

APPENDIX

IMPACT BASELINE SCENARIO FOR ASIA: TRENDS TO 2010 IN FOOD SUPPLY, DEMAND, TRADE, AND CHILD MALNUTRITION

With rapid growth in income, rapid dietary changes due to increasing incomes and urbanization, and the increasing openness of Asian economies, Asia will continue to grow in importance to the global economy and particularly to world food markets. In this appendix, prospects are examined for food supply, demand, and trade to 2010 for Asian countries, in the context of global food supply and demand projections and the international price trends that they imply. Implications for one important barometer of well-being—malnutrition among children—are drawn and discussed. Despite the recent financial and economic crisis in East and Southeast Asia, developing countries there should continue their rapid economic development, with enhanced food security stemming from lower food prices and either greater food surpluses or cheaper food imports. Food insecurity in countries with slower economic growth and persistently high population growth, particularly in South Asia, will be far less amenable to improvement.

ASIA IN THE GLOBAL AGRICULTURAL ECONOMY

Global food policy has been driven by the need to feed an increasing population and to support diversified consumption patterns as incomes rise. Agricultural production

growth has been able to meet these goals: in the past three decades, effective demand has been met, while real food prices have declined dramatically. In 1961, the world produced 867 million metric tons (mt) of cereals for 3.1 billion people; by 1995 production was 1.9 billion mt for 5.7 billion people—2.2 times the grain for 1.8 times the population (FAO 1997). At the same time, real prices of major cereals declined: between 1982 and 1995, real world wheat prices dropped by 28 percent, rice prices by 42 percent, and maize prices by 43 percent.

The International Food Policy Research Institute's (IFPRI), International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT) a tool that takes account of current best estimates for such critical trends as income and population growth, as well as agricultural productivity improvements or declines, allows a country- and/or region-specific look at likely future food supply, demand, and trade. What trends are likely to continue, at what pace, and with what implications within specific regions or countries of the developing world, particularly Asia? Following a brief description of the model, IMPACT projections for supply and demand of cereals and livestock products are examined, and implications for international prices and trade explored. Overall, global trends are presented, but results are highlighted for Asia and specific subregions or countries within Asia. In order to place Asia within the context of global developments in supply and demand, key results for other regions of the world are also presented.

IFPRI'S IMPACT GLOBAL FOOD MODEL: MODEL CHARACTERISTICS

IMPACT covers 37 countries and regions (which account for virtually all of world food production and consumption), and 18 commodities, including all cereals, soybeans, roots and tubers, meats, milk, eggs, oils, and oilcakes and meals. The model is specified as a set of country-level supply and demand

equations. Each country model is linked to the rest of the world through trade. World food prices are determined annually at levels that clear international commodity markets. Demand is a function of prices, income, and population growth. Growth in crop production in each country is determined by crop prices and by the rate of productivity growth. Future productivity growth is estimated by its component sources, including crop-management research, conventional plant breeding, wide-crossing and hybridization breeding, and biotechnology and transgenic breeding. Other sources of growth considered include private-sector agricultural research and development, agricultural extension and education, markets, infrastructure, and irrigation.

A key assumption of the baseline productivity projections is that future trends in public investment in Asia and other developing countries in agricultural research, irrigation, and the social sector (education, total social expenditures, and water and sanitation) will continue at the already reduced rates of growth prevailing in the early 1990s. Water availability also has a significant impact on area and yield assumptions. The increase in municipal and industrial water demand between 1995 and 2010 in Asia is projected to be equivalent to 19 percent of 1995 agricultural water demand (Rosegrant, Gazmuri Schleyer, and Yadav 1997). Under the baseline, it is assumed that just under one half of this is a net loss to agricultural water use, representing a 9 percent reduction in water available for agriculture between 1995 and 2010. The methodology of IMPACT is described in Rosegrant, Gazmuri Schleyer, and Yadav (1995).

The results presented here are generated from a revised and updated version of IMPACT. The updated model incorporates additional features in its structure and input data that improve its capability on both the supply and demand sides. Modifications of the model structure are reflected primarily in the supply and demand equations. In the supply equation, the marginal contribution of further expansion of irrigated area is incorporated in two places. It appears in the area function through potential increases in

cropping intensities and in the yield function through the addition of a yield differential between irrigated and nonirrigated crops that represents the improvement that will be realized with the conversion of farm areas into irrigated ecosystems. The demand side of IMPACT incorporates the dynamic adjustment of income elasticities with respect to growth in income.

In addition to the modifications in the model structure, the baseline data on which the projections are made are updated from 1990 to 1993 (with 1993 representing the three-year average value for 1992–94). The revised IMPACT also includes the November 1996 revised population projections from the United Nations (UN 1996) and updated information on investment in agricultural research. The baseline projection income-growth rates for Asia have been adjusted to reflect the estimated impact on income growth of the Asian financial and economic crisis. Projections for income and population growth for the IMPACT countries and regions during the 1993–2010 period are reported in Table A.1.

PROJECTIONS FOR CEREALS

Projected Cereal Demand and its Composition: The Relative Rise of Feed vs. Food Demand

Changing patterns of demand are apparent in the projected per capita and total food demand for cereals shown in Tables A.2 and A.3, the projected growth rates in feed demand and feed-demand levels (Tables A.4 and A.5), and total cereal demand (Table A.6). Per capita food consumption of all cereals will be virtually constant on a global basis, with slightly declining consumption of cereals in higher-income countries balancing the slightly increasing demands of lower-income countries. Global food consumption of cereals, driven mainly by population growth, will increase by 243 million mt (27 percent), from 918 million mt in 1993 to 1,161 million mt

**Table A.1: Income and Population Growth, 1993-2010
(percnt per year)**

Countries/Regions	Population Growth	Income Growth
USA	0.78	2.2
EC12	0.09	2.2
Other Western Europe	0.35	2.3
Japan	0.12	2.2
Australia	1.05	2.2
Other developed countries	1.59	2.2
Eastern Europe	-0.01	1.6
CIS	0.08	1.6
Argentina	1.20	3.2
Brazil	1.22	3.2
Colombia	1.55	3.2
Mexico	1.48	3.2
Other Latin America	1.72	3.0
Madagascar	3.11	3.8
Nigeria	2.80	3.2
Northern Sub-Saharan Africa	2.89	3.3
Central & Western SSA	2.78	3.8
Southern Sub-Saharan Africa	2.53	3.2
Eastern Sub-Saharan Africa	2.68	4.5
Egypt	1.75	3.2
Turkey	1.40	4.5
Other West Asia & North Africa	2.52	3.2
India	1.48	5.1
Pakistan	2.63	4.6
Bangladesh	1.66	4.5
Other South Asia	2.53	4.6
Indonesia	1.32	5.1
Malaysia	1.85	5.4
Myanmar	1.64	4.0
Philippines	1.86	5.0
Thailand	0.72	5.6
Viet Nam	1.56	5.0
Other Southeast Asian countries	2.12	4.0
People's Republic of China	0.79	5.6
Republic of Korea	0.75	3.9
Other East Asian countries	1.21	2.4
Rest of the World	1.37	4.9

Source: IFPRI IMPACT.

Table A.2: Per Capita Food Demand for Cereals, 1993 and Projected 2010 (kilogram per capita)

	Wheat		Maize		Rice		Other Grains		All Cereals	
	1993	2010	1993	2010	1993	2010	1993	2010	1993	2010
	East Asia	79.5	86.2	25.6	22.5	94.9	94.9	9.5	8.9	209.5
PRC	82.6	89.8	25.8	22.6	95.8	96.2	9.5	8.9	213.7	217.5
Republic of Korea	48.3	51.8	17.6	15.6	105.6	102.6	13.2	12.5	184.7	182.5
Other East Asia	36.4	37.7	27.3	26.3	64.2	61.7	6.2	6.1	134.2	131.8
South Asia	59.1	66.4	7.9	7.7	77.4	79.7	17.9	17.0	162.2	170.9
India	54.6	61.1	8.4	8.1	77.5	81.6	22.7	22.1	163.2	172.9
Pakistan	128.8	135.5	5.5	5.2	15.7	16.1	3.2	3.1	153.1	160.0
Bangladesh	19.9	22.4	0.0	0.0	143.2	146.1	0.6	0.7	163.8	169.2
Other South Asia	39.2	43.0	27.6	28.2	91.4	94.1	7.6	7.8	165.9	173.0
Southeast Asia	13.8	16.0	12.9	12.5	141.2	141.6	1.1	1.1	169.1	171.1
Indonesia	14.1	16.4	20.9	20.4	151.7	151.3	0.2	0.2	186.9	188.4
Thailand	9.3	11.0	0.5	0.4	102.1	100.3	1.6	1.4	113.4	113.1
Malaysia	36.5	41.5	3.6	3.2	96.5	95.8	1.7	1.5	138.3	142.0
Philippines	30.6	34.0	18.1	16.6	89.3	90.6	3.2	3.1	141.2	144.2
Viet Nam	4.7	5.5	7.2	7.0	154.3	156.6	0.4	0.4	166.5	169.5
Myanmar	3.0	3.3	2.2	2.1	211.0	210.0	2.8	2.8	218.9	218.3
Other Southeast Asia	0.9	1.0	5.5	5.5	172.5	172.3	0.1	0.1	179.1	178.9
Latin America	49.4	49.7	44.8	45.2	26.9	28.0	6.5	6.3	127.6	129.2
WANA	157.4	158.9	14.8	13.3	20.4	20.6	21.5	21.8	214.1	214.5
Sub-Saharan Africa	12.7	13.7	39.4	39.4	16.7	17.5	43.1	45.3	111.8	116.0
Developing	62.1	65.6	22.1	21.2	71.8	69.9	15.7	16.7	171.6	173.4
Developed	98.2	98.1	11.8	11.6	12.0	11.9	22.2	21.1	144.1	142.7
Japan	43.9	48.6	23.2	20.8	70.6	68.6	8.9	8.3	146.6	146.3
World	70.4	72.0	19.7	19.3	58.1	58.6	17.2	17.5	165.3	167.4

Source: IFPRI IMPACT.

Table A.3: Food Demand for Cereals, 1993 and Projected 2010 (million metric tons)

	Wheat		Maize		Rice		Other Grains		All Cereals	
	1993	2010	1993	2010	1993	2010	1993	2010	1993	2010
	East Asia	101.2	125.7	32.6	32.9	120.6	138.3	12.0	13.0	266.4
PRC	97.1	120.7	30.4	30.4	112.6	129.2	11.1	12.0	251.2	292.3
Republic of Korea	2.1	2.6	0.8	0.8	4.7	5.1	0.6	0.6	8.1	9.1
Other East Asia	1.9	2.4	1.4	1.7	3.4	4.0	0.3	0.4	7.0	8.5
South Asia	70.2	104.8	9.4	12.1	92.0	125.7	21.2	26.8	192.8	269.4
India	49.2	70.8	7.6	9.3	69.9	94.5	20.4	25.6	147.1	200.3
Pakistan	17.1	28.0	0.7	1.1	2.1	3.3	0.4	0.6	20.4	33.1
Bangladesh	2.3	3.4	0.0	0.0	16.5	22.3	0.1	0.1	18.9	25.8
Other South Asia	1.5	2.6	1.1	1.7	3.6	5.6	0.3	0.5	6.5	10.3
Southeast Asia	6.4	9.5	6.0	7.4	65.5	83.8	0.5	0.7	78.4	101.3
Indonesia	2.7	3.9	4.0	4.9	29.1	36.3	0.0	0.1	35.8	45.2
Thailand	0.5	0.7	0.0	0.0	5.9	6.5	0.1	0.1	6.5	7.4
Malaysia	0.7	1.1	0.1	0.1	1.9	2.5	0.0	0.0	2.7	3.7
Philippines	2.0	3.0	1.2	1.5	5.8	8.0	0.2	0.3	9.1	12.8
Viet Nam	0.3	0.5	0.5	0.7	11.0	14.5	0.0	0.0	11.9	15.7
Myanmar	0.1	0.2	0.1	0.1	9.4	12.4	0.1	0.2	9.8	12.8
Other Southeast Asia	0.0	0.0	0.1	0.1	2.5	3.5	0.0	0.0	2.6	3.7
Latin America	22.8	29.4	20.7	26.7	12.4	16.5	3.0	3.7	58.9	76.3
WANA	58.1	85.3	5.5	7.1	7.5	11.0	7.9	11.7	79.0	115.1
Sub-Saharan Africa	6.5	11.2	20.2	32.3	8.6	14.3	22.1	37.1	57.4	94.9
Developing	265.4	366.1	94.3	118.4	306.9	390.2	66.9	93.0	733.5	967.7
Developed	125.4	133.0	15.1	15.7	15.3	16.1	28.3	28.6	184.2	193.4
Japan	5.5	6.2	2.9	2.6	8.8	8.7	1.1	1.1	18.3	18.6
World	390.8	499.1	109.4	134.1	322.3	406.3	95.2	121.6	917.7	1,161.1

Source: IFPRI IMPACT.

Table A.4: Projected Annual Growth Rates of Feed Demand for Cereals, 1993 - 2010 (percent per year)

	Wheat	Maize	Rice	Other Grains	All Cereals
East Asia	3.52	3.75	0.79	3.20	3.65
PRC	3.67	3.90	0.79	3.24	3.78
Republic of Korea	2.92	2.75	—	3.38	2.81
Other East Asia	2.60	2.60	—	2.73	2.60
South Asia	3.60	6.61	1.94	3.56	4.46
India	3.82	7.61	1.79	3.62	4.96
Pakistan	3.27	3.29	—	3.41	3.29
Bangladesh	—	3.26	—	3.02	3.16
Other South Asia	2.75	3.05	2.71	2.89	2.86
Southeast Asia	3.12	3.34	1.41	3.22	3.15
Indonesia	—	3.42	1.31	—	3.10
Thailand	—	3.09	0.52	3.13	2.93
Malaysia	3.12	3.00	1.74	3.16	2.98
Philippines	—	3.71	1.95	3.61	3.52
Viet Nam	—	3.22	1.66	3.43	2.67
Myanmar	—	3.05	—	3.64	3.12
Other Southeast Asia	—	2.62	—	3.07	2.64
Latin America	2.29	2.17	—	2.28	2.20
WANA	2.64	2.57	—	2.68	2.65
Sub-Saharan Africa	3.74	3.63	—	3.68	3.65
Developing	3.11	3.25	1.15	2.65	3.09
Developed	0.47	0.78	0.09	0.61	0.67
Japan	0.34	0.20	—	0.40	0.27
World	1.11	1.86	1.15	1.05	1.51

Source: IFPRI IMPACT.

Table A.5: Feed Demand for Cereals, 1993 and Projected 2010 (million metric tons)

	Wheat		Maize		Rice		Other Grains		All Cereals	
	1993	2010	1993	2010	1993	2010	1993	2010	1993	2010
	East Asia	8.0	14.3	70.1	131.0	2.1	2.4	3.7	6.3	83.8
PRC	6.4	11.8	60.9	116.8	2.1	2.4	3.2	5.5	72.6	136.5
Republic of Korea	1.2	2.0	3.5	5.6	—	—	0.1	0.2	4.8	7.8
Other East Asia	0.3	0.5	5.6	8.7	—	—	0.3	0.5	6.3	9.8
South Asia	2.9	5.2	1.5	4.3	0.4	0.5	0.7	1.3	5.4	11.3
India	1.8	3.4	1.0	3.6	0.3	0.4	0.6	1.0	3.7	8.5
Pakistan	0.9	1.6	0.3	0.5	0.0	0.0	0.1	0.2	1.3	2.3
Bangladesh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other South Asia	0.2	0.2	0.1	0.2	0.1	0.1	0.0	0.0	0.4	0.6
Southeast Asia	0.1	0.2	12.7	22.2	1.6	2.1	0.2	0.4	14.7	24.8
Indonesia	0.0	0.0	3.2	5.6	0.6	0.8	0.0	0.0	3.8	6.4
Thailand	0.0	0.0	3.6	6.1	0.3	0.3	0.2	0.3	4.1	6.7
Malaysia	0.1	0.2	1.9	3.1	0.0	0.1	0.0	0.0	2.1	3.4
Philippines	0.0	0.0	3.6	6.8	0.5	0.7	0.0	0.0	4.1	7.5
Viet Nam	0.0	0.0	0.2	0.4	0.1	0.2	0.0	0.0	0.4	0.6
Myanmar	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.1	0.2
Other Southeast Asia	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1
Latin America	2.1	3.0	39.1	56.3	—	—	12.4	18.2	53.5	77.5
WANA	7.1	11.1	8.9	13.7	—	—	18.3	28.7	34.3	53.5
Sub-Saharan Africa	0.0	0.0	1.3	2.3	—	—	0.9	1.6	2.2	4.0
Developing	20.2	34.0	133.4	229.8	4.1	5.0	36.2	56.4	193.9	325.2
Developed	77.8	84.3	209.2	238.8	0.0	0.0	155.3	172.3	442.3	495.4
Japan	0.5	0.6	12.1	12.5	—	—	5.5	5.9	18.1	19.0
World	98.0	118.3	342.6	468.6	4.1	5.0	191.5	228.7	636.1	820.6

Source: IFPRI IMPACT.

Table A.6: Total Cereal Demand, 1993 and Projected 2010 (million metric tons)

	Wheat		Maize		Rice		Other Grains		All Cereals	
	1993	2010	1993	2010	1993	2010	1993	2010	1993	2010
East Asia	118.1	151.6	106.4	169.4	133.6	153.1	18.2	22.4	376.3	496.6
PRC	111.2	142.3	91.5	147.4	125.0	143.4	16.6	20.3	344.3	453.4
Republic of Korea	4.6	6.3	6.3	9.3	5.1	5.6	0.7	0.9	16.6	22.0
Other East Asia	2.3	3.0	8.7	12.8	3.6	4.2	0.9	1.2	15.4	21.2
South Asia	79.9	120.1	12.2	18.5	101.7	139.0	24.3	31.2	218.1	308.8
India	56.9	82.8	9.7	14.5	77.4	104.7	23.3	29.6	167.3	231.5
Pakistan	18.8	30.1	1.2	2.0	2.3	3.7	0.6	0.9	22.9	37.4
Bangladesh	2.5	3.6	0.0	0.0	17.9	24.2	0.1	0.1	20.5	28.0
Other South Asia	1.7	2.9	1.3	2.1	4.0	6.3	0.3	0.5	7.4	11.8
Southeast Asia	6.8	10.1	19.4	30.7	73.6	93.9	0.9	1.2	100.7	136.0
Indonesia	2.8	4.1	7.6	11.1	32.8	40.9	0.0	0.1	43.2	56.2
Thailand	0.6	0.7	3.7	6.2	7.6	8.5	0.3	0.5	12.2	15.9
Malaysia	1.0	1.5	2.0	3.3	1.9	2.6	0.1	0.1	5.0	7.6
Philippines	2.0	3.0	5.0	8.5	6.5	9.1	0.2	0.3	13.7	20.9
Viet Nam	0.3	0.5	0.8	1.1	12.8	16.9	0.0	0.1	14.0	18.6
Myanmar	0.1	0.2	0.2	0.3	9.4	12.4	0.1	0.2	9.9	13.1
Other Southeast Asia	0.0	0.0	0.1	0.2	2.5	3.5	0.0	0.0	2.6	3.8
Latin America	27.4	35.7	69.3	96.1	14.4	19.2	17.7	25.1	128.8	176.1
WANA	72.9	107.2	15.8	22.9	8.2	11.9	29.8	45.7	126.5	187.9
Sub-Saharan Africa	6.9	11.8	26.3	42.3	9.6	16.2	27.6	46.4	70.4	116.7
Developing	312.2	437.0	249.4	380.0	341.4	433.8	118.5	172.0	1,021.5	1,422.9
Developed	240.1	256.9	276.8	314.5	17.8	18.8	216.8	237.0	751.5	827.2
Japan	6.5	7.3	16.6	16.8	9.6	9.5	6.9	7.2	39.6	40.8
World	552.2	693.9	526.2	694.5	359.2	452.6	335.3	409.1	1,773.0	2,250.1

Source: IFPRI IMPACT.

in 2010. Increased food demand for wheat will account for 44 percent of the total increase in food demand, followed by rice with 35 percent (Table A.3).

Developed countries as a group have higher per capita wheat consumption levels (led by the former Soviet Union and Eastern Europe, which averaged close to 150 and 120 kilograms (kg) per capita, respectively, in 1993) than developing countries. In this latter group, countries in West Asia and North Africa (WANA) have the highest levels (Table A.2). Still, while in the group of developed countries per capita wheat consumption is projected to stagnate at 98 kg through 2010, levels in the developing world are projected to rise from 62 kg in 1993 to 66 kg in 2010 (Table A.2). At the global level, this translates into slightly slowing growth in per capita food demand for wheat compared to recent trends, but at rates still significantly faster than for maize or rice. Within the developing-country group, per capita food consumption of wheat will remain flat in Latin America and WANA, but is expected to move up in the group of Asian developing countries (see the Tables in Chapter XII for these figures) from 61 kg to 66 kg in the same period. In South Asia, growth in wheat consumption from 59 kg to 66 kg per capita consumption will be driven by solid income growth. In the PRC, per capita wheat demand is expected to increase from 83 kg to 90 kg. Modest growth is projected for the Southeast Asian country group from 14 to 16 kg per capita over the period; this masks a substantial jump in per capita wheat consumption of the region's largest wheat consumer, Malaysia (moving from 37 kg per capita in 1993 to 42 kg in 2010).

Per capita food demand for rice is projected to decline only slightly from 1993 to 2010, as rapid income growth in Asia drives a diversification of diets in developing countries. As a group, developing countries will reduce per capita consumption of rice as food from 72 kg in 1993 to 70 kg in 2010; per capita consumption will virtually stagnate in the group of Asian developing countries, increasing only slightly, from 95 to 96 kg. At the same time, per capita demand for rice will fall for the PRC and most of the Southeast Asian countries (the only

projected increases, and these small, coming in the Philippines and Viet Nam). In some developing countries, however, rice consumption will rise due to a dietary shift to rice from maize and other coarse grains. India will increase its per capita food demand for rice from 78 kg in 1993 to 82 kg in 2010, and slight increases in per capita consumption are projected for the regions of Latin America, Sub-Saharan Africa, and WANA. In developed countries, global per capita consumption levels will be virtually constant. Population growth worldwide, however, will spur an increase in total food demand for rice of 84 million mt (26 percent) over the 1993 level of 322 million mt.

Per capita food demand for maize and other coarse grains will continue to be virtually stagnant or declining in both developing and developed countries, due to the dietary shifts described above. Developing Asia will experience substantial declines in per capita demand for maize as food, whereas demand will increase slightly in Latin America, where the major maize consumer, Mexico, is located. The increase in per capita food demand for other grains in developing countries is mainly due to Sub-Saharan Africa, where these grains are a primary cereal staple. For the world as a whole, food consumption of other coarse grains is stagnant at around 17 kg per capita (Table A.2). Global food demand for maize and other coarse grains will increase by 25 million mt and by 26 million mt, respectively; most of this increase (49 percent and 57 percent, respectively) will occur in Sub-Saharan Africa (Table A.3).

Tables A.4 and A.5 spotlight the fact that the rapid growth in demand for cereals—in particular maize—as animal feed in developing countries, already seen as important for Asia, (see Chapter V) will proceed apace. Demand for maize for feed is projected to grow during 1993–2010 at a strong 7.6 percent per year in India (though from a very low base), and at about 4 percent per year in the PRC and Sub-Saharan Africa. The average growth for all developing countries is projected at 3.3 percent per year, and for the group of Asian developing economies at 3.8 percent annually. This high growth is due to the rapid expansion of the livestock industry, especially in the more rapidly growing developing economies, where

consumption of livestock products (as described throughout this appendix, exclusive of dairy products such as milk) will expand dramatically. Demand for wheat and other coarse grains as feed will also experience high rates of growth in developing countries, at 3.1 and 2.7 percent per year, respectively. Again, demand growth for these commodities will be even higher in the group of Asian developing countries, at 3.5 and 3.3 percent per year, respectively.

Looking at all cereals, demand for feed will increase during 1993–2010 by 3.6 percent per year, on average, in Asian developing countries and by 3.1 percent annually in the group of developing countries. Growth in cereal feed demand will be much lower in developed countries, at 0.7 percent per year in 1993–2010, but slightly higher than the growth rate prevailing since 1982. Global demand for cereals as animal feed will increase by 185 million mt (29 percent), more than 70 percent of which will be accounted for by developing countries (Table A.5). Cereal feed demand will more than double in India (from very low levels) and nearly double in the PRC, to the point that the PRC will overtake the United States as the largest consumer of cereal feeds by 2010.

How will these demand components translate into total demand requirements? Table A.6 shows the projected levels of total demand for cereals in 1993 and 2010. Global cereal demand will increase by 477 million mt (27 percent), compared to the 1993 level of 1,773 million mt. The group of developing countries will account for 84 percent of the global increase in cereal demand, and the Asian developing economies will account for 52 percent. The PRC alone will account for 23 percent and India for another 13 percent. Cereal demand will increase by 66 percent in Sub-Saharan Africa; by 49 percent in WANA; by 37 percent in Latin America; and by 35 percent in Southeast Asia.

The largest increase in demand will be for maize (35 percent), driven by the rapid growth in demand for feed, followed by wheat (30 percent). Eighty-eight percent of the increase in wheat demand will come from the developing world, where both population and income growth are higher than in the developed economies. Even more striking, 99 percent of

the increase in rice demand will be accounted for by the group of (primarily Asian) developing countries. However, rice demand will grow more slowly than wheat and maize because of changing consumption patterns and the limited role of rice in animal feed. Overall rice demand is expected to increase by 93 million mt, with the most significant increases in India (27 million mt), Southeast Asia (20 million mt), and the PRC (18 million mt).

Projected Production Growth in Cereals: Burden on Yield vs. Area to Meet Demand?

How will this growth in demand be met? As shown in Table A.7, world cereal production is projected to grow at an average rate of 1.4 percent per annum, virtually the same annual growth as was achieved during 1982–1993. Annual growth in specific cereals will not maintain its 1982–93 pace: wheat production is projected at 1.4 percent during 1993–2010, compared to 1.5 percent during 1982–93; maize production at 1.7 percent compared to 2.2 percent, and rice production at 1.4 percent compared to 2.0 percent in the former period. Production of other coarse grains will recover from negative growth between 1982 and 1993, to a growth rate of 1.2 percent per year in 1993–2010.

Annual growth in crop production will be higher in the group of developing countries, at 1.8 percent, than in the developed countries, at 1.0 percent. Growth in cereal crop production is projected at 1.5 percent annually, on average, in the group of Asian developing countries. Sub-Saharan Africa will experience the highest production growth rate for each of the cereals; this is mainly due to its past low production levels. In the group of developed countries, Australia is expected to experience the highest cereal-production growth rate, at 2.0 percent, while Japan will face the lowest growth in production at a negative 0.7 percent per year during 1993–2010.

Production trends can better be understood by looking at their component parts, area and yield. Table A.8 provides an overview on the levels of cereal-crop area in 1993 and 2010, Table

Table A.7: Projected Annual Production Growth Rates for Cereals, 1993–2010 (percent per year)

	Wheat	Maize	Rice	Other Grains	All Cereals
East Asia	0.95	1.97	0.71	0.40	1.15
PRC	0.95	1.97	0.74	0.39	1.17
Republic of Korea	—	1.64	0.20	0.10	0.22
Other East Asia	1.44	2.21	0.10	1.12	1.13
South Asia	1.91	2.11	1.79	1.08	1.78
India	1.93	2.09	1.75	1.10	1.75
Pakistan	1.91	2.38	2.09	0.62	1.94
Bangladesh	1.04	1.80	1.77	0.77	1.73
Other South Asia	1.72	1.95	2.42	0.60	2.15
Southeast Asia	0.75	2.27	1.63	0.63	1.74
Indonesia	—	1.85	1.15	—	1.28
Thailand	1.12	2.15	1.17	0.49	1.39
Malaysia	—	1.67	1.56	—	1.56
Philippines	—	3.04	2.35	—	2.66
Viet Nam	—	1.87	1.87	1.39	1.87
Myanmar	0.75	1.93	2.52	0.85	2.46
Other Southeast Asia	—	1.81	2.80	—	2.75
Latin America	2.61	2.17	2.39	1.77	2.23
WANA	2.10	2.07	2.42	2.76	2.30
Sub-Saharan Africa	2.85	3.09	3.20	3.08	3.09
Developing	1.64	2.19	1.41	2.03	1.75
Developed	1.10	1.19	0.46	0.74	1.02
Japan	0.60	0.82	-0.77	-0.21	-0.65
World	1.35	1.65	1.37	1.18	1.41

Source: IFPRI IMPACT.

A.9 presents the projected annual cereal yield growth rates for the same period, and Table A.10 shows the projected cereal yield levels. Only 43 million hectares (ha) (6 percent) will be added to the global cereal crop area of 700 million ha between 1993 and 2010. The largest increases will be in maize (13 million ha) and other coarse grains (15 million ha). Rice area, on the other hand, will be virtually stagnant, with an increase of only 5 million ha by 2010. More than half of this increase will be in the group of Asian developing countries. The major crop-area expansion will occur in the group of developing countries at 35 million ha. Sub-Saharan Africa will experience the lion's share of area expansion with 19 million ha, 44 percent of the global increase, with the additional area mainly planted to other coarse grains (62 percent) and maize (27 percent). Crop area will increase by 6 million ha each in developing Asia and Latin America, and by 3 million ha in WANA. In the group of developed countries, cereal-crop area will stabilize after falling significantly after 1982 due to declining cereal prices, policies to remove land from production, and the economic collapse in much of Eastern Europe and the former Soviet Union. The annual area growth rate will be 0.2 percent for wheat and 0.3 percent for maize. These projected expansions in cereal-crop area are small compared to the projected increases in production.

The projected slow growth in the expansion of crop area places the burden of meeting future cereal demands on crop yield growth. Although yield growth will vary considerably by commodity and country, in general, rates of growth in crop yields are projected to continue to decline compared to the already reduced rates of the 1982–93 period. The global cereal yield-growth rate is projected to decline from 1.7 percent per year in 1982–93 to 1.1 percent in 1993–2010.

In the group of developed countries, yield growth will slow down or stagnate for each of the cereals. Wheat yields are projected to increase by 0.89 percent per year in 1993–2010, on average, compared with an annual growth of 1.74 percent during 1982–93. Maize yield growth will slow from 1.35 percent per year in 1982–93 to 0.87 percent per year in 1993–2010, and yields for other coarse grains will decline from 1.29 percent to 0.67

Table A.8: Cereal Crop Area, 1993 and Projected 2010 (million hectares)

	Wheat		Maize		Rice		Other Grains		All Cereals	
	1993	2010	1993	2010	1993	2010	1993	2010	1993	2010
	East Asia	30.5	30.4	21.7	23.2	33.0	32.4	7.2	7.1	92.4
PRC	29.9	29.8	21.0	22.4	30.9	30.4	6.9	6.8	88.6	89.5
Republic of Korea	—	—	0.0	0.0	1.1	1.0	0.1	0.1	1.3	1.2
Other East Asia	0.6	0.6	0.7	0.7	1.0	1.0	0.2	0.2	2.5	2.5
South Asia	33.5	35.0	7.7	7.9	56.2	58.0	28.7	28.7	126.1	129.6
India	24.3	25.3	6.0	6.1	41.8	43.1	27.3	27.4	99.4	101.8
Pakistan	8.1	8.5	0.9	0.9	2.2	2.3	1.0	1.0	12.1	12.7
Bangladesh	0.6	0.6	0.0	0.0	10.0	10.2	0.1	0.1	10.7	11.0
Other South Asia	0.6	0.6	0.8	0.8	2.2	2.4	0.3	0.3	3.9	4.1
Southeast Asia	0.1	0.2	8.5	8.8	38.2	39.6	0.4	0.4	47.2	48.9
Indonesia	0.0	0.0	3.2	3.3	11.0	11.1	0.0	0.0	14.2	14.4
Thailand	0.0	0.0	1.3	1.3	8.9	9.1	0.2	0.2	10.3	10.6
Malaysia	0.0	0.0	0.0	0.0	0.7	0.7	0.0	0.0	0.7	0.7
Philippines	0.0	0.0	3.2	3.3	3.4	3.6	0.0	0.0	6.6	6.9
Viet Nam	0.0	0.0	0.5	0.5	6.5	6.8	0.0	0.0	7.1	7.4
Myanmar	0.1	0.2	0.1	0.2	5.4	5.9	0.2	0.3	5.9	6.5
Other Southeast Asia	0.0	0.0	0.1	0.1	2.3	2.4	0.0	0.0	2.3	2.5
Latin America	8.3	9.7	27.8	31.5	6.8	7.5	4.9	5.6	47.9	54.3
WANA	28.6	30.0	2.4	2.6	1.5	1.6	23.1	24.9	55.6	59.1
Sub-Saharan Africa	1.1	1.4	20.1	25.2	6.1	7.8	35.2	46.7	62.4	81.1
Developing	102.2	106.7	88.2	99.0	141.7	147.0	99.5	113.5	431.6	466.2
Developed	118.2	122.5	47.0	49.5	4.4	4.2	98.9	100.1	268.5	276.3
Japan	0.2	0.2	0.0	0.0	2.2	1.8	0.1	0.1	2.4	2.1
World	220.4	229.2	135.1	148.5	146.1	151.2	198.4	213.6	700.0	742.5

Source: IFPRI IMPACT.

Table A.9: Projected Annual Cereal Yield Growth Rates, 1993–2010 (percent per year)

	Wheat	Maize	Rice	Other Grains	All Cereals
East Asia	0.96	1.56	0.82	0.45	1.10
PRC	0.96	1.56	0.83	0.45	1.11
Republic of Korea	—	1.55	0.67	0.99	0.72
Other East Asia	1.23	1.81	0.58	0.53	1.11
South Asia	1.65	2.01	1.60	1.07	1.61
India	1.69	2.05	1.57	1.08	1.60
Pakistan	1.59	2.16	1.69	0.79	1.65
Bangladesh	0.95	1.45	1.61	0.79	1.57
Other South Asia	1.51	1.60	2.05	0.71	1.85
Southeast Asia	0.04	2.05	1.41	0.44	1.52
Indonesia	—	1.63	1.10	—	1.19
Thailand	0.99	2.03	1.02	0.91	1.25
Malaysia	—	1.34	1.33	—	1.33
Philippines	—	2.81	2.10	—	2.41
Viet Nam	—	1.46	1.62	0.67	1.60
Myanmar	0.03	1.45	2.01	0.25	1.94
Other Southeast Asia	—	1.22	2.44	—	2.38
Latin America	1.68	1.44	1.78	0.98	1.47
WANA	1.83	1.60	1.85	2.32	1.94
Sub-Saharan Africa	1.43	1.74	1.68	1.37	1.52
Developing	1.38	1.49	1.20	1.24	1.28
Developed	0.89	0.87	0.72	0.67	0.85
Japan	0.67	1.35	0.35	0.21	0.36
World	1.12	1.08	1.17	0.74	1.06

Source: IFPRI IMPACT.

Table A.10: Cereal Crop Yields, 1993 and Projected 2010 (metric tons per hectare)

	Wheat		Maize		Rice		Other Grains		All Cereals	
	1993	2010	1993	2010	1993	2010	1993	2010	1993	2010
East Asia	3.4	4.0	4.7	6.1	4.1	4.7	2.3	2.5	3.8	4.6
PRC	3.4	4.0	4.7	6.2	4.1	4.7	2.3	2.5	3.9	4.7
Republic of Korea	—	—	4.2	5.4	4.4	4.9	3.4	4.0	4.3	4.9
Other East Asia	1.0	1.2	3.5	4.8	3.1	3.4	1.9	2.0	2.6	3.2
South Asia	2.2	3.0	1.6	2.2	1.8	2.4	0.9	1.0	1.7	2.2
India	2.4	3.1	1.6	2.3	1.9	2.4	0.9	1.0	1.7	2.2
Pakistan	1.9	2.5	1.4	2.0	1.7	2.2	0.6	0.7	1.7	2.3
Bangladesh	1.8	2.2	3.7	4.7	1.8	2.3	0.7	0.8	1.8	2.3
Other South Asia	1.3	1.7	1.6	2.1	1.7	2.4	1.1	1.2	1.6	2.1
Southeast Asia	1.0	1.0	2.0	2.8	2.1	2.7	1.0	1.1	2.1	2.7
Indonesia	0.0	0.0	2.2	2.9	3.0	3.6	0.0	0.0	2.8	3.4
Thailand	1.0	1.2	2.9	4.1	1.5	1.8	1.5	1.8	1.7	2.0
Malaysia	0.0	0.0	1.8	2.3	2.0	2.5	0.0	0.0	2.0	2.5
Philippines	0.0	0.0	1.5	2.4	1.9	2.6	0.0	0.0	1.7	2.5
Viet Nam	0.0	0.0	1.7	2.2	2.3	3.0	1.5	1.7	2.2	2.9
Myanmar	1.0	1.0	1.6	2.0	1.8	2.5	0.6	0.7	1.7	2.4
Other Southeast Asia	0.0	0.0	1.9	2.3	1.0	1.6	0.0	0.0	1.1	1.6
Latin America	2.3	3.0	2.4	3.1	1.9	2.5	2.7	3.2	2.4	3.0
WANA	1.8	2.4	3.8	5.0	3.3	4.5	1.0	1.5	1.6	2.2
Sub-Saharan Africa	1.5	2.0	1.2	1.6	1.0	1.4	0.8	1.0	0.9	1.2
Developing	2.4	3.1	2.6	3.4	2.4	2.9	1.1	1.3	2.2	2.7
Developed	2.6	3.0	6.3	7.3	4.0	4.6	2.3	2.6	3.1	3.6
Japan	3.6	4.0	1.0	1.3	4.3	4.6	5.5	5.7	4.3	4.6
World	2.5	3.0	3.9	4.7	2.5	3.0	1.7	1.9	2.5	3.0

Source: IFPRI/IMPACT.

percent annually in the same period. In 2010, however, a yield gap in cereals between developed and developing countries will persist (Table A.10): yields for maize and other coarse grains in developed countries will still be about twice the levels of developing-country yields; rice yields are expected to be 60 percent higher than in developing countries. Wheat yield levels in 2010 are projected to vary widely in both developing and developed countries, with only a slight convergence in yield levels over the projection period.

Compared to developed-country yield-growth rates, growth rates will be much stronger in developing countries, albeit starting from lower levels. However, they will experience a drop-off similar to that seen in developed countries from 1982–93 levels: wheat yields are projected to grow at 1.38 percent per year, compared to 2.64 percent per year in 1982–93; maize yields will increase at 1.49 percent annually, compared to 2.21 percent per year in the earlier period; and rice yields will grow at 1.20 percent per year, compared to 1.86 percent per year in 1982–93. Cereal-crop yields will increase, on average, from 2.2 mt per ha in 1993 to 2.7 mt per ha in 2010; the biggest increases will be in maize yields, from 2.6 mt per ha to 3.4 mt per ha, and wheat yields, from 2.4 mt per ha to 3.1 mt per ha. In the group of developing Asian countries, cereal yields are projected to increase from 2.5 mt per ha in 1993 to 3.1 mt per ha in 2010 and rice yields from 2.5 mt per ha to 3.0 mt per ha during the same period.

PROJECTIONS FOR LIVESTOCK PRODUCTS

Projected Demand for Livestock: Upward Trends Continue to Close the Gap Between Developed and Developing Countries

As shown in Table A.11, per capita demand for meat will grow rapidly in developing countries, particularly in the PRC and East and Southeast Asia. The PRC's per capita meat demand

is projected to increase to 51 kg in 2010, from 33 kg in 1993. This level of meat consumption is substantially higher than the level projected for Japan (46 kg per capita), and is closing the gap between it and the consumption levels of the developed countries, where per capita meat consumption is projected to increase only slightly, from 78 kg to 82 kg. For developing countries as a whole, per capita meat demand is projected to increase from 21 kg to 27 kg.

The strongest projected increase will be in pork and poultry consumption. The per capita meat-consumption levels in the developed countries, however, will still be three times those of the levels of the developing countries by 2010. The United States remains the highest per capita consumer of livestock products at 122 kg in 2010, with an average annual per capita consumption of 42 kg of beef, 30 kg of pork, 48 kg of poultry and 1 kg of sheep and goat meat. Per capita meat consumption is also important in Australia, the only country with significant sheep and goat meat consumption, at 24 kg per capita by 2010.

With continued population growth and strong per capita demand growth, the total demand for livestock products will grow very rapidly in developing countries. The PRC, South Asia, Southeast Asia, Sub-Saharan Africa, and WANA will all experience growth rates in demand at or above 3 percent per year during 1993–2010, with an average growth for all developing countries of 3.16 percent per year, compared to the 0.66 percent per year for the developed countries. These rates of growth are lower than the 5.49 percent per year during 1982–93, but are still substantial. In 1993, developing countries accounted for 47 percent of world meat consumption (Table A.12); in 2010, this figure is projected to jump to 58 percent; developing Asia's share in world meat demand alone will be 40 percent in 2010. In developed countries, on the other hand, demand for livestock products will only increase by 12 million mt. Growth rates in demand for beef and sheep and goat meat will be slightly higher in the 1993–2010 period than in the recent past, whereas the growth rate for poultry and pork will be slower than in 1982–93.

Table A.11: Per Capita Demand For All Meat Products, 1993 and Projected 2010 (kilograms per capita)

	Beef		Pork		Sheep & Goat		Poultry		All Meats	
	1993	2010	1993	2010	1993	2010	1993	2010	1993	2010
East Asia	2.5	4.0	24.3	36.6	1.2	1.5	5.7	9.4	33.7	51.4
PRC	2.1	3.6	24.5	37.4	1.2	1.4	5.0	8.6	32.8	51.1
Republic of Korea	9.3	12.7	17.6	25.7	0.3	0.4	8.7	13.8	35.9	52.5
Other East Asia	5.2	5.8	25.4	28.8	2.5	2.7	17.7	20.8	50.8	58.2
South Asia	2.9	3.9	0.4	0.5	1.1	1.4	0.7	1.0	5.0	6.7
India	2.6	3.6	0.5	0.6	0.7	0.8	0.5	0.8	4.3	5.8
Pakistan	5.8	7.0	0.0	0.0	4.5	4.8	1.6	2.1	11.8	13.8
Bangladesh	1.3	1.6	0.0	0.0	0.8	0.9	0.8	1.3	2.9	3.8
Other South Asia	3.8	4.5	0.3	0.3	0.9	1.0	0.6	0.8	5.7	6.6
Southeast Asia	2.6	3.7	6.7	8.9	0.4	0.4	5.5	7.5	15.1	20.5
Indonesia	1.8	2.6	3.2	4.3	0.5	0.6	3.5	4.8	9.0	12.3
Thailand	4.7	7.8	5.8	8.3	0.0	0.0	10.6	15.8	21.2	32.0
Malaysia	4.2	6.3	11.3	14.4	0.5	0.5	30.8	37.0	46.8	58.2
Philippines	2.6	3.6	13.7	17.4	0.8	0.9	5.4	7.7	22.5	29.6
Viet Nam	2.4	3.7	12.1	16.0	0.0	0.1	2.5	3.8	17.0	23.5
Myanmar	2.5	3.3	2.0	2.5	0.2	0.2	2.1	2.9	6.8	8.8
Other Southeast Asia	3.2	3.9	6.5	7.3	0.0	0.0	2.2	2.8	11.9	14.0
Latin America	22.2	25.7	7.5	8.7	1.0	1.2	15.2	19.2	45.9	54.7
WANA	6.2	7.0	0.1	0.1	5.4	5.9	8.0	9.4	19.7	22.5
Sub-Saharan Africa	4.1	5.0	1.2	1.4	1.7	1.8	1.9	2.2	8.8	10.4
Developing	5.3	6.7	9.0	11.8	1.5	1.8	5.0	6.8	20.8	27.0
Developed	25.2	25.9	29.4	29.7	2.8	3.0	20.3	23.4	77.7	81.9
Japan	9.8	11.1	15.6	16.6	0.5	0.5	14.4	17.7	40.3	45.9
World	9.8	10.4	13.7	15.3	1.8	2.0	8.5	10.0	33.9	37.8

Source: IFPRI IMPACT.

Table A.12: Demand for Livestock Products, 1993 and Projected 2010 (million metric tons)

	Beef		Pork		Sheep & Goat		Poultry		All Meats	
	1993	2010	1993	2010	1993	2010	1993	2010	1993	2010
	East Asia	3.1	5.9	30.9	53.4	1.6	2.1	7.2	13.6	42.8
PRC	2.4	4.9	28.8	50.2	1.4	1.9	5.9	11.6	38.6	68.6
Republic of Korea	0.4	0.6	0.8	1.3	0.0	0.0	0.4	0.7	1.6	2.6
Other East Asia	0.3	0.4	1.3	1.9	0.1	0.2	0.9	1.3	2.7	3.7
South Asia	3.4	6.2	0.4	0.7	1.3	2.1	0.8	1.6	6.0	10.6
India	2.4	4.2	0.4	0.7	0.6	0.9	0.5	0.9	3.8	6.8
Pakistan	0.8	1.4	0.0	0.0	0.6	1.0	0.2	0.4	1.6	2.8
Bangladesh	0.1	0.2	0.0	0.0	0.1	0.1	0.1	0.2	0.3	0.6
Other South Asia	0.1	0.3	0.0	0.0	0.0	0.1	0.0	0.0	0.2	0.4
Southeast Asia	1.2	2.2	3.1	5.3	0.2	0.2	2.5	4.4	7.0	12.2
Indonesia	0.3	0.6	0.6	1.0	0.1	0.1	0.7	1.2	1.7	2.9
Thailand	0.3	0.5	0.3	0.5	0.0	0.0	0.6	1.0	1.2	2.1
Malaysia	0.1	0.2	0.2	0.4	0.0	0.0	0.6	1.0	0.9	1.5
Philippines	0.2	0.3	0.9	1.5	0.1	0.1	0.4	0.7	1.5	2.6
Viet Nam	0.2	0.3	0.9	1.5	0.0	0.0	0.2	0.4	1.2	2.2
Myanmar	0.1	0.2	0.1	0.1	0.0	0.0	0.1	0.2	0.3	0.5
Other Southeast Asia	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.1	0.2	0.3
Latin America	10.3	15.2	3.5	5.1	0.5	0.7	7.0	11.4	21.2	32.3
WANA	2.3	3.7	0.0	0.1	2.0	3.2	2.9	5.0	7.3	12.0
Sub-Saharan Africa	2.1	4.1	0.6	1.1	0.8	1.4	1.0	1.8	4.5	8.5
Developing	22.4	37.3	38.6	65.7	6.4	9.9	21.5	37.9	88.9	150.9
Developed	32.2	35.1	37.5	40.3	3.6	4.1	25.9	31.6	99.3	111.0
Japan	1.2	1.4	1.9	2.1	0.1	0.1	1.8	2.3	5.0	5.8
World	54.6	72.4	76.1	106.0	10.1	14.0	47.4	69.6	188.2	261.9

Source: IFPRI IMPACT.

Projected Production Growth in Livestock Products: Importance of Numbers over Yield

Driven by the rapid increases in demand for livestock products, meat production is expected to increase much more rapidly than cereal production in the coming decades. However, as with the case of cereals, growth in global meat production will slow down compared to past trends, growing at 1.96 percent per year in 1993–2010 (Table A.13), compared to 2.82 percent annually in 1982–93. Global meat production is projected to increase by 74 million mt, from 188 million mt in 1993 to 262 million mt in 2010. In developing countries, the annual rate of growth of meat production will decline from the rapid 5.51 percent in 1982–93 to a still strong 3.08 percent in 1993–2010. This will be accounted for mainly by pork (46 percent) and poultry (27 percent). The group of Southeast Asian countries will show the greatest production growth, at 3.58 percent, with some countries, notably Indonesia and the Philippines, reaching rates close to 4 percent. Growth will be rapid in all developing Asian economies, at 3.36 percent per year, on average. In the developed countries, the production growth rate is expected to decline from 1.05 percent per year in 1982–93 to 0.78 percent per year in 1993–2010, with a livestock production increase of 14 million mt.

More than 80 percent of the increase in global pork production, more than 70 percent of the growth in global beef and poultry production, and more than 60 percent of the increase in global production of sheep and goat meat during 1993–2010 will be accounted for by growth in the numbers of animals slaughtered (Table A.14). Numbers growth is driven mainly by the rapid expansion of developing-country livestock production. Several Asian countries will experience dramatic annual growth in the numbers of livestock slaughtered: in Southeast Asia, numbers growth for beef is projected at 2.77 percent per year; for pork, at 2.72 percent annually; and for poultry, at 2.95 percent per year. The PRC will experience growth in the numbers of cattle and chicken slaughtered in excess of 3 percent annually. In the Republic of Korea, numbers growth is expected to be largest for pork, at 2.77 percent per year during 1993–2010.

Table A.13: Projected Annual Growth Rates of Livestock Production, 1993–2010 (percent per year)

	Beef	Pork	Sheep & Goat	Poultry	All Meats
East Asia	3.80	3.21	1.63	3.92	3.32
PRC	3.94	3.23	1.68	4.06	3.36
Republic of Korea	2.81	3.17	0.14	3.58	3.23
Other East Asia	2.12	2.75	0.99	2.54	2.57
South Asia	3.50	2.46	2.61	3.69	3.27
India	3.61	2.50	2.06	4.04	3.33
Pakistan	3.88	—	3.24	3.16	3.55
Bangladesh	1.37	—	2.48	3.22	2.25
Other South Asia	1.06	1.33	1.31	2.97	1.35
Southeast Asia	3.50	3.44	2.34	3.85	3.58
Indonesia	4.13	3.48	3.08	4.13	3.81
Thailand	3.34	3.54	1.09	3.75	3.62
Malaysia	2.97	3.15	—	3.42	3.32
Philippines	3.49	3.82	1.24	4.60	3.92
Viet Nam	3.12	3.18	0.14	3.88	3.27
Myanmar	3.06	3.14	0.28	3.23	3.08
Other Southeast Asia	2.94	2.55	—	2.44	2.65
Latin America	2.11	2.35	2.24	2.68	2.34
WANA	2.58	1.85	2.64	2.84	2.71
Sub-Saharan Africa	3.66	3.58	2.70	3.72	3.48
Developing	2.84	3.15	2.36	3.37	3.08
Developed	0.74	0.40	1.27	1.26	0.78
Japan	0.43	0.11	—	0.69	0.41
World	1.67	1.97	1.95	2.28	1.96

Source: IFPRI IMPACT.

Table A.14: Projected Annual Numbers and Yield Growth Rates for Livestock Products, 1993–2010
(percent per year)

	Beef		Pork		Sheep & Goat		Poultry	
	Num.	Yield	Num.	Yield	Num.	Yield	Num.	Yield
East Asia	3.05	0.73	2.75	0.45	1.24	0.38	2.98	0.91
PRC	3.26	0.66	2.77	0.44	1.28	0.39	3.10	0.93
Republic of Korea	1.89	0.91	2.77	0.40	-0.13	0.27	2.34	1.21
Other East Asia	1.33	0.78	2.24	0.50	0.47	0.52	1.76	0.77
South Asia	2.54	0.94	1.56	0.89	1.30	1.29	2.71	0.96
India	2.84	0.75	1.60	0.88	1.34	0.71	3.10	0.92
Pakistan	2.99	0.86	—	—	1.31	1.91	2.02	1.12
Bangladesh	0.60	0.77	—	—	1.26	1.21	2.48	0.72
Other South Asia	0.43	0.63	0.34	0.98	1.17	0.13	2.08	0.88
Southeast Asia	2.77	0.71	2.72	0.70	1.53	0.80	2.95	0.87
Indonesia	3.34	0.76	2.64	0.82	1.92	1.14	2.97	1.13
Thailand	2.68	0.65	2.40	1.11	0.38	0.72	2.86	0.86
Malaysia	2.11	0.84	3.06	0.10	0.39	—	2.70	0.70
Philippines	2.48	0.99	3.40	0.41	0.39	0.85	3.77	0.80
Viet Nam	2.42	0.68	2.54	0.63	0.05	0.09	3.29	0.57
Myanmar	2.46	0.59	2.33	0.79	0.06	0.23	2.65	0.57
Other Southeast Asia	2.22	0.70	1.71	0.83	0.05	—	1.92	0.51
Latin America	1.60	0.50	1.40	0.94	1.10	1.13	1.87	0.80
WANA	1.66	0.91	1.47	0.37	1.83	0.79	1.59	1.23
Sub-Saharan Africa	2.53	1.10	2.68	0.88	1.99	0.69	2.71	0.98
Developing	2.15	0.67	2.60	0.54	1.53	0.83	2.45	0.90
Developed	0.27	0.47	0.17	0.23	0.54	0.73	0.76	0.50
Japan	0.25	0.18	-0.17	0.28	-0.00	—	0.40	0.29
World	1.20	0.47	1.63	0.33	1.22	0.72	1.65	0.62

Source: IFPRI IMPACT.

In developed countries, on the other hand, weight growth (carcass weight per animal) will drive production growth, at 0.47 percent annually for beef, and 0.23 percent annually for pork during 1993–2010. Numbers growth outweighs yield growth only for poultry, at 0.76 percent per year.

PROJECTIONS FOR WORLD FOOD PRICES AND INTERNATIONAL TRADE

International Prices for Cereals and Livestock Products: Light to Moderate Downturns

The world food-price implications of these projected outcomes are summarized in Table A.15. The baseline projection results of IMPACT indicate that food production in the world will grow fast enough for real world prices of food to be falling (but very slowly), or to increase only slightly, compared to the past two decades. Projected real cereal prices will be particularly strong through the year 2010. Over the 17-year period, world wheat prices are projected to decline by 1.4 percent, compared to the much bigger drop of 28 percent between 1982 and 1995. Rice prices will increase by 5.9 percent compared to the earlier decline of 42 percent, but when the projections are extended to 2020, the rice price begins to fall again and will decline by 7.3 percent to 2020 compared to 1993. Maize prices will also increase to 2010 by 0.8 percent (and fall by 3.1 percent to 2020), compared to the 43 percent drop between 1982 and 1995. Finally, prices for other coarse grains will experience the biggest decline, 4.9 percent from 1993 values. The weighted average price for all cereals will increase by 1.2 percent by 2010 (but fall by 7.9 percent over the 1993–2020 period). It is only after 2010 that the combination of continued declines in the rate of population growth and declining income elasticities for cereals will reduce demand growth enough to cause real cereal prices to decline more sharply.

**Table A.15: Real World Prices for Selected Commodities, 1993 and 2010
(US dollars per metric ton)**

	World prices		Percent Change
	1993	2010	1993–2010
Wheat	148	146	-1.35
Maize	126	127	0.79
Rice	286	303	5.94
Other Grains	122	116	-4.92
All Cereals	164	166	1.22
Beef	2,023	1,835	-9.29
Pork	1,366	1,260	-7.76
Sheep & Goat	2,032	1,915	-5.76
Poultry	1,300	1,175	-9.62
All Meat	1,576	1,431	-9.20

Source: IFPRI IMPACT.

Prices for livestock commodities will drop more sharply throughout the 1993–2010 period, with price declines in the range of 7.5 to 10 percent. The average meat price will decline by 9.2 percent between 1993 and 2010. Beef and pork prices both declined by 22 percent between 1982 and 1991, but will decline by only 9.3 and 7.8 percent, respectively, during 1993–2010. The price for sheep and goat meat is expected to decrease by 5.8 percent during 1993–2010, compared to a drop in the proxy price of lamb of 33 percent between 1982 and 1991. The price of poultry is expected to decrease by 9.6 percent, compared to a decline of 18 percent between 1982 and 1991.

International Trade in Cereals and Livestock Products: A Higher Volume of Trade With More Cereal Imports and Some Livestock Exports for Asia

The slow decline in cereal and livestock prices will be accompanied by rapidly increasing world trade in food, with the primary impetus for expanded trade being generated by the group of developing countries increasing its food imports from developed countries. World trade in cereals is projected to increase by 73 million mt, from 185 million mt in 1993 to 259

million mt in 2010. Among the cereals, wheat imports will show the biggest absolute increase, 40 million mt, from 91 million mt in 1993 to 131 million mt in 2010. Net cereal imports by developing countries will increase by nearly 90 percent, from 94 million mt in 1993 to 177 million mt in 2010, with Asia accounting for the largest increase (74 percent), followed by WANA (23 percent) (Table A.16).

The increase in exports of maize from developed to developing countries is the highest in percentage terms, with a more than 150 percent increase from 18 million mt in 1993 to 46 million mt in 2010. It should be noted that trade among developed countries causes the aggregate exports of maize (and other commodities) from developed countries to be lower than the exports of some individual developed countries. The developed countries will also substantially increase exports of wheat and other coarse grains to 2010 and increase their imports of rice from developing countries by 5 million mt.

The major beneficiaries of increased cereal import demand from developing countries will be the main cereal exporters, particularly the United States, whose cereal exports are expected to increase by 38 percent, from 85 million mt in 1993 to 117 million mt in 2010. In addition, Eastern Europe and the former Soviet Union are expected to take advantage of the increased import demands of developing countries, shifting from a large net importing position of 27 million mt in 1993 to become net exporters (of 9 million mt) by 2010. Removal of food subsidies and other price distortions, combined with sharply lower incomes, have already resulted in falling per capita cereal consumption in these regions. Feeding-efficiency improvements in the livestock industry and a projected gradual recovery in incomes will cause production growth to outstrip demand growth.

World net trade in livestock products will expand proportionally even more rapidly than the cereal trade, although from much lower levels. Global net trade is projected to increase from 8 million mt in 1993 to 11.5 million mt in 2010, an increase of 42 percent over 1993 levels. Developing countries will dramatically increase their imports of livestock products.

Table A.16: Net Trade for All Cereal Crops, 1993 and Projected 2010 (million metric tons)

	1993				2010				Total	
	Wheat	Maize	Rice	O Grains	Total	Wheat	Maize	Rice		O Grains
East Asia	-15.1	-4.6	0.5	-1.8	-21.0	-30.6	-27.6	-2.0	-4.7	-64.9
PRC	-8.8	7.8	0.9	-0.9	-0.9	-22.1	-9.2	-0.7	-3.4	-35.3
Republic of Korea	-4.6	-6.2	-0.1	-0.4	-11.2	-6.3	-9.1	-0.4	-0.5	-16.3
Other East Asia	-1.7	-6.3	-0.4	-0.5	-8.9	-2.3	-9.3	-0.9	-0.8	-13.3
South Asia	-4.9	-0.0	1.6	0.1	-3.3	-16.6	-1.1	0.7	-1.9	-18.9
India	0.4	0.0	0.7	0.1	1.3	-3.3	-0.7	0.2	-1.3	-5.2
Pakistan	-3.1	-0.0	1.3	-0.0	-1.8	-9.1	-0.1	1.4	-0.3	-8.1
Bangladesh	-1.3	-0.0	-0.1	-0.0	-1.5	-2.3	-0.0	-0.2	-0.0	-2.6
Other South Asia	-0.9	-0.0	-0.3	-0.0	-1.3	-1.8	-0.3	-0.7	-0.2	-3.0
Southeast Asia	-6.7	-2.6	6.5	-0.5	-3.2	-10.0	-6.0	11.5	-0.8	-5.2
Indonesia	-2.8	-0.5	-0.4	-0.0	-3.7	-4.1	-1.4	-1.5	-0.1	-7.1
Thailand	-0.6	0.0	5.5	-0.1	4.9	-0.7	-0.9	7.6	-0.2	5.8
Malaysia	-1.0	-2.0	-0.6	-0.1	-3.7	-1.5	-3.3	-0.9	-0.1	-5.9
Philippines	-2.0	-0.2	-0.2	-0.2	-2.6	-3.0	-0.6	0.4	-0.3	-3.5
Viet Nam	-0.3	0.1	1.9	-0.0	1.6	-0.5	0.1	3.3	-0.0	2.8
Myanmar	-0.0	0.0	0.4	-0.0	0.4	-0.1	0.0	2.6	-0.0	2.5
Other Southeast Asia	-0.0	0.0	-0.1	-0.0	-0.2	-0.0	-0.0	0.2	-0.0	0.2
Latin America	-8.6	-1.4	-1.7	-4.4	-16.0	-6.6	-1.7	-0.1	-7.2	-12.2
WANA	-22.1	-6.7	-3.3	-5.6	-37.7	-35.0	-10.1	-4.6	-7.4	-57.0
Sub-Saharan Africa	-5.2	-2.5	-0.0	-0.5	-11.6	-9.1	-2.4	-5.5	-1.0	-18.0
Developing	-62.8	-17.8	0.0	-12.7	-93.9	-108.3	-45.5	5.0	-23.0	-177.2
Developed	62.8	17.8	0.0	12.7	93.9	108.3	45.5	-5.0	23.0	177.2
Japan	-5.8	-16.6	-0.4	-6.3	-29.1	-6.6	-16.8	-1.4	-6.7	-31.5

Source: IFPRI IMPACT.

WANA will be the primary importer of livestock products by 2010, at 2.8 million mt. Some Latin American countries, on the other hand, will improve their exporter positions: Brazil, for example, will increase its net meat exports from 0.8 million mt to 1.2 million mt by 2010. Although Asia has long been considered to be a primary region for livestock imports, this situation has dramatically changed as a consequence of the Asian economic crisis. A combination of declining income growth and increased domestic prices has led to a more mixed picture, with some countries, especially in Southeast Asia, projected to be significant net exporters by 2010. Again, the developed countries will satisfy most of the increased importing demands, led by Australia, at 2.0 million mt, followed by the United States, at 1.5 million mt. Japan, on the other hand, is expected to remain the largest net livestock importing country, at 2.4 million mt in 2010 (Table A.17).

PROJECTIONS OF MALNUTRITION AMONG PRE-SCHOOL CHILDREN

Table A.18 shows that the projected number of malnourished pre-school children (less than 5 years of age) under the baseline scenario is expected to decline in developing countries by 20 million, from 185 million to 165 million children—a drop of only 11 percent. Despite the availability of food on a global level to meet effective demand at slowly declining world prices, food security in one region, Sub-Saharan Africa, will actually worsen, with the absolute number of malnourished children expected to grow from 27 million in 1993 to 36 million by 2010. Another region, WANA, shows no improvement in numbers of malnourished children (8 million in both 1993 and 2010). Within Asia, numbers of malnourished children are expected to decline in Southeast Asia (by 3 million in the 1993–2010 period), and the PRC (by 7 million in the same period). Within South Asia, although India shows significant progress in reducing malnutrition, it is projected

Table A.17: Net Trade for Livestock Products, 1993 and Projected 2010 (thousand metric tons)

	1993					2010				
	Beef	Pork	Sheep & Goat	Poultry	All Meats	Beef	Pork	Sheep & Goat	Poultry	All Meats
East Asia	-313	663	-20	-204	126	-587	667	-100	-162	-182
PRC	57	676	6	111	850	-54	391	-50	234	521
Republic of Korea	-217	-4	-11	-21	-253	-326	32	-16	-31	-341
Other East Asia	-153	-9	-15	-294	-471	-208	244	-35	-364	-363
South Asia	101	2	10	-4	109	149	-87	-23	-126	-87
India	99	1	9	1	110	269	-84	-53	-5	127
Pakistan	1	0	0	-5	-4	32	0	42	-77	-3
Bangladesh	0	0	0	0	0	-62	0	1	-36	-97
Other South Asia	1	1	1	0	3	-89	-3	-13	-9	-114
Southeast Asia	-151	195	-24	120	140	-350	567	-20	603	800
Indonesia	-47	69	-14	-111	-103	-29	181	11	-51	112
Thailand	0	0	0	178	178	-33	63	0	449	479
Malaysia	-67	116	-9	54	94	-143	187	-13	172	203
Philippines	-44	0	-1	-2	-47	-97	134	-14	67	90
Viet Nam	0	9	0	1	10	-47	-2	-1	-15	-65
Myanmar	0	0	0	0	0	-7	9	-3	-10	-11
Other Southeast Asia	7	1	0	0	8	6	-5	0	-9	-8
Latin America	690	-152	-36	112	614	453	-216	-43	-167	27
WANA	-669	-4	-336	-388	-1,397	-1,233	-15	-603	-942	-2,793
Sub-Saharan Africa	-14	-29	36	-97	-104	-241	-53	-45	-181	-520
Developing	-382	672	-423	-480	-613	-1,877	820	-934	-1,022	-3,013
Developed	382	-672	423	480	613	1,877	-820	934	1,022	3,013
Japan	-637	-628	-57	-456	-1,778	-772	-768	-59	-754	-2,353

Source: IFPRI IMPACT.

Table A.18: Number of Malnourished Children Under 5 Years of Age, 1993 and Projected 2010

	1993	2010
	(million children)	
Latin America	10	8
Sub-Saharan Africa	27	36
WANA	8	8
India	76	59
Other South Asia	24	24
Southeast Asia	16	13
PRC	24	17
Developing	185	165

Source: IFPRI IMPACT.

to remain the home of 59 million malnourished children by 2010, 40 percent of the total in developing regions. At the same time, moreover, child malnutrition figures for the rest of South Asia are projected to hold steady at 24 million. In short, under current likely trends, the ability to meet food needs on a global scale will continue to fail to translate into meeting food needs for each individual, and those living in certain parts of the developing world will continue to suffer.