per capita consumption of poultry meat is still at a middling level (17.2 kg, up from 9 kg in the mid-1980s), so the process still has some way to go. This will raise the group's overall meat average, as the decline in the consumption of beef, mutton and pork that characterized past developments is not likely to continue at past rates.

Average per capita consumption in the *Near East and North Africa* region grew little since the mid-1980s, in contrast with the sharp increases experienced in the preceding decade of the oil boom. The recent slowdown of the regional average reflected the sharp declines in Iraq, and the near stagnation of per capita consumption in several other countries. Most countries of the region are in a middling position as regards per capita consumption (in the range of 17-47 kg in 1997/99), although some of the smaller oil-rich countries (such as Kuwait and the United Arab Emirates) have fairly high levels. The three most populous countries of the region, Egypt, Turkey and the Islamic Republic of Iran (which between them have 53 percent of the region's population) are in the range of 20-22 kg. In this region there has also been a consumption trend towards poultry meat – in fact all growth in average meat consumption came from poultry – although the shift has not been as strong as in Latin America. The income growth prospects of the region for the next ten years are somewhat better than in the preceding ten years (see Figure 2.3). Therefore, some resumption of the growth in meat consumption, accompanied with further shifts towards poultry meat, may be expected.

Finally, *sub-Saharan Africa's* economic prospects suggest that little growth in its per capita consumption of meat is likely. There have been no improvements in the past 30 years, with per capita consumption stagnant at around 10 kg. Although some countries did increase consumption of poultry meat significantly (e.g. Gabon, Mauritius, Senegal and Swaziland), the region has hardly benefited from the options offered by the poultry sector – a situation that will probably persist for some time. For the longer term, the projections suggest only very modest gains.

Per capita meat consumption in the *transition economies* will eventually reverse its downward trend of the 1990s (having fallen from a peak of 73 kg in 1990 to 45 kg in 1999). However, at the projected level of 61 kg, it will not have reverted to the pre-reform levels even by 2030. In the *industrial countries*, average per capita consumption of meat at 88 kg is fairly high, although, as noted, countries with high fish consumption (Japan and Norway) have much lower levels. In principle, the achievement of near-saturation levels of overall food consumption, as well as concerns about health, suggest that there is very little scope for further increases. Yet the data indicate that such increases do take place even in countries that have passed the 100-kg mark, probably reflecting a mix of overconsumption and growing post-retail waste or feeding of pets. For example, the United States went from 112 to 123 kg in the last ten years (1989-99) and the latest FAPRI projections foresee an increase of 5 percent by 2011 (FAPRI, 2002). The USDA projections, however, foresee a slight decline (about 1 kg in retail weight) by 2011 (USDA, 2002, Table 22).[25] Even in the more food quality/safety conscious EU, per capita consumption of meat is projected to continue growing, from 89 kg to 94 kg

[25] Long-term historical series (1909-2000) of meat consumption in the United States can be found in www.ers.usda.gov/Data/FoodConsumption/Spreadsheets/mtpcc

Table 3.14 Net trade in meat[1] and milk/dairy ('000 tonnes)

	1964/66	1974/76	1984/86	1997/99	2015	2030
Type of meat						
			Developing countries			
Bovine	859	706	13	-114	-310	-650
Ovine	52	-29	-229	-259	-700	-1 170
Pig meat	90	55	516	-173	-550	-830
Poultry meat	-33	-200	-430	-693	-2 340	-3 250
Total meat	969	532		-129-1 238	-3 900	-5 900
			Industrial countries			
Bovine	-907	-375	370	1 491	1 860	1 840
Ovine	-20	86	372	375	820	1 270
Pig meat	-167	-273	25	891	930	1 010
Poultry meat	-9	110	314	2 624	4 320	4 800
Total meat	-1 103	-452	1 080	5 380	7 930	8 920
			Transition countries			
Bovine	116	-80	-160	-626	-810	-590
Ovine	43	34	-16	12	10	20
Pig meat	207	282	65	-479	-100	100
Poultry meat	44	108	143	-918	-1 000	-620
Total meat	409	344	33	-2 012	-1 900	-1 090
Total meat by developing region						
Sub-Saharan Africa	111	180	-60	-92	-280	-740
Near East/North Africa	-97	-337	-1 437	-1 246	-2 360	-3 520
Latin America and the Caribbean	829	672	867	658	1770	2 770
South Asia	-6	0	47	173	-80	-410
East Asia	132	18	454	-732	-2 950	-4 000
Milk and dairy products in whole milk equivalent (excluding butter)						
Developing countries	-5 300	-8 735	-20 040	-19 848	-29 600	-38 900
Sub-Saharan Africa	-522	-1 206	-2 785	-2 321	-3 600	-5 200
Near East/North Africa	-753	-2 031	- 757	-4 980	-8 900	-12 500
Latin America and the Caribbean	-1 879	-2 571	-5 500	-5 374	-6 350	-6 700
South Asia	-662	-553	-1 247	-804	-1 200	-1 500
East Asia	-1 486	-2 374	-3 751	-6 370	-9 550	-13 000
Industrial countries	**6 920**	**8 973**	**18 420**	**19 665**	**28 000**	**35 700**
Transition countries	**135**	**898**	**1 886**	**2 212**	**3 500**	**5 200**

[1] Includes the meat equivalent of trade in live animals.

in the ten years 1998-2008 (European Commission, 2001, Table 1.19). These trends have to be taken into account, even if they make little sense from the standpoint of nutrition and health. In the projections for the industrial countries we have factored in rather more modest increases than the EU projections indicate: a 12 kg increase in per capita consumption for the entire 34-year period, raising it from 88 kg in 1997/99 to 100 kg in 2030. The whole of the increase will be in the poultry sector.

These prospects for changes in the per capita consumption of meat, in combination with slower population growth, suggest that the strength of the meat sector as a driving force of the world food economy will be much weaker than in the past. Thus, world aggregate demand for meat is projected to grow at 1.7 percent p.a. in the period to 2030, down from 2.9 percent in the preceding 30 years. The reduction is even more drastic for the developing countries, in which the growth rate of aggregate demand is reduced by half, from 5.3 to 2.4 percent. Much of this reduction is a result of the projected slower growth of aggregate consumption in China and, to a lesser extent, in Brazil. If these two countries are removed from the developing countries aggregate, there is very little reduction in the growth of aggregate demand for meat, from 3.8 percent p.a. in the preceding three decades to 3.1 percent p.a. in the next three. All this reduction reflects the slowdown in population growth from 2.0 p.a. to 1.3 percent p.a. (Table 3.11).

In conclusion, the projected slowdown in the world meat economy is based on the following assumptions: (i) relatively modest further increases in per capita consumption in the industrial countries; (ii) growth rates in per capita consumption in China and Brazil well below those of the past; (iii) persistence of relatively low levels of per capita consumption in India; and (iv) persistence of low incomes and poverty in many developing countries. If these assumptions are accepted, the projected slowdown follows inevitably. Naturally, a slower growth rate applied to a large base year world production (218 million tonnes in 1997/99, of which 116 million in the developing countries) will still produce large absolute increases (some 160 million tonnes by 2030, of which some 130 in the developing countries). These quantitative increases will accentuate environmental and other problems associated with such large livestock sectors (see Chapter 5).

No slowdown in the consumption of dairy products. The average dairy consumption of the developing countries is still very low (45 kg of all dairy products in liquid milk equivalent), compared with the average of 220 kg in the industrial countries. Few developing countries have per capita consumption exceeding 150 kg (Argentina, Uruguay and some pastoral countries in the Sudano-Sahelian zone of Africa). Among the most populous countries, only Pakistan has such a level. In South Asia, where milk and dairy products are preferred foods, India has only 64 kg and Bangladesh 14 kg. East Asia has only 10 kg. In this region, however, food consumption preferences do not favour milk and dairy products, but the potential for growth is still there with growing urbanization. Overall, therefore, there is considerable scope for further growth in consumption of milk and dairy products. The projections show higher world growth than in the recent past (Table 3.9) because of the cessation of declines and some recovery in the transition economies. Excluding these latter countries, world demand should grow at rates somewhat below those of the past but, given slower population growth, per capita consumption would grow more quickly than in the past.

Meat trade expansion will continue, some recovery in dairy trade. Despite the projected slowdown in meat demand growth, some of the forces that made for the buoyancy in the world meat trade in the recent past discussed above are likely to continue to operate – in particular the changes in trade policy regimes. The projected net trade positions are shown in Table 3.14. They reflect the above-mentioned factors making for growth in demand and the analysis of production possibilities, as well as the prospect that the more liberal trade policies of recent years will continue to prevail. Overall, the trend for the developing countries to become growing net importers of meat is set to continue. This is another important component of the broader trend for developing countries to turn from net exporters to growing net importers of food and agricultural products (see Section 3.1). Imports of poultry meat are likely to dominate the picture of growing dependence on imported meat.

Trade in dairy products will also likely recover, with net imports of the developing countries resuming growth after a period of stagnation from the mid-1980s onwards (Table 3.14). This would reflect continuation of the growth of imports of East Asia, as well as the resumption of import growth into the major deficit region, the Near East/North Africa, following recovery in the growth of demand.

Growth of feed use of cereals will resume. Demand for cereals for feed is projected to grow at 1.9 percent a year between 1997/99 and 2015, and at 1.5 percent p.a. thereafter to 2030. The growth rate of the first subperiod is a little higher than that of livestock production (1.7 and 1.5 percent in the two subperiods, respectively). The projected growth rates of feed demand for cereals are higher than the depressed ones of the historical period, despite the projected slowdown in livestock production (Table 3.11, memo items). The main reasons are as follows:

- As noted in the section on cereals, the turnaround of the transition economies and the EU from declines in the preceding decade to renewed growth in feed use of cereals (or at least, the cessation of declines) will lead to resumption of growth of demand for cereals in this sector. This process has been under way in the EU since the early 1990s (INRA, 2001, p. 46). These two regions have a large weight (33 percent) in world cereal feed consumption. Therefore, the continued turnaround will be reflected in higher growth rates of the global demand for feed compared with the past (European Commission, 2001, Table 1.6).
- In parallel, the shift in meat production away from bovine meat towards poultry meat will exert a much weaker downward pressure on the demand for feedstuffs than in the past. As shown in Table 3.11, in the past 20 years poultry production increased at 5.1 percent p.a. and bovine meat at 1.2 percent p.a. In the period to 2015, the difference in the growth rates will be much smaller, 2.9 and 1.4 percent, respectively, hence the downward pressure exerted on the aggregate grain-meat conversion rates will also be weaker.

In the developing countries, the growth of cereal use for feed and the growth of livestock production have moved much more in unison than in the industrial countries. If these trends were to continue, the growing weight of the developing countries in world livestock production would imply that the global totals and relationships will increasingly reflect developments in these countries. Will the trends continue? It is likely that, for some time, there will be a tendency for the use of concentrates in total animal feed to increase more quickly than aggregate livestock output in the developing countries. This will reflect the gradual shift of their production from grazing and "backyard" systems to stall-fed systems using concentrate feedstuffs (see Chapter 5). Such structural change in the production systems will tend to raise the average grain-meat ratios of the developing countries and perhaps compensate for opposite trends resulting from improvements in productivity. A strong case for this prospect is made in a recent analysis by the Centre for World Food Studies in the Netherlands (Keyzer, Merbis and Pavel, 2001).

3.4 Oilcrops, vegetable oils and products

3.4.1 Past and present

Fastest growth of all subsectors of global agriculture. The oilcrops sector has been one of the most dynamic parts of world agriculture in recent decades. In the 20 years to 1999 it grew at 4.1 percent p.a. (Table 3.15), compared with an average of 2.1 percent p.a. for all agriculture.[26] Its growth rate exceeded even that of livestock products. The major driving force on the demand side has been the growth of food demand in developing countries, mostly in the form of oil but also direct consumption of soybeans, groundnuts, etc. as well as in the form of derived products other than oil.[27] Food demand in the developing countries accounted for half the

[26] For the derivation of the growth rates of the entire oilcrops sector, the different crops are added together with weights equal to their oil content. This is what the expression "oil equivalent", used in this study, means.

[27] For example, in China it is estimated that out of total domestic consumption of soybeans (production plus net imports) of about 15 million tonnes, only about nine million tonnes are crushed for oil and meal and the balance is consumed as food directly or in other forms (Crook, 1998, Table 8.1).

increases in world output of the last two decades, with output measured in oil content equivalent (Table 3.16). China, India and a few other countries represented the bulk of this increase. No doubt, the strong growth of demand for protein products for animal feed was also a major supporting factor in the buoyancy of the oilcrops sector. The rapid growth of this sector reflects the synergy of the two fastest rising components of the demand for food (Table 3.16, lower part): food demand for oils favouring the oil palm and for livestock products favouring soybeans.

Growing contribution to food supplies and food security. World production, consumption and trade in this sector have been increasingly dominated by a small number of crops (soybeans, oil palm, sunflower and rapeseed) and countries. However, the more traditional and less glamorous oilcrops continue to be very important as major elements in the food supply and food security situation in many countries, such as groundnuts and sesame seed in the Sudan and Myanmar, coconuts in the Philippines and Sri Lanka and olive oil in the Mediterranean countries.

Rapid growth of food demand in the developing countries, in conjunction with the high calorie content of oil products, has contributed to the increases achieved in food consumption in developing countries (measured in the national average kcal/person/day, see Chapter 2). In the mid-1970s, consumption of these products (5.3 kg/person/year, in oil equivalent, Table 3.17) supplied 144 kcal/person/day, or 6.7 percent of the total availability of 2 152 calories of the developing countries. By 1997/99 consumption per capita had grown to 9.9 kg contributing 262 kcal to total food supplies, or 9.8 percent of the total, which itself had

Table 3.15 Oilcrops, vegetable oils and products, production and demand

	Million tonnes	Growth rates, percentage p.a.				
	1997/99	1969 -99	1979 -99	1989 -99	1997/99 -2015	2015 -2030
		Aggregate consumption (all uses, oil equivalent)				
World	98.3	4.0	3.9	3.7	2.7	2.2
Developing countries	61.8	5.0	4.8	4.6	3.2	2.5
Sub-Saharan Africa	6.7	3.2	3.4	4.3	3.3	3.2
Near East/North Africa	6.2	5.1	4.3	3.2	2.5	2.2
Latin America and the Caribbean	9.0	4.7	3.7	3.2	3.2	2.4
South Asia	13.6	4.5	4.5	4.2	3.5	2.5
East Asia	26.2	6.2	6.1	5.8	3.2	2.3
Industrial countries	30.6	3.2	3.4	3.1	1.7	1.8
Transition countries	6.0	1.1	-0.4	-1.4	1.3	1.4
		Production (oilcrops, oil equivalent)				
World	103.7	4.1	4.1	4.3	2.5	2.2
Developing countries	67.7	4.8	5.0	4.7	2.8	2.4
Sub-Saharan Africa	6.0	1.5	3.0	3.5	3.2	3.0
Near East/North Africa	1.8	2.0	2.4	2.4	2.3	2.1
Latin America and the Caribbean	14.6	5.7	4.8	5.3	2.9	2.6
South Asia	9.7	3.6	4.6	2.4	3.2	2.4
East Asia	35.5	6.2	5.8	5.5	2.7	2.2
Industrial countries	30.2	3.6	3.1	4.6	1.7	1.7
Transition countries	5.8	0.7	0.9	-0.5	1.3	1.6

risen to 2 680 kcal. In practice, just over one out of every five calories added to the consumption of the developing countries originated in this group of products. This trend is set to continue and intensify: 44 out of every 100 additional calories in the period to 2 030 may come from these products. This reflects the prospect of only modest growth in the direct food consumption of staples (cereals, roots and tubers, etc.) in most developing countries, while non-staples such as vegetable oils still have significant scope for consumption increases.

Non-food uses. The second major driving force on the demand side has been the non-food industrial use of vegetable oils, with China and the EU being major contributors to this growth (Table 3.16). The existing data do not permit us to draw even a partial balance sheet of the non-food industrial products for which significant quantities of vegetable oil products are used as inputs.[28] The main industrial products involved (paints, detergents, lubricants, oleochemicals in general) are commodities for which demand can be expected to grow as fast, if not faster, than the demand for food uses of vegetable oil products, particularly in the developing countries. In addition, the rapid demand growth for industrial uses in the EU probably reflects the incentives given in recent years to farmers to grow crops (oilseeds, rape, linseed) for non-food uses on land set aside under the CAP rules for limiting excess production of food crops. There have been serious efforts in several European countries to expand the market for biofuel from rapeseed oil as a substitute for diesel fuel (Koerbitz, 1999, Raneses *et al.*, 1999). This option has been viewed not only as a way out of the impasse of surplus food production but also as a desirable land use for environmental reasons, although the energy efficiency and the net effect on the environment remain to be established (Giampietro, Ulgiati and Pimentel, 1997). In terms of actual oil produced and used (rather than of oil equivalent of oilcrops) the world is apparently using some 24 million tonnes for non-food industrial uses out of a total use of 86 million tonnes. In the mid-1970s the comparable figures were 6 and 33 million tonnes, respectively.

Concentration of growth in a small number of crops and countries. The demand for protein meals for animal feed also contributed to a change in the geographic distribution of oilseeds production. This shifted towards countries that could produce and export oilseeds of high protein content, in which oilmeals are not by-products but rather joint products with oil, e.g. soybeans in South America. In addition, support policies of the EU helped to shift world production of oilseeds in favour of rapeseed and sunflower seed. Overall, four oilcrops, oil palm, soybeans, rapeseed and sunflower seed account for 72 percent of world production. In the mid-1970s they accounted for only 55 percent (Table 3.18). These four crops contributed 82 percent of the aggregate increase in oilcrops production since the mid-1970s (Table 3.16). Moreover, a good part of these increases came from a small number of countries, as shown in the lower part of Table 3.16: palm oil mainly from Malaysia and Indonesia; soybeans from the United States, Brazil, Argentina, China and India; rapeseed from China, the EU, Canada, India and Australia; and sunflower seed from Argentina, the EU, the United States, Eastern Europe, China and India. For many countries, including some major producers, these fast expanding oilseeds are new crops that were hardly cultivated at all, or in only insignificant amounts, 20 or even ten years ago.[29]

Growing role of trade. The rapid growth of demand in the developing countries was accompanied by the emergence of several countries as major importers, with net imports rising by leaps and bounds. Thus, by the mid-1990s there were ten developing countries, each with net imports of over 0.7 million tonnes (India, China,[30] Mexico, Pakistan, etc., see Table 3.20). These ten together now have net imports of 13 million tonnes, a 12-fold increase in the period since the mid-1970s. Numerous other

[28] One should be careful with these numbers as this category of demand is often used by statisticians as the dumping ground for unexplained residuals of domestic disappearance and statistical discrepancies. There is no doubt, however, that non-food industrial uses are a dynamic element of demand.

[29] For example, soybeans in India and even Argentina, sunflower seed in China, Pakistan, Brazil, Myanmar, oil palm in Thailand, rapeseed in the United States and Australia.

[30] It is believed that China's net imports of vegetable oils are much larger than reported in the trade statistics because of considerable smuggling (1.5-2.0 million tonnes, OECD, 1999, p. 18).

Table 3.16 Sources of increases in world production and consumption of oilcrops (in oil equivalent)

		Major countries/regions
Increase in world consumption, 1974/76-1997/99		**% contribution to increment of each item, 1974/76 to 1997/99**
Total world increase (=100), of which:	100	
Developing countries, food	50	China 29, India 18, N. East/N. Africa 10, Indonesia 8, Brazil 5, Nigeria 5, Pakistan 5
Developed countries, food	13	United States 34, EU 34, Japan 9, E. Europe 7
Non-food industrial uses, world	29	EU 17, China 10, Indonesia 9, United States 12, Brazil 5, Malaysia 4, India 4
Other uses (feed, seed, waste), world	8	
Increase in world production, 1974/76-1997/99		**% contribution to increment of each item, 1974/76 to 1997/99**
Total world increase (=100), of which:	100	
Oil palm (palm oil and palm kernel oil)	28	Malaysia 51, Indonesia 34, Thailand 3.2, Nigeria 2.6, Colombia 2.5
Soybeans	27	United States 38, Brazil 21, Argentina 17, China 8, India 7
Rapeseed	18	EU 27,China 26, Canada 21, India 12, Australia 5
Sunflower seed	9	Argentina 33, EU 20, United States 10, E. Europe 8, China 9, India 5
All other oilcrops	18	

developing countries are smaller net importers, but still account for another 4 million tonnes of net imports, up from small net exports 20 years ago. This group includes a number of countries that turned from net exporters to net importers over this period, e.g. Senegal, Nigeria and Sri Lanka. With these rates of increase of imports, the traditional net trade surplus of the vegetable oils/oilseeds complex (oils, oilmeals and oilseeds) of the developing countries was reduced to zero in both 1999 and 2000, compared with a range of US$1.0-US$4.4 billion in the period 1970-98. This happened despite the spectacular growth of exports of a few developing countries that came to dominate the world export scene, i.e. Malaysia and Indonesia for palm oil and Brazil and Argentina for soybeans. As happened with the livestock sector, the overall evolution of trade of oilseeds and products has contributed to the agricultural trade balance of the developing countries diminishing rapidly and becoming negative (Figure 3.2).

Oilcrops responsible for a good part of agricultural land expansion. On the production side, these four oilcrops expanded mainly, although not exclusively, in land-abundant countries (Brazil, Argentina, Indonesia, Malaysia, the United States and Canada). Particularly notable is the rapid expansion of the share of oil palm products (in terms of oil palm fruit) in Southeast Asia (from 40 percent of world production in 1974/76 to 79 percent in 1997/99) and the dramatically shrinking share of Africa (from 53 to 14 percent). Africa's share in terms of actual production of palm oil (9 percent of the world total – down from 37 percent in the mid-1970s) remained well below that of its share in oil palm fruit production. This denotes the failure to upgrade the processing industry – but also the potential offered by more efficient processing technology to increase oil output from existing oil palm areas. The contrast of these production shares with the shares of land area under oil palm is even starker: Africa still accounts for 44 percent of the world total, three-quarters of it in Nigeria.

The oil palm and the other three fast growing crops (soybeans, rapeseed and sunflower) have been responsible for a good part of the expansion of cultivated land under all crops in the developing countries and the world as a whole. In terms of

Table 3.17 Vegetable oils, oilseeds and products, food use: past and projected

	1964/66	1974/76	1984/86	1997/99	2015	2030
	Food use (kg/capita, oil equivalent)					
World	**6.3**	**7.3**	**9.4**	**11.4**	**13.7**	**15.8**
Developing countries	4.7	5.3	7.5	9.9	12.6	14.9
Sub-Saharan Africa	7.7	8.0	7.9	9.2	10.7	12.3
Near East/North Africa	6.7	9.4	12.1	12.8	14.4	15.7
Latin America and the Caribbean	6.2	8.0	11.1	12.5	14.5	16.3
South Asia	4.6	5.0	6.2	8.4	11.6	14.0
East Asia	3.4	3.5	6.4	9.7	13.1	16.3
East Asia, excl. China	4.9	5.4	8.4	11.2	13.6	16.3
Industrial countries	11.3	14.5	17.3	20.2	21.6	22.9
Transition countries	6.9	8.2	10.1	9.3	11.5	14.2

	Million tonnes	Growth rates, percentage p.a.				
	1997/99	1969-99	1979-99	1989-99	1997/99 -2015	2015 -2030
		Total food use (oil equivalent)				
World	**66.9**	**3.7**	**3.3**	**2.8**	**2.3**	**1.9**
Developing countries	45.1	4.8	4.3	3.6	2.9	2.2
Sub-Saharan Africa	5.3	3.3	3.5	4.2	3.5	3.2
Near East/North Africa	4.8	4.5	3.3	2.5	2.6	2.1
Latin America and the Caribbean	6.2	4.4	3.0	2.0	2.2	1.7
South Asia	10.8	4.4	4.4	3.9	3.5	2.4
East Asia	17.9	6.0	5.5	4.3	2.7	2.0
East Asia, excl. China	6.8	5.5	4.9	2.8	2.4	2.1
Industrial countries	18.0	2.3	2.1	1.8	0.8	0.6
Transition countries	3.8	1.3	-0.1	-0.7	1.0	1.2

harvested area,[31] land devoted to the main crops (cereals, roots and tubers, pulses, fibres, sugar crops and oilcrops) in the world as a whole expanded by 59 million ha (or 6 percent) since the mid-1970s. A 105-million ha increase in the developing countries was accompanied by a 46-million ha decline in the industrial countries and the transition economies. The expansion of land under the four major oilcrops (soybeans, sunflower, rape and oil palm) was 63 million ha, that is, these four crops accounted for all the increase in world harvested area and more than compensated for the drastic declines in the area under cereals in the industrial countries and the transition economies (Table 3.19). In these countries, the expansion of oilseed area (25 million ha) substituted and compensated for part of the deep decline in the area sown to cereals. But in the developing countries, it seems likely that it was predominantly new land that came under cultivation, as land under the other crops also increased.

These numbers clearly demonstrate the revolutionary changes in cropping patterns that occurred, particularly in the developed countries, as a result

[31] The increase of harvested area implies not only expansion of the cultivated land in a physical sense (elsewhere in this report referred to as arable area) but also expansion of the land under multiple cropping (in the harvested or sown area definition, a hectare of arable land is counted as two if it is cropped twice in a year). Therefore, the harvested area expansion under the different crops discussed here could overstate the extent to which physical area in cultivation has increased. This overstatement is likely to be more pronounced for cereals (where the arable area has probably declined even in the developing countries) than for oilcrops, as the latter include also tree crops (oil and coconut palms and olive trees).

Table 3.18 Major oilcrops, world production

	Production of oilcrops in oil equivalent (Million tonnes)						Actual oil production	Growth rates, % p.a.				
	1964/66	1974/76	1984/86	1997/99	2015	2030	1997/99	1969-99	1979-99	1989-99	1997/99 -2015	2015 -2030
Soybeans	5.8	10.5	17.2	27.7	42	58	22.5	4.1	3.2	4.5	2.5	2.2
Oil palm	2.1	3.7	8.7	21.6	35	49	21.6	8.2	7.7	6.5	2.8	2.3
Rapeseed	1.7	3.0	7.1	14.5	22	32	11.9	6.9	6.6	5.6	2.4	1.8
Sunflower seed	3.4	4.2	7.5	10.3	15	21	9.3	3.7	3.1	2.3	2.2	2.4
Groundnuts	4.8	5.4	6.1	9.4	15	20	4.8	2.3	3.2	4.1	2.6	2.2
Coconuts	3.1	3.7	4.3	6.0	9	12	3.2	2.3	2.7	2.5	2.4	1.8
Cottonseed	3.4	3.7	5.0	5.3	7	9	3.8	1.6	1.2	0.1	2.0	1.4
Sesame seed	0.7	0.8	1.0	1.2	2	3	0.7	1.5	1.9	2.4	3.0	2.5
Other oilcrops	3.7	4.3	4.8	7.6	10	13	5.1	1.3	1.6	2.7	1.6	1.8
Total	29.0	39.0	62.0	104.0	157	217	83.0	4.1	4.1	4.3	2.5	2.2
Oils from non-oilcrops (maize, rice bran)							2.6					

of policies (e.g. the EU support to oilseeds) and of changing demand patterns towards oils for food in the developing countries and oilcakes/meals for livestock feeding everywhere. They also demonstrate that land expansion still can play an important role in the growth of crop production. The 200 percent increase in oilcrop output between 1974/76 and 1997/99 in developing countries was brought about by a 70 percent (50 million ha) expansion of land under these crops, at the same time as land under their other crops also increased by an almost equal amount (Table 3.19).

3.4.2 Prospects for the oilcrops sector

Food demand. The growth of food demand in the developing countries was the major driving force behind the rapid growth of the oilcrops sector in the historical period. The most populous countries played a major role in these developments (Table 3.16).

Will these trends continue in the future? In the first place, slower population growth, particularly in the developing countries, will be reflected in slower growth rates of their aggregate demand for food, *ceteris paribus*. Naturally, others things will not be equal: in particular, the per capita consumption of the developing countries was only 5.3 kg in the mid-1970s. This afforded great scope for the increases in consumption that took place. However, in the process, per capita consumption grew to 9.9 kg in 1997/99. There is reduced scope for further increases and this will lead to slower growth in the future. A deceleration in growth has already been evident for some time: the annual growth rate of per capita demand declined to 1.9 percent p.a. in the decade to 1999, down from 2.9 percent p.a. in the preceding ten-year period. Even this reduced growth rate was well above that for other food products. The corresponding growth rate for cereals (direct food demand per capita in the developing countries) has been near zero in recent years. Only demand for meat has had higher growth rates, heavily influenced by developments in China where meat production data may grossly overstate actual consumption (see Section 3.3).

Despite the increases already achieved, vegetable oils and oil products still have relatively high income elasticities in the developing countries, particularly those in which consumption of livestock products and animal fats is and will likely remain at low levels. In our earlier projections to 2010, the per capita food consumption of all vegetable oils, oilseeds and products (expressed in oil equivalent) was projected to rise from 8.2 kg in 1988/90 to 11 kg in 2010 (Alexandratos, 1995, Table 3.5). By 1997/99 it had grown to 9.9 kg. In the current projections, the per capita food demand for the developing countries as a whole

Table 3.19 Harvested area increases: main oilseeds versus other main crops

	Developing countries			Rest of world		
	1974/76	1997/99	Change	1974/76	1997/99	Change
Main crops			Million ha			
Cereals	406	441	35	306	242	-63
Roots and tubers	33	40	7	15	11	-4
Pulses	53	60	7	10	9	-1
Sugar beet and cane	12	20	7	9	7	-2
Fibre crops	30	28	-2	9	9	0
Oilcrops	70	120	50	38	63	25
Total above	603	708	105	387	342	-46
of which:						
Soybeans	15.6	38.9	23.3	22.2	31.0	8.8
United States				20.8	28.6	7.8
Brazil	5.8	12.6	6.8			
China	7.0	8.3	1.3			
Argentina	0.4	7.2	6.8			
India	0.1	6.1	6.0			
Sunflower	2.4	7.8	5.4	7.0	13.3	6.3
EU (15)				0.7	2.2	1.5
Former Soviet Union				4.4	6.8	2.4
Eastern Europe				1.1	2.2	
India	0.3	1.8	1.5			
Argentina	1.2	3.5	2.3			
Rapeseed	6.5	14.3	7.7	2.6	11.5	8.9
China	2.2	6.6	4.4			
India	3.5	6.7	3.2			
Canada				1.3	5.3	4.0
EU (15)				0.8	3.1	2.3
Oil palm	3.5	9.0	5.4			
Malaysia	0.4	2.6	2.2			
Indonesia	0.1	1.8	1.6			
Nigeria	2.1	3.0	0.9			
Groundnuts	18.6	22.5	3.9	1.0	0.7	-0.2
India	7.1	7.2	0.1			
China	1.8	4.0	2.2			
Nigeria	1.3	2.5	1.2			
Sudan	0.8	1.5	0.6			
Senegal	1.3	0.7	-0.5			
Indonesia	0.4	0.6	0.2			
United States				0.6	0.6	0.0

Note: In this table, cotton is included in fibre crops and not in oilcrops.

rises further to 12.6 kg in 2015 and to nearly 15 kg by 2030 (Table 3.17). We have already noted earlier that average per capita food consumption (all food products) in developing countries may rise from the 2 680 kcal of 1997/99 to 2 850 kcal in 2015 and to 2 980 kcal by 2030 (see Chapter 2). Vegetable oils and products would contribute some 45 percent of this increase. This is an acceleration of the historical trend for these commodities to account for an ever-increasing part of the growth in food consumption in the developing countries. They had contributed 18 percent of the total increment in the decade from the mid-1970s to the mid-1980s and 27 percent in the subsequent decade.

It follows that this group of products will play an important role in increasing dietary energy availability. However, it is clear that, given lower growth rates of both population and per capita demand, the growth of aggregate food demand for these products will probably be well below that of the past. The relevant data and projections are shown in Table 3.17. The growth rate of food demand in developing countries is projected to be 2.9 percent p.a. in the period to 2015, down from 3.6 percent p.a. in the 1990s. Obviously, the explosive growth in the demand for food of the past two decades in countries such as China and India (which contributed 47 percent of the increase in total food demand of the developing countries, see Table 3.16) cannot be sustained at the same rates in the decades to come, even though further substantial growth is in prospect. What was said earlier in relation to the slowdown of aggregate demand for all agricultural products (Section 3.1) applies *a fortiori* to the food demand for vegetable oils. That is, much higher growth rates than projected here of these calorie-rich products would drive the average food consumption of many countries to excessive levels.

Non-food industrial uses. We noted earlier the inadequacy of the statistics on vegetable oil products used for non-food industrial purposes. However, we also noted that some of the industrial products resulting from such use have high income elasticities of demand. There is, therefore, a prima facie case to believe that the share of total vegetable oil production going to non-food industrial uses will continue to grow fairly rapidly. In the projections, we make an allowance for this category of demand to grow at rates above those of the demand for food (3.5 percent p.a. versus 2.1 percent p.a.). Even so, this growth rate is lower than the historical one. This is an additional factor contributing to the slowdown of the growth of aggregate demand for all uses (Table 3.15).

Trade. The projected fairly buoyant growth in demand, and the still considerable potential for expansion of production in some of the major exporters, suggest that past trade patterns will continue for some time, i.e. rapidly growing imports in most developing countries, matched by continued export growth of the main exporters. The projections are shown in Table 3.20. For the developing countries, they suggest a continuation of past patterns. Further rapid growth of exports from the major developing exporters will be more than compensated by the equally rapid growth of imports by other developing countries. The positive net trade balance of the developing countries, as measured here,[32] will stagnate or even decline somewhat. With the development of the livestock sector in developing countries and growing use of feed concentrates, their demand for oilmeals will increase and their net trade surplus in this subsector of the oilcrops complex will tend to disappear and eventually become negative. It is considered that China will become a major contributor to these developments. According to a recent USDA report, "Expansion of its feed manufacturing sector will require China to import more oilseed meals and more oilseeds for crushing. China's meal production from domestically grown soybeans is currently about 6 million tonnes, far short of the country's estimated demand for 20 to 30 million tonnes of oilseed meals annually over the next decade" (USDA, 1999b).

Production. Production issues are discussed in Chapter 4. Production analysis of oilcrops is conducted separately in terms of the individual crops listed in Table 3.18. Cotton is included among these crops because it contributes some 4 percent of

[32] The trade numbers in Table 3.20 comprise the oils traded as well as the oil equivalent of the trade in oilseeds and products made from vegetable oils. They do not include trade in oilmeals in order to avoid double counting when all numbers are expressed in oil equivalent.

world oil production, although projected production is determined in the context of world demand-supply balance of cotton fibre rather than oil. The production projections for these major oilcrops are shown in Table 3.18. It was noted in Table 3.19 that oilcrop production has been responsible for a good part of the area expansion under crops in, mainly, the developing countries.

Will these crops continue to play this role? The analysis presented in Chapter 4 suggests that they will indeed continue to be a major force in the expansion of harvested area in developing countries. As shown in Table 3.19, in the preceding two decades oilcrops accounted for 47 percent of the total increase in the harvested area under the major crops of the developing countries. In the projection period, they will account for 50 percent. The relatively land-intensive nature of oilcrop production growth reflects in large part the fact that they are predominantly rainfed crops (less than 10 percent irrigated, compared with about 40 percent for cereals).

Table 3.20 Net trade balances for oilseeds, oils and products

	1974/76	1997/99	2015	2030
	Million tonnes (oil equivalent)[1]			
Developing countries	3.0	4.0	3.4	3.5
Malaysia	1.3	9.0		
Argentina	0.2	4.9		
Indonesia	0.4	3.9		
Brazil	1.0	2.6		
Philippines	1.1	0.9		
Subtotal, five major exporters	*4.0*	*21.3*	*31.6*	*44.0*
India	0.0	-2.9		
China	0.0	-2.8		
Mexico	-0.1	-1.5		
Pakistan	-0.2	-1.3		
Egypt	-0.2	-0.9		
Bangladesh	-0.1	-0.8		
Korea, Rep.	0.0	-0.7		
Iran, Islamic Rep.	-0.2	-0.7		
Taiwan Province of China	-0.2	-0.7		
Hong Kong SAR	-0.1	-0.7		
Subtotal, ten major importers	*-1.1*	*-13.1*	*-21.3*	*-30.0*
Other developing countries	*0.0*	*-4.1*	*-6.9*	*-10.5*
Industrial countries	-2.9	-0.9	-0.5	-1.3
United States	2.8	4.9		
Canada	0.2	2.3		
Japan	-1.3	-2.6		
EU-15	-4.3	-5.0		
Other industrial countries	-0.3	-0.6		
Transition countries	0.0	-0.2	-0.2	0.0
World balance (stat. discrepancy)	0.2	2.9	2.7	2.3

[1] Trade in oils and products derived from oils plus the oil equivalent of trade in oilseeds; trade in oilmeals not included in order to avoid double counting in the equation: production + net trade = consumption expressed in oil equivalent.

3.5 Roots, tubers and plantains

3.5.1 Past and present

Food consumption of roots, tubers and plantains. This category of basic foods comprises a variety of products; the main ones are cassava, sweet potatoes, potatoes, yams, taro and plantains.[33] Average world food consumption is 69 kg per capita, providing 6 percent of total food calories. However, these products represent the mainstay of diets in several countries, many of which are characterized by low overall food consumption levels and food insecurity. The great majority of these countries are in sub-Saharan Africa. The region's per capita consumption is 194 kg, providing 23 percent of total calories, but some countries depend overwhelmingly on these products for food. Thus, Ghana, Rwanda and the Democratic Republic of the Congo derive 50 percent or more from these foods. Another 16 countries, all in sub-Saharan Africa, derive between 20 and 50 percent.

Figure 3.13 shows the relevant data for the 19 countries that derive more than 20 percent of total food consumption from these products. Collectively, they have a population of 345 million (60 percent of sub-Saharan Africa's total population). Most have low overall per capita food consumption (under 2 200 calories, several of them under 2 000) and, consequently, high incidence of undernourishment. Cereals, which in the developing countries as a whole provide 56 percent of total food calories, account in these countries for much smaller proportions, typically 20-45 percent, rising to just over 50 percent only in the United Republic of Tanzania (mostly maize), Togo (maize, sorghum and rice) and Madagascar (rice).

The high dependence on roots, tubers and plantains reflects the agro-ecological conditions of these countries, which make such products suitable subsistence crops, and to a large extent also the persistence of poverty and lack of progress towards diet diversification. There are significant differences as to which of these starchy products provide the mainstay of diets in the 19 countries dependent on this family of products. Cassava predominates in most of them (the Congo, the Democratic Republic of the Congo, Angola, Mozambique, the United Republic of Tanzania, the Central African Republic, Liberia and Madagascar). In contrast it is mostly plantains in Rwanda and Uganda, and cassava and sweet potatoes in Benin, Togo, Nigeria and Burundi, while there is more balance among the different products (cassava, plantains, sweet potatoes and other roots and tubers – mostly yams) in the other countries (Ghana, Cameroon, Côte d'Ivoire, Guinea and Gabon).

It should be noted that although high dependence on these foods is typical of many countries with low overall food consumption, the phenomenon is far from universal. Many countries with low food intakes consume only minuscule quantities of starchy roots. For example, there are 13 countries[34] with low calories (under 2 200), which derive less than 10 percent from roots, and some less than 2 percent. The explanation of these wide disparities is straightforward for some of these countries: their agro-ecologies are not suitable for rainfed cultivation of these products. In several countries (e.g. Yemen, Somalia, Afghanistan, Eritrea, the Niger and Mongolia) the potential land suitable for any rainfed crops (at the intermediate level of technology as defined in the agro-ecological zones study discussed in Chapter 4) is extremely scarce (in per capita terms) and very little of it is suitable for any of the starchy crops considered here. Irrigated agriculture in these countries is devoted to other more valuable crops.

However, there are also several low food-intake countries that consume few starchy products, even though high proportions of their potential agricultural land are suitable for their rainfed cultivation. The explanation is probably to be found, at least in part, in the fact that even higher proportions are suitable for other more preferred crops, e.g. rice (Bangladesh, Cambodia and the Lao People's Democratic Republic) or maize (Zimbabwe and Kenya). Beyond that, the factors that contributed to the formation of traditional agricultural production patterns and present prevailing food consumption habits, probably explain why fairly similar agro-ecological conditions can result in widely differing diet preferences for starchy foods.

[33] Plantains are included with the roots and tuber crops because "… Plantains and cooking bananas are grown and utilized as a starchy staple mainly in Africa …" (FAO, 1990).

[34] Yemen, Afghanistan, Cambodia, Bangladesh, Somalia, Zimbabwe, Mongolia, the Niger, the Lao People's Democratic Republic, Eritrea, the Democratic People's Republic of Korea, Chad and Kenya.

This is most evident in Thailand which produces some 17 million tonnes of cassava but consumes only 4 percent of it as food (11 kg per capita), with the rest going to export as animal feed (see below).

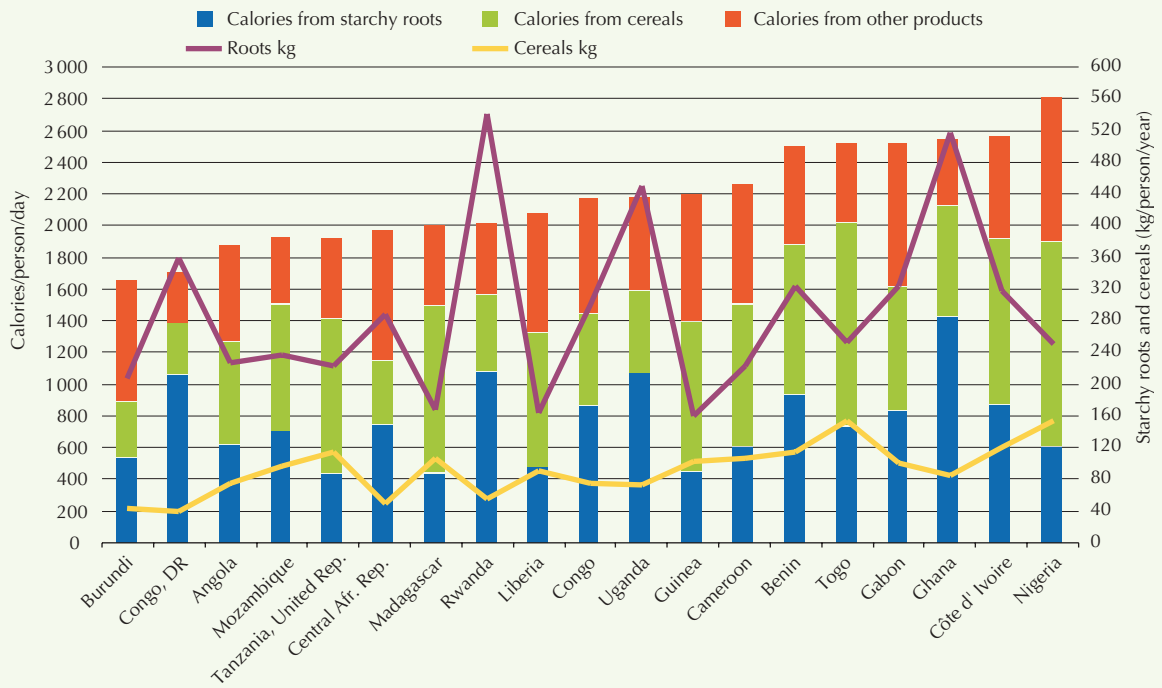
In conclusion, a positive correlation between dependence of food consumption on starchy foods and agro-ecology certainly exists in countries with low incomes and food consumption, but it is rather weak. It is more significant if we control for the effects of the level of total food consumption (kcal/person/day from all foods.) The higher the level, the lower the percentage coming from starchy foods, ceteris paribus – this is a proxy for the negative income elasticity of demand for these products. Another factor causing a difference in "food habits" is the share of calories coming from rice and maize.

The preceding discussion reflects the current situation (average 1997/99) across different countries. The evolution over time shows declining per capita food consumption of starchy foods for the developing countries and the world as a whole up to about the late 1980s, followed by some recovery in the 1990s. These developments were a result of two main factors:

- the rapid decline in food consumption of sweet potatoes in China (from 94 kg in the mid-1970s to 40 kg at present), the parallel rise in that of potatoes, in both China (from 14 kg to 34 kg) and the rest of the developing countries (from 9 kg to 15 kg); and
- the rapid rise of food consumption of all products in a few countries, e.g. Nigeria, Ghana and Peru, with Nigeria having a major weight in shaping the aggregate for sub-Saharan Africa.

These developments are plotted in Figure 3.14. Some studies highlight the high income elasticity of demand for potatoes in the developing countries, the majority of which have very low levels of per capita consumption.[35] This contrasts with the position of the other starchy foods (particularly sweet potatoes but also cassava), whose per capita food consumption in the developing countries has

Figure 3.13 Countries with over 20 percent of calories from roots, tubers and plantains in 1997/99



35 "Whereas potatoes are typically considered a cheap, starchy staple in industrialized countries, they tend to be high-priced and sometimes are luxury vegetables in the developing world … Consumption of potatoes increases as income increases. The relationships for cassava and sweet potato are different. As per capita incomes increase, per capita consumption declines" (Scott, Rosegrant and Ringler, 2000).

apparently stagnated or declined.[36] However, caution is required in drawing firm inferences from these numbers because of the particularly poor quality of data as regards the production and consumption of several of these crops.

Recent efforts to improve the cassava data in Africa in the context of the collaborative study of cassava in Africa (COSCA), initiated in 1989, suggest that cassava is far from being the inferior good put forward in traditional thinking. "The COSCA study found that the income elasticities of demand for cassava products were positive at all income levels" (Nweke, Spencer and Lyman, 2000). Indeed, cassava played an important role in the nutrition gains made by a number of countries that faced severe food insecurity problems. For example, gains in per capita food consumption in Ghana (from 1 925 calories in 1984/86 to 2 545 calories in 1997/99) and in Nigeria (from 2 060 to 2 815) came largely from increases in the production and consumption of cassava – 80 and 50 percent of the total calorie increases, respectively. Indeed, these two countries are presented in *The State of Food Insecurity in the World 2000* (FAO, 2000a) as success cases in improving food security based on the diffusion of improved high-yielding cassava cultivars, largely developed by the International Institute of Tropical Agriculture (IITA) (see also Nweke, Spencer and Lyman, 2000).

However, such gains were the exception rather than the rule in the many countries with food insecurity problems and dependence on starchy foods. Of the 19 countries in Figure 3.13 only three (Ghana, Nigeria and Benin[37]) registered significant increases in the per capita food consumption of these products. The others had no gains, indeed most of them suffered outright declines according to the reported production statistics. In conclusion, the experiences of the "success" countries indicate that these crops have a promising potential to contribute to improved food security.

Analysing why most countries with high dependence on these crops (over 20 percent of calories in 1997/99) failed to benefit from such potential can throw some light on the more general issue of conditions that must be met if progress in food security is to be made. The fact that some of these countries have been experiencing unsettled political conditions and war is certainly part of the problem.

Feed uses of root crops. Significant quantities of roots are used as feed, mostly potatoes (14 percent of world production goes to feed), sweet potatoes (36 percent) and cassava (19 percent). A small number of countries or country groups account for the bulk of this use. As regards potatoes, this is mostly represented by the countries of the former Soviet Union, Eastern Europe and China. Potato feed use has declined in recent years in absolute tonnage as well as percentage terms, mainly as a result of the decline of the livestock sector in the transition economies. For sweet potatoes, China accounts for almost the totality of world feed use and for about 70 percent of world production. Feed use in China has been expanding rapidly following the fast growth of its livestock sector and the shift of human consumption to potatoes and other preferred foods.

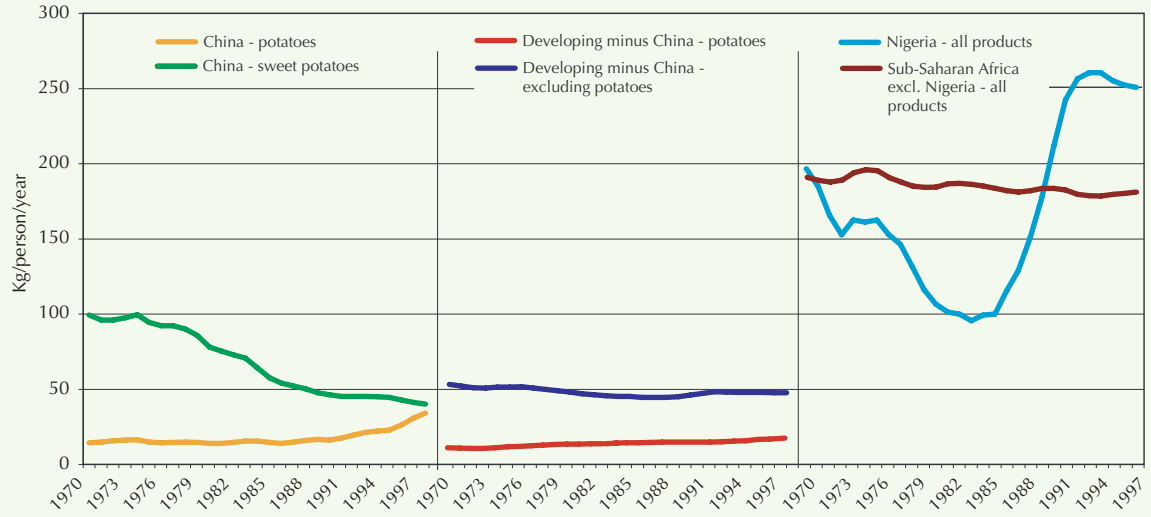
For cassava, it is mostly Brazil (50 percent of its production goes to feed) and the EU (all imported), each accounting for one-third of world feed use. The EU's feed consumption currently amounts to some 10 million tonnes (fresh cassava equivalent). This is less than half the peak it reached in the early-1990s. The rapid growth of cassava as feed in the EU provides an interesting story of the power of policies to change radically feeding patterns and exert significant impacts on trade as well as on production and land use in distant countries. High domestic cereal prices of the CAP, in combination with low import barriers for oilseeds/meals and cassava, reduced the EU's feed use of cereals (see previous discussion) and increased the use of imported cereal substitutes (such as cassava, oilmeals and corn gluten feed).

The cassava trade (mostly of dried cassava) skyrocketed from less than 5 million tonnes (in fresh

[36] "Outside of Kerala (India) and isolated mountain areas of Viet Nam and China, most cassava in Asia for direct food purposes is first processed. As incomes increase over time, also these areas will reduce their non-processed cassava intake in favour of the preferred rice. On-farm cassava flour consumption seems to behave in a similar way to non-processed cassava in Asia, as it is also substituted for rice as economic conditions improve. Nonetheless, on-farm, in the poorer Asian rural areas (Indonesia, Viet Nam and China) cassava may remain as an emergency or buffer crop in times of rice scarcity. However, this is not the primary nor the preferred use" (Henry, Westby and Collinson, 1998). Also, "the general tendency is that cereals are preferred to root crops" (FAO, 1990, p. 24) and "In general, cassava is not well regarded as a food, and in fact there is often a considerable stigma against it" (Plucknett, Phillips and Kagbo, 1998).

[37] If we extend the sample of countries to include those with dependence between 10-20 percent (another 11 countries) then Malawi, Zambia and Sierra Leone also registered significant increases in production and per capita food consumption of these products.

Figure 3.14 Roots, tubers and plantains, food consumption (kg/person/year), 1970-99



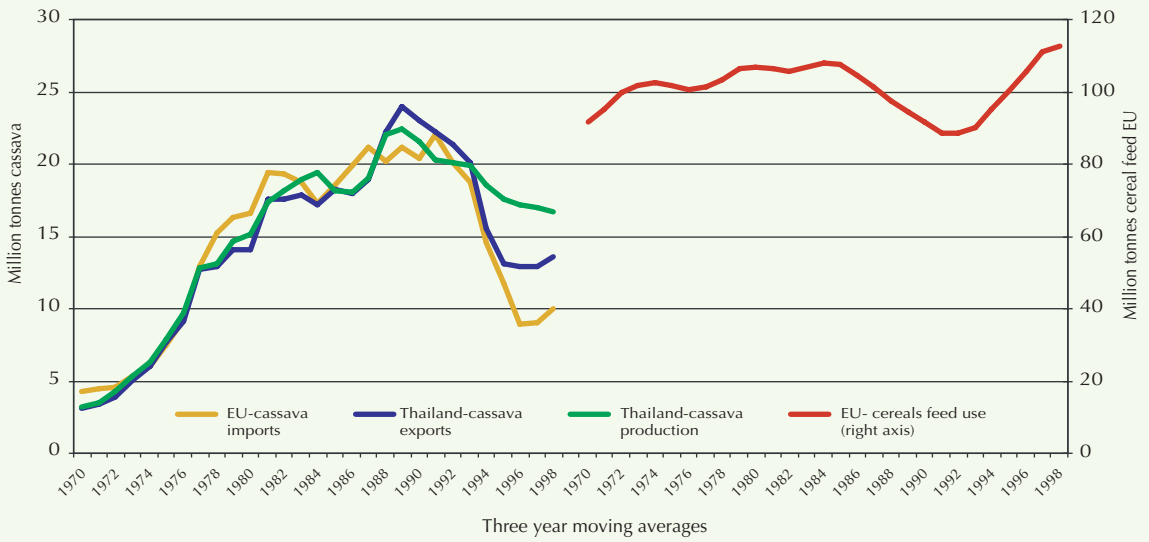
root equivalent) in the early 1970s to a peak of 30 million tonnes at the beginning of the 1990s, before falling to half that level in recent years. Much of the increase came from the EU on the import side and from Thailand (and, to a much lesser extent, Indonesia) on the export side. The same holds for the contraction of world trade in recent years following the CAP policy reforms, which reduced cereal prices and improved the competitiveness of cereals vis-à-vis cassava (Figure 3.15). Some compensation for the contraction of the European markets has been provided in recent years by increased imports of cassava for feed use in a number of Asian countries (China, Taiwan Province of China, the Republic of Korea and Japan). However, the problem of low cereal prices in world markets continues to be an obstacle to further expansion (Plucknett, Phillips and Kagbo, 2000).

In Thailand, cassava production has been one of the major factors in the expansion of agricultural land. Between the early 1970s and the peak of the late 1980s land under cassava increased sevenfold to 1.5 million ha, approximately the same rate as production, as yields remained virtually stagnant at around 15 tonnes/ha. In the same period, deforestation in Thailand (a heavily forested country up to the middle of the last century) proceeded very rapidly. The country's forest cover is estimated to have fallen from 53 percent in 1961 to 25 percent in 1998 (Asian Development Bank, 2000, Chapter 2). The two processes are certainly not unrelated, particularly as cassava can be grown on soils with limited alternative agricultural uses, low fertility, slopes denuded of tree cover and subject to erosion and degradation.[38] A recent study on the environmental impact of cassava production concludes that in Thailand "the area expansion [took place] through deforestation of frontier areas, mainly in the northeast ... The massive deforestation continued until the late 1980s, when most land within Thailand's borders, up to the borders with Laos and Cambodia, had already been cleared" (Howeler, Oates and Costa Allem, 2000).

The preceding paragraph provides an illustration of how the environmental impacts of agricultural policies and policy distortions spread far and wide across the world and are not confined locally. The environmental effects of high agricultural support and protection in Europe have been mostly debated in terms of the adverse effects these policies have on the local environment (as a consequence of the more intensive agriculture they promote), such as nitrates in waterbodies, eutrophication, landscape deterioration and the effects of pesticides. However, environmental impacts of policies, particularly those that affect trade, must

[38] "Cassava often winds up in hill-lands, lands with low soil fertility, or lands susceptible to periodic or seasonal drought or flooding" (Plucknett, Phillips and Kagbo, 2000).

Figure 3.15 Cassava in Thailand and the EU



be evaluated in a global context, with particular reference as to how those impacts manifest themselves in countries that receive the economic stimuli but have no environmental policies in place to internalize costs.

3.5.2 Roots, tubers and plantains in the future

These products will continue to play an important role in sustaining food consumption levels in the many countries that have a high dependence on them and low food consumption levels overall. The possible evolution in food consumption per capita is shown in Tables 2.7-2.8. The main factor causing the decline in the average of the developing countries (precipitous decline of sweet potato food consumption in China) will be much weaker. The scope for further declines is much more limited than in the past. In parallel, the two factors creating increases on the average – the positive income elasticities of the demand for potatoes and the potential offered by productivity increases in the other roots (cassava and yams) – will continue to operate. It will be possible for more countries in sub-Saharan Africa to replicate the experiences of countries such as Nigeria, Ghana, Benin and Malawi, and increase their food consumption. Thus, the recent upturn in per capita consumption of the developing countries is projected to continue (Table 2.7), while the declining trend in sub-Saharan Africa (other than Nigeria and Ghana) may be reversed (Table 2.8).

3.6 Main export commodities of the developing countries

3.6.1 General

Agriculture, and often the overall economy, poverty incidence and food security of several developing countries depend heavily on the production of one or a few agricultural commodities destined principally for export. For example, in Côte d'Ivoire a small number of commodities (cocoa, coffee, cotton, rubber, bananas and palm oil) account for 45 percent of the country's aggregate agricultural output, cocoa predominating with 27 percent. In the past two decades, the dependence of agriculture on these commodities actually increased (from 38 percent in the early 1980s). Agriculture carries a large weight in the country's overall economy (26 percent of GDP), while exports of these commodities provide 50 percent of the country's aggregate export earnings (aggregate, not only agricultural, earnings).[39] There has

[39] Aggregate export earnings are the sum of goods (merchandise) exports, exports of (non-factor) services and income (factor) receipts (definition and data from World Bank, 2001b).

been little movement towards diversification; the levels of dependence of the economy on agriculture, and of the balance of payments on export earnings from these commodities have remained static since the early 1980s. The importance of these commodities as earners of foreign exchange is further enhanced by the fact that the country has a heavy external debt to service; it is classified by the World Bank in the "severely indebted" category (World Bank, 2001b).

Côte d'Ivoire exemplifies the case of countries with high dependence on exports of a few agricultural commodities (both for the incomes generated in agriculture and for foreign exchange earnings) and showing no signs of diversification from such dependence. The country is the world's largest producer and exporter of cocoa, so its own production and exports impact world market prices directly. An additional problem is that some of these export commodities (e.g. coffee and cocoa) are consumed mainly in the industrial countries. The latter have reached fairly high consumption levels, and have low income and price elasticities of demand and low population growth rates. There is, therefore, limited potential for market expansion. In such conditions, attempts to expand production and exports by the main producers/ exporters and/or new entrants can lead to falling prices rather than increased incomes and export earnings.

Another example is Malaysia, which shares Côte d'Ivoire's high dependence of agriculture on a few export commodities, of which the country is a major world supplier. Malaysia is the world's largest producer and exporter of palm oil and the third largest exporter of natural rubber (it was the first until the late 1980s). These two commodities account for 36 percent of the country's agriculture. But here the similarities with Côte d'Ivoire end. Malaysia's per capita income is five times that of Côte d'Ivoire, and the country has been diversifying its economy away from agriculture (from 21 percent of GDP in the early 1980s to 11 percent currently) and reducing its dependence on palm oil and rubber as sources of export earnings. These two commodities now account for 5.6 percent of its aggregate export earnings, down from 20 percent in the early 1980s, even though palm oil exports have tripled in the same period.

In a smaller number of countries there is high dependence of agriculture on a single export commodity. For example, 56 percent of the aggregate agricultural output in Mauritius is sugar, almost all of it exported. Sugar is 46 percent of Swaziland's agriculture (85 percent exported), while in Cuba the shares are 33 and 74 percent, respectively.

The most common case is of countries with high dependence of the balance of payments on the earnings of one or a few agricultural commodities which, however, account for modest percentages of their total agriculture, since domestic crops predominate. For example, Burundi's export earnings are dominated by coffee and, to a much lesser extent, tea (over 80 percent together) but these two crops represent a very small part of the country's agriculture (9 percent) in which bananas, roots/tubers, beans and maize predominate. Likewise, Malawi derives 60 percent of its aggregate export earnings from tobacco and, to a much lesser extent, tea. However, its agriculture is mostly potatoes and maize; tobacco and tea account for only 18 percent of total agricultural production.

It is obvious that in the countries with high dependence on exports of one or a few commodities, the overall economy, and often the welfare of the poor,[40] are subject to changing conditions in world markets, i.e. commodity prices and the rate of expansion of markets. For some commodities, the rate of expansion of world consumption has been too slow, while producers/exporters have been competing with one another to capture a market share. The result has been declining and widely fluctuating export prices. This has been particularly marked for coffee in recent years: per capita consumption in the industrial countries, accounting for two-thirds of world consumption, has been nearly constant for two decades at around 4.5 kg (green beans equivalent), while production increased, including from recent entrants in world markets such as Viet Nam (see below). The result has been that the robusta coffee price had precipitated to US$0.50/kg by January 2002 (monthly average), down from a range of US$1.3-2.0/kg in the monthly averages of the three years 1997-99, which itself was not a period of peak prices.

Coffee and cocoa belong to the class of commodities produced exclusively in the devel-

[40] Several export commodities, e.g. coffee and natural rubber, are more often than not smallholder crops and significant parts of the agricultural population in many countries depend on them for a living. Even when they are not smallholder crops, the rural poor depend on them as labourers.

oping countries and consumed overwhelmingly in the industrial countries, where there is no close substitute in the agricultural commodities produced locally (although vegetable oils are increasingly making inroads in the chocolate industry as substitutes for cocoa butter). This means that trade policy issues for the countries dependent on the production and exports of these commodities transcend the field of agricultural protectionism and export subsidization often practised by the industrial countries, e.g. for sugar. The main handicap of exporting countries dependent on these commodities is that world demand has been, and will probably continue to be for some time, tantamount to the demand of the industrial countries, and this is not growing at anywhere near the rates required to provide profitable export expansion opportunities for all supplying countries.

Other export commodities are much less subject to these constraints because import demand for them originates increasingly in markets with rapidly growing consumption, notably the importing developing countries. We mentioned earlier the role of these latter as rapidly growing outlets for vegetable oils originating in other developing countries. A similar case is represented by sugar, where imports of the importing developing countries are now equal to almost three-quarters of the net exports of the developing exporters, up from only one tenth in the mid-1970s. The policy issues relevant to sugar and similar commodities (produced in both developed and developing countries) are very much at the heart of the agricultural trade policy debate, because of high support and protection granted to them in the main industrial countries that are, or used to be in the recent past, large importers. For example, under such policies the EU turned from a large net importer of sugar up to the second half of the 1970s to a large net exporter in subsequent years. In the United States aggregate consumption of sweeteners continued to grow, but little of it went to sugar, as the strong protection of the sector from external competition favoured corn-based sweeteners (high fructose corn syrup [HFCS], glucose syrup and dextrose).

It is a common theme in the development literature that countries that have not managed to diversify their economies away from heavy dependence on primary commodity exports have been handicapped in their development. However, this need not be so for all countries. Those that achieve cost-reducing productivity gains can increase export earnings (often, in the case of slowly growing global demand, by gaining a market share at the expense of other exporting countries), and thus pave the way for diversification and an eventual sharp reduction in their dependence on these commodities. Thus, diversification and reduced dependence more often than not pass through a stage of increased and more efficient production of the very commodities from which the country seeks to diversify (World Bank, 1994). The abovementioned examples of Malaysia and the Côte d'Ivoire are telling. Naturally, for commodities such as coffee, this avenue is not open to all exporting countries simultaneously (adding-up problem or fallacy of composition). The poorer countries in this category face formidable problems in their development because more often than not they are at a disadvantage vis-à-vis other and more advanced competitors.

There is an ongoing need to increase productivity and eventually diversify out of export crops (in relative, not absolute, terms). The long-term trend towards falling real prices of primary farm commodities is not likely to be reversed.[41] Limited demand growth together with virtually incessant growth in agricultural productivity has been fuelling this trend. The pipeline of technological innovations, including genetic technologies, is apparently not drying up, indicating further potential for cost reductions (Evenson, 2002). The problem is that countries that do not or cannot benefit from genetic technology will have to accept ever-decreasing returns to the labour producing these commodities. This will further aggravate poverty problems, as there are few alternative employment opportunities in an undiversified economy. If these countries remain in the business of producing "unprofitable" (for them) commodities for export (e.g. tapping rubber trees even more

[41] "On balance, we do not see compelling reasons why real commodity prices should rise during the early part of the twenty-first century, while we see reasons why they should continue to decline. Thus, commodity prices are expected to decline relative to manufactures as has been the case for the past century" (World Bank, 2000a, p. 8-29).

intensively when prices are low), they will face continued difficulties. For more discussion on policies relating to these matters, see Chapter 9.

In what follows, we present possible future outcomes for a few of the main commodities. This is not a comprehensive list but endeavours to cover commodities that span a wide range of policy concerns, from strictly "non-competing"[42] commodities (coffee, cocoa) to the "semi-competing" ones (bananas, competing with temperate zone fruit, and natural rubber, competing with synthetic rubber) to fully competing ones (sugar). In recognition of the great diversity of individual developing countries as concerns trade positions and interests in these commodities, a distinction is made between net exporters and net importers. Thus, the sum of the net exports of all net exporter developing countries is taken here as the meaningful measure of performance. It is a much more appropriate indicator than the often used net trade status of all the developing countries together. For example, sugar exports of the net exporting developing countries have been booming in recent years, at least in quantities, mainly because of fast growth of imports of other developing countries (see Table 3.23 below).

3.6.2 Coffee

Coffee is the commodity *par excellence* produced in one zone (the exporting developing countries in the tropics) and consumed in another (the developed industrialized countries). The growth rate of aggregate demand for coffee has been slow and declining. In this situation, competition to capture a market share among low-income producers (including relatively new entrants such as Viet Nam[43]) increases production more quickly than consumption, leading to stock accumulation and accentuating the long-term trend towards price declines.

Such price declines are hitting hard the economies of the countries with major dependence on coffee production and exports. The following quotation from *The Economist* (21 September 2001) is telling: "A slump in the price of coffee is adding to economic misery in Latin America – and no relief is at hand. In Nicaragua, coffee pickers with malnourished children beg for food at the roadside. In Peru, some families have abandoned their land, while others have switched to growing drug crops in search of cash, just as they have in Colombia. From Mexico to Brazil, tens of thousands of rural labourers have been laid off, swelling the peripheries of the cities in a desperate search for work". See also Oxfam (2001).

At the same time, consumers are not getting much benefit from such price declines since retail prices in the main consuming countries have fallen by only a small fraction of the corresponding declines in the world price of coffee beans (Oxfam, 2001, Figure 5). At the same time, coffee producers are getting prices below the world price and only a minuscule part of the retail price of coffee. These large gaps and difference in the behaviour between world trade prices and those received by producers or paid by the consumers are said to reflect, *inter alia*, the dominance of the world coffee trade by a few giant multinational companies (see Chapter 10, Box 10.2). The relative position of producers has worsened following the collapse of the International Coffee Agreement in 1989. In the pre-1989 period producers were getting around 20 percent of the total income generated by the coffee industry and importing country operators around 50 percent. It is estimated that after 1989 the shares shifted dramatically in favour of the latter (Ponte, 2001, Table 3).

Coffee has benefited much less than other commodities (such as sugar, bananas and natural rubber) from the factors that contributed to market expansion, i.e. the rapid growth of demand and imports in importing developing countries and, in more recent years, in the transition economies. The importing developing countries were taking 4 percent of the net coffee exports of the exporting developing countries in the mid-1970s. This share has now risen to only 7 percent. In contrast, for sugar the net imports of the importing developing countries amount to three-quarters of the net exports of the exporting developing countries, up from only 10 percent in the mid-1970s.

In the projections shown in Table 3.21 there are

[42] That is, non-competing with locally produced close substitutes in the main importing/consuming countries, although there is no commodity that does not face some degree of competition in consumption, such as soft drinks for coffee and non-cocoa confectionery for chocolate. As noted, cocoa now faces the competition of vegetable fats in the production of chocolate.

[43] Viet Nam had become the world's second largest producer after Brazil by 2000. Its exports now account for 10 percent of aggregate exports of the developing countries (sum of net exports of all the net exporting developing countries, see Table 3.21), up from only 1 percent ten years earlier.

Table 3.21 Coffee and products, production, consumption and trade: past and projected

	'000 tonnes	Growth rates, percentage p.a.				
	1997/99	1969-99	1979-99	1989-99	1997/99 -2015	2015 -2030
				Production*		
Developing countries	6 452	1.6	1.1	1.0	1.2	1.2
Industrial countries	3	3.1	9.1	16.1	2.3	3.2
World	6 455	1.6	1.1	1.0	1.2	1.2
				Food consumption (kg/person/year)*		
	1964/66	1974/76	1984/86	1997/99	2015	2030
Developing countries	0.5	0.4	0.4	0.4	0.4	0.5
Industrial countries	3.8	4.1	4.4	4.4	4.7	5.0
Transition countries	0.3	0.5	0.6	1.2	1.6	2.2
World	1.2	1.1	1.1	1.0	1.1	1.1
				Net trade ('000 tonnes)*		
Industrial countries	-2 620	-3 106	-3 550	-3 969	-4 475	-4 875
Transition countries	-90	-193	-220	-502	-640	-830
Developing countries	2 681	3 247	3 902	4 555	5 200	5 800
Exporters in 1997/99	2 790	3 395	4 088	4 947	5 825	6 660
Brazil	910	867	1 003	1 205		
Colombia	352	426	664	649		
Viet Nam	2	5	12	420		
Indonesia	88	125	294	351		
Guatemala	95	127	152	243		
Mexico	95	145	206	238		
Côte d'Ivoire	192	287	234	228		
Uganda	155	186	142	202		
India	27	53	82	191		
Costa Rica	51	79	110	126		
El Salvador	103	149	148	121		
Honduras	22	41	73	119		
Peru	37	39	63	119		
Ethiopia	75	60	77	114		
Other exporters	585	805	828	620		
Importers in 1997/99	-109	-148	-186	-392	-625	-860
Algeria	-26	-34	-62	-81		
Morocco	-9	-12	-14	-23		
Other Near East/North Africa	-23	-44	-62	-101		
Korea, Rep.	0	-2	-19	-76		
Argentina	-33	-38	-34	-39		
Hong Kong SAR, Taiwan Province of China	-3	-1	-5	-23		
Other importers	-14	-19	11	-50		

* Coffee and products in green bean equivalent

no radical changes from past trends. World coffee consumption per capita may increase a little and aggregate demand may grow at 1.2 percent p.a., a rate slightly above that of the last two decades. The weight of the industrial countries in world consumption and imports will continue to be dominant, although the importing developing countries and the transition economies will continue to increase their role as consumers and importers, but at a very slow pace. The present very low price levels are not sustainable, and some recovery is expected as producing countries take measures to control the growth of production. The latest World Bank price projections foresee such an upturn in prices. By 2010 they may recover (in real terms) the ground lost in 2000 and 2001, years of sharp declines (World Bank, 2001c, Table A2.13).

3.6.3 Cocoa

Cocoa shares some of the characteristics of coffee in the sense that it is produced exclusively in tropical developing countries and consumed mainly (two-thirds of world consumption) in the industrial countries. However, consumption growth, at 2.4 percent p.a. in the last ten years, has been faster than that of coffee (0.7 percent p.a.). In parallel, the importing developing countries are increasingly providing export outlets: they now account for 12 percent of the exporting countries' net exports, up from only 3 percent in the mid-1970s.

On the exporter side, there have been some radical changes in the relative positions of the different countries. Côte d'Ivoire continues to be the world's largest exporter and has increased its share considerably, to almost 50 percent of the aggregate net exports of the exporting developing countries, up from 33 percent in the mid-1980s and only 17 percent in the mid-1970s (Table 3.22). In contrast, Brazil, the world's second largest exporter up to the late 1980s, had almost disappeared as a net exporter by the late 1990s, mainly as a result of disease that hit production but also because a growing part of production went to increase domestic consumption. Meanwhile, first Malaysia (from the early 1980s) and then Indonesia (ten years later) emerged as major and growing exporters. Between them (but with Indonesia growing and Malaysia declining recently), they have been providing 15-20 percent of the aggregate exports of the net exporting countries in recent years, up from less than 4 percent in the early 1980s.

Consumption per capita is likely to continue to grow in all country groups, although at slower rates than in the past (Table 3.22). The growth of world production, which decelerated sharply in the second half of the 1990s (to under 1 percent p.a. in the five years to 2001), will resume higher rates, but still below those of the longer-term historical period, given the slower growth of per capita consumption and of population. Cocoa prices have been characterized by short booms and long periods of oversupply with depressed prices. The latest trough in prices was in the second half of 2000, with prices around US$900/tonne, down from the previous peak of around US$1 700 in mid-1998. Prices recovered to US$1 380/tonne in January 2002. World Bank projections foresee little further recovery up to 2015 in real terms.

3.6.4 Sugar

Consumption has been growing fast in the developing countries, which now account for 72 percent of world consumption (up from 52 percent in the mid-1970s), including the sugar equivalent of some 60-65 percent of Brazil's sugar-cane production used in ethanol production (USDA, 1998a). In contrast, consumption has grown very little in the industrial countries, and has declined in the transition economies in the 1990s. An important factor in the stagnation of sugar consumption in the industrial countries has been the rapid expansion of corn-based sweeteners in the United States, where they now exceed consumption of sugar (11.8 million short tonnes dry weight, versus 9.4 million short tonnes of refined sugar). Production of the major sweetener, HFCS, shot up from negligible quantities in the mid-1970s to 5 million short tonnes in the mid-1980s and to 9.7 million short tonnes currently.[44]

Sugar is produced under heavy protection in the industrial countries, with the exception of the traditional exporters among them (Australia and South Africa) (OECD, 2002). Under this shelter, production grew at 1.5 percent p.a. in the last three decades, at a time when total consumption in indus-

[44] Data from www.ers.usda.gov/briefing/sugar/Data/data.htm/

Table 3.22 Cocoa and products, production, consumption and trade: past and projected

	'000 tonnes	Growth rates, percentage p.a.				
	1997/99	1969-99	1979-99	1989-99	1997/99 -2015	2015 -2030
				Production*		
Developing countries	3 000	3.1	3.8	2.1	1.8	1.4
World	3 000	3.1	3.8	2.1	1.8	1.4
				Food consumption (kg/person/year)*		
	1964/66	1974/76	1984/86	1997/99	2015	2030
Developing countries	0.08	0.06	0.08	0.14	0.17	0.21
Industrial countries	1.37	1.42	1.65	2.08	2.38	2.62
Transition countries	0.40	0.70	0.73	0.87	1.15	1.48
World	0.38	0.37	0.40	0.49	0.52	0.55
				Net trade ('000 tonnes)*		
Industrial countries	-1 011	-1 070	-1 352	-1 802	-2 310	-2 625
Transition countries	-133	-266	-288	-375	-475	-580
Developing countries	1 114	1 310	1 614	2 126	2 725	3 160
Exporters in 1997/99	1 159	1 354	1 688	2 413	3 145	3 715
Côte d'Ivoire	133	233	557	1 170		
Ghana	458	369	194	329		
Indonesia	0	0	28	322		
Nigeria	232	228	157	163		
Cameroon	86	99	108	122		
Malaysia	-1	9	102	95		
Ecuador	34	64	86	63		
Dominican Republic	26	26	35	43		
Brazil	107	229	325	31		
Other	83	98	97	75		
Importers in 1997/99	-45	-43	-75	-287	-420	-560
Mexico	6	7	4	-40		
China (incl.Taiwan Prov.of China and Hong Kong SAR)	-10	-10	-17	-39		
Argentina	-11	-10	-14	-26		
Philippines	-9	-3	0	-25		
Turkey	-1	-2	-4	-20		
Korea, Rep.	0	-1	-7	-14		
Chile	-2	-1	-4	-13		
Other	-20	-23	-33	-110		

* Cocoa and products in bean equivalent

trial countries was not growing. The result has been that these countries turned from net importers of 7.4 million tonnes in the mid-1970s to net exporters of 3.8 million tonnes in 1997/99 (Figure 13.16). This reflected partly the growing exports of Australia, declining imports of the United States and nearly stagnant imports in Japan, but above all it reflected the shifting of the EU from a net importer of 1.9 million tonnes to a net exporter of 4 million tonnes. As a result, the net exports of the developing exporters showed little growth from the late 1970s to the mid-1990s and shot up only in the second half of the 1990s as several developing countries became major importers.

A major characteristic of these developments is that the low prices prevailing in world markets acted as a disincentive to production in countries that failed to improve productivity and, together with the rapid growth of their own consumption, contributed to turning several traditional exporting developing countries into net importers. These include countries such as the Philippines, Peru and Taiwan Province of China. Collectively, they were net exporters of 2.2 million tonnes in the mid-1970s. They now have net imports of 0.7 million tonnes.

Consumption in the developing countries is projected to continue to grow, from 21 kg person/year currently to 25 kg in 2030 (Table 3.23). Growth could be higher if China's policy to limit saccharin consumption succeeds (Baron, 2001, p. 4). Much of the growth would occur in Asia, as Latin America and the Near East/North Africa have already attained fairly high levels of consumption (Table 2.8). Per capita consumption will probably remain constant in the industrial countries, compared with declines in part of the historical period during which corn sweeteners were substituting for sugar in the United States. This process, very pronounced up to the mid-1980s, has by now been largely exhausted. It could be reversed if sugar prices were not to be supported at the high levels set by policy. Some increases are expected in the transition countries, making up for some of the declines suffered during the 1990s.

A significant unknown that may influence the sugar aggregates in the future is the fate of the use of sugar cane and its main by-product, molasses, as feedstocks for the production of fuel ethanol. There has been renewed interest in this option during the recent (year 2000) peak of world petroleum prices, which coincided with low sugar prices in world markets.[45] Several countries, including "Australia, Thailand and India began to consider the feasibility of large-scale ethanol production while Mexico had proceeded as far as to undertake pilot ethanol programmes to combat urban air pollution" (Jolly, 2001). Enthusiasm with this option weakened as price relationships returned to more "normal" levels. Obviously, the prospect that interest will be rekindled in the future will depend on developments in the oil/sugar price ratios. The latest World Bank price projections to 2015 indicate that developments will probably not favour this option. If anything, price prospects point in the opposite direction: one barrel of oil may be worth about 80 kg of sugar in 2015 (World Bank, 2001c, Table A2.12).

The trade implications of these trends in consumption are shown in Table 3.23. By and large, recent trends in the pattern and rates of expansion of the world sugar trade would continue. This means that the fairly rapid expansion of imports into the deficit developing countries will provide scope for the main developing sugar-exporting countries to continue to expand production for export. The main divergence from past patterns is the likely arrest and some reversal of the trend for the industrial countries to be growing net exporters. The traditional exporters in this group (Australia and South Africa) should continue to expand exports, but the EU is unlikely to continue on the past path of rising net exports and may see some reduction in net exports under the WTO rules (Poonyth *et al.*, 2000).

Further pressure leading to increased EU imports (hence lower net exports) will come from the implementation of the Everything but Arms Initiative (EBA) of free access to exports from the least developed countries, with sugar liberalization being phased in during the period 2006-09 (Baron, 2001, p. 6). However, the potential effect of EBA on the EU's sugar imports from this source is unlikely

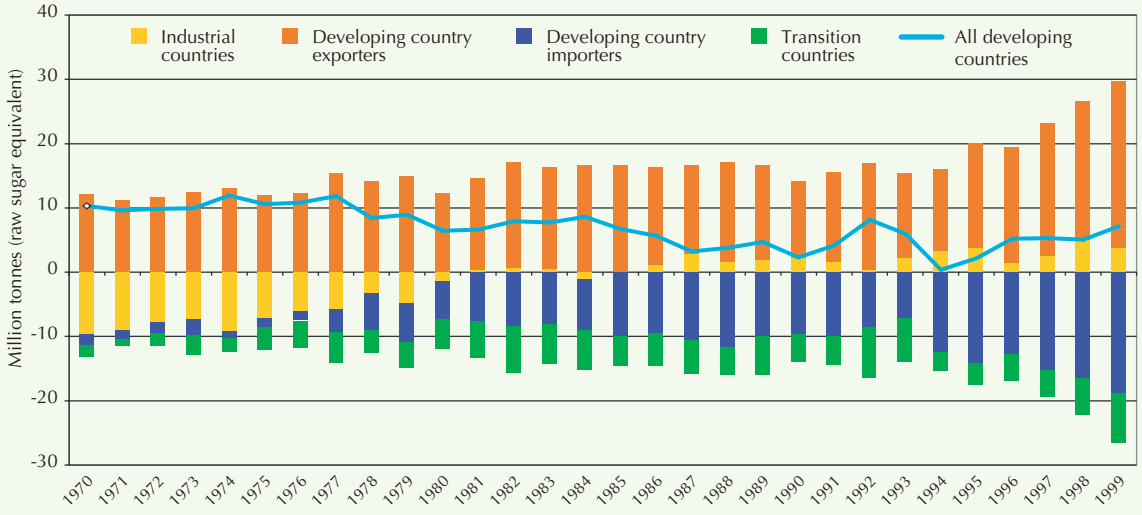
[45] In the first half of 1999 a barrel of oil (US$14, average monthly price January-June 1999) was worth about 100 kg of sugar at the then prevailing world free market price of US$140/tonne. A year later (first half of 2000) it was worth almost twice as much (195 kg of sugar). The latest six-month average price data (August 2001-January 2002) indicate a return to more normal levels (127 kg). Price data from the World Bank: http://Worldbank.org/prospects/pinksheets/

Table 3.23 Sugar, production, consumption and trade: past and projected

	'000 tonnes	Growth rates, percentage p.a.				
	1997/99	1969-99	1979-99	1989-99	1997/99 -2015	2015 -2030
				Production*		
Developing countries	128 814	3.2	2.8	2.6	1.8	1.4
Industrial countries	36 049	1.5	1.1	1.7	0.1	0.3
Transition countries	8 553	-1.2	-2.4	-5.6	0.8	0.7
World	173 415	2.4	2.0	1.8	1.4	1.2
				Food consumption (kg/person/year)*		
	1964/66	1974/76	1984/86	1997/99	2015	2030
Developing countries	14	16	19	21	23	25
Industrial countries	37	39	33	33	33	33
Transition countries	37	45	46	34	35	36
World	21	23	23	24	25	2
				Net trade ('000 tonnes)*		
Industrial countries	-7 425	-7 519	12	3 755	2 850	3 570
Australia	1 228	1 919	2 539	4 304		
EU15	-2 675	-1 857	2 595	4 125		
South Africa	426	780	861	1 142		
Japan	-1 451	-2 535	-1 880	-1 608		
United States	-3 536	-4 196	-2 246	-2 309		
Other industrial	-1 417	-1 630	-1 857	-1 899		
Transition countries	-748	-3 281	-5 281	-5 863	-5 350	-4 270
Developing countries	7 908	11 107	6 993	5 833	6 000	4 000
Exporters in 1997/99	8 803	12 391	16 143	22 696	28 850	34 400
Brazil	672	1 783	3 535	9 304		
Thailand	64	725	1 702	3 348		
Cuba	4 570	5 667	6 706	2 924		
Guatemala	46	215	259	1 179		
Colombia	85	142	239	975		
Mexico	509	196	11	877		
Pakistan	-28	-16	-77	592		
Mauritius	575	573	566	531		
Other	2 310	3 106	3 203	2 969		
Importers in 1997/99	-895	-1 283	-9 150	-16 864	-22 850	-30 350
Korea, Rep.	-41	-215	-591	-1 021		
Iran, Islamic Rep.	-395	-377	-496	-1 119		
Egypt	-103	-114	-790	-1 236		
Indonesia	62	-137	-23	-1 535		
Other	-417	-440	-7 249	-11 953		

* Sugar in raw sugar equivalent

Figure 3.16 Sugar, net trade positions, 1970-99



to be dramatic (Stevens and Kennan, 2001). In addition, the United States may revert to being a growing net importer, mainly as a result of the gradual reduction of tariffs on sugar imports from Mexico under the NAFTA rules leading to tariff-free market access from 2008 onwards (USDA, 2002, p. 45). Finally, the world's largest importer, Russia (1997/99 net imports 4.5 million tonnes, 73 percent of consumption) is likely to continue to hold this role for some time and only lose it in the second half of the projection period, as other countries become larger importers and Russia itself moves towards 50 percent self-sufficiency (Gudosnikov, 2001).

3.6.5 Bananas

Bananas are an important food crop in several tropical developing countries (see earlier discussion of roots and tubers). There are 12 countries with a production of over 1 million tonnes annually, ranging from India (12 million tonnes) to Venezuela (1 million tonnes). However, in only four of them are bananas produced primarily for export, with the part of total production going to exports ranging from over 90 percent in Colombia and Costa Rica, to 70 percent in Ecuador and 33 percent in the Philippines.[46] Among the major producers, China is a significant net importer.

Traditionally, markets for banana-exporting countries were overwhelmingly in the industrial countries (western Europe, North America and Japan). Only in recent years have a number of developing countries and transition economies become significant importers. These two groups now take 26 percent of exports from exporting countries, up from only 9 percent ten years ago (see Table 3.24). These trends are likely to continue and their share could rise further to 33 percent by 2030, as both the transition economies and the importing (largely non-producing) developing countries will be increasing further their per capita consumption and imports. However, the industrial countries will continue to hold a dominant position as major importers, with their consumption per capita increasing further, although at a slower pace than in the past.

The trade policy reform in prospect in the EU (shift from the preferential tariff-rate quotas granted to the African, Caribbean and Pacific Group of States [ACP] to a tariffs-only regime from 2006 onwards) will remove one of the major sources of friction and may encourage consumption in the EU by increasing supplies at lower prices from the more efficient Latin American producers. Naturally, this shift in policy has the

46 Other countries that produce predominantly for export include Guatemala, Panama, Côte d'Ivoire, Jamaica and several of the smaller Caribbean countries whose banana production, and often their overall economies, depend on exports to the EU under the preferential access regime (tariff-rate quotas) of the ACP, which however is to terminate in 2006 when the EU will shift to a tariffs-only regime (WTO, 2001f).

Table 3.24 Bananas, production, consumption and trade: past and projected

	'000 tonnes	Growth rates, percentage p.a.				
	1997/99	1969-99	1979-99	1989-99	1997/99 -2015	2015 -2030
				Production		
Developing countries	57 933	2.5	3.0	3.0	2.0	1.5
Industrial countries	996	1.3	0.8	0.9	0.7	0.7
World	58 929	2.5	2.9	3.0	2.0	1.5
				Food consumption (kg/person/year)		
	1964/66	1974/76	1984/86	1997/99	2015	2030
Developing countries	7.1	6.9	7.7	8.5	9.6	10.4
Industrial countries	6.1	7.2	7.8	9.3	11.8	13.3
Transition countries	0.2	0.6	0.3	3.2	4.5	5.9
World	6.2	6.4	7.1	8.2	9.6	10.6
				Net trade ('000 tonnes)		
Industrial countries	-3 954	-5 310	-5 964	-4 012	-10 900	-12 600
Transition countries	-52	-219	-133	-1 421	-1 900	-2 350
Developing countries	3 922	5 361	5 951	10 447	13 600	16 000
Exporters in 1997/99	4 113	5 765	6 417	12 240	16 800	20 400
Ecuador	1 287	1 236	1 129	4 250		
Costa Rica	323	1 070	917	2 272		
Colombia	245	388	932	1 522		
Philippines	0	761	815	1 204		
Guatemala	65	282	351	663		
Panama	328	490	648	555		
Honduras	560	572	788	353		
Mexico	14	5	52	220		
Côte d' Ivoire	130	136	98	204		
Others	1 161	825	685	997		
Importers in 1997/99	-192	-403	-465	-1 793	-3 200	-4 400
Korea, Rep.	0	-6	-4	-129		
Saudi Arabia	-12	-35	-88	-144		
Chile	-33	-43	-37	-148		
Iran, Islamic Rep.	-3	-103	0	-190		
Argentina	-177	-123	-102	-263		
China	23	2	-28	-491		
Others	11	-96	-206	-429		

potential of damaging the ACP countries that will lose preferential access to the EU market, particularly those that are not in the LDC category. As noted, the latter will have tariff-free access under the EU's EBA.

3.6.6 Natural rubber

Developments in natural rubber have some similarities with those in the sugar sector. In the first place, a good part of the growth in world consumption originated in developing countries, which now account for 50 percent of the world total, up from only 28 percent in the mid-1970s. This growth reflected, among other things, large increases in consumption in some of the main producing countries such as Malaysia and India including, in the case of Malaysia, domestic consumption used in the production of rubber manufactures for export. Second, the growth of exports of the developing exporting countries has become increasingly dependent on the growth of imports of other developing countries (Table 3.25). And third, natural rubber faces strong competition from synthetic rubber in the industrial countries and transition economies. However, unlike sugar, such competition does not come from substitute agricultural products produced under protection in the industrial countries. Therefore, in contrast to the case of sugar, policy issues relating to the rubber trade and export earnings of the developing countries transcend the agriculture-specific aspects of the trade policy debate, and extend into the more general issues of, for example, price stabilization schemes, commodity development and tariff escalation with degree of processing.

The demand for rubber (both natural and synthetic) is a close correlate of overall economic growth and industrialization, in particular the growth of the automotive sector (65-70 percent of total rubber use is for tyres). The share of natural rubber in total rubber consumption is influenced by prices, technology and the mix of final rubber products. This latter factor can be particularly important; the increase in the share of radial tyres and those for heavy trucks (which require a higher component of natural rubber) in total tyre production will favour natural rubber. This now accounts for about 40 percent of aggregate rubber consumption,[47] up from some 30 percent in the 1980s. This increase in the share reflected some radical changes in the geographic patterns of consumption of both natural rubber (above-mentioned increases in consumption in the major producing countries) and synthetic rubber, following the decline of total rubber consumption (mostly synthetic) in the transition economies. These factors, particularly the second, will be less influential in the future and the rise in the share of natural rubber is not likely to continue.

In the longer term, the competitive position of natural rubber vis-à-vis synthetic will depend on its price relative to that of the main feedstock for the production of synthetic rubber – petroleum. The latest World Bank projections foresee a recovery in the natural rubber price by 2015 from its very low current levels, and a decline in the price of petroleum.[48] Therefore, the share of natural rubber may not continue growing and indeed may fall,[49] leading to a slowdown in total demand compared with the past. This is reflected in the projections of Table 3.25: world demand is projected to grow at around 2.0 percent p.a. compared with 2.6 percent p.a. in the last ten years. The historical trends of faster growth in the consumption of natural rubber in the developing countries compared with the industrial ones are likely to continue, leading to further increases in their share in world consumption, to 60 percent by 2030.

The predominance of the industrial countries as major importers will continue although it will be somewhat less pronounced than at present. These countries now take 65 percent of the exports of the producing/exporting developing countries. They may still account for 56 percent in 2030. The importing developing countries undergoing rapid industrialization (e.g. China, the Republic of Korea and Brazil) will be gradually increasing their share in world imports. However, prospective changes in the role of the importing developing countries as growing outlets for the exports of the producing/exporting countries of natural rubber will be nowhere near as revolutionary as those that have characterized, and are still in prospect for, the sugar sector.

47 Average 1999/2000, from *Rubber Statistical Bulletin,* 56 (6). March 2002.
48 Changes to 2015 from the three-year average of 1999/2001 (World Bank, 2001c, Table A2.12).
49 A recent projections study suggests that the share of natural rubber may fall back to 35 percent by 2020 (Burger and Smit, 2000, Figure 5.4).

Table 3.25 Natural rubber, production, consumption and trade: past and projected

	'000 tonnes	Growth rates, percentage p.a.				
	1997/99	1969-99	1979-99	1989-99	1997/99 -2015	2015 -2030
				Production		
Developing countries	6 601	3.0	3.4	2.9	2.1	1.9
World	6 601	3.0	3.4	2.9	2.1	1.9
				Total demand ('000 tonnes)		
	1964/66	1974/76	1984/86	1997/99	2015	2030
Developing countries	3 252	6.0	6.1	3.5	2.9	2.4
Industrial countries	3 091	1.7	2.0	2.2	1.1	1.2
Transition countries	170	-4.9	-6.8	-3.5	2.0	2.3
World	6 512	2.8	3.2	2.6	2.1	1.9
				Net trade ('000 tonnes)		
Industrial countries	-1 500	-2 044	-2 349	-3 090	-3 750	-4 500
Transition countries	-383	-493	-379	-170	-240	-350
Developing countries	1 902	2 452	2 728	3 424	4 150	5 000
Exporters in 1997/99	2 220	3 033	3 555	4 767	6 250	7 950
Thailand	210	356	680	1 982		
Indonesia	684	798	990	1 498		
Malaysia	928	1 507	1 493	589		
Viet Nam	56	17	36	193		
Côte d'Ivoire	3	16	41	96		
Other exporters	339	339	316	409		
Importers in 1997/99	-318	-581	-827	-1 343	-2 100	-2 950
China*	-171	-275	-294	-516		
Korea, Rep	-13	-72	-163	-304		
Brazil	-6	-45	-65	-104		
Other importers	-129	-189	-305	-419		

* Includes net trade of Hong Kong SAR and Taiwan Province of China.