

# XII ALTERNATIVE FUTURES FOR ASIAN AGRICULTURE AND FOOD SECURITY

## INTRODUCTION

The preceding chapters have explored the rapid economic growth and massive transformation in agriculture and the rural economy in Asia and have analyzed many of the challenges and uncertainties that continue to face Asian policymakers. In this chapter we explore how alternative policies can influence food supply, demand, and trade and food security in Asia. This chapter starts out by highlighting these and other emerging trends for developing Asia in the global economy to 2010, based on the best available assessment of likely policies and population growth scenarios as captured by IFPRI's International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT). For more detail on the model, plus a description of best-assessment "baseline" results for critical supply and demand outcomes in 2010 compared to 1993, broken down by region, and for much of Asia by country, please see the Appendix.

How robust, though, are best-assessment baseline outcomes in the face of a range of realistic, but different, policy strategies? Investment in agriculture, water resources, and social sectors may fall off in Asia, with policies focusing on other sectors. Slow progress on economic policy reform may result in a more prolonged economic crisis dampening income growth in Asia. Alternatively, policymakers may take a more aggressive stance towards improving agriculture and other rural economic sectors, boosting investment and accelerating the pace of policy reform in agriculture and the general economy. Would either of

these policy directions substantively change projections of developing Asia's contribution to cereal and livestock markets, and, if so, with what implications for the people of this region, particularly its children? Strikingly, policy packages that moderately disfavor agriculture, natural resources, and social sectors and moderately slow economic reform lead to a much worsened overall impact vis-à-vis the baseline, while those moving more aggressively to strengthen agriculture and economic policy reform yield an outcome that, while far from utopian, is much improved. Together, the alternative scenarios plus the baseline establish a range of possible outcomes for Asia in 2010 that are vastly different in terms of human suffering and are directly dependent on policy decisions.

This chapter lays out and contrasts results from IMPACT simulations of two alternative policy scenarios for Asia in 2010: one containing a series of plausible, moderate declines in investment with slower policy reform, the other consisting of renewed, but again moderate and plausible, policy efforts in the agricultural sector, irrigation and water, and social sectors. After the summary of projected Asian trends, the two scenarios are described in more detail. This is followed by a look at selected supply, demand, and trade figures for Asian regions under the alternative scenarios, as against 2010 baseline results and 1993 figures. The implications of these alternatives for food availability and for malnutrition in children are presented in a separate subsection. Finally, to explore the potential for more aggressive policies and investments to eliminate malnutrition in Asia, we assess an alternative scenario designed to launch a major attack on childhood malnutrition through income growth, agricultural growth, and social investment.

## **GLOBAL TRENDS—A PROMINENT ROLE FOR ASIAN DEVELOPING ECONOMIES**

As described in considerable detail in the Appendix, the long-term prospects for food supply, demand, and trade indicate

a strengthening of world cereal markets. Real world prices of cereals will be virtually constant through 2010, indicating a much stronger market for these commodities than in the past few decades, when real prices declined rapidly. The stronger price picture is the result of the continued gradual slowing in the rate of growth in both production and demand. Even taking account of the likely effects of the current economic crisis, developing Asia is projected to play a major role in global cereal and livestock markets.

On the production side, there will be virtually no growth in crop area in Asia. Crop yield growth will therefore account for nearly all production growth. In Asia and most other countries and regions, however, the gradual slowdown in crop yields that began in much of the world in the early 1980s will continue. Nevertheless, yield growth will outstrip the decline in prices, presenting the potential for improved long-term profitability in cereal production. Livestock production in Asia will grow considerably faster than crop production, but will also slow down relative to its growth in the past decade.

Countering the continued gradual slowing of production will be a matching decline in the growth rate in food demand. Fundamental changes are occurring in the global structure of food demand, driven in large part by economic growth, rising incomes, and rapid urbanization in the developing economies. Population growth rates in Asia (and most of the world) will be declining throughout the projection period. Rising incomes and rapid urbanization—particularly in Asia, and even with the slowdown due to the Asian financial crisis—will change the composition of demand. Per capita food consumption of maize and coarse grains will decline as consumers shift to wheat and rice with increasing incomes. As Asian incomes rise further and lifestyles change with urbanization, there will be also be a shift from rice consumption to wheat. Growth in incomes in developing countries will stimulate strong growth in per capita and total meat consumption, which will in turn induce strong growth in feed consumption of cereals, particularly maize. These trends will lead to an extraordinary increase in the importance of Asia in global food markets. A full 84 percent of the increase

in global cereal and meat demand between 1993 and 2010 will come from the developing countries. By 2010, developing countries will account for 63 percent of global cereal demand and 58 percent of global meat demand. Even more strikingly, the share of developing Asia in the increase in global cereal demand to 2010 will be 52 percent and the share in the increase in global livestock demand will be even higher at 57 percent.

Asia will not be able fully to meet its rapidly growing food demand through growth in its own production. Food import demand from Asia (and other developing countries) will grow rapidly, particularly for cereals. Although regions outside Asia will be important growth centers for imports of some of these commodities, such as West Asia and North Africa (WANA) for wheat, it is East and South Asia that will drive the boom in cereal import demands.

In developing countries worldwide by 2010, rates of malnutrition among children 0–5 years old will have fallen to 25 percent from 1993 levels of 32 percent. Still, absolute numbers will remain unacceptably high—165 million children malnourished. Of these, 68 percent, or 113 million, will reside in developing Asian countries, particularly South Asia. While rates in the rest of Asia and other developing countries will have rates of child malnutrition falling to 3 or 4 percentage points from a base of 25 percent or less, in South Asia rates of child malnutrition started out at 57 percent of all children in 1993 and will drop to 46 percent in 2010.

### **ALTERNATIVE SCENARIOS FOR AGRICULTURE IN DEVELOPING ASIA: WEAK VS. STRONG INVESTMENT/POLICY REFORM STRATEGIES**

The baseline results briefly summarized above and described in more detail in the Appendix represent our best assessment of future directions in the world food situation. These results, however, may be sensitive to rates of agricultural productivity growth stemming from assumptions about research

investment levels or to underlying assumptions about population and income growth. There are continuing debates in developed nations over possible large cuts in foreign aid that would slash public investment in international agricultural research. What would be the impact on food prices and malnutrition if, instead of maintaining investments, national governments and international institutions were to continue to reduce their investments in agricultural research, irrigation and water, and social-sector expenditures? What if, at the same time, slow economic reform in response to the ongoing economic crisis resulted in slower- than-projected income growth? What if, in addition, water-policy reform failed to respond to growing demand for nonagricultural water uses, resulting in more rapid loss of water from agricultural uses; and if population growth increased relative to the "medium" UN population projections? Would these steps, jointly taken, make a difference for malnutrition and food prices for developing Asia in 2010? Alternatively, can increased investment and improved policy reforms in each of these areas make a significant positive impact on food security and malnutrition?

### **Low Investment and Weak Policy Reform**

This scenario incorporates the following changes to the baseline scenario:

- A 25-percent reduction in annual nonagricultural income growth in Asian countries (i.e., a growth rate of 5.0 percent per year is reduced to 3.75 percent per year), beginning in 1998. This assumption results in projected income growth consistent with relatively low income projections that assume that relatively slow policy reform will lead to prolongation of the crisis in East and Southeast Asia and relatively slow economic liberalization in South Asia.

- A 10-percent cut in the growth rate in public investment in Asian national and international agricultural research systems relative to the base case.
- A 10-percent reduction in investment in health, education, and sanitation compared to baseline 2010 projections, leading to a worsening of the projected percentage of women with access to secondary education, the projected percentage of the population with access to clean water, and projected social expenditures.
- An increase in population growth in Asia and the world relative to the baseline projections, to the 1996 United Nations “high” population growth rates (UN 1996). Under this scenario, population growth still slows relative to past rates of growth.
- An increase in soil degradation that reduces crop area and both yield growth and animal numbers growth in Asia by 0.05 percent per year.
- Increased transfer of water away from agriculture, assuming weak reforms in institutions, policies, and technologies to achieve water savings and mitigate the impact of the transfer, resulting in
  - no increase in irrigated area to the year 2010 (with any current pipeline investment balanced by investment cutbacks and loss of existing irrigated area due to degradation and urban encroachment), leading in 2010 to a reduction of 15.8 million ha (11 percent) in irrigated area in Asia compared to the 2010 baseline projection;
  - phased reductions in agricultural water use over the projection period, averaging 10 percent by the end of the period (2010) across countries and regions, which assume slow improvements in water use efficiencies for agricultural as well as for domestic and industrial uses (see also the description of the baseline scenario in the Appendix);

- declines in crop area growth in proportion to the reduction in agricultural water use; and
- reduction in crop yield growth, in proportion to changes in relative water supply, based on the relative water supply/crop yield function approach.

The combined effect of the full scenario is a reduction in projected constant-price cereal yield growth (i.e., the yield growth in mt/ha that would obtain if commodity prices were constant) for the Asian developing countries, 1995–2010 of 0.31 percentage points, from 1.31 percent per year under the baseline to 1.00 percent per year under the low-investment/weak policy-reform scenario. Constant-price area growth is projected as assumed to fall from an average across Asian countries of 0.12 percent per year to –0.20 percent per year. Livestock yield growth (in kg carcass weight) is projected to decline from 0.80 percent per year to 0.68 percent per year, and growth in animal herd numbers from 1.71 percent per year to 1.19 percent per year.

### **High Investment and Strong Policy Reform**

This scenario incorporates the following changes to the baseline scenario:

- A 25-percent increase in annual nonagricultural income growth in Asian countries, 1999–2010, with projected growth rates consistent with relatively rapid recovery from the financial and economic crisis in East and Southeast Asia and relatively fast economic liberalization in South Asia.
- A 10-percent increase in the growth rate in public investment in Asian national and international agricultural research systems relative to the base case.
- A 10-percent increase in investment in health, education, and water and sanitation compared to baseline 2010 projections, leading to an improvement

in the projected percentage of women with access to secondary education, the projected percentage of the population with access to clean water, and projected social expenditures.

- A reduction in the rate of increase in population growth in Asia and the rest of the world relative to the baseline population growth rate, to the 1996 UN “low” population growth scenario (UN 1996).
- A decrease in environmental degradation that increases Asian crop area and yield growth and animal numbers growth each by 0.05 percent per year.
- Effective water policy reform and increased irrigation investment that results in
  - a five percent increase in irrigated area relative to the baseline 2010 projections;
  - phased increases in agricultural water use compared to the baseline, amounting to 10 percent by the end of the period (2010);
  - increases in crop area growth, in proportion to the increase in agricultural water use; and
  - increases in crop yield growth, in proportion to changes in relative water supply, based on the relative water-supply/crop-yield function approach.

The combined effect of the full scenario is an increase in projected constant-price cereal yield growth for the Asian developing countries, 1995–2010, from 1.31 percent per year under the baseline to 1.58 percent per year under the high-investment/strong policy-reform scenario. Constant-price area growth is projected to increase from an average across Asian countries of 0.12 percent per year to 0.33 percent per year. Livestock yield growth (in kg carcass weight) is projected to increase from 0.80 percent per year to 0.93 percent per year, and growth in animal herd numbers from 1.71 percent per year to 1.81 percent per year.

## ALTERNATIVE SCENARIOS: IMPACT ON ASIAN FOOD MARKETS AND FOOD SECURITY IN 2010

If the policy steps in the low-investment/weak-reform package are taken, the profile of developing Asia by 2010 is projected to look substantially worse for the poor than it would under the baseline: higher food prices, reduced levels of production, and higher dependence on imports, with concomitant sharp falls in per capita food consumption and increased prevalence of malnutrition among children. With the policy steps described in the high-investment/strong-reform package, on the other hand, the picture projected for the region in 2010 brightens considerably across all these measures when compared with the baseline, and even more so when compared with the bleak low-investment scenario.

The sections below quantify the extent of these different outcomes for the two scenarios simulated by using the IMPACT model. They concentrate first on market factors of supply, demand, net trade and international commodity prices for cereals, roots and tubers, and livestock products (plus milk), then more specifically on one component of demand—demand for food per capita—along with welfare indicators of per capita food availability and child malnutrition. Results (other than international prices) are presented in the aggregate for all developing Asia, then disaggregated for the major subregions of South and Southeast Asia, as well as the PRC.

### Scenario Effects on Supply, Demand, and Net Trade

#### *Alternative Scenarios for Crops*

Both policy scenarios, as laid out in Table XII.1, show cereals production up in 2010 for developing Asian countries as a group. In the low-investment scenario, Asian cereals production is 46 million mt (5.4 percent) below the baseline result in 2010 of 852 million mt. Under the high-investment

scenario, production increases an additional 44 million mt (5.2 percent), to 897 million mt. Both scenarios project changes in the same direction as production and of roughly similar magnitudes in component area and yield outcomes. The changes in area and yield over time are lower than might be expected given the projected constant-price yield and area growth assumptions described above. The initial assumed reduction in underlying yield and area growth causes a reduction in supply, which drives up commodity prices, generating a positive area and yield response and ultimately resulting in equilibrium area, yield, and supply at higher levels than predicted from the initial constant-price assumptions alone.

Downside and upside cereals production figures for these scenarios do not straddle the baseline so neatly everywhere in the region, however. In the PRC, for example, projected cereals production under the low-investment strategy drops 2 percent from the baseline (primarily due to yield declines, as area increases slightly), but rises nearly 6 percent from the baseline under the more favorable strategy, with increase in both area and yield contributing. In both South and Southeast Asia, by contrast, cereals production falls more under the low-investment package than it rises under the high-investment one (down 10 percent vs. up 6 percent for South Asia, and down 6 percent vs. up 1 percent for Southeast Asia). The striking drop in South Asia under the low-investment strategy can be traced to substantial shrinkage in area under production and yields (both down roughly 5 percent from the baseline).

The production picture for roots and tubers shows relatively little change across the region as a whole for either of the two scenarios as compared to the baseline in 2010. In the PRC, the main Asian producer for this group of crops (across all scenarios), however, yield and production for this group of crops actually improves under the low-investment strategy due to large increases in world prices because of population increases in Sub-Saharan Africa. On the other hand, South Asian root and tuber production drops considerably (roughly 12 percent) under the low-investment strategy scenario, albeit compared to a baseline already at a relatively low level of production (45 million mt).

**Table XII.1: Area, Yield, and Production for all Cereals and Roots & Tubers, Developing Asia, 1993 and Projected 2010, Baseline and Alternative Policy Scenarios (area in M ha; yield in mt/ha; production in M mt)**

	1993	2010		
		Base	Low Inv/ Weak Reform	High Inv/ Strong Reform
<b>All Cereals</b>				
<b>Asia (developing)</b>				
Area	265.6	271.7	264.9	277.8
Yield	2.5	3.1	3.0	3.2
Production	667.7	852.2	806.2	896.6
PRC				
Area	88.6	89.5	91.2	92.1
Yield	3.9	4.7	4.5	4.8
Production	343.3	418.1	409.9	441.9
South Asia				
Area	126.1	129.6	122.4	132.8
Yield	1.7	2.2	2.1	2.3
Production	214.9	289.8	259.6	308.4
Southeast Asia				
Area	47.2	48.9	47.5	49.3
Yield	2.1	2.7	2.6	2.7
Production	97.5	130.8	122.9	132.6
<b>All Roots &amp; Tubers</b>				
<b>Asia (developing)</b>				
Area	16.1	16.4	16.0	16.6
Yield	14.7	18.1	18.5	18.0
Production	235.7	296.6	296.4	297.6
PRC				
Area	9.6	9.4	9.4	9.5
Yield	16.2	20.2	20.7	20.1
Production	155.8	191.2	195.3	191.8
South Asia				
Area	1.9	2.2	2.0	2.3
Yield	14.8	20.3	20.3	20.4
Production	28.1	45.1	39.7	46.7
Southeast Asia				
Area	4.4	4.5	4.4	4.5
Yield	11.2	12.6	13.1	12.2
Production	48.6	56.5	57.4	55.3

Source: IFPRI IMPACT.

While production for cereals in most parts of developing Asia decreases under the low-investment/weak-reform strategy, total cereal demand changes relatively little. This is because the offsetting impact from higher population growth boosts total demand, while higher prices and lower per capita incomes reduce total demand (Table XII.2). The net effect from significant changes in production and modest changes in total demand: dramatic shifts in imports—from 89 million mt under the baseline to 150 million mt under this scenario (a jump of nearly 70 percent). For the PRC, responsible for nearly half of total cereal demand for the region, consumption grows by 4 percent over the baseline; with drops in production, this means an 80 percent rise in cereal imports compared with the 35 million mt needed in the baseline scenario. For South and Southeast Asia, with the more dramatic drops in supply already described coupled with only slight dips in demand, import needs in 2010 more than double from what they would under the baseline, to 46 million mt (from 19 in the baseline), and 11 million mt (from 5 in the baseline), respectively.

Cereal imports decline significantly for the region under the high-investment scenario. Consumption still increases over the baseline scenario (by about 2 percent for the region as a whole and in each of the subregions), but the substantial gains in supply more than compensate in most areas, leaving a narrower trade gap for cereal imports, amounting to 30 percent less than the baseline regionwide (and nearly 88 million mt less in cereal imports than the unfavorable scenario). The trend is most pronounced where supply improves the most from favorable policy: in the PRC and South Asia, with import levels at 45 and 64 percent of the baseline, respectively (and only a third and a little more than a sixth, again respectively, of the low-investment scenario import result). The exception to the trend is Southeast Asia, where cereal imports increase slightly from the baseline under the positive policy scenario, as income-driven demand growth outpaces supply gains, but import levels remain considerably below those under the negative policy scenario.

**Table XII.2: Total Supply, Demand, Net Trade (in Mmt) and Per Capita Food Demand (in kg/cap) for All Cereals and Roots & Tubers, Developing Asia, 1993 and Projected 2010, Baseline and Alternative Policy Scenarios**

	1993	2010		
		Base-line	Low Inv/ Weak Reform	High Inv/ Strong Reform
<b>All Cereals</b>				
<b>Asia (developing)</b>				
Total Supply	667.7	852.2	806.2	896.6
Total Demand	695.1	941.3	955.7	958.6
Food (per capita)	183.9	187.7	183.1	193.2
Net Trade	-27.4	-89.1	-149.5	-61.9
<b>PRC</b>				
Total Supply	343.3	418.1	409.9	441.9
Total Demand	344.3	453.4	473.5	461.4
Food (per capita)	213.7	217.5	214.2	220.8
Net Trade	-0.9	-35.3	-63.6	-19.4
<b>South Asia</b>				
Total Supply	214.9	289.8	259.6	308.4
Total Demand	218.1	308.8	305.1	315.1
Food (per capita)	162.2	170.9	165.2	178.3
Net Trade	-3.3	-18.9	-45.5	-6.7
<b>Southeast Asia</b>				
Total Supply	97.5	130.8	122.9	132.6
Total Demand	100.7	136.0	134.1	138.9
Food (per capita)	169.1	171.1	165.8	178.3
Net Trade	-3.2	-5.2	-11.3	-6.3
<b>All Roots &amp; Tubers</b>				
<b>Asia (developing)</b>				
Total Supply	235.7	296.6	296.4	297.6
Total Demand	214.9	278.0	290.9	267.5
Food (per capita)	40.0	39.4	42.8	37.0
Net Trade	20.8	18.7	5.5	30.2
<b>PRC</b>				
Total Supply	155.8	191.2	195.3	191.8
Total Demand	155.9	192.1	199.1	184.7
Food (per capita)	61.0	57.2	63.9	51.9
Net Trade	-0.1	-0.8	-3.9	7.1
<b>South Asia</b>				
Total Supply	28.1	45.1	39.7	46.7
Total Demand	28.0	44.5	43.6	47.1
Food (per capita)	18.6	21.9	21.2	23.6
Net Trade	0.1	0.7	-3.9	-0.3
<b>Southeast Asia</b>				
Total Supply	48.6	56.5	57.4	55.3
Total Demand	25.6	34.8	40.9	29.5
Food (per capita)	44.9	47.8	54.9	41.5
Net Trade	23.0	21.7	16.6	25.8

Source: IFPRI IMPACT.

For roots and tubers, the baseline scenario projects developing Asia to remain an exporter, but for exports from the region to decline slightly from 1993 levels of 21 million mt to 19 million mt in 2010. The alternative policy scenarios both show Asia remaining a net exporter of this category of crops in 2010, but the export levels are much lower under the low-investment than under the high-investment scenario. Indeed, under the high-investment policy package, regional exports would be expected to rise from their 1993 levels to around 30 million mt, whereas the low-investment scenario would bring export levels in 2010 down to around 5.5 million mt. As noted above, the two scenarios make no substantial difference to projections of supply in 2010, so the difference in imports across scenarios must lie in demand. Regional demand does differ considerably across scenarios, rising by about 5 percent vis-à-vis the baseline for the poor policy scenario and declining by close to 4 percent under the positive investment/reform policy, again using the baseline as comparator. Behind these regional figures lies substantial variation in root and tuber markets in each subregion for the alternative scenarios.

The PRC once again plays a paramount role, responsible for close to 65 percent of total regional supply and almost 70 percent of total regional demand for roots and tubers. The baseline scenario shows the PRC moving from a slightly negative net trade position to that of a net importer, but of less than one million mt in 2010. The low-investment scenario would exacerbate this trend, so that the PRC would need to import 4 million mt of roots and tubers by 2010. Under the high-investment scenario, on the other hand, PRC exports of roots and tubers would reach 7 million mt in 2010. Southeast Asia in 2010 is expected to account for nearly 19 percent of regional supply and between 11 and 15 percent (depending on the scenario) of total consumption. As in the PRC, in Southeast Asia demand for roots and tubers rises under the low-investment scenario (by about 6 million mt from the baseline figure of 35 million mt—17 percent of the baseline figure), and drops under the high-investment package (by about 5 million mt, or 15 percent of the baseline, to 30 million mt). Unlike the PRC, though, Southeast Asia starts out in 1993 and finishes in 2010

as a net exporter (with virtually all exports from Thailand), regardless of the scenario examined, with the level of exports considerably lower in the low-investment scenario (17 million mt) than in the high (26 million mt). These figures establish a range of nearly 24 percent below, and 19 percent above, the Southeast Asian baseline export figure of 22 million mt.

#### *Alternative Scenarios for Livestock and Dairy Products*

Developing countries in Asia will sharply increase production as well as consumption of meat from 1993 levels to 2010 under the baseline scenario (see the Appendix for more detail on growth rates and types of meat projected to increase the most by location in Asia). As was the case for crops, depending on what type of policy package is adopted in the region, developing Asia is projected to face two substantially different potential futures for livestock product markets in 2010. Again, as Table XII.3 shows, the general trend holds of production levels lowered from the baseline due to a low-investment strategy, and boosted from the baseline due to a high-investment strategy. Here, though, the low-investment strategy depresses demand for livestock products compared to the baseline. The high-investment strategy, conversely, induces even greater meat consumption than was the case in the baseline. So, for developing Asia, meat production and consumption move up in tandem in response to the high-investment scenario and down in response to the low-investment scenario.

In the baseline, meat consumption in the region roughly keeps pace with production, leaving net trade for all developing Asia similar in 2010—a net exporting position on the order of 0.5 million mt—to 1993 levels (exporting 0.4 million mt). The downside shifts in supply and demand for meat from the low-investment strategy are of similar magnitude (roughly 7 percent), but demand falls slightly more, leaving the region with higher net exports than in the baseline (but still under one million mt, at 0.9), but at significantly lower production levels (91 million mt, compared to 98 in the baseline). Under the high-investment scenario, demand again responds slightly more than

**Table XII.3: Total Supply, Demand, Net Trade (Mmt), and Per Capita Food Demand (kg/cap) for All Meats and Milk, Developing Asia, 1993 and Projected 2010, Baseline and Alternative Policy Scenarios**

	1993	2010		
		Base-line	Low Inv/ Weak Reform	High Inv/ Strong Reform
<b>All Meats</b>				
<b>Asia (developing)</b>				
Total Supply	56.1	98.3	91.4	104.7
Total Demand	55.8	97.7	90.5	104.7
Food (per capita)	19.1	26.9	24.4	29.7
Net Trade	0.4	0.5	0.9	0.0
PRC				
Total Supply	39.4	69.1	63.8	73.5
Total Demand	38.6	68.6	63.2	72.7
Food (per capita)	32.8	51.1	46.0	55.5
Net Trade	0.9	0.5	0.6	0.8
South Asia				
Total Supply	6.1	10.5	9.7	11.7
Total Demand	6.0	10.6	10.2	11.3
Food (per capita)	5.0	6.7	6.3	7.4
Net Trade	0.1	-0.1	-0.4	0.4
Southeast Asia				
Total Supply	7.1	13.0	12.4	13.7
Total Demand	7.0	12.2	11.4	13.4
Food (per capita)	15.1	20.5	18.7	23.4
Net Trade	0.1	0.8	1.0	0.3
<b>Milk</b>				
<b>Asia (developing)</b>				
Total Supply	93.2	173.6	162.3	189.1
Total Demand	99.2	181.5	169.4	198.0
Food (per capita)	28.5	44.6	40.5	50.3
Net Trade	-6.0	-7.9	-7.1	-8.9
PRC				
Total Supply	8.3	14.3	13.0	14.8
Total Demand	9.2	15.0	13.9	15.6
Food (per capita)	6.8	9.9	9.0	10.6
Net Trade	-0.9	-0.7	-0.8	-0.8
South Asia				
Total Supply	81.1	153.6	143.9	168.3
Total Demand	81.6	154.4	144.0	169.3
Food (per capita)	57.7	87.5	79.4	99.0
Net Trade	-0.6	-0.7	0.0	-1.0
Southeast Asia				
Total Supply	1.6	2.6	2.4	2.8
Total Demand	5.5	8.8	8.3	9.4
Food (per capita)	11.4	14.3	13.1	15.8
Net Trade	-4.0	-6.2	-5.9	-6.6

Source: IFPRI IMPACT.

supply, but this time on the upside, so that all that is produced is consumed in the region at a level of 105 million mt (as compared to the baseline, this is 6.6 percent higher on the supply side, and 7.2 percent higher on the demand side). Note that the supply-and-demand profile of each alternative creates a band of possibility for levels of production and consumption of about 7 percent around the baseline for the region.

Net export and import positives change little under the high-and low-investment scenarios. The PRC, responsible for about 70 percent of regional production and consumption (across all 2010 scenarios), could end up exporting between 0.6 and 0.8 million mt of meat (the extremes projected under low and high-investment scenarios, respectively). South Asia is the exception: under the low-investment strategy, the subcontinent needs to import 0.4 million mt of meat to meet demand. Note, however, that the picture for East Asia other than the PRC, not reported in Table XII.3, is also an exception (under the high-investment scenario): taken as a whole, East Asian developing countries under the favorable policy package would be net importers of 0.7 million mt of meat in 2010. This explains why, with all regions reported in Table XII.3 as net exporters under the high-investment scenario, net meat trade for developing Asia nevertheless stands at 0.

Under the baseline, milk production for all developing countries in Asia is projected to rise 3.7 percent annually from a 1993 level of 93 million mt, to 174 million mt in 2010 (Table XII.3). With the unfavorable policy package, though, in 2010 production levels will only climb to 162 million mt (6.4 percent less than in the baseline). The high-investment/strong-reform scenario is projected to result in 2010 levels of milk production of 189 million mt, 9 percent above the baseline level. Milk consumption will also rise under the baseline scenario, at 3.6 percent annually from 1993 to 2010, to 182 million mt. Developing Asia, then, will continue to be a net importer of milk, with imports increasing from 6 million mt in 1993 to 8 million mt under the 2010 baseline. Southeast Asia continues its role as the major net importer of milk among the subregions throughout this period.

As was the case for meat, under the low-investment scenario demand for milk in the region is reduced significantly relative to the baseline level in 2010 (to 7 percent less), and under the high-investment scenario substantially exceeds the baseline level (this time by 9 percent). Under the low-investment scenario, import needs in 2010 will still be up from 1993 levels to 7 million mt, but at lower levels than the baseline. More imports will be needed to satisfy milk consumption under the high-investment scenario—nearly 9 million mt. As in the baseline, Southeast Asia dominates other subregions within Asia as regards milk imports.

South Asia, however, will continue to account for the dominant share of production and consumption of milk for developing Asia, ranging from 85 to 90 percent of total regional supply and demand in 2010 (amounting to between 144 and 170 million mt, depending upon the scenario). Under the baseline, South Asian imports of milk are projected to increase slightly (from 0.6 to 0.7 million mt) from 1993 to 2010 (when supply and demand are projected at close to 154 million mt). Under the low-investment strategy, South Asia supply and demand of milk balance out at roughly 144 million mt. Under the high-investment strategy, imports of 1 million mt are needed to meet milk consumption of 169 million mt (production projected at 168 million mt).

Even taking into account the variability across subregions and commodities, the overall difference that either of these policy scenarios makes vis-à-vis the baseline for developing Asia is clear: for a broad range of crop and livestock/dairy products and across the major subregions within Asia out to 2010, the low-investment/weak-reform policy package means lower production and weakening trade positions, while the high-investment/strong-reform policy package means improved production scenarios and stronger trade positions.

*Alternative Scenarios: Effects on International Commodity Prices*

As shown in Table XII.4, international commodity prices will be affected strongly and in different directions by the policy scenarios for developing Asia (low-investment/weak-reform and high-investment/strong-reform) underlining the importance of the region in global markets.

More specifically, under the low-investment scenario, cereals prices would all turn upward, not just from the baseline but from 1993 levels, hurting the food security of the poor. The international price of wheat, for example, is projected to go up 21 percent from its 1993 levels, to US\$179/mt under this scenario, instead of dropping 1 percent under the baseline. Similarly, international maize prices would rise to US\$151/mt (up about 20 percent from 1993 levels). Rice, one of few commodities expected to increase in price under the baseline (by 5 percent from 1993 levels), would have an even higher price of US\$387/mt (up 35 percent from 1993) under this low-investment scenario. Figures for specific roots and tubers tell a similar story:

**Table XII.4: Commodity Prices, Developing Asia, 1993 and Projected 2010, Alternative Scenarios**

	1993	2010		
		Base-line	Low Inv/ Weak Reform	High Inv/ Strong Reform
		(US dollars per metric ton)		
Wheat	148	146	179	120
Maize	126	127	151	111
Rice	286	303	387	222
Other Grains	122	116	138	97
Potatoes	160	159	208	119
Sweet Potatoes	91	90	143	55
Cassava & other R&T	54	56	87	38
Beef	2,023	1,835	1,956	1,732
Pigmeat	1,366	1,260	1,330	1,202
Sheep&Goat	2,032	1,915	2,067	1,773
Poultry	1,300	1,175	1,238	1,124
Milk	234	217	233	209

Source: IFPRI IMPACT.

higher prices and less food security for the poor (international potato prices, for example, are projected to climb 30 percent under the low-investment strategy/weak policy-reform scenario.

With the low-investment strategy in place in Asia, international prices for most meats and milk are projected to decline less from 1993 to 2010 than they would under the baseline but retain a slightly downward trend (or remain practically stagnant, as is the case for pork prices, down just US\$30/mt over the period under the low-investment strategy, to US\$1,330/mt; or milk, remaining close to US\$230/mt from 1993 to 2010 under this scenario). With the high-investment strategy in place, on the other hand, international crop prices decline more sharply than under the baseline and downward price trends in livestock and dairy product prices (although still slight) become more firmly discernible.

#### *Alternative Scenarios: Effects on Per Capita Food Demand*

The changes in per capita income growth and commodity prices under the alternative scenarios have large impacts on per capita food demand, which is a significant determinant of food security. As can be seen in Tables XII.2 and XII.3, the impacts include shifts in the composition as well as the level of food demand. Per capita food consumption of roots and tubers in 2010 actually increases by 8.6 percent in the low-investment scenario relative to the baseline. Although white potatoes have strongly positive income elasticities of demand in Asia, they account for just over one fourth of direct consumption of roots and tubers in the base year. Sweet potatoes, cassava, and other roots and tubers, which account for the bulk of roots and tubers food consumption, are inferior goods characterized by negative income elasticities. The depressed per capita income growth under the low-investment/weak-reform scenario therefore results in a shift in consumption away from preferred staples such as wheat to inferior staples such as cassava and sweet potatoes. For the same reasons, the high-investment/strong-reform scenario results in a decline in per capita consumption of roots and tubers in 2010 compared to the baseline projection.

The changes in per capita consumption of cereals under the scenarios are also slightly less dramatic than might be expected because, for many of the East and Southeast Asian countries, rice is an inferior good. Under the low-investment/weak-reform scenario, there is thus a shift out of wheat and into rice that somewhat compensates for the decline in consumption of wheat. Nevertheless, under the low-investment scenario, per capita food consumption of all cereals in Asia declines by 4.6 kg/capita (2.5 percent) relative to the baseline, and in fact is projected to be nearly one kilogram lower than in the base year of 1993 (Table XII.2). The sharpest fall is in South Asia, a decline of 5.7 kg/capita compared to the baseline projection. Under the high-investment scenario, cereal consumption increases by 5.5 kg/capita (2.9 percent) compared to the baseline 2010 projection, with South Asia showing the most dramatic increases of 7.4 kg/capita (4.3 percent) relative to the baseline, and 16.2 kg/capita compared to 1993 (Table XII.2).

The relative impact of the alternative policy scenarios on meat and milk consumption per capita is even more dramatic. Projected meat consumption per capita declines by 2.5 kg/capita (9.3 percent) under the low-investment/weak-reform scenario (Table XII.3). The biggest impact is for the PRC, which would see a decline in meat consumption relative to the baseline of 5.1 kg/capita, or 10 percent. Food consumption of milk would also be hard hit, with a decline of 4.1 kg/capita (9.2 percent) for developing Asia. In South Asia, which relies much more heavily on milk than on meat, the projected decline in milk consumption is 8.1 kg/capita (9 percent) compared to the baseline level in 2010. The improvements in meat and milk consumption under the high-investment/strong-reform scenario are comparably large. For developing Asia, projected meat consumption would increase by 2.8 kg/capita (10.4 percent) and milk consumption by 5.7 kg/capita (12.8 percent). The PRC is projected to have the biggest absolute gain in per capita meat consumption, 4.4 kg/capita, but the most dramatic relative gain would be in Southeast Asia, where the 2.9 kg/capita increase represents a 14.4 percent increase in meat consumption compared to the baseline projection for 2010. South Asia is the largest gainer in milk consumption, with

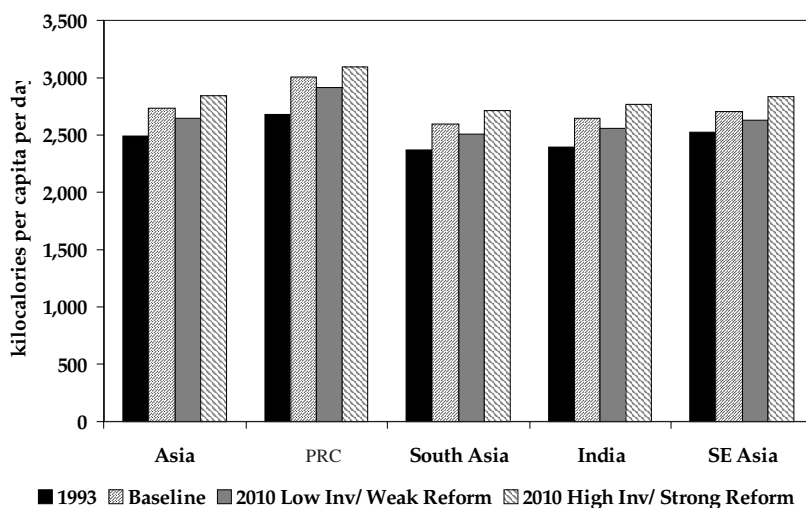
projected consumption in 2010 reaching 99 kg/capita compared to 87.5 kg/capita in the baseline, an increase of 13.1 percent.

### **Scenario Effects on Food Security: Childhood Malnutrition**

The alternative scenarios have profound effects on food security as measured by childhood malnutrition. For the low-investment/weak-reform scenario, reductions in per capita income and increased food prices reduce per capita food consumption as described above. The reduction in food consumption reduces per capita calorie consumption, which in turn increases the percentage of the childhood population that is malnourished. Reductions in public investment in the social sector, including total social expenditures, education and water, and sanitation, result in further increases in the percentage of malnourished children. The total childhood population also increases due to the higher fertility rates incorporated in the high population-growth scenario. The combined result of these effects is an increase in the number of malnourished children. The high-investment/strong policy-reform scenario has the opposite effects on the number of malnourished children.

The projected levels of per capita food availability, as measured by kilocalories per day, are shown in Figure XII.1 for the alternative scenarios. Under the low-investment/weak-reform scenario, projected calorie consumption for developing Asia declines in comparison to the baseline, from 2,734 kilocalories to 2,646 kilocalories, a drop of 3.2 percent, eliminating nearly 45 percent of the gains in calorie consumption projected under the baseline scenario. The order of magnitude in the decline in projected food availability is similar across the countries and subregions shown in Table XII.5. The high-investment scenario boosts daily calorie consumption to a projected 2,842 kilocalories in 2010, an increase of 4 percent compared to the baseline projection. The biggest increase in calorie consumption is in Southeast Asia, an increase of 132 kilocalories per day, or 4.8 percent (Table XII.5).

Figure XII.1: Per Capita Food Availability, Developing Asia, 1993 and Projected 2010, Alternative Scenarios



Source: IFPRI IMPACT.

Table XII.5: Per Capita Food Availability, Developing Asia, 1993 and Projected 2010, Alternative Scenarios

	1993	2010		
		Base-line	Low Inv/ Weak Reform	High Inv/ Strong Reform
		(kilocalories per day)		
Asia	2,488	2,734	2,646	2,842
PRC	2,680	3,008	2,913	3,096
South Asia	2,370	2,599	2,510	2,719
India	2,397	2,644	2,559	2,764
Southeast Asia	2,525	2,707	2,626	2,838

Source: IFPRI IMPACT.

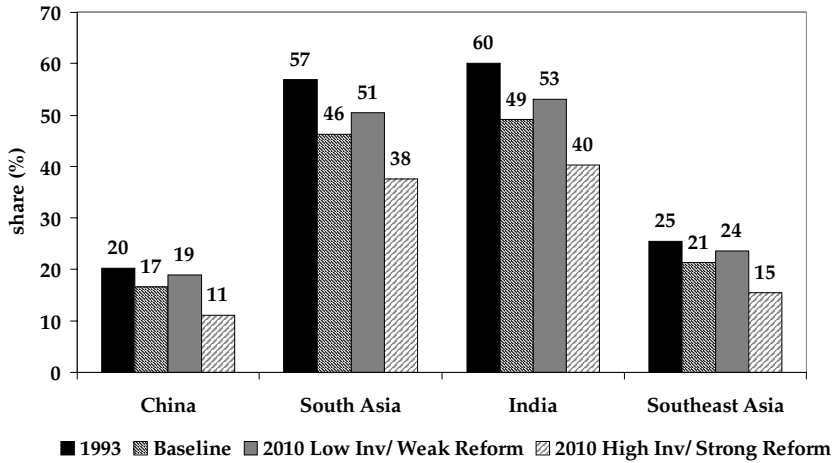
The decline in calorie consumption under the low-investment scenario, combined with reduced social expenditures, results in significant increases in the percentage of malnourished children (aged 0 to 5 years) in the Asian developing countries. The proportion of children malnourished is projected to increase

by 2.4 percentage points in the PRC, by 4.3 percentage points in South Asia, and by 2.5 percentage points in Southeast Asia (Figure XII.2). The increase in the proportion of children malnourished, together with the higher population of children, causes a dramatic absolute worsening of childhood malnutrition. The low-investment/weak-reform scenario results in an increase of 27.9 million compared to the baseline projection, a full 25 percent increase. The projected number of malnourished children in developing Asia actually increases relative to the 1993 level. Two thirds of the projected increase in numbers relative to the baseline is in South Asia, where nearly 3 million additional children are projected to be malnourished compared to 1993. The high-investment/strong-reform scenario, on the other hand, dramatically lowers the rate of childhood malnutrition. The number of malnourished children is reduced by 36.8 million compared to the baseline 2010 level, a reduction of fully one third and of almost one half compared to 1993 (Figure XII.3).

The results of this scenario analysis indicate that a series of moderate and plausible policy differences can generate dramatic changes in food security and welfare in developing Asia within the relatively brief span of years to 2010. Under the low-investment/weak-reform scenario, Asian cereal imports of 150 million mt are projected to be five times the 1993 level and more than double the 2010 level under the high-investment/strong-reform scenario. Cereal prices will be nearly 50 percent higher under the former scenario than under the latter. The difference between the low-investment/weak-reform and high-investment/strong-reform scenarios generates a swing of 10 kg/capita in consumption of both cereals and milk, and more than 5 kg/capita in consumption of meat. Most importantly, the high-investment/strong-reform scenario would reduce the number of malnourished children in developing Asia in 2010 by nearly 65 million compared to the low-investment/weak-reform scenario, from 141 million to 76 million children.

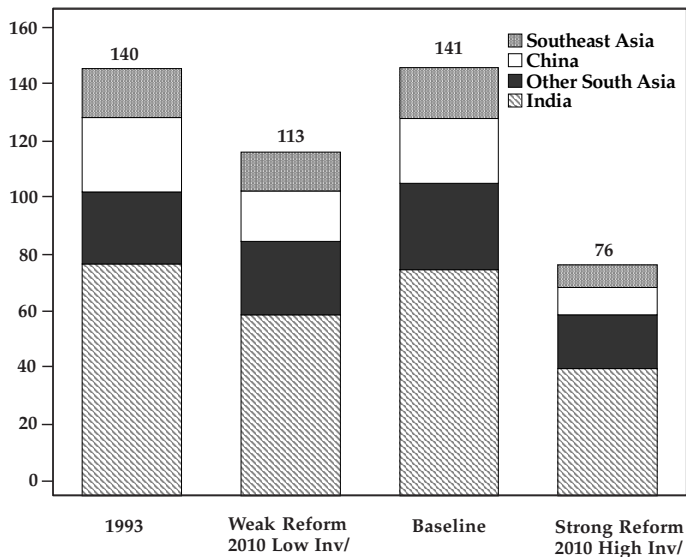
This high-investment/strong-reform scenario combines three broad courses for reducing the projected levels of malnutrition: the first way is through broad-based and rapid agricultural productivity growth and economic growth to

Figure XII.2: Percentage of Malnourished Children in Developing Countries, 1993 and Projected 2010, Alternative Scenarios



Source: IFPRI IMPACT.

Figure XII.3: Number of Malnourished Children in Developing Countries, 1993 and Projected 2010, Alternative Scenarios



Source: IFPRI IMPACT.

increase effective incomes, effective food demand, and food availability; the second way is through a reduction in population growth rates; and the third is through investments in education, social services, and health (the latter proxied by access to clean water in the model). The relative contribution of these three courses to reducing malnutrition can be estimated by undertaking a series of simulations embodying specific interventions such as lower population growth or higher social investments. These disaggregated simulations indicate that 31 percent of the improvement in childhood malnutrition from the high-investment/strong-reform scenario can be attributed to higher income growth and higher agricultural production growth due to increased research investment, improved water policy, and reduced environmental degradation. The combined contribution of improved income and productivity cannot be disaggregated further because a significant portion of the contribution is an interaction effect: the improved agricultural production growth reduces prices and increases the effective demand created by the increased incomes. Conversely, in the absence of improved income growth, the impact of production growth would be reduced, because agricultural prices would be driven down, dampening the production growth.

Higher social investment accounts for 32 percent of the improvement in childhood malnutrition and reduced population growth rates account for 37 percent of the improvement. The powerful impact of reduced population growth on childhood malnutrition indicates that policies and investments that reduce population growth rates would have large benefits. However, while policy changes can reduce population growth, the pathways for this reduction are not always direct, neither are they felt in the short term. Income growth does go hand in hand with fertility decline as expectations shift about the economic costs of bearing and rearing offspring and about their subsequent income benefits. Higher expected incomes overall may enhance incentives for parents to invest more in fewer children (see, for example, Becker and Lewis 1974; Schultz 1981).

Broader social development also has important effects on fertility. For example, more education for women may reduce fertility rates via delayed onset of marriage and childbearing as well as being an increased incentive for women to enter the formal workforce, thereby cutting into incentives for childbearing and -rearing. But it takes time for this effect on fertility decisions to play out in terms of lower population growth rates (since this effect is balanced against declining mortality and since not all of the childbearing cohort is affected, at least initially). Indeed, analysis of the timing of fertility decline in relation to economic development indicators has revealed wide variation from country to country (see Bongaarts and Cotts Watkins 1996; they attribute much intercountry difference to sociocultural factors). Given the uncertainty about short-term payoffs from population-oriented policies, it is important to examine whether significant inroads can be made on child malnutrition without influencing population growth rates.

### **Can Childhood Malnutrition in Asia Be Eliminated by 2010?**

The high-investment/strong policy-reform scenario shows that relatively moderate improvement in policies in key strategic areas can significantly improve food security in Asia, as measured by childhood malnutrition. But even in this scenario, 76 million children in Asia remain malnourished, including 59 million in South Asia, hardly a desirable outcome. Instead of moderate improvements that leave millions of children malnourished, would it be possible to launch an attack on food insecurity that would eliminate childhood malnutrition in Asia by 2010? Given the difficulty and uncertainty in directly reducing population growth rates in the relatively short time between now and 2010, we examined whether plausible combinations of income growth, agricultural productivity growth, and social investments could attain this goal while maintaining the baseline medium population-growth assumptions.

The results reveal that a combination of high income growth, high productivity growth for crops and rapid expansion in numbers of livestock, and large social investments can dramatically reduce (but not entirely eliminate) childhood malnutrition by 2010 and virtually eliminate it by 2020. In order to achieve these food security gains, the improvements in projected performance must be much higher for South Asian countries than for the rest of Asia, because of the far greater initial severity of childhood malnutrition. The “rapid reduction of malnutrition” scenario combines the following elements: annual income growth rates are increased by 50 percent compared to the baseline for the East and Southeast Asian countries and 75 percent for South Asian countries. The resulting aggregate income growth rates are 9.6 percent for India, 8.8 percent for Pakistan, and 7.9 percent for Bangladesh. While these rates are high, they are within the bounds of growth rates achieved in East and Southeast Asia from 1975 to 1995. For the latter regions, the growth rates of, for example, 9 percent for the PRC and 9.75 percent for Indonesia and Malaysia would imply a return to the peak growth rates of the 1980s and early 1990s, while for the Philippines, the growth rate of 7.5 percent would imply a take-off into sustained growth similar to the East Asian success stories.

Crop productivity, expressed in terms of annual yield growth per hectare for cereals, roots and tubers, and soybeans, is assumed to increase by 50 percent for East and Southeast Asia and by 75 percent for South Asia. The projected realized cereal yield growth rates to 2010 under these assumptions would be 1.45 percent per year for East Asia, 1.90 percent per year for Southeast Asia and 2.44 percent for South Asia. These growth rates are higher than the 1989-95 yield-growth trends but lower than the yield-growth rates achieved during the peak green-revolution growth (see Chapter VI). Higher growth rates in production of meat and livestock products are assumed to be generated by more rapid expansion in animal numbers, with a 50 percent increase in annual growth rates in animal numbers for East and Southeast Asia and a 75 percent increase for South Asia.

The third pillar for rapid reduction in childhood malnutrition is increased social investments. All Asian countries are assumed to increase female access to education to 90 percent in 2010 and to 95 percent in 2020. This compares to average values in South Asia of 42 percent and in East and Southeast Asia of 48 percent in 1993. Access to clean water is assumed to increase to 95 percent in 2010 and 98 percent in 2020, compared to 57 percent in South Asia and 55 percent in East and Southeast Asia. Finally, government social expenditures are assumed to reach levels that are 50 percent higher than baseline projected levels in 2010 and 2020 for East and Southeast Asia, and 75 percent higher in South Asia. This implies average annual growth rates in public social expenditures of 6.8 percent per year in South Asia and 5.0 percent per year in East and Southeast Asia.

What would be the impact on malnutrition of these dramatic improvements in economic, agricultural, and social performance? In Southeast Asia, it is projected that childhood malnutrition would decline from 16.1 million persons to 4 million in 2010, with complete elimination of malnourished children in Thailand and less than 0.2 million remaining in Malaysia and Indonesia. By 2020, childhood malnutrition would be eliminated in Southeast Asia. The PRC would achieve dramatic reductions in childhood malnutrition, from 24.4 million in 1993 to only 0.4 million in 2010, and would have completely eliminated malnutrition by the following year.

In South Asia, extraordinary improvements would also be made, but the high initial levels of malnutrition mean that significant numbers of malnourished children would persist in 2010. It is projected that numbers of malnourished children in South Asia would decline from 99.8 million in 1993 to 40.1 million in 2010. In India, the numbers would fall from 76 million to 30.9 million, in Pakistan from 9.9 million to 5.7 million, in Bangladesh from 11.4 million to 3.6 million, and in the rest of South Asia from 2.4 million to 0.7 million. By 2020, the number of malnourished children would further decline to 7.7 million in India and 0.3 million in Pakistan, and childhood malnutrition would be eliminated in Bangladesh and the rest of South Asia.

## CONCLUSIONS

Under the baseline scenario, the Asian and global food supply-and-demand picture in the most aggregate sense is relatively positive: if governments and the international community maintain their commitment to agricultural growth through sustained, cost-effective investment in agricultural research, extension, irrigation and water development, human capital, and rural infrastructure, there will not be overwhelming pressure on aggregate Asian and world food supplies from rising populations and incomes. Projected per capita availability of food in Asia will increase and real world food prices will be steady or declining slowly for the main food commodities. However, these positive aggregate outcomes hide the massive human suffering that would continue under the business-as-usual baseline scenario. Despite gains from trade and the overall ability of the world's productive capacity to meet effective demand for food, there will be only slow improvement in food security in Asia as measured by the number of malnourished children, with 113 million children suffering from malnutrition in 2010, including 83 million in South Asia. Moreover, food security is vulnerable to relatively small declines in policy efforts relative to business as usual. Policies that moderately disfavor agriculture and natural resources, reduce social investment, and slow economic reform lead to a much worsened food security impact compared to the baseline. Complacency toward agricultural and social investments risks a severe negative food security impact.

Conversely, the results shown here indicate that a significant assault on childhood malnutrition in Asia could be mounted within the boundaries of plausible long-term performance of the Asian economies. Moderate but important reductions in childhood malnutrition can be achieved through relatively small improvements in income growth, investment in agricultural research and irrigation, improved water policy, reductions in environmental degradation, slower population growth, and increases in social investments. But the near-

elimination of childhood malnutrition will require policy reform and public investment that produce dramatic long-term gains in income growth, agricultural productivity, and social indicators. Although the precise set of policy reforms and the priorities and magnitudes of increases in investments required to eliminate childhood malnutrition would need to be determined in detail for each country, the results here confirm that the three foundations for success are broad-based economic growth, growth in agricultural production, and investment in social services including education and health. Failure in any of these three areas will severely hamper efforts to eliminate childhood malnutrition.