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# Approaches to Combat Hunger in Asia and the Pacific

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and Raghbendra Jha





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**Approaches to Combat Hunger in Asia and the Pacific**

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**Abstract**

The views expressed in this Working Paper are those of the author(s) and should not necessarily be considered as reflecting the views or carrying the endorsement of the United Nations. Working Papers describe research in progress by the author(s) and are published to elicit comments and to further debate. This publication has been issued without formal editing.

Asia and the Pacific, despite visible signs of prosperity due to years of rapid economic growth, has made insufficient progress in freeing its population from hunger and malnutrition, the most basic marker of true development. Given the importance of reducing poverty and hunger as core development priorities, the international community has placed these as the first Millennium Development Goal (MDG), adopted in the historic Millennium Declaration of September 2000. The MDGs envision halving the incidence of poverty and hunger by 2015 and call for major improvements in the provision of basic services, promising a better life to millions of poor across the globe. However, if progress in reducing poverty and hunger is not accelerated in the region, such hopes will remain unrealized.

This paper aims to trace the progress of efforts to reduce hunger in Asia and the Pacific, to identify reasons for their successes and failures, and to suggest policy initiatives to help make tangible progress of the Millennium Development Goal targets from now until 2015.

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# 1. Introduction

Asia and the Pacific, despite visible signs of prosperity due to years of rapid economic growth, has made insufficient progress in freeing its population from hunger and malnutrition, the most basic marker of true development. Given the importance of reducing poverty and hunger as core development priorities, the international community has placed these as the first Millennium Development Goal (MDG), adopted in the historic Millennium Declaration of September 2000. The MDGs envision halving the incidence of poverty and hunger by 2015 and call for major improvements in the provision of basic services, promising a better life to millions of poor across the globe. However, if progress in reducing poverty and hunger is not accelerated in the region, such hopes will remain unrealized.

The extreme poverty in Asia and the Pacific that affects around 900 million people, as well as the persistence of hunger in well over half a billion, questions the long-term sustainability of the region's economic growth and development. About one in every six persons in the region suffers from malnourishment, and about one in three children is underweight. These problems are particularly severe in South Asia and Southeast Asia. The MDG target to reduce hunger by half is unlikely to be achieved in the case of child hunger; the region may also miss the target for undernourishment, particularly if restored economic growth from the current slowdown is sluggish and if food prices start increasing. The task before the region's governments to achieve this crucial development goal is thus demanding, requiring greater prioritization of efforts and the adoption of new, more efficient approaches. Further, more regional and international efforts are also needed.

The primary purposes of this paper are to trace the progress of efforts to (i) reduce hunger in Asia and the Pacific, (ii) identify reasons for their successes and failures, and (iii) suggest policy initiatives to help make tangible progress on these first MDG targets in the time remaining to 2015.

## 2. Hunger Definitions

There is no single, universally accepted definition of hunger or of its measurement. As hunger has become better understood over the years, however, the discussion has shifted from the mere availability of food to its access, affordability, and nutrition. In its report on the World Food Summit of 1996, the Food and Agriculture Organization (FAO) posited that hunger can be eliminated "when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (FAO 1996).

MDG goal 1 focuses on reducing the incidence of extreme poverty and hunger deprivation, and has two targets (United Nations Development Programme [UNDP] 2008). While the first target envisages halving of the proportion of poor between 1990 and 2015, the second target aims to halve the proportion of people who suffer from hunger by 2015, with the following indicators to measure progress:

- (i) prevalence of underweight children under age 5 years (United Nations Children's Fund [UNICEF] definition), and
- (ii) proportion of population below the minimum level of dietary energy consumption (FAO definition).

These hunger indicators provide two critical dimensions: child malnutrition measured by low weight and lack of sufficient dietary energy consumption. While other indicators exist, these two are most often referred to, partly owing to the availability of data.

However, while experts recommend a minimum of 2,200 calories for adults undertaking light activity, some suggest other standards for measuring hunger.<sup>1</sup> The MDG target of undernourishment in the general population uses the FAO definition, which derives a proportion of the undernourished through distribution of the dietary energy supply within a country's population and by establishing a minimum cut-off point, below which persons are considered energy-consumption deficient (Box 2). The energy-deficiency measure of hunger has additional drawbacks, including failing to include other vital nutrients, such as minerals and vitamins;<sup>2</sup> different energy requirements of men, women, and children; and varying needs of persons engaged in different types of work. As seen in Appendix 1, the minimum daily nutritional requirements in rural India, recommended by an expert group on nutrition, vary greatly for age, gender, and occupational status.

As a single measure of hunger, the total population suffering from energy-consumption deficiency has limitations. Thus, many development agencies have advocated also focusing on the most vulnerable group in the population—children. Examining child malnutrition is also critical due to the large costs that the problem causes for labor and overall economic productivity. Thus, the second MDG indicator on overall hunger—that is, child hunger—came about.

Attempts to construct composite indexes using both hunger indicators have also been made. The global hunger index (GHI), developed by the International Food Policy Research Institute (IFPRI), for example, combines three equally weighted indicators: (i) the proportion of people who are food-energy deficient, as estimated by FAO; (ii) the prevalence of underweight in children under age 5 years, as estimated by the World Health Organization (WHO); and (iii) the under age 5 years mortality rate, estimated by UNICEF. This measure suffers from the deficiencies associated with composite measures. All three measures, for example, are arbitrarily weighted equally, and the quality of the data used varies widely across countries, which aggregation may compound (Ahmed et al. 2007a).

While improvements in hunger measures are necessary, the rest of this paper uses the two main MDG hunger indicators.

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<sup>1</sup> For example, Ahmed et al. (2007a and 2007b) defined three categories of the hungry according to the number of calories consumed per day: (i) subadjacent hungry, consuming 1,800–2,200 calories per day; (ii) medial hungry, consuming 1,600–1,800 calories per day; and (iii) ultra hungry, consuming less than 1,600 calories per day. Regarding its definition of hunger, the International Food Policy Research Institute uses the popular \$1 per day per person (adjusted for purchasing power parity [PPP]) as the cut-off point for poverty. The poor are further classified according to intensity of poverty being experienced: (i) subadjacent poor, living on \$0.75–\$1.00 per day; (ii) medial poor, living on \$0.50–\$0.75 per day; and (iii) ultra poor, living on less than \$0.50 a day. The authors find that there is strong association only between ultra poverty and hunger.

<sup>2</sup> There is further discussion of micronutrients in section 5. For an analysis of micronutrient deprivation and its relation to calorie deprivation in rural India, see Jha et al. (2009a).



### 3. Estimates and Trends of Hunger and Poverty in the Region

This section studies (i) how the incidence of hunger has reduced over time, particularly in comparison to poverty; (ii) which countries have the most hungry by MDG hunger definitions; (iii) how the current economic and food crises have impacted hunger; and (iv) whether the MDG hunger targets are likely to be achieved.

#### 3.1 Trends in Poverty and Hunger

Asia and the Pacific witnessed a rapid reduction in poverty between 1990 and 2005 (Tables 1 and 2). However, the incidence of hunger and the number of hungry have not fallen as dramatically, indicating that hunger is a more stubborn adversary than poverty, necessitating different instruments for engagement.

**Table 1: Incidence of Poverty and Hunger**

Region or subregion	Headcount ratio				Prevalence of undernourishment		Proportion of underweight children under age 5 years <sup>c,d</sup>	
	(% , \$1.00 PPP per day)		(% , \$1.25 PPP per day)		(% of population) <sup>b</sup>		Earliest	Latest
	1990	2005	1990	2005	1990–1992	2004–2006	(1990–1994)	(2003–2007)
Asia and the Pacific	36	16	52	27	20	16	40	31
East Asia	44	9	60	16	15	10	19	7
Southeast Asia	25	10	39	19	24	15	34	24
South Asia	34	24	52	40	25	23	53	46
Central and West Asia	4	12	6	19	15	11	19	7
Pacific <sup>a</sup>	33	21	43	30	12	13	29	26

PPP = purchasing power parity.

<sup>a</sup> The Pacific includes Papua New Guinea only, owing to scant data availability.

<sup>b</sup> For prevalence and number of undernourished persons, East Asia's regional average includes the Democratic People's Republic of Korea and the Republic of Korea, while Southeast Asia's regional average includes Myanmar.

<sup>c</sup> Country weights for proportion and number of underweight children under age 5 years were calculated by the Asian Development Bank (ADB) staff using 2005 population of children age 0–4 years from the 2008 Revision of the United Nations' World Population Prospects.

<sup>d</sup> For proportion and number of underweight children under age 5 years, the range of years for the earliest data is 1990–1994, while the range of years for latest data is 2003–2007 for all countries. For countries with missing data, backward or forward forecasts were calculated based on available data points using simple linear regression. With only one data point (2005) available for Tajikistan, the value for the earliest year was imputed using the average annual growth rate in Central Asia (i.e., Kazakhstan, the Kyrgyz Republic, Turkmenistan, and Uzbekistan).

Sources: World Bank. PovCalNet (accessed 19 April 2010) for poverty data; Food and Agriculture Organization (FAO). Food Security Statistics (accessed 8 March 2010) for undernourishment data; Statistics Division of the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) for underweight children under age 5 years data for all countries except Papua New Guinea, for which 2005 data point is taken from the United Nations Children's Fund (UNICEF, 2009) and 1996 and 2006 data points are taken from ADB. Statistical Database System Online (accessed 19 April 2010); and United Nations Population Division. World Population Prospects (accessed 19 April 2010) for population data used as country weights.

**Table 2: Absolute Numbers of Poor, Undernourished Population, and Underweight Children (million)**

Region or Subregion	Poor				Number of Undernourished Persons <sup>b</sup>	Number of Underweight Children Under Age 5 Years <sup>c,d</sup>	Earliest (1990–1994)	Latest (2003–2007)
	(\$1.00 PPP per day)	(\$1.25 PPP per day)	1990	2005				
Asia and the Pacific	978	521	1,415	903	586	566	127	98
East Asia	500	118	684	208	183	136	17	6
Southeast Asia	98	50	153	93	106	85	17	12
South Asia	377	344	572	585	286	337	92	79
Central and West Asia Pacific <sup>a</sup>	2	9	4	14	10	8	1.3	0.5
	1.4	1.3	1.8	1.8	0.5	0.7	0.3	0.2

PPP = purchasing power parity.

<sup>a</sup> The Pacific includes Papua New Guinea only, owing to scant data availability.

<sup>b</sup> For prevalence and number of undernourished persons, East Asia's regional average includes the Democratic People's Republic of Korea and the Republic of Korea, while Southeast Asia's regional average includes Myanmar.

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The incidence of poverty for the region dropped from 52% to 27%, using the updated \$1.25-a-day measure (2005 purchasing power parity or PPP).<sup>3</sup> Yet the incidence of undernourished population fell from 20% in 1990–1992 to only 16% in 2004–2006 (Table 1). Further, the extent of child undernourishment denoted by the prevalence of underweight children under age 5 years fell only from 40% to 31% in a similar period (although not the same period—due to scant data, estimates based on ranges within 1990–1994 and 2003–2007 have been reported).<sup>4</sup>

As far as the total number of the poor and hungry are concerned, the statistics are similar. While the number of poor has fallen dramatically—from about 1.4 billion in 1990 to about 900 million in 2005—the number of undernourished has stayed roughly the same, declining only from 586 million to 566 million from 1990–1992 to 2004–2006. Similarly, the number of underweight children has decreased only from 127 million to 98 million.

<sup>3</sup> The reduction in poverty, using the earlier \$1-a-day measure (1993 PPP), is from 36% in 1990 to 16% in 2005.

<sup>4</sup> ESCAP–ADB–UNDP (2007) estimated a drop for the region in the incidence of underweight children from 35% to 28% between 1990 and 2005, which shows a much smaller reduction.

### 3.2 Location of Hunger Hotspots by Subregion and Country

Trends in poverty and hunger in Asia and the Pacific subregions<sup>5</sup> indicate that all have (i) experienced a decrease in the incidence of poverty (except for Central and West Asia); (ii) experienced a reduction in the incidence of hunger by proportion of undernourished population (except for the Pacific); and (iii) seen a decline in the incidence of underweight children under age 5 years, although this reduction has been less dramatic. In the case of Central and West Asia, the incidence of poverty increased, while incidence of undernourishment in the general population and of underweight children declined—perhaps the result of stronger state involvement in basic services and human development.<sup>6</sup> For the Pacific, the poverty incidence fell, but general undernourishment marginally increased. Both of these subregions demonstrate that poverty and hunger do not necessarily go hand-in-hand.

In absolute numbers, while East Asia and Southeast Asia have seen significant reductions in poverty, South Asia and Central and West Asia have seen increased numbers of poor. Further, the reduction in the number of undernourished persons has not fallen much, even in East Asia and Southeast Asia, while it has increased in South Asia and the Pacific, and declined only minimally in Central and West Asia. In the case of child hunger, the trend is similar to that of general hunger. The reduction in terms of proportion and number between the earliest figures (early 1990s) and the latest (around 2005) show a much less pronounced decline as compared to poverty.

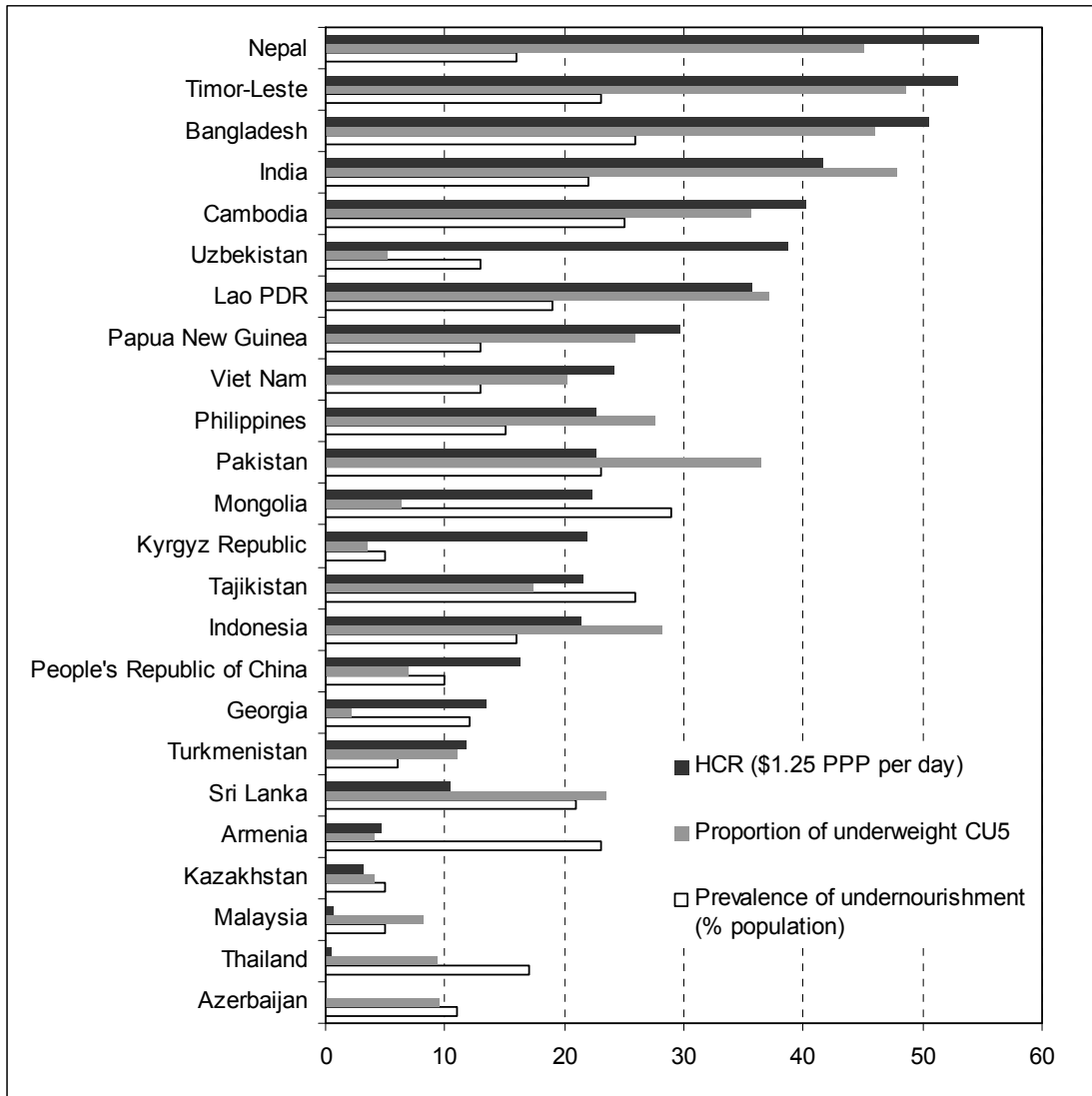
The region's divergent performance on poverty and hunger suggests that policies that attempt to reduce poverty alone may not reduce hunger. Thus, special measures are called for to address hunger. Focus is also needed on South Asia, which accounted for almost 60% of the region's hungry, 65% of the extreme poor, and 81% of underweight children. Further, South Asia is witnessing an increase in the absolute number of both poor and undernourished. Other countries where undernourishment in the general population persist (i.e., with incidence exceeding 15% by the latest count) are the Central and East Asian nations of Armenia, Mongolia, and Tajikistan; and the Southeast Asian nations of Cambodia, Indonesia, the Lao People's Democratic Republic (Lao PDR), the Philippines, Thailand, and Timor-Leste (Figure 1). By incidence of underweight children, countries other than those in South Asia that need to be monitored (i.e., having incidence exceeding 15%) are the Southeast Asian nations of Cambodia, the Lao PDR, Indonesia, the Philippines, Timor-Leste, and Viet Nam; Tajikistan in Central Asia; and Papua New Guinea in the Pacific.

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<sup>5</sup> The list of countries in these subregions is provided in Appendix 3.

<sup>6</sup> The discrepancy could also be due to the difference in the data range endpoints for poverty and hunger.

**Figure 1: Poverty and Hunger in Selected Asian Countries**



CU5 = children under age 5 years, HCR = headcount ratio, Lao PDR = Lao People's Democratic Republic, PPP = purchasing power parity.

Note: The latest undernourishment data for Kazakhstan, the Kyrgyz Republic, and Malaysia are based on 2003–2005 data from an earlier release of the Food and Agriculture Organization (FAO) food security statistics.

Sources: World Bank. PovCalNet (accessed 19 April 2010) for poverty data; FAO. Food Security Statistics (accessed 8 March 2010) for undernourishment data; Statistics Division of the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) for underweight children under age 5 years data for all countries except Papua New Guinea, which are taken from the United Nations Children's Fund (UNICEF 2009).

The GHI rankings also reveal a similar picture (Appendix 2). Of 26 countries in the region with a GHI ranking, all of South Asia were in the bottom half and have seen little improvement in rankings between 1992 and 2003. Several Southeast Asian countries have also seen little progress in the GHI (i.e., less than 25% during 1992–2003) including Cambodia, the

Lao PDR, Myanmar, and the Philippines, all of which also figure in the bottom 50% of the rankings.

Variations within countries show interesting facets of hunger in the region. For instance, despite a common pattern of higher poverty in rural areas, all countries have a higher food energy deficiency incidence in urban areas (Jha et al. 2009a). This is expected, since despite higher incomes, the urban poor have little income left for food after meeting minimum expenses for housing, transport, and health. Appendix 3 provides a profile of the evolution of poverty and calorie deprivation in some countries in the region.

### **3.3 The Global Food and Economic Crises and Impact on Poverty and Hunger**

Analyzing hunger and poverty is complicated by the fact that their data are available only after considerable delay. As such, the estimates of poverty and hunger presented in this paper relate to 2005 for poverty and 2004–2006 for undernourishment. Estimates of child undernourishment are even more problematic, as data are less regularly available. Reliable survey-based estimates of the impact of the global food and economic crises on hunger are therefore unavailable. However, some judgments can be made.

The regional slowdown caused by the global economic crisis has not generally caused a contraction in regional or individual country economic growth rates, except in a few cases. Within most countries, however, there have been sharp contractions in some sectors, such as those associated with exports, with resulting unemployment. The deceleration of growth will slow down reduction in the incidence of poverty rather than increase it. In addition, some estimates suggest that an additional 21 million people in the region who would have been raised up from absolute poverty during 2008–2010 (i.e., if the crisis did not occur) will remain trapped in poverty (ESCAP–ADB–UNDP 2010).

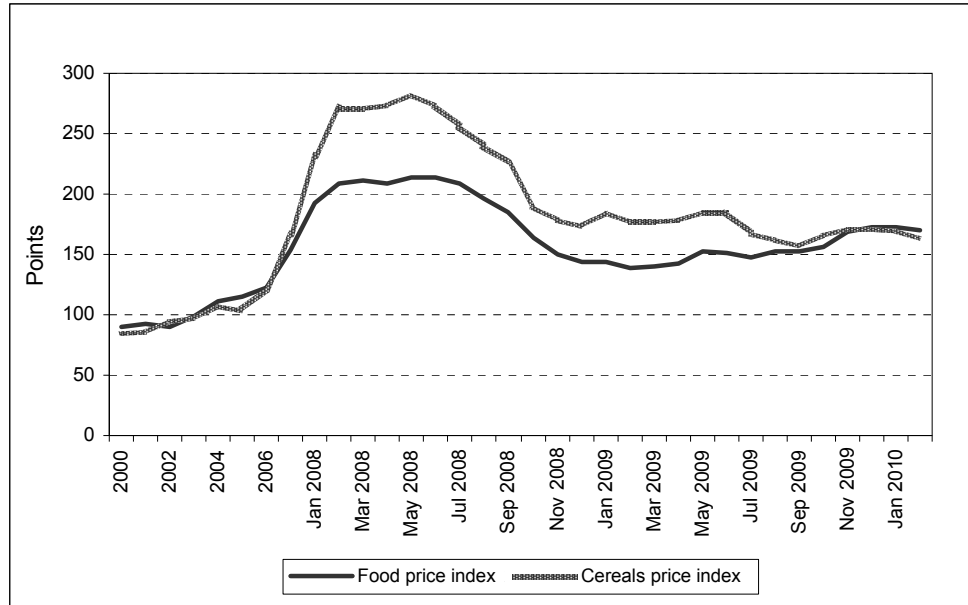
The food crisis, on the other hand, by impacting on the price of food that forms a major part of the budget of the poor, has had a more severe impact. Food prices have been rising steadily since 2004. The FAO Food Price Index, which was 111 in 2004, peaked at 214 in June 2008. Though it declined thereafter, it began increasing again in 2009, reaching 172 in December 2009. Cereal prices have stayed much higher, and also appear to be stabilizing at much higher levels than in 2004–2006 (Figure 2). This index was 107 in 2004, peaking at 282 in May 2008, and remaining as high as 170 in December 2009 (i.e., about 60% higher than 2004 levels) (FAO 2010).

Rough estimates made suggest that the incidence of hunger and poverty has risen in most countries in the region as a result of the rise in food prices. In the Philippines, for example, a 30% increase in food prices, could have resulted in a 10% increase in poverty. In fact, cereal prices were higher by 97% in 2008 than 2006 and by about 50% in 2009.<sup>7</sup>

The increase in the number and incidence of undernourishment resulting from both crises was confirmed by FAO, which estimated that the total undernourished population in the region increased from 566 million in 2004–2006 to 642 million in 2009 (FAO 2009a). This also implies an increase in the incidence of hunger from 16% to 18% in this period.

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<sup>7</sup> See ADB (2008).

**Figure 2: Food and Cereal Price Indices**

Source: Food and Agriculture Organization 2010.

### 3.4 Future Projections

Regarding future trends, there is concern whether the MDG hunger targets will be reached. As far as undernourishment of the population is concerned, in its 2009 *State of Food Insecurity in the World* report, FAO indicated that "[w]hile the proportion of undernourished continually declined from 1990–92 to 2004–06, the decline was much slower than the pace needed to meet the hunger reduction target of the first Millennium Development Goal" (2009a, p. 8). This is borne out by the data and trends presented in Table 1.

From Table 1, it can be inferred that the region has achieved roughly a 1.6% annual reduction (geometric) in the incidence of undernourishment in the population, which is too slow to achieve the MDGs. The main stumbling block is South Asia, where the reduction has been abysmally slow at just 0.6% per year. Moreover, the region is much further away in meeting the stricter World Food Summit target of reducing the absolute number of hungry by one half from the 1990 level of 586 million to 293 million by 2015. In fact, by 2004–2006, the region had reduced the population of malnourished by only 20 million, to 566 million. In the case of South Asia, the numbers of malnourished have heavily increased. With the steady increase in food prices being witnessed again since 2009, the prospects of the target being reached have further receded.

As far as the MDG target on incidence of underweight children is concerned, the latest projections indicate that, given current trends, the region is unlikely to achieve it (ESCAP–ADB–UNDP 2010). Asia and the Pacific has a higher proportion of underweight children than even sub-Saharan Africa. In fact, Asia and the Pacific's overall performance on child malnutrition was considered in an earlier report as one of the region's greatest failures (ESCAP–ADB–UNDP 2007). This problem, like malnourishment in the general population, has also been further aggravated by the increase in food prices. This calls for a more detailed discussion of hunger in this particularly vulnerable group—children.

## 4. Child Hunger

Child malnutrition, as reflected in body weight, is an important indicator of hunger, and is the second of the two hunger indicators in MDG goal 1. Child malnutrition measured by body weight can also be monitored more closely than adult malnutrition and is, therefore, a better indicator of malnutrition in the population. The World Bank also considers it a singularly important indicator of deprivation.<sup>8</sup> In many countries, child malnutrition<sup>9</sup> has been linked to poverty, low levels of education, and poor access to health services. The undernourishment of children at a young age has lasting impacts, with severe consequences on their cognitive development and increases their risk of death.

The foundations of adequate child nutrition are laid during the mother's pregnancy. As the World Bank notes, provision of adequate nourishment to expectant and lactating mothers is crucial to the healthy development of their offspring.

Among regions, Asia and the Pacific accounts for an astonishing 68.0% of the world's underweight children.<sup>10</sup> As few as seven countries (i.e., Bangladesh, the People's Republic of China [PRC], India, Indonesia, Pakistan, the Philippines, and Viet Nam) account for 62.6% of these children, with India alone accounting for 39.0%. In South Asia, around 40% of children under age 5 years are underweight in Bangladesh, India, Nepal, and Pakistan, with the figure somewhat lower in Sri Lanka (29%). Regarding progress on this MDG target, a study estimated that neither Afghanistan, India, Nepal, nor Pakistan will achieve the MDG target, with Pakistan regressing (ESCAP–ADB–UNDP 2010).

In Southeast Asia, a somewhat better-performing subregion, the larger countries of Indonesia, the Philippines, and Viet Nam continue to face significant problems relating to child malnourishment, with prevalence rates ranging from 20% to 30%. In Cambodia, the Lao PDR, and Timor-Leste, over 35% of all children under age 5 years are underweight. Apart from Viet Nam, none of these countries will reach the MDG target, and Timor-Leste is regressing (ESCAP–ADB–UNDP 2010).

In East Asia, the problem of child undernourishment is less severe. The PRC more than halved the proportion of underweight children between 1990 and 2005, from 19% to 7%, and may achieve the MDG target. However, the Democratic People's Republic of Korea has a relatively high proportion of underweight children, and progress in reduction has been slow.

Malnourishment in children appears to be a contributing cause of reduced infant and child survival rates (Appendix 4). The correlation rate between the incidence of underweight children under age 5 years and under age 5 years child mortality is moderately high at 0.42 for the latest period reported.

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<sup>8</sup> Child undernourishment is defined as the proportion of children age 0–59 months who fall below the median weight for the age of the National Center for Health Statistics–WHO standard reference population by more than three standard deviations. In a normally distributed population, only 0.13% of children would be expected to be severely underweight. See World Bank (2007a).

<sup>9</sup> UNESCAP (2007) also noted that the number of children under age 5 years who are underweight is an internationally recognized indicator of public health.

<sup>10</sup> Some of the discussion on child hunger in this section is derived from the Global Framework for Action–Ending Child Hunger and Undernutrition Initiative through the REACH partnership, in which ADB has also participated. See World Food Programme and UNICEF (2007).

Child malnutrition requires a multidisciplinary approach. The causes, according to a recent global study by REACH (2007) are mainly threefold: (i) inadequate access to food, including nutrients; (ii) insufficient maternal and child care; and (iii) lack of essential health services. Adverse political, economic, and cultural environments also play a role, as well as inadequate information and education about proper nutrition. Required interventions suggested by REACH that need to be scaled up are (i) local and homestead food production; (ii) nutrition education; (iii) micronutrient fortification and supplementation; (iv) provision of safety nets to vulnerable households; (v) household water treatment; (vi) improved hygienic practices, particularly hand washing with soap; (vii) parasite control (e.g., deworming and use of bed nets in malaria-endemic areas); (viii) special feeding programs; and (ix) maternal care, maternal nutrition, and breast-feeding. At the same time, continuing attention must be paid to ensure national food security; disease prevention and control (e.g., improved acute respiratory infection and diarrhea treatment, and immunization programs); provision of clean water and improved hygiene; and improved reproductive health, particularly safe motherhood and birth spacing.

REACH has also suggested a strategy designed to achieve four major outcomes regarding child malnutrition and hunger: (i) increased awareness and understanding of the problem and its causes and solutions; (ii) strengthened, resourced, and monitored national programs; (iii) increased capacities on the international, national, and household levels for taking action on this issue; and (iv) increased efficiency and better monitoring and evaluation of global efforts. The strategy requires incorporating programs for hunger and malnutrition at the national and subnational strategic planning levels, devoting more resources to the problem compared to current allocations, creating better synergies and partnerships among supporting national and international agencies, stoking greater involvement of and partnership with communities, improving micro-level planning to tie up delivery agencies and outreach partners with support and funding agencies, and bettering capacities at all levels involved with planning and delivery of programs.

How do these suggestions square with the implementation experience of existing child malnutrition programs? India, which faces one of the biggest challenges in this regard, has introduced some of the largest child nutrition and feeding programs in the world. These include the Integrated Child Health Services Scheme and the National Midday Meal Scheme for primary schoolchildren (Box 1). Better targeting, involving communities, and adopting a multidisciplinary approach are all aimed to help improve the effectiveness of the Integrated Child Health Services Scheme. The National Midday Meal Scheme has demonstrated benefits for schoolchildren; however, the problem of preschool-age child malnutrition remains a challenge and cannot be corrected by programs for older children.

**Box 1: Integrated Child Development Services  
and National Midday Meal Schemes in India**

A 2006 World Bank study by Gragnolati et al. highlighted some basic characteristics of child malnutrition in India: it is higher in (i) rural than in urban areas, (ii) female children than in male children, (iii) lower castes and tribal households than in the general population, and (iv) the poor than in the general population. About 60% was in the poorest wealth quintile. Six states (i.e., Bihar, Madhya Pradesh, Maharashtra, Orissa, Rajasthan, and Uttar Pradesh) accounted for the bulk of underweight children, and one-quarter of all districts accounted for more than half. Micronutrient deficiency was also widespread, with 75% of preschool-age children suffering from iron-deficiency anemia and 57% from vitamin A deficiency. Iodine deficiency was endemic in 85% of districts. While progress on reducing child malnutrition has occurred, it has been far slower in India than other countries experiencing similar economic growth. Clearly, economic growth alone cannot be relied upon to solve this problem.



Against this background, the World Bank found weaknesses in the Integrated Child Development Services Scheme. First, although the scheme was designed to address the multidimensional causes of undernutrition, it focused predominantly on supplementary feeding and preschool education for children 4–6 years old, failing to address children under the age of 3 years (i.e., those who suffer most from malnutrition) and to counsel parents on better feeding and child care practices. More attention to disease control and prevention activities, education to improve domestic child care and feeding practices, and micronutrient supplementation are needed. These will require restoring the multidisciplinary approach of the scheme, as well as integrating activities into the health sector and the Reproductive and Child Health Program. Second, better targeting is needed toward the most vulnerable age groups (i.e., children under age 3 years and pregnant women), and to states and districts with the highest prevalence of malnutrition. Similarly, supplementary feeding activities need to be aimed to those who need it most. Third, greater community involvement is necessary to augment resources and to improve the quality of service delivery and accountability. Finally, monitoring and evaluation activities need strengthening.

In 1995, the National Midday Meal Scheme was introduced but did not become a universal feeding program for primary schoolchildren until a 2003 Supreme Court ruling. Under this scheme, all children in public schools receive a cooked meal, consisting of no less than 300 calories and 8–12 grams of protein. Surveys quoted by Singh (2008) confirmed the benefits from this scheme, including increased enrollment rates, especially benefiting girls and lower castes, and reduced calorie and protein deficiency. Studying the scheme's impact in Andhra Pradesh, Singh also found that there were long-term improvements in cognitive skills. However, the scheme did not have strong long-term nutritional effects on body weight and height, except for younger children affected by drought.

Sources: Gagnolati et al. 2006 and Singh 2008.

## 5. Causes and Correlates of Hunger

### 5.1 Poverty and Hunger

Although most assume that poverty is the central cause of hunger, the reduction in hunger has not matched the decline in poverty in the region. Poverty and hunger are expected to be highly correlated, since an overwhelmingly large proportion of the poor's expenditure is on basic necessities like food. Poor people not only struggle to acquire adequate quantities of food, but also face food insecurity because their diet often lacks essential micronutrients.

Hunger is also a central cause of poverty as well, although this causal link is less recognized. Undernourished people are less productive, while child malnutrition has severe and permanent consequences for physical and intellectual development. Undernourished people and children severely impair their future earning capacity. Thus, the effects of poverty and malnutrition can often last over several generations.

Regressions, using cross-country data for 1990–2008 for 43 countries, do not show a strong relationship between undernourishment in the general population (measured by the FAO index) and poverty—both the \$1.00- and the updated \$1.25-a-day measures (Table 3). The regression of the logarithmic values of these variables do not yield a good fit (low  $R^2$  values). On the other hand, the relationship between poverty and incidence of underweight children (measured by the UNICEF index) is stronger, indicating that poverty is an important cause of the incidence of underweight children in the region. Correlation between the updated \$1.25-a-day poverty measure and malnourishment in the population is only 0.24, while it is 0.72 using

the measure for underweight children. Similar correlations are observed with \$1.00 poverty (0.21 and 0.67, respectively).

**Table 3: Regressions of Poverty and Hunger, Asian Countries  
(1990–2008)**

Dependent Variable	Poverty Headcount Ratio					
	(PPP \$1.00 per day)			(PPP \$1.25 per day)		
	Coefficient	P-Value	R <sup>2</sup>	Coefficient	P-Value	R <sup>2</sup>
Proportion of underweight children under age 5 years	0.78	0.000	0.45	0.64	0.000	0.52
Undernourished population (% of total)	0.13	0.083	0.04	0.11	0.042	0.06

PPP = purchasing power parity, R<sup>2</sup> = coefficient of determination.

Sources: World Bank. PovCalNet (accessed 4 August 2010); Asian Development Bank (2001–2009) *Key Indicators for Asia and the Pacific Series*; World Development Indicators Online (accessed 4 August 2010); and Hasan et al. 2008.

Ahmed et al. (2007a), using survey data of 16 countries and defining the hungry as those consuming less than 2,200 calories a day, found a higher correlation (0.63) between hunger in the general population as measured by calorific deficiency and poverty. However, analyzing the disaggregated results for adjacent, medial, and ultra poverty and hungry groups shows that the correlations between poverty and hunger are relatively high and statistically significant only for the ultra poor and hungry. The correlation between the incidence of poverty (i.e., all subgroups combined) and the incidence of low nutrition quality in diets<sup>11</sup> are found to be weakly positive (0.43).

One possible reason why the two seemingly close phenomena of poverty and hunger fail to show high correlation is that the measurement of both involves issues that have not been fully resolved. Box 2 discusses some of these data and measurement difficulties.

### Box 2: Data Limitations in the Computation of Hunger and Poverty

Computing poverty and hunger indexes is difficult. Regarding poverty, problems include (i) differences in consumption figures computed from household-level data and those from national data (Ravallion 2003), (ii) defining an acceptable global poverty line, and (iii) the existence of measurement errors in the data (Reddy and Pogge 2005; Pogge and Reddy 2006). The new \$1.25-a-day measure, based on a 2005 comprehensive international comparison project, may help estimate poverty more accurately.

Challenges also exist in measuring hunger. Food and Agriculture Organization (FAO) methodology for computing hunger, for instance, has several issues. It comprises estimating (i) the national per-capita availability of calories; (ii) the distribution of available calories across households; and (iii) a minimum cut-off point as the lowest acceptable per-capita availability (intake) of calories, below which households are classified as undernourished (Svedberg 1999). However, the quality of data from different regions varies greatly, and while the survey techniques used are designed to minimize error, the sample sizes are small, and sampling is not random. Finally, the estimation of the cut-off point involves a complex procedure and

<sup>11</sup> This is a measure of nutritional quality, and the study considers one to have a low-quality diet if he or she consumes food from less than five of the seven essential food groups.

relies on a wide range of difficult-to-measure variables, for which FAO uses a subjective best judgment. According to Svedberg, the FAO methodology is simplistic; provides a supply-side explanation of undernourishment, shedding little light on demand-side factors; and cannot properly identify undernourished individuals and households. Svedberg's alternative method—anthropometrics—has advantages in that it is based on data collected for individuals; allows estimation of intra-household allocation of nutrients by age and gender, which is useful for targeting households and individuals in intervention schemes; and is simple and accurate. However, data requirements are quite demanding, relying on family health surveys rather than household surveys.

These data difficulties may partly explain why poverty reduction is not observed to translate into hunger reduction. In particular, the relationship between prices for food and non-food items in a price index used to measure poverty influences how poverty translates into hunger. For example, if non-food items are more expensive and are given greater weight in the index, then the index will be higher, causing more people to be measured as poor, even though their nutritional needs are met. Conversely, if non-food items are relatively cheaper (as is currently happening with prices falling due to better technologies), then fewer people may be classified as poor, even though they are nutritionally deficient. Such factors may weaken the relationship between hunger and poverty.

Sources: Pogge and Reddy 2006, Reddy and Pogge 2005, and Svedberg 1999.

## 5.2 Economic Growth

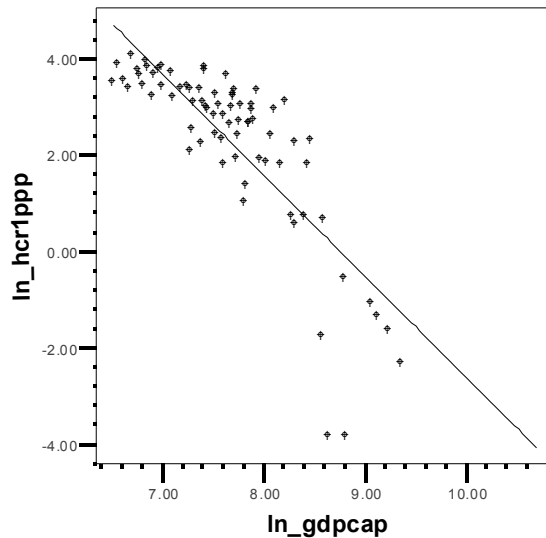
Economic growth has been an important factor in the reduction of poverty in Asia and the Pacific. However, the impact of economic growth on hunger in general has been much less pronounced, suggesting (i) that the quality of economic growth and particularly its greater inclusiveness is important, and (ii) that more instruments than merely striving for higher economic growth are necessary to combat hunger in the region.

Cross-country regressions, using per capita gross domestic product (GDP) as an explanatory variable on the two MDG indicators of hunger in 43 countries and on the two poverty indicators (i.e., the \$1.00-a-day and the updated \$1.25-a-day markers) reveal that the association of growth to poverty reduction is substantially stronger than to reduction of hunger. Thus, the regressions (Figure 3) reveal an elasticity of 2.1 between per capita GDP and poverty measured by \$1.00-a-day for the countries studied, similar to that obtained in ADB's *Key Indicators* (2004a). On the other hand, the responsiveness of the updated \$1.25-a-day poverty measure is less strong, with an elasticity of 1.7. This bears out with the now better-estimated and larger magnitudes of poverty that are revealed to be present despite rapid economic growth.<sup>12</sup>

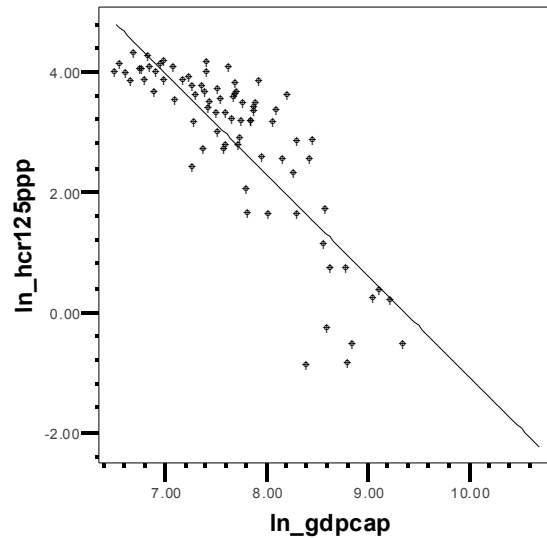
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<sup>12</sup> UNDP (2009), however, found a stronger association between hunger and national poverty data.

**Figure 3: Regression of the Change in Poverty Headcount Ratio (\$1.00 per day) and Gross Domestic Product per Capita Levels**



**Figure 4: Regression of the Change in Poverty Headcount Ratio (\$1.25 per day) and Gross Domestic Product Per Capita Levels**



Note: Trend line represents fitted values.

ln\_gdpcap = Natural logarithm of gross domestic per capita

ln\_hcr1ppp = Natural logarithm of poverty headcount ratio (\$1.00 per day)

ln\_hcr125ppp = Natural logarithm of poverty headcount ratio (\$1.25 per day)

Sources: World Bank. PovCalNet (accessed 4 August 2010); ADB (2001–2009) *Key Indicators for Asia and the Pacific Series*; World Development Indicators Online (accessed 4 August 2010)

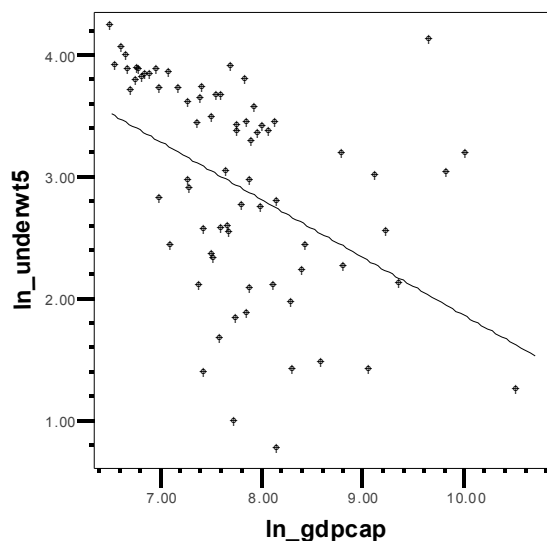
On the other hand, a 1.0% growth in per capita income leads to only a 0.5% reduction in the incidence of underweight children below age 5 years and an even lower 0.2% reduction in the incidence of undernourishment in the overall population (Figure 5).

Using subregional dummies to compare structural subregional differences to a base subregion, East Asia, reveals that growth has even less impact on underweight children in South Asia than in East Asia, while it has more impact in Central and West Asia. As far as overall undernourishment of the general population is concerned, the impact of growth on undernourishment is stronger. These are important conclusions for policy.

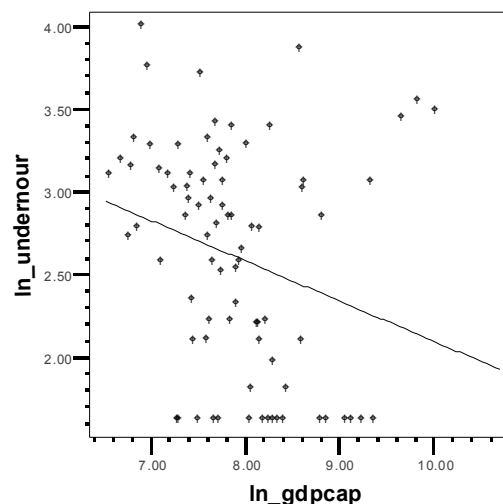
Some have also argued for the existence of a reverse causation from hunger to economic growth as well as for the existence of a growth–nutrition trap (FAO et al. 2005a and 2005b). Hunger adversely affects health and productivity, lowers output, and increases health-related expenses that reduce economic growth, further increasing hunger. FAO (2005b) indicated that the present discounted value of losses, due to undernourishment from a cohort of undernourished children over a lifetime, adds up to around \$500 billion–\$1 trillion, or roughly 5%–10% of GDP of the developing world. Moreover, the developing world annually spends about \$30 billion on health problems associated with hunger; this amount is more than one third of total official development assistance. Thus, the hunger–low-productivity–extreme poverty nexus acts as a trap for the poor and hungry.<sup>13</sup>

<sup>13</sup> Jha et al. (2009a) provided evidence of such a poverty nutrition trap for calories and micronutrients in India.

**Figure 5: Regression of the Change in the Proportion of Underweight Children under Age 5 Years and Gross Domestic Product per Capita Levels**



**Figure 6: Regression of the Change in the Proportion of Population below Minimum Level of Dietary Energy Consumption and Gross Domestic Product per Capita Levels**



Note: Trend line represents fitted values.

ln\_gdpcap = Natural logarithm of gross domestic per capita

ln\_underwt5 = Natural logarithm of proportion of underweight children under age 5 years

ln\_undernour = Natural logarithm of proportion of population below minimum level of dietary energy consumption

Sources: World Bank. PovCalNet (accessed 4 August 2010); ADB (2001–2009) *Key Indicators for Asia and the Pacific Series*; World Development Indicators Online (accessed 4 August 2010)

Arcand (2001) studied this relationship using two measures of nutritional status defined by FAO: (i) prevalence of food inadequacy, which is seen to have a negative effect on economic growth; and (ii) dietary energy supply per capita, which has a positive effect. The study found a statistically significant and quantitatively important impact of nutrition on growth. It also found nonlinearities between nutrition and economic growth,<sup>14</sup> suggesting that for a country with an already high GDP per capita, increasing nutrition would have little impact on economic growth. In other words, as countries improve their nutritional status, the gains to economic growth from this will eventually be exhausted.

In addition to the initial GDP per capita, the initial nutritional status of the population is also important. The findings revealed that if initial consumption is below a certain critical level, then undernourishment will adversely affect productivity, which, in turn, will keep per capita GDP low, thus depriving people of the economic means to improve their nutritional profile and to climb out of poverty. Arcand found considerable support for the nutrition–poverty growth trap. His results also suggest that average GDP per capita growth would have been higher in developing countries and more equally distributed if minimum calorific norms were attained.

<sup>14</sup> The threshold level of the dietary energy supply per capita at which its marginal impact on growth begins to become negative is equal to 3,066 calories per day, which is quite high. For the prevalence of food inadequacy, experimentation revealed a cubic specification, although this was not found to be universally statistically significant in the full range of tests.

Several factors are responsible for the weaker impact of economic growth on hunger and nutrition than on income poverty. First, the poor do not necessarily spend more on increased food consumption (or on food with high-calorie content, such as food grains) when their incomes increase. In a study of 13 countries, Banerjee and Duflo (2006) found that the extreme poor (i.e., those existing on less than \$1.00 a day) do not put all their income into food. Rural poor households spend 56%–78% of their budgets on food, and the urban poor, 56%–74%. Significant amounts were spent on items such as alcohol, tobacco, and festivals (Banerjee and Duflo 2006). Behrman and Deolalikar (1989) have also shown that the income elasticity of calorific consumption is very low, although income elasticity of food expenditure is generally much higher. This implies that as incomes increase, people spend extra income on greater varieties of food that do not necessarily correspond to higher calories. A key implication of these results—if these relative income elasticities reflect informed choices—is that the hungry in developing countries place a low priority on nutrition and so increasing nutritional intake requires directly targeting food consumption, rather than income.<sup>15</sup> Alternatively, these choices may result from a lack of sufficient information, which can be rectified through better literacy and education.

Secondly, economic growth in the region, particularly in recent years, has not been inclusive enough. Such inclusiveness—specifically in widening access to learning, literacy, health, and nutrition opportunities—is more critical for hunger.<sup>16</sup> Since hunger affects mainly those “ultra poor” within the poor (see footnote 1), unless incomes can be raised among the ultra poor group, growth will not impact on hunger. Lack of inclusiveness is also evident in the insufficient development of rural areas, where deprivations are particularly acute. For example, against an average incidence of 38% of underweight children under age 5 years in India in 1999, the average rural incidence was 50% (ESCAP–ADB–UNDP 2007). In Nepal in 2006, the urban and rural incidences were 23% and 41%, respectively. Populations in rural areas also suffer more deprivations in primary education, access to clean water, and health services, and are subject to greater gender and other forms of discrimination. While inclusiveness of growth in the income dimension (by reducing income inequalities) is critical for poverty reduction, reducing hunger—whose causes are also the result of non-income-related exclusions—is far more dependent on a fully inclusive growth process.

Finally, while economic growth is critical for poverty reduction and also plays a role in reducing hunger, there are other factors that affect hunger, some more than they affect poverty.

### **5.3 Looking beyond Economic Growth for Factors Affecting Hunger**

Other factors likely to influence hunger are literacy, population growth, access to food, and women's empowerment. Lack of a sufficient understanding of nutrition—owing to insufficient literacy—may lead to inappropriate choices of food and allocation of household budgets, and contribute to undernourishment. Rapid population growth implies a larger family

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<sup>15</sup> A contrasting, and more traditional view, is from Subramanian and Deaton (1996), who estimated an income elasticity of calorific consumption at 0.3–0.5 in India's state of Maharashtra, which contrasts with the results of Behrman and Deolalikar. The results may arise from the different techniques used. Jha et al. (2009b), using an all-India sample, found calorie-elasticity values that were significant and between the values given by Behrman and Deolalikar and by Subramanian and Deaton.

<sup>16</sup> ADB (2007a) argued that increasing income inequality in recent years diminished the impact of growth on poverty. This is likely to be true for hunger as well. The effect of lack of inclusiveness of growth on hunger can be studied by introducing measures of income and non-income inequality as controls in the relationship between hunger and growth and should be a subject of future research.

size; greater health burden on mothers to raise children (with less food available for them and each household member, causing more hunger in general); and severe impacts on maternal and child nutrition. If the price of food is far too high and food becomes unaffordable so that its consumption falls, this would increase hunger and reduce the nutritional status in the population. Finally, women's empowerment affects their status in households, the allocation of budgets toward nutrition, and better maternal and child nutrition and health. Other institutional factors that affect hunger are improvements in the status of other socially deprived groups and capacity of public agencies. Access to micronutrients and clean water also has a significant bearing on overall nutrition beyond merely increased calorie intake.

Although all these factors are important, not all have readily available indicators. Therefore, multiple regressions were run using literacy (ages 15–24 years), population growth rate, per capita grain consumption, share of women in nonagricultural wage employment, and GDP per capita as explanatory variables for each of the two hunger definitions. Comparisons were also made using these factors to explain income poverty. Logarithmic values were used in a multiplicative model so that the coefficients yield elasticities. The results are presented in Table 4 for only regressions yielding significant coefficients. As some variables may be related, alternate combinations were attempted.

Regarding the incidence of underweight children, these regressions demonstrate that per capita GDP, population growth, literacy, women's empowerment, and access to food are all important. Literacy has by far the highest elasticity (ranging in absolute value between 0.93 and 1.26), followed by the other variables (absolute elasticity values ranging around 0.33 to 0.55). On the other hand, in explaining undernourishment in the overall population, only two variables are significant—per capita GDP (elasticity 0.49) and grain consumption per capita (0.34).

In the case of income poverty, as before, economic growth had the most impact (1.51) while grain consumption also mattered (0.5).<sup>17</sup> Other variables play no part. This emphasizes that more interventions than those just concerned with economic growth—which has a large impact on poverty, but less so on hunger—are necessary to take on hunger. It is interesting to note that the food availability variable, found to be significant in the regressions, was average grain consumption per capita. It was not average grain production per capita, as the former is a more accurate measure of access to food, underscoring the need to ensure distribution and access of food by the poor.

The overall conclusion from these regressions is that economic growth, along with population growth, literacy, access to food, and women's empowerment, are important factors in explaining hunger. Other variables also impact on hunger, but these could not be studied owing to lack of data. Among these factors, population growth is critical, as it has obvious adverse implications for welfare outcomes. At the macro level, it reduces average incomes, availability of public resources for education and health services, and per capita availability of food. At the household level, it adversely impacts the health and nutrition of mothers and their children. Given the considerable attention population growth has received, this paper does not intend to discuss this issue in more detail, and turns instead to other important factors affecting hunger.

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<sup>17</sup> Consumption of food affects hunger measures as well as poverty measures. The latter relationship, influenced by the fact that greater food access could be the result of lower food prices and given the usually large weight of food in computing the poverty line, resulted in fewer people also considered poor.

**Table 4: Regression Results—Determinants of Hunger**

Dependent variable (ln)	Explanatory Variables (in natural logarithm, ln)					N	Adj. R <sup>2</sup>
	Gross domestic product per capita	Population growth rate	Literacy	Share of women in non- agricultural employment	Per capita grain consumption <sup>a</sup>		
Proportion of underweight children under age 5 years	(0.40)	0.39	(0.93)			69	0.46
<i>t-value</i>	(3.53)	(3.10)	(2.20)				
	(0.37)		(1.26)		(0.35) <sup>b</sup>	63	0.44
<i>t-value</i>	(3.11)		(3.08)		(1.92)		
	(0.33)	0.40		(0.37) <sup>b</sup>	(0.55) <sup>b</sup>	44	0.44
<i>t-value</i>	(2.51)	(2.07)		(1.71)	(1.98)		
Undernourished population (% of total)	(0.49)				(0.34) <sup>b</sup>	78	0.25
<i>t-value</i>	(4.49)				(1.87)		
Percentage of population living below \$1.25 (PPP) per day	(1.51)				(0.53)	81	0.58
<i>t-value</i>	(9.33)				(2.32)		

( ) = negative, Adj. R<sup>2</sup> = adjusted regression, N = number of observations, PPP = purchasing power parity.

<sup>a</sup> Grain consumption is the total of domestic food and other uses (including feed, seed, and industrial use) of wheat, rice, corn, barley, sorghum, millet, rye, oats, and mixed grains. Per capita values of grain consumption were calculated by dividing total domestic grain consumption by total population during the respective year for individual countries.

<sup>b</sup> Significant at 10% level.

Sources: Asian Development Bank (2001–2008), *Key Indicators for Asia and the Pacific Series* for underweight children, undernourishment, and literacy data; World Development Indicators Online for growth data of gross domestic product and population (accessed 4 May 2010); World Bank. PovCalNet for poverty data (accessed 19 April 2010); World Resources Institute. EarthTrends for grain consumption data (accessed 4 May 2010); Statistics Division of the United Nations Economic and Social Commission for Asia and the Pacific for women in nonagricultural employment data; and the United Nations Population Division. World Population Prospects for population data (accessed 19 April 2010).

## 5.4 Literacy

The finding that literacy is a key factor affecting child hunger is expected. Knowledge of categories of food that improve nutrition is likely to improve with a population's literacy, as do feeding habits and health and sanitation practices. As discussed earlier, increased incomes do not necessarily lead to increased consumption of food. Part of the reason could be inadequate knowledge of better diets within a household's budget constraint. Households that have adult members with higher literacy may therefore be able to optimize and allocate household budgets toward improved nutrition outcomes, which have long-term impacts on child growth and development.

Many studies have shown that literacy and education play a critical role in alleviating child hunger. A recent study in Cambodia by Miller and Rodgers, for example, confirmed the



traditional view that mothers' education is important for the nutrition status of their children.<sup>18</sup> The knowledge and information of the community, which increases through literacy and education, also helps modify behavior toward nutrition outcomes and thus plays a critical role. Moestue and Huttly (2007), in a study of Andhra Pradesh in India and of Viet Nam, found that child nutrition is positively associated with literacy of mothers, fathers, and grandmothers, and also the overall proportion of literate mothers in the community.

Although other measures can be used in the short term to change household behaviors toward better nutrition practices—such as employing conditional cash transfers to induce improved nutrition<sup>19</sup>—improving literacy and education is a more sustainable intervention. Thus, this should form an essential part of the strategy to reduce hunger.

## 5.5 Availability and Affordability of Food

The availability of food at affordable prices has an important bearing on hunger. This is affected by several factors.

**Long-term structural factors.** The demand for food has been rising at a faster pace than supply, particularly in Asia and the Pacific. With the region's rapid increase in incomes, resulting from swift economic growth, the demand for food has been growing at a faster pace than has the growth of population. This income effect is reinforced by the fact that people with higher incomes demand a larger proportion of protein in their diets, which in turn leads to a demand for grains as feedstock (United Nations Environmental Programme 2009). However, managing demand for food at the aggregate level is not a policy option, and actions lie principally on the supply side.

Falling investments in agriculture and public support for new technology research, increased costs of agricultural inputs such as fertilizers, and reduction in the availability of land and water are all cited as causing a gradual plateauing of agricultural yields (World Bank 2007b). Further, diversion of land for biofuels has been aggravating the problem.<sup>20</sup> Currently, about 1% of the world's arable land is used for liquid biofuels production. Addressing the supply-side factors requires more investments in irrigation and farm-to-market roads, greater support to research agencies, crop diversification, improved marketing, policies to encourage larger farm sizes and mechanization, increased market access and trade in agriculture, and greater incentives for food production. Introduction of genetically modified crops holds great promise for ushering in sharp increases in yields, provided that safety concerns can be properly addressed.

The PRC's success in agricultural development is due to prioritization of many of these crucial supply-side interventions (Box 3). Needs would differ, however, according to country

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<sup>18</sup> From the latest (2005) demographic and health survey for Cambodia, Miller and Rodgers (2009) found that the mother's education reduced the risk of low birth size and stunting, a measure of long-term nutritional status.

<sup>19</sup> Conditional cash transfers could be used to ensure minimum dietary intakes. The essential premise of such a program is cash transfers to households, conditioned on their participation in health, nutrition, and education services. Aguero et al. (2007) demonstrated that in the context of South Africa, large doses of cash support for children early in their lives had a favorable impact on nutritional outcome measures, such as height for age. Improving behavioral responses can also play an important role in improving nutritional outcomes. In Madagascar, a large community-based nutritional program (i.e., SEECALINE) induced sufficient behavioral changes to cause strong improvements in the nutritional outcomes of children under age 5 years (Galasso and Umapathi 2007).

<sup>20</sup> For example, see Abbott et al. (2008). In line with the emphasis on the increased use of biofuels, Krugman (2008) suggested that subsidies on biofuel production should be cut, if not removed. For an analysis of the economics of biofuel production, see Science Council Secretariat (2008).

context. In Viet Nam, for example, which is now a large rice exporting country, institutional reform—particularly land reforms and introduction of market incentives—have played a major role in its agricultural development.

### **Box 3: Expansion of Food Production in the People's Republic of China**

Food production in the People's Republic of China has witnessed one of the most rapid expansions in Asia and the Pacific. While agricultural growth reached 6% in the early 1980s, growth since the mid-1980s to early 2000s remained at the brisk pace of around 4% per year. This is one of the major factors responsible for the country's remarkable performance in reducing poverty and hunger.

Introduced in 1979, the household responsibility system dismantled collectives and contracted land to households. This reform, which brought about private incentives in farming, is considered the single major factor in raising agricultural productivity in the 1980s. In 2006, further land rights were conferred to contract holders, including those to inheritance and transfer and exchange of contracted land.

Since the early institutional reforms, other factors have helped raise productivity. Irrigation has been a consistent factor in establishing highly productive agronomic systems. The proportion of cultivated areas under irrigation increased from 18% in 1952 to about 50% in 2007. Although high investments in the agricultural sector eventually tapered off, falling to 3.6% of gross domestic product in 1995, this has since been reversed.

Research and development to foster new technology has been another major factor. Since the mid-1990s, research and development investments in biotechnology have been rising. By the late 1990s, the People's Republic of China invested more in agricultural biotechnology research than all other developing countries combined, and its public spending on agricultural biotechnology was second only to the United States. Investment in government-sponsored research and development increased by 5.5% annually between 1995 and 2000, and by 15.0% per year after 2000.

Rapid commercialization of agriculture has also contributed in the country's agricultural development. This has been aided by communication developments (i.e., roads, telephones including mobile phones, and establishment of internet-marketing sites), which reduced transaction costs and accelerated the flow of information and goods. The liberalization of private trading and transport has also boosted development, while licensing fees and taxes are also low or nonexistent.

Further, the country's markets function well. For example, maize prices in four different northeastern cities track each other closely, and soybean prices in markets in different regions move in almost perfect concert. The share of integrated markets has risen from 50% in the early 1990s to virtually 100% in the early 2000s. Rice markets function as well as those in the United States, in terms of efficiency of moving commodities between producing and consuming regions. Horticultural, dairy, and livestock markets are dominated by millions of small traders operating in extremely competitive environments. Market improvement has also allowed crop specialization, and the number of villages that have become specialized producers of a single commodity rose from 20% in 1995 to 40% in 2004.

Pro-agriculture policies have also helped, including subsidies and gradual elimination of taxes. Earlier subsidies were on procurement, storage, and exports of grains, which have been replaced by a national program in 2004 providing direct cash subsidies to farmers and input subsidies for seeds, fertilizers, machinery, and other inputs. Nearly 80% of farming households receive subsidies. In addition, by 2007, farmers were paying almost no taxes.

Source: Huang and Rozelle 2009.

**Climate change.** Long-term climate change and weather variability has obvious implications for agricultural output and food availability and therefore on prospects to reduce hunger.<sup>21</sup> However, not all impacts in developing countries will be negative. While some areas may suffer from increased aridity, others may gain from increased rainfall. Accurate projections are difficult to make due to uncertainties relating to (i) magnitude and geographic distribution of temperature changes, (ii) changes in rainfall patterns and the evaporative demands imposed on crops by warmer weather, and (iii) physiological response of crops to enriched carbon dioxide. In addition, socioeconomic conditions and policies prevailing in particular countries are also important determinants of food availability, including political and economic stability, technological progress, and poverty reduction. Thus, long-term projections of climate change on agricultural production and food security need to be taken with caution.

Appendix 5 reports on anticipated changes in the absolute level of agricultural output across various countries. Even as world agricultural output is likely to drop in absolute terms, the distribution of this decline is highly skewed against countries like India, which are already experiencing a high degree of hunger and undernutrition. Even taking into account the effects of carbon fertilization, India's plunge in agricultural production is expected to be as high as 29%, against the region's overall decline of about 7%. Hence, per capita food entitlements are expected to fall even more sharply over the longer term unless remedial action is taken through large-scale investment in new agricultural technology and research.

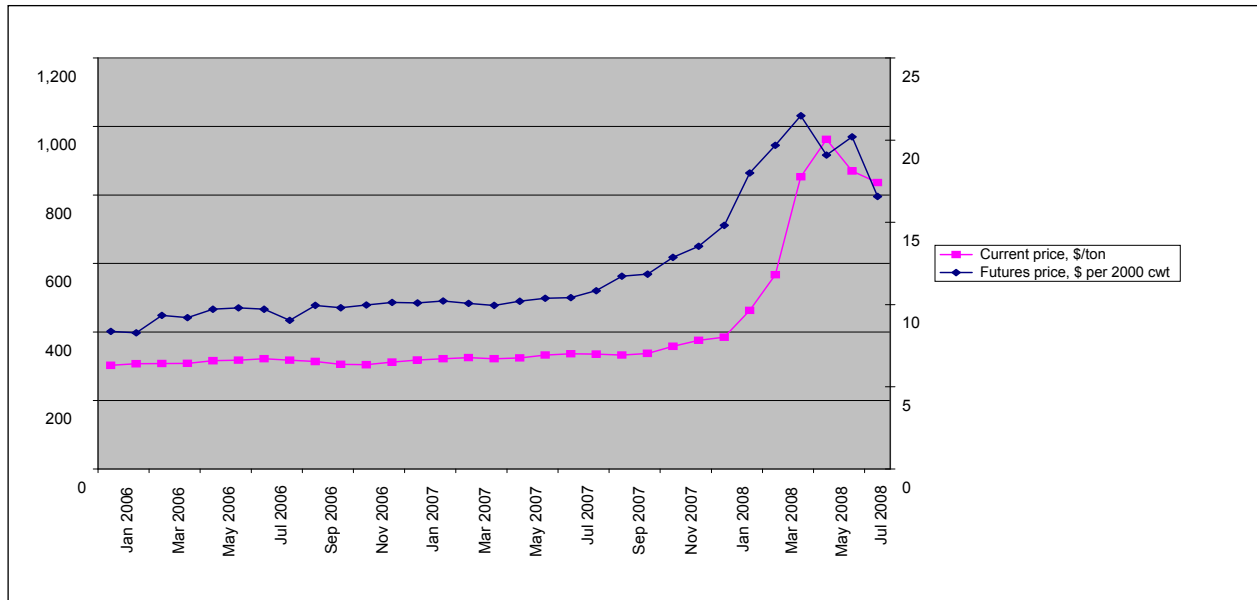
**Short- and medium-term factors.** In addition to the above longer-term factors, cyclical factors may be at play in the short to medium term. For example, the world experienced a sharp increase in food prices since 2006, which peaked in 2008. Prices still remain well above 2006 levels as discussed earlier. The price of rice, the most important cereal crop consumed in the region, rose steadily until 2008.<sup>22</sup> Prices of other food grains had also experienced similar, if less spectacular, spikes. The rise in food prices led to increases in the incidence of poverty and of those who are hungry, as discussed in section 3. Several short- to medium-term factors were responsible, including declining food stocks, the sudden onset in 2007 of drought in some large grain-producing countries (such as Australia), flooding in Southeast Asia and cold weather in Viet Nam, the decline in the exchange rate of the US dollar against currencies of major Asian rice exporters that increased dollar prices, and export bans introduced by some major food exporting countries (ADB 2008).

There is also increasing evidence that excessive trading in grain futures (excessive in terms of the normal needs of grain trading) played a role in the food price increases witnessed in 2008 (Jha 2008). After the emergence of the subprime mortgage problem in August 2007, investors started to move away from stock markets. Opportunities appeared in food grain markets, since food is inelastically demanded. This resulted in huge investment in future markets for food grains, triggering sharp prices in future markets for food grains, which also led to feedback effects on food grain prices. Figure 7 plots future prices (right scale) of Thai 100% B grade rice against the current price (left scale) during 2008. This highlights the need for greater regulation of speculative activity in food grains.

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<sup>21</sup> Using household level data for 2004/05 for India, Jha and Dang (2008) showed that variations in rainfall patterns caused substantial changes in household vulnerability in rural India.

<sup>22</sup> As a reaction to this, countries took some extreme steps. In March 2008, India banned exports of all types of rice except *basmati*. The severity of the problem led the President of the World Bank to urge a "new deal" on the hunger policy (British Broadcasting Corporation [BBC] 2008). The World Bank estimated that food prices are not projected to fall significantly until 2015 and warned that the food crunch is undermining poverty reduction goals as well as education and mortality rate targets across the developing world.

**Figure 7: Current and Future Prices of Rice**

Source: *International Business Times*. Commodities and Futures.

**State action on food prices and affordability for the poor.** From the point of view of hunger, not only is overall availability of food important, but also its availability at affordable prices across a country for the undernourished. This calls for building adequate food stocks<sup>23</sup> and improved food distribution and its access by the poor. Many developing countries in the region have attempted to provide targeted food subsidies to the poor, such as India's public distribution system and a further recent initiative through the Right-to-Food Bill.<sup>24</sup>

Keeping food prices low and stable is contingent on adequate domestic availability of food grains. For food-deficient countries, this depends on both efforts to raise domestic production as well as on imports and building adequate stocks. Regional cooperation efforts can help promote regional food security such as through regional food reserves. The South Asian Association for Regional Cooperation (SAARC) Food Bank, established in 2007, is an example. Regional agreements to avoid export restrictions to regional destinations and cooperation to build up production capacities can also help (ESCAP-ADB-UNDP 2010). Recent regional efforts are highlighted in Box 4.

In addition, improving food distribution within a country is critical. A rise in food prices particularly affects the urban poor and those in the rural areas who are not growers but net purchasers of food. Thus, improving food distribution requires policies to build up infrastructural and logistical capabilities. Development of road and rail infrastructure (and marine in case of archipelagic countries) is needed to connect rural and remote areas with important economic and transport hubs, thus allowing easy, economical transport of food items to these areas. Ancillary infrastructure facilities, such as refrigeration to prevent spoilage, are also necessary.

<sup>23</sup> "Adequate" should not mean "excessive," as pointed out by Sen (2003). Excessive stock holding raises food prices and hurts poor consumers, benefiting only the commercial farming lobby.

<sup>24</sup> The bill intends to provide 25 kilograms of food grains to all families below the poverty line at highly subsidized prices.

#### **Box 4: Food Reserves—Stabilizing Supply and Insuring against Risks**

Governments in Asia and the Pacific have traditionally held national stocks of rice and other staple foods to serve as insurance against shortfalls. In addition, building such stocks helps provide support to grain prices and incentives to food production. India, for example, had built a reserve of 50 million tons of rice and wheat by 2009 (Dev 2009) that helped prevent millions from falling into hunger due to the failed monsoon of 2009.

At times of shortage, food held in reserves is released to those in need of food assistance, and to create employment for the needy through food-for-work programs in Bangladesh, Cambodia, and the Lao Democratic People's Republic, and through the National Rural Employment Guarantee Scheme in India. India is also using its food stocks to provide midday meals to schoolchildren.

The People's Republic of China set up a grain reserve system in 1990 and built up stocks of 150–200 million tons by 2009, equivalent to about 30%–40% of the country's annual grain consumption or double the 17%–18% level regarded by the Food and Agriculture Organization (FAO) as a safe minimum (Xinhua 2009). The reserves helped the People's Republic of China deal with threats of hunger in 2007, which it had not been able to prevent during the famine of 1959–1961 that claimed by some estimates up to 30 million lives (Brown 1995).

Intergovernmental agencies have also held food reserves. In 1988, the South Asian Association for Regional Cooperation (SAARC) Food Bank established a food security reserve, consisting of nearly 250,000 tons of food grains. However, it was not used, as access was conditioned on declarations of national food emergencies, which members were reluctant to do. In 2004, SAARC officials recommended that the reserve be reestablished as a more flexible regional food bank to which each country would contribute a certain amount. Each country could then draw upon it as needed, but it could also borrow from food held in storage in a neighboring country. The borrowing country would not be charged for this, but would need to replace the stock when in a position to do so. A similar arrangement has been in existence in the Association of Southeast Asian Nations (ASEAN)—the ASEAN Emergency Rice Reserve—since 1983 with a stock of 50,000 tons, later augmented to 67,000 tons when Brunei Darussalam and Viet Nam joined ASEAN. However, owing to the small size of the reserves, it has never been utilized and has raised doubts about its effectiveness as a regional food security instrument (Mukherjee n.d.).

Sources: Brown 1995, Dev 2009, Mukherjee n.d., and Xinhua 2009.

Many countries, particularly geographically large ones, with insufficiently developed infrastructure can face considerable variability in food prices. Although the average price may be low, a large dispersion of prices can make food unaffordable to poorer groups (Box 5). Policy responses necessary include development of competitive yet equitable market mechanisms that facilitate trade of food items; improvement of transport, storage, and other necessary infrastructure; encouragement of the private sector to play a bigger role in facilitating a more efficient market for food; and a well-targeted public distribution system with subsidies to provide food at affordable prices to the poor.

### Box 5: Subnational Variation in Food Prices

The variation in the prices of essential food items within a country can make food unaffordable to poorer groups in consumption centers where food prices are high. Unlike other nonessential commodities, even temporary spikes in food prices can cause distress to the poor. Therefore, food price variability must be minimized.

In some developing countries, significant variation in food prices within countries exists, resulting from inadequate food distribution infrastructure and institutions. Latest price information on rice, for example, shows significant variations within India and Indonesia. In India, while the average monthly price of rice in the country for October 2009 was recorded as 20.56 rupees (Rs) per kilogram, the price across 78 consumption centers ranged from Rs10.34 to Rs30.55 with a coefficient of variation of 26.16%. In Indonesia, the coefficient of variation of rice prices was 10.5% across 30 centers of consumption in June 2008. On the other hand, in the Philippines—despite archipelagic transport bottlenecks—the coefficient of variation was just around 7.7% across 80 consumption centers in October 2009.

Sources: Price data from the Labor Bureau India; Badan Pusat Statistik Republik Indonesia (Statistics Indonesia), Indonesia; and National Statistical Coordination Board, Philippines.

## 5.6 Gender and Other Institutional Factors

Developing societies in Asia and the Pacific face many formal and nonformal institutional challenges that affect their ability to reduce hunger and that are responsible for reducing the effectiveness of economic instruments in fighting hunger. It is necessary to look beyond economic factors alone, therefore, when trying to ascertain the causes of hunger.

**Gender.** The regressions in Table 4 include one in which the impact of gender empowerment is explored. It shows that the MDG indicator, share of women in nonagricultural wage employment, a proxy for women's empowerment, is noteworthy in explaining child hunger along with economic growth, population growth rate, and grain consumption per capita.<sup>25</sup>

Continuation of gender discrimination has been found to perpetuate malnutrition and hunger. Two-thirds of the region's poor are women, mainly living in rural areas, and the proportion of households headed by women ranges from 20% to 40%. Given disparities in education, health care, economic and political participation, and incomes, women and girls are most vulnerable to hunger and poverty. Change in the household structure, with women increasingly responsible for the double burden of earning and family care, has made women's situation worse, especially for women with several dependents. It has contributed to an increasing trend in feminization of poverty in the region. This poses serious constraints to hunger and poverty reduction, because malnourished women and the children of poor are more likely to repeat cycles of poverty and social disadvantage.

The manner in which food is distributed within the household may subject girls and women to a greater risk of hunger as well, regardless of the level of family income or food access. In many parts of Asia and the Pacific, and in particular in the poorer regions of South Asia, men and boys are accorded priority in the household distribution of food. This is one reason why girls and women have inferior nutrition and health outcomes, even in families that have sufficient income and food access to afford an adequate diet (UNICEF East Asian and

<sup>25</sup> This indicator was not used, along with literacy. There is a strong correlation between the two, and including both would introduce multicollinearity and affect the reliability of the estimates.

Pacific Regional Office 2003). An extensive survey done of dietary discrimination found that women in Bangladesh, India, and Pakistan have a lower status in terms of dietary discrimination than women in other parts of Asia, and also compared to most other countries of the world (Hunt and Quibria 1999). This contributes to the perpetuation of the low status of women from one generation to the next, via preferences for boys, less food for girls, and lower investment in female human capital. Low birth weights result, causing undernutrition to be passed from generation to generation.

It has been observed that women place greater priority on nutrition and health in allocating household expenditures than do men.<sup>26</sup> This attribute in women can be employed to enhance public programs to improve nutrition by channeling resources disproportionately through them.<sup>27</sup>

**Caste and ethnicity.** Complex variations in ethnicity, caste, language, and religion influence access to schooling, employment, health care, and natural resources in several countries. In some, the dominant ethnic, caste, religious, or social groups are in positions of power, have administrative and political connections, possess educational and cultural advantages, and unscrupulously capture public resources. Those who are socially excluded from progress tend to suffer multiple disadvantages, including a higher poverty incidence and greater malnutrition. In India, for example, lower-caste children disproportionately suffer from child malnutrition and infant and child mortality (Thorat 2008). This is also true in other parts of South Asia. For example, UNDP (2005) reported that in Nepal, the lowest-caste group earns less than one half of what the upper-caste groups earn, and their life expectancy is 13 years lower. Rarely are the differences in poverty and hunger conditions among different social groups reflected in national statistics, although reducing differences in living standards may be central to interventions aimed at tackling poverty and hunger.

**Public institutional capacity.** The extent and magnitude of hunger in the developing world, much more than in wealthier societies, are influenced to a great extent by public policy and action.<sup>28</sup> Public policies determine the supply of food and its prices. Social protection measures to overcome transient or more chronic causes of hunger can either effectively address the needs of the vulnerable or fail to do so. Thus, the manner and degree of efficiency with which public programs are undertaken can make substantial differences to the conditions of poor and hungry households.

Given the critical role governments can play in ameliorating hunger, public institutional capacities and governance systems and structures must assume importance in any discussion on this topic. It is also crucial that governments are able to develop effective partnerships with other stakeholders, particularly nongovernment organizations and local community organizations that play an important role in the delivery of public programs.

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<sup>26</sup> Sinha (2007), using household-level data for India's rural households, found that transfers made to women within the household have a greater positive impact on household, including child nutrition, than if these transfers were made to male members. Further, whereas at low wage rates neither the husband nor the wife share their wage income, as wage rates rise, wives are shown to share a higher proportion of their wage earnings within the household than are husbands. These are important insights into the targeting of transfers to improve nutritional outcomes.

<sup>27</sup> In the Indian context, it has been discovered that an immediate reason for the widespread prevalence of child malnutrition is the nutritional deprivation of the mothers of these children (Rao 2004). Hence, improving child and maternal nutritional outcomes are inextricably linked.

<sup>28</sup> Drèze and Sen (1989) have eloquently drawn attention to this issue.

The efficiency of public delivery mechanisms are also important ingredients in overall public institutional capacity. Issues that are often raised concern design of social protection measures (Box 1), including public food distribution programs, their efficient targeting, and capacities of public agencies particularly local governments and communities.

## **5.7 Vulnerabilities, Risks, and Shocks**

Many who face hunger and malnourishment do so owing to transitory shocks with which they are unable to cope. The nature of the risks and shocks faced may be those specific to individual households, referred to as "idiosyncratic," or may be common risks and shocks faced by all or many households, known as "covariate." Examples of the former are death of the principal income earner, major sickness, or job loss. Examples of the latter are climatic events such as droughts, economic shocks such as the present economic crisis, or food price increases. Empirical evidence suggests that idiosyncratic risks and shocks are the dominant causes of hunger and contribute more to hunger in the region (Mukherjee 2009).

The ultimate solution to mitigate such risks and shocks is through universal social protection coverage, but this is currently unaffordable for governments and households in most developing countries. While efforts at increasing coverage must remain a long-term objective, the most practical approach is to ensure that at least all households are able to meet their basic food requirements. This requires that prices of food are kept low, and, if necessary, subsidies are provided to allow the poorest families access to it. These measures need to be supplemented by targeted ones aimed at raising incomes of the poor and vulnerable, such as food-for-work programs and cash transfers to the poorest, and by direct feeding programs for the weakest groups. Bangladesh's efforts in this area have been effective and are highlighted in Box 6.

Vulnerable households, whether caused by idiosyncratic or covariant risks and shocks, adopt common coping mechanisms, which can be used to target assistance. One universal reaction is to migrate to urban areas in search of work. The region's cities are overcrowded by such migrants, and public action, supplemented with support from civil society, is essential to provide such groups with food, shelter, skills, and employment. Distress sales of land and other assets also occur during times of drought and flood, and should be taken as signals for focused public support through employment-generation schemes and temporary loan waivers. Better public information systems, as well as more vigilant and active media and civil society, are needed to alert authorities about such occurrences quickly.



### Box 6: Bangladesh—Food-for-Work Programs

Bangladesh has a long history of safety nets. The principal programs supported by food aid from donors are (i) the Food-for-Work Program, which provides wages in kind (usually wheat) to rural laborers (mainly men) for working in labor-intensive public works, such as roads, irrigation and flood control, fishery, and forestry during the dry season; and (ii) the Vulnerable Groups Development Program, which aims to provide food to the poorest women of rural Bangladesh in exchange for their participation in development works. The Vulnerable Groups Development Program beneficiaries include women from landless households (i.e., owning less than 0.5 acre of land), women with irregular (i.e., less than 300 *takas* per month) or no individual income, daily or casual female laborers, and women from households lacking ownership of productive assets. Under the program, about 0.5 million households headed by women receive 31.25 kilograms of food grains for 18 months. New groups of women are brought into the program after graduation of the existing groups. The development package includes savings, group-based social awareness, functional education, skills training in income-generating activities, and credit, some of which are administered by nongovernment organizations. The allocation of food grains for the program in 1999–2000 exceeded 192,000 metric tons.

Evaluation studies indicate that these programs have predominantly benefited the poor and improved their nutrition tangibly. The Food-for-Work Program has led to increased food consumption and calorie intake by households, and improved nutrition of the population in program areas. Evaluations of the Vulnerable Groups Development Program show that in-kind transfers of wheat increased wheat consumption dramatically, by 70.0% for program households compared to 13.9% for its cash-based equivalent transfers. A Canadian International Development Authority (CIDA) evaluation found, however, that cash transfer programs are cheaper to implement. The CIDA evaluation also found the Vulnerable Groups Development Program to have positively affected the status of women within the community, as their self-discipline, interpersonal communications, and care-taking skills were developed. It also found that increased household access to food is a necessary, but not sufficient, condition to improve the nutritional status of its most vulnerable members, preschool-age children. Health services, improved sanitation, and a clean water supply, as well as better child care practices, are also needed for improvements in nutritional status when additional food is provided.

Sources: Kabeer et al. 2006 and CIDA 2006.

## 5.8 Hidden Hunger: Micronutrients and Clean Water

No discussion of hunger is complete without touching on two essential constituents of nutrition beyond calorific intake: micronutrients and clean water.<sup>29</sup> High prevalence of micronutrient deficiencies among women and children endangers health, shortens life expectancy, retards the cognitive potential of children, and reduces productivity (UNICEF and Micronutrient Initiative [MI] 2004). The links among diet quality, access to essential vitamins and minerals (i.e., micronutrients), health outcomes, educational achievement, and productivity are now well understood. What is now referred to as “hidden hunger,” or insufficient consumption of micronutrients, affects nearly 1.5 billion in the region, constituting three quarters of all those suffering globally from micronutrient deficiency.

Unsurprisingly, the poor are most likely to suffer from micronutrient deficiency. This is evident from positive and weak to moderately strong correlations between \$1.25-a-day poverty

<sup>29</sup> Material in this and the part of the section on institutions were also discussed in Chatterjee et al. (2004).

incidence and the following indicators:<sup>30</sup> (i) total goiter rate (indicating iodine deficiency) with a 0.33 correlation, (ii) iron-deficiency anemia in children under age 5 years with a 0.55 correlation, (iii) iron-deficiency anemia in pregnant women with a 0.59 correlation, (iv) iron-deficiency anemia in non-pregnant women of reproductive age with a 0.58 correlation, and (v) vitamin A deficiency in children under age 6 years with a 0.54 correlation, using the data in Appendix 6 on vitamin and mineral deficiency and the new poverty estimates for countries for which both pairs of data were available. However, the correlations are not very strong, particularly for iodine deficiency, and a large number of families with incomes above the poverty line also suffer from micronutrient deficiency, and are thus subject to hidden hunger. This illustrates the complexity of the interaction between poverty and hunger when adequate nutritional quality is considered.

The most serious micronutrient problem is iron-deficiency anemia. In Asia and the Pacific, 39% of all pregnant women, one-third of women of reproductive age, and 49% of preschool children suffer from this condition (MI and CIDA 2009; UN Population Division 2008). Consequently, there is high maternal mortality, impaired intellectual development and learning capacity, decreased physical activity and productivity, and reduced immunity. Children with iron-deficiency anemia often never enter school or drop out early. An ADB study estimated that the national income loss in Bangladesh from iron-deficiency anemia alone was nearly 2% of its GDP (Hunt 2001; ADB 2004b).

Another major micronutrient deficiency is iodine deficiency, which is a major cause of preventable mental retardation. Between 2000 and 2006, about 21 million children were born unprotected from iodine deficiency in Asia annually (UNICEF 2008).<sup>31</sup> As of 2004, in countries with a total goiter rate (caused by iodine deficiency) above 10%—which include most of those in the region—learning capacity is lowered by 10%–15% (UNICEF and MI 2004). Salt iodization prevents this, but considerable variability exists in its practice between countries.

Vitamin A deficiency contributes to impaired vision and blindness. Within the region, one-quarter of the child population suffers from it. Reported prevalence as of 2007 ranges from a low of 9.3% in the PRC to a high of 64.5% in Afghanistan. India has the largest absolute number of vitamin A-deficient children in the world, and has yet to reach 62% of its children under age 5 years with supplementary vitamin A (MI and CIDA 2009; UN Population Division 2008). Efforts to control vitamin A deficiency are being made through food fortification and supplementation, with children receiving vitamin A supplements in most countries in the region, although supplementation dosages may be insufficient (UNICEF and MI 2004).

Access to clean, potable water is as important as micronutrients in diets for improving nourishment. Contaminated water may make consumption of even nutritious food ineffective in improving overall nutritional status of individuals. Poor water quality causes many diseases, and is a major contributing factor to ill health, which aggravates undernourishment. The importance of good hygiene and sanitation and provision of clean water have been discussed in the context of child hunger (see section 4) but are also important in the context of undernourishment of the general population. Recognizing their importance, access to improved water supply and sanitation has been made targets under the MDGs, and considerable attention is being placed

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<sup>30</sup> Total goiter rate (TGR) data used is obtained from the Vitamin and Mineral (VM) Deficiency Assessments table in UNICEF and MI (2004). Data on other indicators is obtained from Annex A in MI and CIDA (2009). Only correlations of poverty with other indicators (iron deficiency and vitamin A deficiency) were found significant, at the 1% level.

<sup>31</sup> Protection from iron deficiency is measured by the percentage of households consuming adequately iodized salt. Asia refers only to countries of South Asia, East Asia, and the Pacific.

on them. It is not necessary, therefore, to discuss this issue at length here. The issue of water and sanitation needs to be stressed, nevertheless, as public programs to reduce undernourishment may fail if not complemented with programs to improve access to clean water and better sanitation.

## 6. Conclusions: Major Elements of a Hunger Strategy

With over half a billion people (one in every six persons) undernourished, and almost one in every three children under age 5 years underweight, Asia and the Pacific faces a massive task in freeing its population from hunger. Although economic growth has helped reduce hunger in the region, its impact has generally been low—much lower than on reducing poverty. Hunger has proved to be much more difficult to eradicate, requiring more instruments than only those concerned with economic growth and necessitating determined state action through a coordinated multidisciplinary approach to succeed.<sup>32</sup>

Only 5 years remain to achieve the MDGs. What are the most critical actions needed to bring about a substantial improvement in performance? While detailed actions have been indicated in each of the previous sections to address the main identified causes of hunger, including illustrations of policy actions and interventions, the following are critical priorities.

**Scale up domestic priorities, resources, and attention to hunger elimination.** The MDG hunger targets are not likely to be achieved given current efforts. Although hunger and undernourishment are now well recognized as major problems in the region, there is still inadequate prioritization of efforts to end hunger. Although all governments were signatories to the Millennium Declaration, all have not incorporated the MDGs within their planning targets. Countries have only loosely adapted the MDG targets in accordance with budget constraints and generally have not established national targets consistent with achieving the MDGs (ESCAP–ADB–UNDP 2008, p. 44). These indicate the following for urgent action:

- (i) Countries at the national-level and decentralized government authorities within them must be encouraged to adopt definite targets (consistent with the MDG target of 2015) within their national and local development plans and to develop credible strategies to achieve them.
- (ii) In particular, a definite commitment to prioritize resources for achieving the MDG hunger targets, not only at the central government levels but also at state, provincial, and local and community levels, is essential.
- (iii) Universal acceptance and commitment from all stakeholders—public, private, local, community, and nongovernment organizations—has to be secured by stepped-up dialogue between regional and national policy makers, and with a larger group of stakeholders.

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<sup>32</sup> Given the enormity of the hunger problem, urgent calls to action have been made by several international development agencies. UNDP has suggested a seven-point program, which resonates with various points made in this paper that (i) focuses on targeted interventions, (ii) judges development outcomes through hunger impact, (iii) revives public investments in agriculture, (iv) builds a national and global coalition, (v) makes primary education mandatory, (vi) gives subsidies to consumers for staple foods, and (vii) rebuilds global food policy (Noman and Changchui 2008).

**Focus attention on hunger hotspots.** The hunger problem is especially acute in some countries, and efforts must begin with these. Among these, some (e.g., India, Indonesia, the Philippines, Thailand, and Viet Nam) have reached or nearly reached middle-income status and can effectively reduce hunger through their own efforts. The low-income countries, on the other hand, will need to be supported through international efforts, including traditional and newly emerging donors within Asia and the Pacific.

Resources for tackling hunger are currently inadequate, and although MDG global commitments call for a dedication of 0.7% of GDP by developed countries as aid for the MDG effort, not much of this has actually been received by developing countries in the region, partly due to inadequate capacity to make effective use of and to absorb aid.<sup>33</sup>

Hunger hotspots also exist within each country. As pointed out in this paper, only six of India's states account for the bulk of the child malnutrition problems in the country. Hence, these point to the following necessary actions.

- (i) The focus of international and regional assistance to eliminate hunger in the region must be on the hotspots identified in this paper and particularly on the low-income countries among them. Bilateral and multilateral agencies should review their aid allocation criteria to ensure that adequate financial assistance is actually available to these countries.
- (ii) Countries need to map out geographical areas where hunger remains persistent and develop hunger-removal strategies according to local needs. Local governments with large populations in hunger should be assisted with resources.

**Strengthen inclusive growth and rural and agricultural development.** As this paper discusses, growth has not impacted as strongly on hunger as it has on poverty. Nevertheless, growth in income does act positively on improving nutrition and making more resources available for governments to undertake effective public action to reduce hunger. However, growth can be a more powerful instrument in the region to tackle hunger if it can be made more broad-based and inclusive. This will require attention in several areas.

- (i) First, focusing attention on socially excluded and discriminated groups who suffer disproportionately from hunger and malnutrition is important. These include women, lower castes, indigenous peoples, and minorities.
- (ii) In addition, encouraging the development of remote and rural areas where most of the poor and hungry live will help strengthen the inclusiveness of growth and reduce hunger. There is increasing consensus with this view.<sup>34</sup> This will require all-around development, supporting not only agricultural development but also expanding nonfarm opportunities and human and social development in rural areas (ADB 2007b).

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<sup>33</sup> A 2009 World Bank policy note highlighted the fact that many Asian countries lack institutional and absorptive capacity to expand spending. Such countries would need investment support to continue and, if possible, expand basic infrastructure and services (World Bank 2009).

<sup>34</sup> FAO, for example, has been advocating rural development and a vibrant rural economy as prerequisites for reducing hunger and undernourishment, with agricultural development being a major constituent (2009b).

**Make food available and affordable for the poor.** Dual-pronged action from both the supply and demand sides is essential to reduce hunger. Food production can be increased using many of the lessons of the green revolution, which remain relevant, and utilizing new approaches tailored to country needs. The steep decline in resources for agricultural and rural development over the past 20 years needs to be urgently reversed.<sup>35</sup> Ensuring access to food by the poor is also essential. The following need to be emphasized:

- (i) Food production has to be stepped up to keep pace with increasing demand. Scaling up investments in rural and agriculture-related infrastructure, encouraging research and adoption of improved technology, and strengthening commercialization are important measures. Climate change will affect food production adversely in some countries already experiencing high hunger levels, and measures to counter the climate effects on production must be initiated.
- (ii) Equally crucial is ensuring affordability of food by the poor. This will require paying more attention to improving efficiency in distribution of food domestically through improved food distribution systems and infrastructure, and through measures to keep food prices low, particularly for the poor, by taking actions to prevent harmful speculation, reducing internal variability in prices to avoid local shortages, and via targeted subsidized food for the poor. Problems of ineffective targeting and avoidance of leaks that have traditionally affected public distribution systems should be urgently resolved.
- (iii) Regional cooperation efforts involving establishing regional food reserves, strengthening food production, and fostering agreements to avoid export curbs on food are important actions at the regional level.

**Ensure availability of micronutrients in diets and access to clean water.** The problem of malnutrition is not just of calorific deficiencies. Essential micronutrients must be made available to the population. In addition, without clean water, even consumption of nutritive food can be ineffective.

- (i) A strategy to reduce undernourishment must include emphasis on programs to substantially increase the intake of micronutrients by 2015, particularly iodine, iron, and vitamin A, through food fortification and supplementation.
- (ii) In addition, access to clean water must be ensured as an essential ingredient of nutrition- and micronutrient-deficiency reduction measures.

**Provide targeted assistance to most-vulnerable groups.** The recommended actions require supplementing targeted interventions for especially vulnerable groups in the population, whose needs are urgent, such as children and mothers. The region faces the most serious problem on child malnutrition, accounting for more than two-thirds of all underweight children in the world. The improvement of maternal nutrition and health is also of singular importance in this context, affecting the health and nutrition of children and has been well documented.<sup>36</sup> Programs relating to hunger and nutrition have a better chance of success if they are directed to and include women. Special attention also needs to be directed toward socially vulnerable groups that suffer from greater deprivation. It would follow that groups falling in the intersection

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<sup>35</sup> Between 1983–1987 and 1998–2000, the annual average official development assistance allocations for agriculture in least-developed and other low-income countries fell by 57% from \$5.14 billion (2002 prices) to \$2.22 billion (FAO et al. 2005a, p. 2).

<sup>36</sup> For example, see Krishnakumar (2005).

of vulnerabilities (e.g., rural women and children belonging to lower-caste communities in India) would be ones most desperately needing help and assistance.

- (i) Targeted interventions to stop child and maternal undernourishment in the population are crucial. Necessary interventions require simultaneous action on food and nutrition, health care, literacy, and education of mothers, and should target areas and groups where the most attention is needed. Obtaining community support is also essential for the effectiveness of such programs.
- (ii) A proactive program of women's participation and empowerment must be central to a strategy aiming to reduce hunger. This would include literacy and education programs, especially in the light of evidence that increasing literacy has a significant effect in improving child nutrition.
- (iii) Other vulnerable groups—such as those facing discrimination on the basis of caste, indigenous, and minority status—and those at the intersection of several types of vulnerabilities need to be especially targeted.

**Undertake coordinated and effective multidisciplinary action involving several public agencies.** This paper emphasizes that hunger cannot be tackled solely by resolving food-related issues alone, as it is caused by a variety of factors requiring a coordinated and multidisciplinary approach. A simultaneous, coordinated provision of services and public investments in hunger hotspots and targeted interventions to vulnerable populations needs to be an important part of the hunger eradication strategy. Efforts to improve capacities at local government levels to fight hunger are also needed. The following urgent actions are necessary:

- (i) Solving hunger requires simultaneous action on several fronts, including improving literacy in the general population and spreading information about nutrition, ensuring food availability, stepping up food fortification, improving access to potable water and better sanitation practices, improving primary health services, helping control rapid population increase, and focusing on the welfare of women and children.
- (ii) All government agencies concerned with agriculture and irrigation; food supply and distribution; education and literacy; welfare of women, children, minorities, and socially discriminated groups; health; population control and reproductive health; and water and sanitation must be involved. Better-coordinated action by all such ministries and agencies is essential, as separate and uncoordinated individual actions are destined to fail.
- (iii) Capacity development and measures to improve delivery of services by agencies involved in fighting hunger, particularly at the local government level, is crucial. Special programs to address these will need to be taken up.
- (iv) The urgency and importance of the issue call for appointment of nodal coordinating bodies for hunger elimination at suitably authoritative positions (such as in prime ministers' offices) and empowerment to undertake cross-agency actions.

**Engage nonpublic stakeholders—communities, civil society, and private sector—effectively.** Public efforts to achieve the MDG hunger targets are inadequate, considering the massive task involved. Public agencies must encourage meaningful involvement—if not the leadership of communities, civil society, and the private sector—in the effort to end hunger. In every area of intervention, the participation of these stakeholders is essential. Many major hunger interventions have failed owing to lack of such participation.

- (i) The effort to eliminate hunger requires successful harnessing of efforts by crucial players outside the public sector such as communities, civil society groups, and the private sector. These will require active strategies to involve them and policies to encourage their participation. Where necessary, support to build up capacity of such groups to fight hunger must be provided.

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**Appendix 1: Daily Allowances of Nutrients for Indians, Rural Sector  
(Recommended by the Nutrition Expert Group in 1968)**

Group	Particulars	Calories	Proteins (g)	Calcium (g)	Iron (mg)	Vitamin A		Thiamine (mg)	Riboflavin (mg)	Nicotinic acid (mg)	Ascorbic acid (mg)	Folic acid (µg)	Vitamin B12 (µg)	Vitamin D (I-U)
						Retinol (µg)	Beta carotene (µg)							
Men	Sedentary work	2,400						1.2	1.3	16				200
	Moderate work	2,800	55	0.4–0.5	20	750	3,000	1.4	1.5	19	50	100	1.0	
	Heavy work	3,900						2.0	2.2	26				
Women	Sedentary work	1,900						1.0	1.0	13				
	Moderate work	2,200	45	0.4–0.5	30	750	3,000	1.1	1.2	15	50	100	1.0	
	Heavy work	3,000						1.5	1.7	20				
	In 2nd half of pregnancy Lactation (up to 1 year)	+300  +700	+10  +20	1.0	40  30	...  1,150	3,000  4,600	+0.2  +0.4	+0.2  +0.4	+2  +5	50  80	150– 300  150	1.5	
Infants	0–6 months	120/kg	1.8–2.3 kg	...	1.0 mg/kg	400	...	...	...	...	30	25	0.2	
	7–12 months	100/kg	1.5–1.8 kg	0.5–0.6		300	1,200	...	...	...				
Children	1 year		17	0.4–0.5	15– 20						30–50	50– 100	0.5–1.0	
	2 years	1,200	18			250	1,000	0.6	0.7	8				
	3 years		20											

Group	Particulars	Calories	Proteins (g)	Calcium (g)	Iron (mg)	Vitamin A		Thiamine (mg)	Riboflavin (mg)	Nicotinic acid (mg)	Ascorbic acid (mg)	Folic acid (µg)	Vitamin B12 (µg)	Vitamin D (I-U)
						Retinol (µg)	Beta carotene (µg)							
	4–6 years	1,500	22			300	1,200	0.8	0.8	10				
	7–9 years	1,800	33			400	1,600	0.9	1.0	12				
	10–12 years	2,100	41			600	2,400	1.0	1.2	14				
Adolescents	13–15 years (boys)	2,500	55	0.6–0.7	25	750	3,000	1.3	1.4	17				
	13–15 years (girls)	2,200	50	0.5–0.6	35	750	3,000	1.1	1.2	14				
	16–18 years (boys)	3,000	60		25			1.5	1.7	21				
	16–18 years (girls)	2,200	50		35			1.1	1.2	14				

I-U = International unit, g = grams, mg = milligrams, µg = micrograms  
 Source: Gopalan et al. 1971, p. 27.

## Appendix 2: Global Hunger Index Ranking of Selected Countries in Asia and the Pacific

GHI Rank	Country	Global Hunger Index (GHI)			Percentage change, 1992–1997	Percentage change, 1997–2003	Percentage change, 1992–2003
		1992	1997	2003			
14	Fiji Islands	7.14	5.97	3.07	(16.39)	(48.58)	(57.00)
40	Malaysia	10.17	7.73	7.23	(23.99)	(6.47)	(28.91)
45	Kazakhstan	...	4.96	8.17	...	64.72	...
47	China, People's Republic of	12.57	8.57	8.23	(31.82)	(3.97)	(34.53)
48	Kyrgyz Republic	...	10.34	8.36	...	(19.15)	...
52	Azerbaijan	...	14.89	10.27	...	(31.03)	...
53	Turkmenistan	...	11.40	10.40	...	(8.77)	...
58	Thailand	17.83	13.80	12.36	(22.60)	(10.43)	(30.68)
59	Indonesia	18.53	15.60	12.47	(15.81)	(20.06)	(32.70)
63	Uzbekistan	...	11.74	13.60	...	15.84	...
67	Mongolia	18.10	24.68	15.83	36.35	(35.86)	(12.54)
68	Myanmar	19.33	15.53	16.17	(19.66)	4.12	(16.35)
69	Sri Lanka	22.40	21.87	16.63	(2.37)	(23.96)	(25.76)
72	Philippines	21.80	19.63	17.55	(9.95)	(10.60)	(19.50)
75	Viet Nam	25.93	22.37	18.37	(13.73)	(17.88)	(29.16)
83	Korea, Democratic People's Republic of	15.51	20.91	20.33	34.82	(2.77)	31.08
88	Pakistan	25.97	23.60	21.77	(9.13)	(7.75)	(16.17)
89	Timor-Leste	...		22.29	...	...	...
91	Lao People's Democratic Republic	25.83	26.73	23.83	3.48	(10.85)	(7.74)
92	Nepal	27.77	27.77	24.50	0.00	(11.78)	(11.78)
96	India	32.80	25.73	25.73	(21.55)	0.00	(21.55)
102	Bangladesh	36.50	35.73	28.27	(2.11)	(20.88)	(22.55)
108	Tajikistan	...	19.86	30.25	...	52.32	...
109	Cambodia	33.03	36.03	30.73	9.08	(14.71)	(6.96)

... = no data available, ( ) = negative.

Source: Ahmed et al. 2007b.



## Appendix 3: Poverty and Hunger in Asia and the Pacific

	Percentage of Population below the Poverty Line				Prevalence of Underweight Children under Age 5 Years (%)				% of Population below Minimum Level of Dietary Energy Consumption		
	(\$1.25/day PPP)		National		Earliest		Latest		1990–1992	2000–2002	2004–2006
	1990	Latest Year	1990	Latest Year	1990	Total	Girls	Boys			
<b>East Asia<sup>a</sup></b>											
China, People's Republic of	60.2	15.9 (2005)	6.0 (1996)	4.6 (2007)	19.1 (1993)	6.9 (2005)	...	...	15	10	10
Mongolia	18.8 (1995)	22.4 (2005)	36.3 (1995)	35.2 (2008)	12.3 (1992)	6.3 (2005)	7.0 (2005)	6.0 (2005)	30	25	29
<b>Southeast Asia</b>											
Cambodia	48.6 (1994)	40.2 (2004)	47.0 (1994)	34.7 (2004)	39.8 (1993)	35.6 (2005)	36.0 (2005)	35.0 (2005)	38	27	25
Indonesia	54.3	21.4 (2005)	17.5 (1996)	15.4 (2008)	34.0 (1995)	28.2 (2003)	...	...	19	17	16
Lao People's Democratic Republic	55.7 (1992)	44.0 (2002)	45.0 (1993)	32.7 (2003)	44.0 (1993)	37.1 (2006)	38.0 (2006)	37.0 (2006)	27	22	19
Malaysia	1.6 (1992)	0.5 (2004)	...	3.6 (2007)	23.3 (1993)	8.1 (2005)	...	...	...	...	Less than 5 <sup>b</sup>
Philippines	30.7 (1991)	22.6 (2006)	32.1 (1994)	32.9 (2006)	33.5 (1990)	27.6 (2003)	...	...	21	17	15
Thailand	5.5 (1992)	0.4 (2004)	9.8 (1994)	9.6 (2006)	18.6 (1993)	9.3 (2005)	10.0 (2005)	9.0 (2005)	29	20	17
Timor-Leste	...	52.9 (2001)	...	41.0 (2001)	42.6 (2002)	48.6 (2007)	45.0 (2007)	53.0 (2007)	18	15	23
Viet Nam	63.7 (1993)	21.5 (2006)	37.4 (1998)	16.0 (2006)	44.9 (1994)	20.2 (2006)	19.0 (2006)	21.0 (2006)	28	17	13
<b>South Asia</b>											
Bangladesh	52.7 (1992)	50.5 (2005)	51.0 (1996)	40.0 (2005)	67.4 (1992)	46.3 (2007)	49.0 (2004)	46.0 (2004)	36	28	26
India	49.4 (1994)	41.6 (2005)	36.0 (1994)	27.5 (2004)	53.4 (1993)	47.8 (2005)	49.0 (2005)	46.0 (2005)	24	21	22
Nepal	68.4 (1996)	55.1 (2004)	41.8 (1996)	30.9 (2004)	48.7 (1995)	45.0 (2006)	40.0 (2006)	38.0 (2006)	21	19	16
Pakistan	64.7 (1991)	22.6 (2005)	28.6 (1993)	22.3 (2005)	40.4 (1991)	37.8 (2002)	36.0 (2002)	38.0 (2002)	22	21	23
Sri Lanka	15.0 (1991)	14.0 (2002)	20.0 (1991)	15.2 (2007)	37.7 (1993)	29.4 (2002)	30.0 (2002)	29.0 (2002)	27	20	21
<b>Central and West Asia</b>											
Armenia	17.5 (1996)	10.6 (2003)	55.1 (1999)	25.0 (2007)	3.9 (1998)	4.0 (2005)	6.0 (2005)	2.0 (2005)	46	30	23
Azerbaijan	15.6 (1995)	0.0 (2005)	68.1 (1995)	13.2 (2008)	10.1 (1996)	9.5 (2006)	10.0 (2006)	9.0 (2006)	27	19	11
Georgia	4.5 (1996)	13.4 (2005)	52.1 (2002)	39.4 (2005)	3.1 (1999)	2.1 (2005)	2.0 (2005)	2.0 (2005)	47	21	12
Kazakhstan	4.2 (1993)	3.1 (2003)	34.6 (1996)	16.1 (2004)	8.3 (1995)	4.0 (2006)	4.0 (2006)	4.0 (2006)	...	...	Less than 5 <sup>b</sup>
Kyrgyz Republic	18.6 (1993)	21.8 (2004)	47.6 (2001)	39.9 (2006)	11.0 (1997)	3.4 (2006)	3.0 (2006)	4.0 (2006)	17	...	Less than 5 <sup>b</sup>
Tajikistan	44.5 (1999)	21.5 (2004)	74.9 (1999)	44.4 (2003)	17.4 (2005)	17.6 (2007)	17.0 (2005)	18.0 (2005)	34	54	26
Turkmenistan	63.5 (1993)	24.8 (1998)	...	29.9 (1998)	12.0 (2000)	11.0 (2005)	10.0 (2005)	12.0 (2005)	9	7	6
Uzbekistan	32.1 (1998)	46.3 (2003)	...	29.9 (1998)	18.8 (1996)	5.1 (2006)	5.0 (2006)	5.0 (2006)	5	7	13

	Percentage of Population below the Poverty Line				Prevalence of Underweight Children under Age 5 Years (%)				% of Population below Minimum Level of Dietary Energy Consumption		
	(\$1.25/day PPP)		National		Earliest		Latest		1990–1992	2000–2002	2004–2006
	1990	Latest Year	1990	Latest Year	1990	Total	Girls	Boys			
<b>Pacific Islands</b>											
Fiji Islands	...	...	25.5 (1996)	34.3 (2007)	7.9 (1993)	...	...	...	8	...	...
Kiribati	...	...	...	...	...	13.0 (1999)	...	...	8	5	5
Papua New Guinea	...	...	35.8 (1996)	24.0 (1990)	...	26.4 (2005)	...	...	...	...	...
Samoa	...	...	15.0 (1997)	20.3 (2004)	...	...	...	...	9	...	...
Solomon Islands	...	...	...	22.7 (2007)	...	...	...	...	25	12	9
Vanuatu	...	...	17.2 (1994)	25.9 (2006)	...	15.9 (2007)	...	...	10	8	6

PPP = purchasing power parity, ... = data not available.

Note: Year of survey indicated in parentheses.

<sup>a</sup> Regional classifications are based on United Nations composition of macrogeographical regions.

<sup>b</sup> Latest undernourishment data for Kazakhstan, Kyrgyz Republic, and Malaysia are based on 2003–2005 data from an earlier release of Food and Agriculture Organization food security statistics.

Sources: World Bank. PovCalNet (accessed 19 April 2010) for poverty data; FAO. Food Security Statistics. (accessed 8 March 2010) for undernourishment data; UNESCAP Statistics Division for underweight children under age 5 years data for all countries except Papua New Guinea and Vanuatu, which are taken from UNICEF (2009) and ADB. Statistical Database System Online (accessed 19 April 2010) for percentage of population living below the national poverty line, and male and female child hunger data.

### Appendix 4: Broader Indicators of Child Health in Asia and the Pacific

	Infant Mortality Rate (deaths per 1,000 live births)					Under Age 5 Years Mortality Rate (deaths per 1,000 live births)					Prevalence of Underweight Children (% of children under age 5 years)			
	1990	1995	2000	2005	2008	1990	1995	2000	2005	2008	Earliest		Latest	
												(Year)	(Year)	(Year)
Afghanistan	168	165	165	165	165	260	257	257	257	257	48.0	(1997)	39.3	(2004)
Armenia	48	42	32	24	21	56	48	36	27	23	3.9	(1998)	4.0	(2005)
Azerbaijan	78	75	58	40	32	98	93	69	46	36	10.1	(1996)	9.5	(2006)
Bangladesh	103	86	67	51	43	149	122	91	66	54	67.4	(1992)	46.3	(2007)
Bhutan	91	79	68	59	54	148	125	106	90	81	...	...	18.7	(1999)
Brunei Darussalam	9	7	6	6	6	11	9	8	7	7	...	...	...	...
Cambodia	85	86	80	73	69	117	119	106	96	90	39.8	(1993)	35.6	(2005)
China, People's Republic of	37	36	30	22	18	46	45	36	25	21	19.1	(1990)	6.9	(2005)
Cook Islands	16	15	15	14	14	18	17	17	16	15	10.0	(1997)	...	...
Fiji Islands	19	17	16	16	16	22	19	18	18	18	7.9	(1993)	...	...
Georgia	41	35	31	28	26	47	40	35	32	30	3.1	(1999)	2.1	(2005)
India	83	75	68	58	52	116	104	94	77	69	53.4	(1993)	47.8	(2005)
Indonesia	56	46	40	34	31	86	67	56	46	41	34.0	(1995)	28.2	(2003)
Iran	55	47	38	31	27	73	60	48	37	32	15.7	(1995)	5.2	(2004)
Kazakhstan	51	48	38	31	27	60	56	44	35	30	8.3	(1995)	4.0	(2006)
Kiribati	65	56	49	42	38	89	75	63	53	48	...	...	13.0	(1999)
Korea, Democratic People's Republic of	42	42	42	42	42	55	55	55	55	55	60.0	(1998)	23.4	(2004)
Korea, Republic of	8	7	6	5	5	9	8	6	6	5	...	...	...	...
Kyrgyz Republic	63	53	44	37	33	75	62	51	43	38	11.0	(1997)	3.4	(2006)
Lao People's Democratic Republic	108	82	64	53	48	157	115	86	70	61	44.0	(1993)	37.1	(2006)
Malaysia	16	12	9	7	6	18	13	10	8	6	23.3	(1993)	8.1	(2005)
Maldives	79	62	43	30	24	111	83	55	36	28	38.9	(1994)	30.4	(2001)
Marshall Islands, Republic of	39	33	32	30	30	49	41	39	37	36	...	...	...	...
Micronesia, Federated States of	45	41	38	34	32	58	52	47	42	39	15.0	(1997)	...	...
Mongolia	71	61	49	39	34	98	82	63	48	41	12.3	(1992)	6.3	(2005)
Myanmar	85	81	77	73	71	120	113	107	101	98	32.4	(1990)	31.8	(2003)
Nauru		19	41	38	36		21	51	47	45	...	...	...	...
Nepal	99	83	63	48	41	142	117	85	62	51	48.7	(1995)	45.0	(2006)
New Zealand	9	7	6	5	5	11	9	8	6	6	...	...	...	...
Pakistan	101	94	85	76	72	130	121	108	96	89	40.4	(1991)	37.8	(2002)
Palau	18	14	14	14	13	21	16	16	15	15	...	...	...	...
Papua New Guinea	67	61	57	54	53	91	82	77	72	69	...	...	26.4	(2005)
Philippines	42	33	28	27	26	61	45	36	34	32	33.5	(1990)	27.6	(2003)
Russian Federation	23	23	20	15	12	27	27	24	17	13	3.0	(1995)	...	...
Samoa	40	33	28	24	22	50	41	34	29	26	...	...	...	...
Singapore	6	4	3	2	2	7	5	4	3	3	...	...	3.4	(2000)

	<b>Infant Mortality Rate</b> (deaths per 1,000 live births)					<b>Under Age 5 Years Mortality Rate</b> (deaths per 1,000 live births)					<b>Prevalence of Underweight Children</b> (% of children under age 5 years)			
	<b>1990</b>	<b>1995</b>	<b>2000</b>	<b>2005</b>	<b>2008</b>	<b>1990</b>	<b>1995</b>	<b>2000</b>	<b>2005</b>	<b>2008</b>	<b>Earliest</b>		<b>Latest</b>	
Solomon Islands	31	31	30	30	30	38	38	37	36	36	...	...	...	...
Sri Lanka	23	21	17	15	13	29	25	21	17	15	37.7	(1993)	29.4	(2000)
Tajikistan	91	89	75	62	54	117	114	94	74	64	17.4	(2005)	17.6	(2007)
Thailand	26	21	17	14	13	32	25	20	16	14	18.6	(1993)	9.3	(2005)
Timor-Leste	138	116	100	83	75	184	153	129	105	93	42.6	(2002)	48.6	(2007)
Tonga	19	18	18	17	17	23	21	20	20	19	...	...	...	...
Turkey	69	52	36	25	20	84	62	42	28	22	10.4	(1993)	2.8	(2008)
Turkmenistan	81	70	59	49	43	99	87	71	55	48	12.0	(2000)	11.0	(2005)
Tuvalu	42	38	35	31	30	53	47	42	38	36	...	...	...	...
Uzbekistan	61	57	53	40	34	74	68	62	46	38	18.8	(1996)	5.1	(2006)
Vanuatu	23	23	25	26	27	27	28	29	31	33	...	...	15.9	(2007)
Viet Nam	39	33	24	15	12	56	44	30	18	14	44.9	(1994)	20.2	(2006)

Note: Year of survey indicated in parentheses.

Source: United Nations Economic and Social Commission for Asia and the Pacific 2010.

### Appendix 5: Agricultural Impact of Climate Change by Major Regions, Developing and Industrial Countries

Country and region	Base output (\$ billion, 2003)	Population (million)	Change in agricultural output, potential preferred estimate (%)	
			Without carbon fertilization	With carbon fertilization
<b>Developing Countries</b>	838	5,202	(19.7)	(7.7)
Excluding Europe	745	4,807	(21.0)	(9.1)
<b>Africa</b>	73	660	(27.5)	(16.6)
Nigeria	15	136	(18.5)	(6.3)
South Africa	6	46	(33.4)	(23.4)
<b>Asia</b>	500	3,362	(19.3)	(7.2)
China, People's Republic of	213	1,288	(7.2)	6.8
India	132	1,064	(38.1)	(28.8)
Indonesia	35	215	(17.9)	(5.6)
<b>Middle East</b>	61	280	(21.2)	(9.4)
Algeria	7	32	(36.0)	(26.4)
Egypt	13	68	11.3	28.0
Iran	15	66	(28.9)	(18.2)
<b>Latin America</b>	111	506	(24.3)	(12.9)
Argentina	14	37	(11.1)	2.2
Brazil	30	177	(16.9)	(4.4)
Mexico	25	102	(35.4)	(25.7)
<b>Europe</b>	93	395	(9.4)	4.1
Poland	5	38	(4.7)	9.5
Russian Federation	22	143	(7.7)	6.2
Turkey	27	71	(16.2)	(3.6)
<b>Industrialized Countries</b>	338	846	(6.3)	7.7
Australia	13	20	(26.6)	(15.6)
Canada	17	32	(2.2)	12.5
Germany	17	83	(2.9)	11.7
United Kingdom	13	59	(3.9)	10.5
United States	99	291	(5.9)	8.2
<b>World</b>	1,176	6,049	(15.9)	(3.2)
Population Weighted			(18.2)	(6.0)

( ) = negative.

Source: Cline 2007, p. 79.

## Appendix 6: Vitamin and Mineral Deficiency in Selected Countries

Country	Iron deficiency			Iodine deficiency		Vitamin A deficiency
	Proportion of preschool age children with anemia (%)	Proportion of pregnant women with anemia (%)	Proportion of non-pregnant women with anemia (%)	Proportion of school aged children with iodine deficiency (%)	Total goiter rate (%) <sup>a</sup>	Proportion of pre-school age children with vitamin A deficiency (%)
Afghanistan	37.9	61.0	24.7	71.9	48	64.5
Armenia	23.9	12.0	12.4	6.3	12	0.6
Azerbaijan	31.8	38.4	40.2	74.4	15	32.1
Bangladesh	47.0	47.0	33.2	42.5	18	21.7
Bhutan	80.6	49.6	54.8	13.5	...	22.0
Brunei	24.2	38.9	20.4	...	...	0.0
Darussalam	63.4	66.4	57.3	...	18	22.3
Cambodia	20.0	28.9	19.9	15.7	5	9.3
China, People's Republic of	24.7	27.2	18.2	...	...	10.4
Cook Islands	31.7	34.7	34.7	...	...	27.5
Korea, Democratic People's Republic of	39.1	55.6	31.8	75.4	...	13.6
Fiji Islands	40.6	41.6	22.7	80.0	21	30.9
Georgia	74.3	49.7	52.0	31.3	26	62.0
India	44.5	44.3	33.1	16.3	10	19.6
Indonesia	35.0	40.5	33.0	19.7	9	0.5
Iran, Islamic Republic of	36.3	26.0	35.5	53.1	21	27.1
Kazakhstan	41.9	38.4	30.7	...	...	21.8
Kiribati	49.8	34.1	38.0	88.1	21	26.3
Kyrgyz Republic	48.2	56.4	46.1	26.9	14	44.7
Lao People's Democratic Republic	32.4	38.3	30.1	57.0	...	3.5
Malaysia	81.5	55.4	49.6	43.1	...	9.4
Maldives	30.0	38.1	24.1	...	...	60.7
Marshall Islands	18.7	37.8	24.2	...	...	54.2
Micronesia, Federated States of	21.4	37.3	13.6	52.8	15	19.8
Mongolia	63.2	49.6	44.9	22.3	17	36.7
Myanmar	20.0	19.2	25.7	...	...	10.0
Nauru	78.0	74.6	66.7	27.4	24	32.3
Nepal	21.6	31.7	11.9	...	...	15.5
Niue	50.9	39.1	27.9	63.6	38	12.5
Pakistan	22.2	27.3	21.1	...	...	8.9
Palau	59.8	55.2	43.1	27.7	...	11.1
Papua New Guinea	36.3	43.9	42.1	23.8	15	40.1
Philippines	16.5	22.6	14.0	...	...	0.0
Korea, Republic of	35.5	33.4	19.7	...	...	16.1
Samoa	18.9	23.8	18.4	...	...	0.0
Singapore	51.7	51.1	39.2	...	...	13.1
Solomon Islands	29.9	29.3	31.6	30.0	...	35.3
Sri Lanka	37.7	44.6	41.2	...	28	26.8
Tajikistan	25.2	22.3	17.8	34.9	13	15.7
Thailand	31.5	22.9	31.5	...	...	45.8
Timor-Leste	27.6	34.0	21.5	...	...	17.0
Tonga	35.8	29.9	47.3	18.7	11	28.0
Turkmenistan						

Country	Iron deficiency			Iodine deficiency		Vitamin A deficiency
	Proportion of preschool age children with anemia (%)	Proportion of pregnant women with anemia (%)	Proportion of non-pregnant women with anemia (%)	Proportion of school aged children with iodine deficiency (%)	Total goiter rate (%) <sup>a</sup>	Proportion of pre-school age children with vitamin A deficiency (%)
Tuvalu	34.2	33.1	26.3	...	...	21.8
Uzbekistan	38.1	53.8	64.8	39.8	24	53.1
Vanuatu	59.0	57.3	54.1	...	...	16.1
Viet Nam	34.1	32.2	24.3	84.0	11	12.0

... = data not available.

<sup>a</sup> Total goiter rate (%) data is obtained from an earlier version of the Vitamins and Mineral Deficiency Report by the United Nations Children's Fund (UNICEF) and Micronutrient Initiative (MI).

Sources: MI and Canadian International Development Agency 2009; UNICEF and MI 2004.