

Food Security, Agriculture, and Poverty in Asia

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INTRODUCTION: ASIA'S FOOD INSECURITY

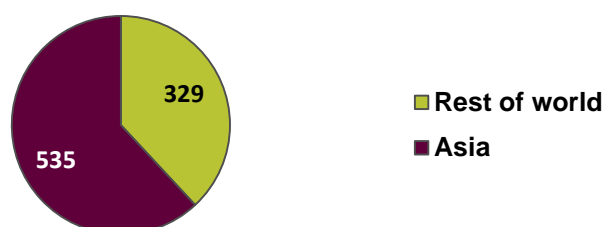
Food security is back on the global agenda, triggered by alarm over the international food price surges of 2007-08. The international price of rice temporarily tripled, and wheat and maize prices more than doubled. For those poor people who are net purchasers of food and for the governments and other institutions concerned with their welfare, food price fluctuations like these are deeply alarming. They raise the prospect that poor people in particular may be unable to obtain the food they need.

A central policy question for Asia and other food-insecure regions of the world is how to respond to the threat posed by food insecurity. In particular, is it more effective to promote improvements in agricultural productivity or to pursue price interventions aimed at promoting food self-sufficiency at a national level? In this paper I want to present some recent evidence on undernourishment and some other dimensions of food security in Asia and elsewhere that are relevant for this question. The key underlying research questions are: what drives changes in food security; and what does this imply for agricultural and food policy?

Food security is a particular concern for Asia. The first reason is the sheer size of Asia's undernourishment problem. Recent data are summarized in Figure 1. According to a recent FAO report, of the 868 million people estimated to be undernourished in the world, 564 million, or 65 per cent of the total, reside in countries of Asia (FAO 2012). Undernourished people constitute 14 per cent of the population of Asia, compared with 12.5 per cent of the world population. Of Asia's malnourished people, 304 million, or 35 per cent of the global total, are in South Asia alone, exceeding the total number, 234 million, in Sub-Saharan Africa. The problem is particularly alarming with regard to children. Among several Asian countries the incidence of childhood stunting exceeds 40 per cent. This proportion is comparable with the Sub-Saharan African experience but in Asia the absolute numbers of children affected are larger.

A second reason is the dependence of much of Asia on a single crop. Rice is the staple food of most of Asia and for the majority of Asia's poor people expenditure on this one commodity accounts for a large proportion of their household budgets, a much larger proportion than for the non-poor. This, together with the first point above, explains why Asian countries were so greatly alarmed by the huge increases in the price of rice during the 2007-08 food price crisis. The global market for rice is particularly thin, making international price volatility more pronounced than for most other staple foods. In recent decades both supply and demand conditions for food have changed rapidly in Asia. A growing middle class has diversified its diet away from staple cereals such as rice and towards fruit, vegetables and livestock products. But at the same time rapid urbanization and accelerating non-agricultural demands for land have placed greater pressure on agricultural resources. Finally, agricultural production in much of Asia is especially vulnerable to climate change, requiring much greater policy attention to the requirements of agricultural adaptation.

Figure 1— Number of undernourished people in the world, 2010-12



Although the international food price increases of 2007-08 altered the way food security is understood and prioritized, decades of neglect have not helped. Between 1980 and 2005 total annual foreign assistance to less-developed countries that was designated for agricultural development declined from US\$ 8 billion to US\$ 3.4 billion, a reduction from 17 to 3 per cent of total foreign assistance to these countries. In the 1980s 25 per cent of US foreign aid went to agriculture. In the 1990s it was 6 per cent and in 2011 it was 1 per cent. The share of World Bank lending going to agriculture was 30 per cent in 1978, 16 per cent in 1988 and 8 per cent in 2006. In many developing countries themselves, including several Asia-Pacific nations, public commitment to investment in agriculture has also waned, as other development priorities have seemed more promising. The combined implication of the neglect of agriculture is that continued productivity growth in Asian agriculture can no longer be assumed.

Section 2 briefly reviews the definition of food (in)security, including the possibility of developing quantitative measures for it. Section 3 summarizes recent data on one such limited measure, undernourishment, meaning the proportion of the population whose intake of calories is below the nutritionally-determined minimum daily requirement. People below this level of caloric intake are not necessarily starving (most are not), but they are receiving insufficient caloric intake to lead a normal, active and healthy life. Moreover, people above but close to this level of caloric intake are vulnerable to negative shocks that might reduce their intake to welfare-reducing levels. Undernourishment, so defined, is thus one useful indicator of nutritional status, but nutritional adequacy involves more than just calories and this point is especially important for children. Section 4 briefly summarizes data on stunting and underweight among children under five years of age. Section 5 uses data on changes in undernourishment across countries to analyze first the effect of economic growth and relative food prices and second the roles of changes in the supply of food (availability) and changes in poverty incidence (access). Section 6 concludes.

THE MEANING OF FOOD SECURITY

Why food is different

Food is not a 'normal' commodity. It has no substitutes. If we are unable to obtain adequate food we suffer, and soon die, regardless of how much we possess of other things. Moreover, because our bodies lack the capacity to store large amounts of energy and other essential nutrients, we must have adequate food intake almost continuously. This applies most especially to children, whose development may be impaired permanently by prolonged dietary inadequacy. But for large numbers of poor people, the reliability of food supplies cannot be assumed. The prospect of food insufficiency, even if the probability is small and even if the expected duration of inadequate intake is short, is frightening for anyone. For these reasons, it makes sense to speak of 'food security' in a way that we do not speak of, say, 'clothing security' or 'entertainment security'. We can survive for a long time without a reliable supply of these things.

Food is different, but is it uniquely so? Clean drinking water, shelter, access to basic medical care and education for children are similarly essential, in addition to adequate nutrition. There are no substitutes for any of them. The cruel nature of poverty is that it compels households to make choices among these items, all of which are essential for a minimally adequate standard of living. It is therefore important to recognize that a focus on food security does not mean that other requirements for a decent life can be ignored. But there remains a basic difference between the requirement for food and almost all other 'essentials'. Whereas there is usually scope for temporary postponement of acquisition of other essentials, there is very limited scope to postpone the requirement for food, particularly in the case of children.

Defining food security

At the 1996 World Food Summit food security was defined as existing 'when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life.' The World Health Organization (WHO) adds to this definition a description that is widely cited and drawn upon in subsequent studies. It says that food security rests on three pillars:

- food availability (sufficient quantities existing);
- food access (households are able to obtain the quantities required); and
- food use (appropriate nutrition and hygiene).

The first two components of the WHO definition, food availability and food access, are generally understood to relate to the national level (aggregate supplies) and the household level (capacity to purchase). But there is another way of interpreting these two categories. Food availability may be thought of in terms, not of aggregate quantities of food, but of the prices at which food is available. This in turn depends on productivity in the production and distribution of food within the domestic economy, the capacity of international trade to augment domestic food supplies and supplementary measures to provide food to households otherwise unable to purchase it. Improving food availability is about reducing the supply price of food.

Food access, the capacity of households to obtain the food they require, depends on the level of household incomes relative to the price of food. But as noted above, food is not the only requirement for a decent life. The poverty line is a measure of the amount of income required to purchase the goods and services needed for a minimally adequate standard of living, and because food is so important it necessarily forms a large component of the poverty line. Poverty incidence measures the proportion of households whose incomes fall below this poverty line. Food access is therefore inversely related to poverty incidence. The lower the level of poverty incidence, the higher the proportion of households possessing adequate access to food. But reducing poverty incidence is not enough. Some households will continue to be food-deficient even though poverty incidence falls, and unexpected disasters can also lead to temporary but widespread hunger. *Improving food access is about reducing poverty and establishing food social safety nets.*

A problem with both the WHO and World Food Summit definitions is that they are non-quantitative. Our interest in the subject of food security derives from the fact that the stated conditions for food security do *not* always exist, as defined. But the degree of departure from these conditions varies. The focus on food security is motivated by the possibility of food *insecurity*, but there are degrees of food insecurity, some more severe than others. It is not obvious how varying degrees of departure from full food security could be quantified, based on the World Food Summit or World Health Organization definitions. An operational definition would make this quantification meaningful (United States Department of Agriculture, 2000). It is not enough to know merely whether food security does or does not exist. We need to be able to quantify the degree of departure from full food security. In contrast, the concept of poverty incidence has been precisely defined quantitatively, making it possible to study scientifically the causes of changes in poverty incidence over time and across environments.

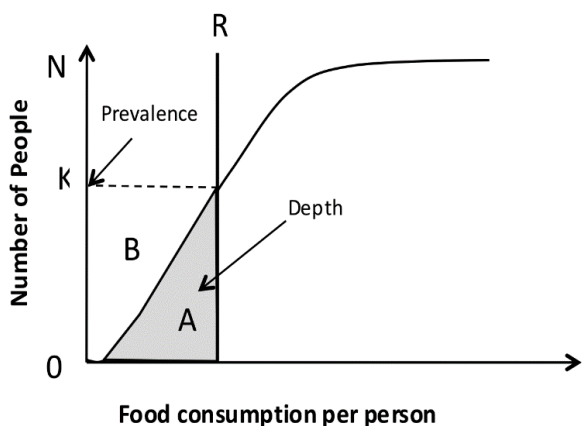
It is helpful to distinguish between three levels of food security.

- (i) *Household level* food security refers to having access to adequate food at all times, roughly along the lines of the above definition. At the household level, food 'security' relates to more than just the adequacy of food intake today. It implies something forward-looking, involving *expectations* of future circumstances and not simply present circumstances. In particular, it relates to the expected availability of sufficient food in the future, which inherently involves uncertainty.
- (ii) *National level* food security is based on food security at the household level. If households are not food secure, it is hard to see how the nation could be. The real price of food may be a good proxy for national food security.
- (iii) *Global level* food security means whether global supplies are sufficient to meet aggregate global requirements. Reportedly, there are just fewer than 1 billion hungry people in the world and also a similar number of obese people. The amount of food currently produced is seemingly enough for everyone, leaving only a problem of distribution. But while arithmetically correct, this simplistic description does not necessarily provide a practical means of reducing hunger in poor countries. Increasing food production in the poorest parts of the world may be the most effective means of reducing global hunger.

Data about current levels of food intake are useful as indicators of what expectations may be. Figure 2 draws upon the above concepts to show a hypothetical cumulative distribution function of food consumption per person at the national level. The population of size N is ordered from lowest food consumption per person (left hand side of the horizontal axis) to the highest (right hand side). The point at which the cumulative distribution cuts the horizontal axis is the lowest level of consumption that can be observed in the population. The vertical axis shows the number of people whose consumption of food per person is less than or equal to the quantity shown on the horizontal axis.

If food requirement per person is R , the number of persons with intake less than or equal to R is given by K . The proportion of the population whose intake is expected to be inadequate is therefore K/N . This ratio corresponds to the *prevalence* of undernutrition. The total amount of food that would need to be consumed by these K persons for their intake to be adequate is given by the rectangle KR . Their actual consumption is the area B . Area A is therefore a measure of the degree to which actual consumption falls below the requirement. It indicates the *depth of food insecurity*, or alternatively the magnitude of the *food security gap*. A measure of the food security gap that might be compared across countries is its magnitude relative to either total consumption or the total consumption that would occur if all persons consumed exactly R , given by RN .

Figure 2—Prevalence and depth of food insecurity: cumulative distribution function



Quantifying food security

Several measures of food security are available, all based at the national level. The International Food Policy Research Institute publishes a Global Hunger Index (GHI) and various Food Security Vulnerability Indices (FCVI). The Economist Intelligence Unit in association with Dupont publishes a Food Security Index (FSI). In addition the Food and Agriculture Organization of the United Nations, in association with the World Bank publishes a widely used Food Price Index (FPI).

It is important that the FPI weights the commodities used in the index with value of international trade as the basis for the weights, rather than global consumption. This means that commodities like sugar, that are highly traded, receive high weights relative to commodities like rice, where trade is small, even though rice is a much more important commodity in terms of consumption. This has been important in interpreting recent price surges because sugar prices have been increasing dramatically, but not those of staples such as rice. The FPI has increased as a result of the sugar price increases, reflecting their large weight in the index, but staple food prices were much more stable, a fact not reflected in the behavior of the index. While the spikes in the level of the FPI in 2007-08 did indeed reflect increased prices of staples, more recent price surges did not.

Considerable progress in the quantification of food security was made in a recent joint report of the Food and Agriculture Organization, the International Fund for Agricultural Development and the World Food Program, *The State of Food Insecurity in the World, 2012* (FAO/IFAD/WFP 2012). The report presents improved estimates, for most countries of the world, of average availability of dietary energy supplies and average protein supplies. It also provides data on access to food, measured as physical access in the form of paved roads relative to total roads, road density and the density of rail lines, and economic access in the form of food prices, though these prices are not related in the report to incomes, as is done in measures of poverty incidence. The report contains important information on nutritional outcomes, including the prevalence of undernourishment and the 'depth of the food deficit' meaning the degree to which consumption of the undernourished falls below dietary requirements.

More than calories

Nutritionists emphasize that food security is about more than just caloric intake. Protein intake is important as well, along with essential fats and micronutrients. Moreover, data on 'average' nutrient intakes miss the special importance of adequate nutrition for the development of children. Malnutrition in childhood contributes to mortality, mental and physical impairment and chronic disease risk across

the life cycle in a way that cannot always be remedied by improved diets later in life. In economic terms, malnutrition in childhood impedes the formation of human capital through investment in education, with subsequent implications for economic growth. Survey-based data summarized by Neufeld *et al.* (2012) show high levels of stunting in children under 5 years of age in South and Central Asia and parts of Southeast Asia. In South Asia childhood stunting has been reported in 40 per cent of children and severe wasting in over 5 per cent. But in addition the data show high levels of anemia (low levels of blood hemoglobin, arising from iron deficiency) and vitamin A deficiency in India, Pakistan, Nepal, Cambodia and Myanmar. Not far behind are Bangladesh, Vietnam, Indonesia and the Philippines.

Data assembled by the World Health Organization confirm that as real GDP per capita rises, the incidence of childhood stunting declines, on average, but the incidence of adult and childhood obesity rises. A reflection of the latter is the rising incidence of diabetes in Asia. In India and China the incidence of diabetes is already far higher than in Japan and even exceeds that in Western countries like the United States and Italy. Caloric adequacy is a necessary but not sufficient condition for food security. *Nutrition security* is about meeting, but not exceeding, dietary requirements across a range of essential nutrients. Nutrition insecurity, as defined above, can exist even in the presence of food abundance.

DATA ON UNDERNOURISHMENT

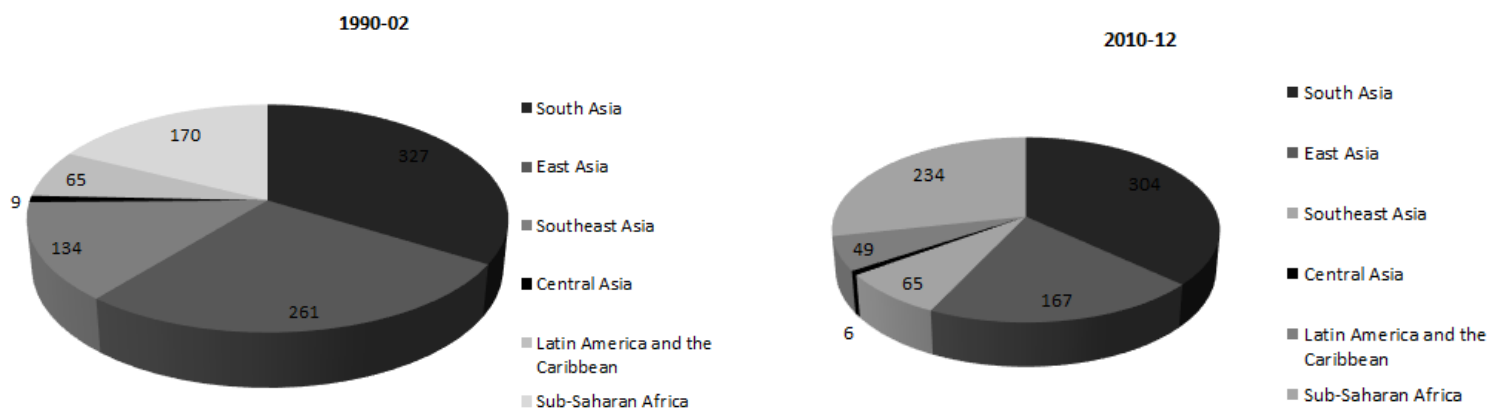
Undernourishment remains a serious social problem in Asia, but impressive progress has been made. Over the two decades from 1990-02 to 2010-02 the total number of undernourished people in the world declined from one billion to 868 million and the number in the Asia-Pacific region declined from 739 to 563 million. This means that the proportion of the global number of undernourished people represented by Asia declined from 74 per cent to 65 per cent. Within Asia the proportion of undernourished people within the total population declined from 23.7 per cent to 13.9 per cent.

Figure 3 and Table 1 summarize these newly available data. While in 2010-12 the proportion of the population that was undernourished was lower in Asia than in Sub-Saharan Africa (at 26.8 percent), the population of Asia was so much larger that the absolute number of undernourished people in Asia was still more than double (at 563 million) the number in Sub-Saharan Africa (at 234 million). In South Asia alone the number of undernourished people (327 million) exceeds the total number in Sub-Saharan Africa. Figures 4 to 7 show the time path of the FAO undernourishment data for 18 individual Asian countries.

The most striking feature of the data is the variation in the rates at which undernourishment has declined in different parts of the world. In Asia as a whole the rate of decline far exceeds the global rate. In Sub-Saharan Africa the absolute number of undernourished people increased over these two decades by 38 per cent, but within Asia the total declined by 24 per cent. The rate of improvement also varied widely within Asia. In Southeast Asia the absolute number of undernourished people declined by more than 50 per cent and East Asia was not far behind, at 36 per cent. But the rate of decline was much lower in South Asia, at 7 per cent. There may be many reasons for the variation but the differences seemingly correlate with differences in rates of poverty reduction, themselves correlating with differences in rates of economic growth.

The relationship between undernourishment and poverty incidence is explored further in Figures 8 and 9, for the developing countries as a whole and for Asia, respectively. For the developing countries as a whole, progress towards achieving the Millennium Development Goal target of halving by 2015 the 1990 rate of undernourishment is slightly behind schedule (shown by the dashed line), whereas for Asia and the Pacific as a whole the target has already been reached. These charts suggest that movements in undernourishment and poverty incidence are correlated, but that the relationship is far from a perfect one-to-one connection.

Figure 3— Numbers of undernourished people, 1990-92 and 2010-12



Source: Data from FAO Food Security Indicators, 2012.

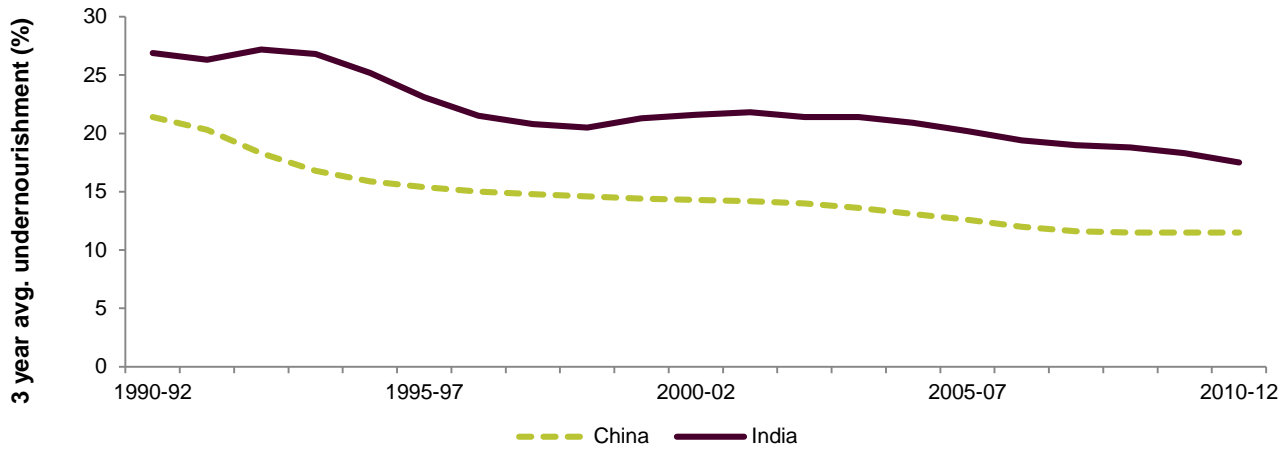
Table 1—The poverty-reduction gap between baseline growth and MDG1

Region		1990-92	2000-02	2010-12
World	Prevalence	18.6	14.9	12.5
	Depth	130	106	94
Asia	Prevalence	23.7	17.6	13.9
	Depth	165	125	104
Central Asia	Prevalence	12.8	14.5	7.4
	Depth	NA	98	51
East Asia	Prevalence	20.8	14.3	11.5
	Depth	151	98	77
South Asia	Prevalence	26.8	21.3	17.6
	Depth	175	150	127
South East Asia	Prevalence	29.6	19.2	10.9
	Depth	214	132	77
Oceania	Prevalence	13.6	15.9	12.1
	Depth	82	98	74
Sub-Saharan Africa	Prevalence	32.8	29.7	26.8
	Depth	235	219	205

Note: *Prevalence* means the percentage of the population with caloric intake less than the minimum daily requirement. *Depth* means the mean difference between intake and minimum daily caloric requirement, in kcal per person per day, among those whose intake is below the minimum daily requirement.

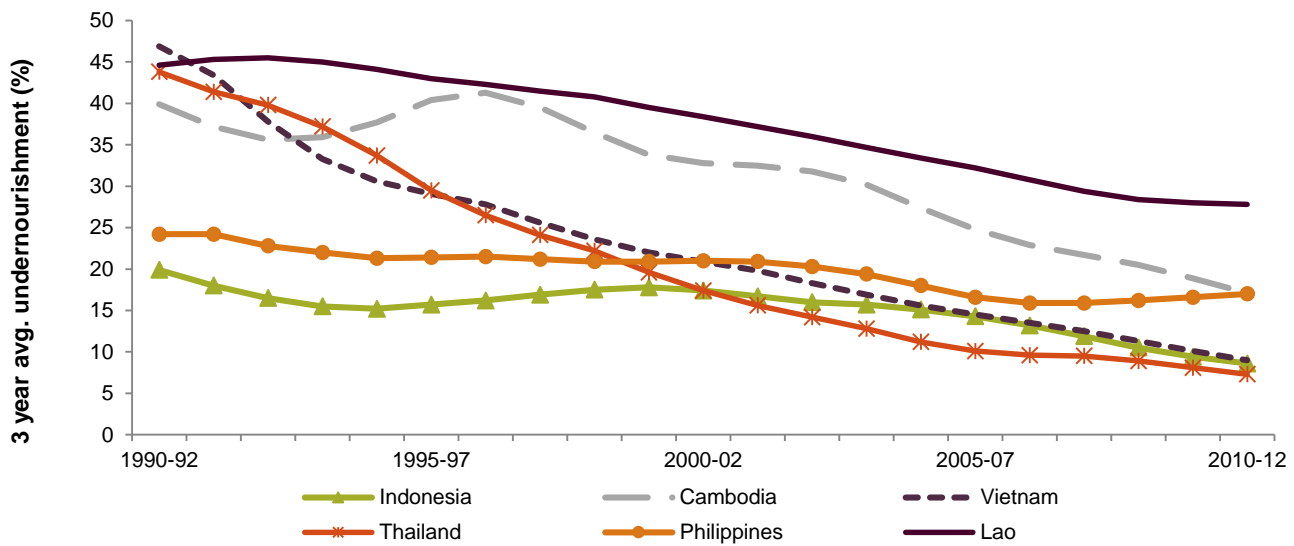
Source: Data from FAO Food Security Indicators, 2012.

Figure 4—Proportion of undernourished people: China and India



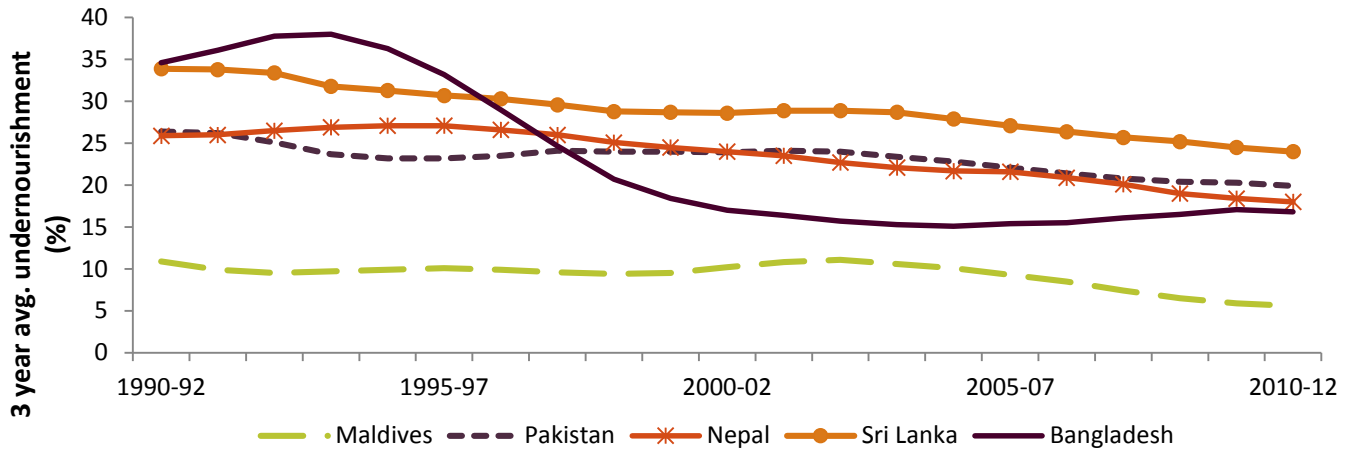
Source: Data from FAO Food Security Indicators, 2012.

Figure 5— Proportion of undernourished people: Southeast Asia



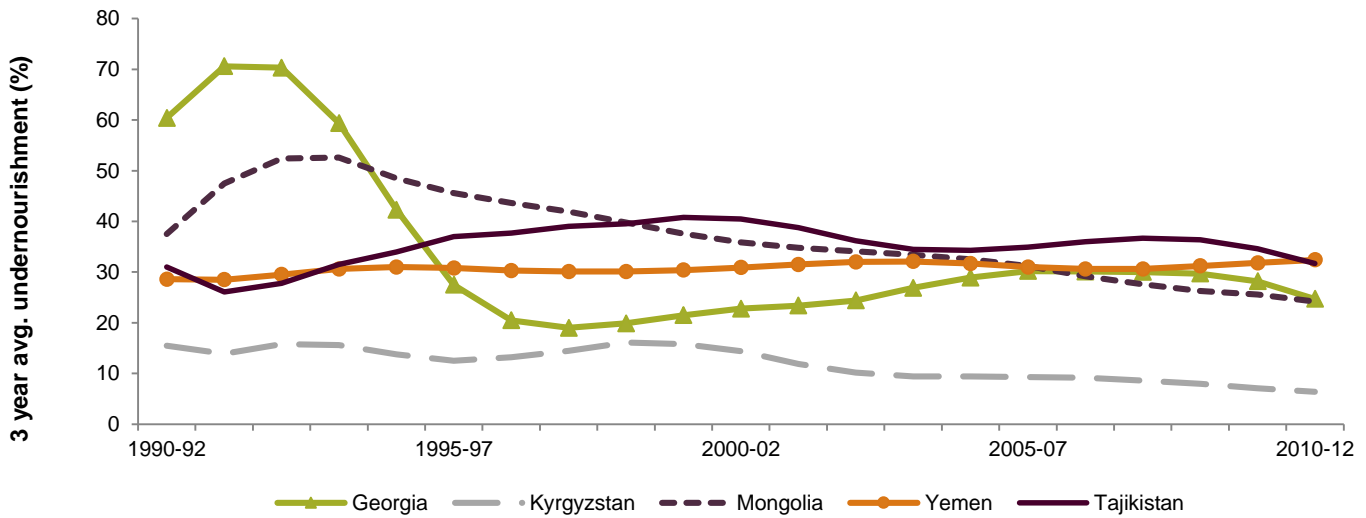
Source: Data from FAO Food Security Indicators, 2012.

Figure 6—Proportion of undernourished people: South Asia (except India)



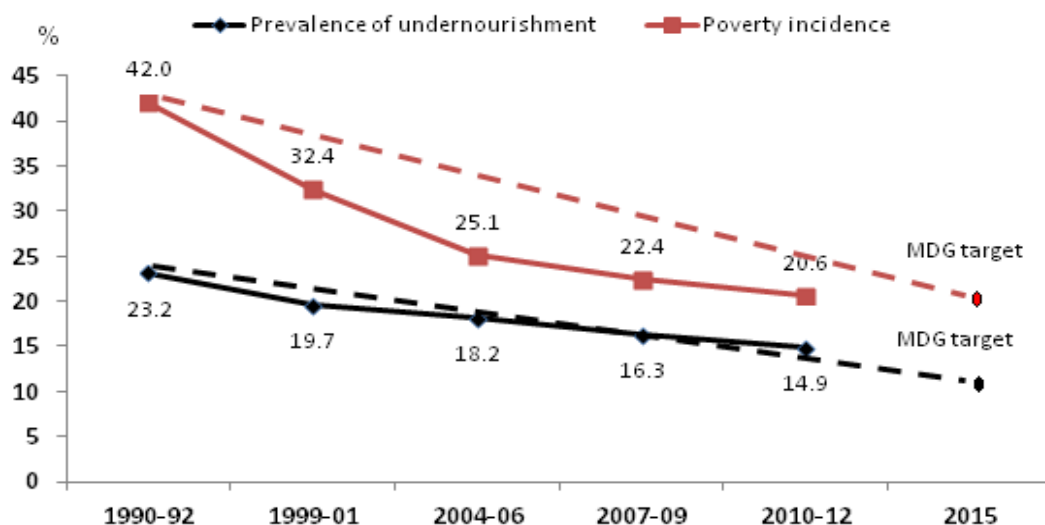
Source: Data from FAO Food Security Indicators, 2012.

Figure 7—Proportion of undernourished people: North, West and Central Asia



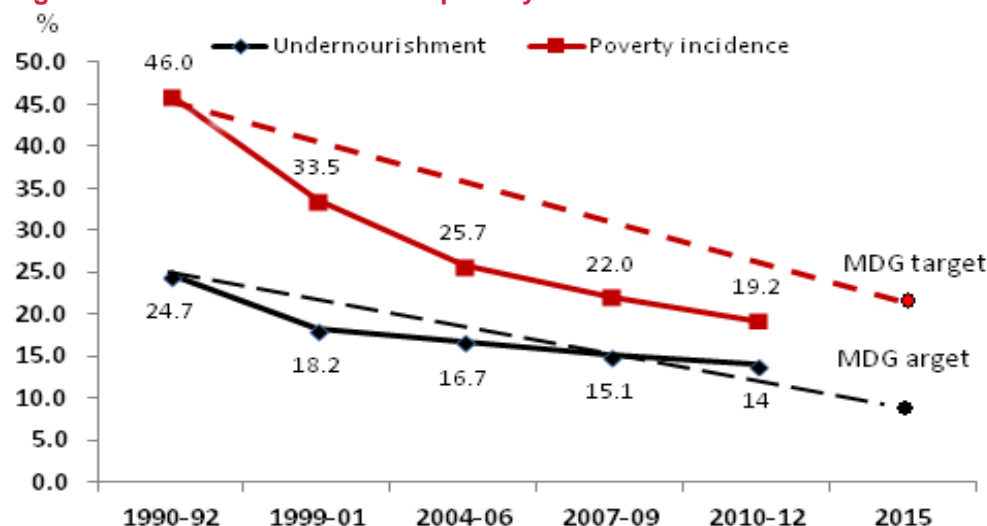
Source: Data from FAO Food Security Indicators, 2012.

Figure 8—Undernourishment and poverty in the developing countries



Source: Data from FAO Food Security Indicators, 2012 and World Bank, PovcalNet database (<http://iresearch.worldbank.org/PovcalNet/index.htm>).

Figure 9—Undernourishment and poverty in Asia



Source: Data from FAO Food Security Indicators, 2012 and World Bank, PovcalNet database. (<http://iresearch.worldbank.org/PovcalNet/index.htm>).

4. DATA ON STUNTING AND UNDERWEIGHT IN CHILDREN

Undernourishment, measured by caloric intake, is only one aspect of food security. Nutritionists also emphasize the importance of nutrients other than calories and often prefer to rely upon anthropometric measures of nutritional outcomes rather than measures of nutrient intake. Two important examples are stunting and underweight in children. Table 2 summarizes data on stunting and underweight in children under 5 years old in a manner comparable to Table 1 above for undernourishment. The decline in the incidence of stunting and underweight is far less impressive than the decline in overall undernourishment. Levels of stunting and underweight are both higher in South Asia than in Sub-Saharan Africa. Figure 10 shows that in Asia as a whole the decline of childhood stunting since the 1980s has exceeded the decline in other low and middle income countries the average incidence of stunting is still higher. Figure 11 shows that a similar point applies to the incidence of underweight in children.

Because stunting and underweight in children involve lagged effects of nutritional intake, it should not necessarily be expected that short time series data sets will explain changes in these nutritional outcomes well. Figure 12 shows a scatter diagram across countries of average annual rates of change of childhood stunting and economic growth. A significant relationship can be found between these variables, indicated by the fitted line. The statistical features of this relationship are summarized in Table 3. Although childhood stunting does respond significantly to economic growth in the short-run, the relationship is not strong. The true relationship is presumably longer-run than can be identified with these data and other factors are probably more important.

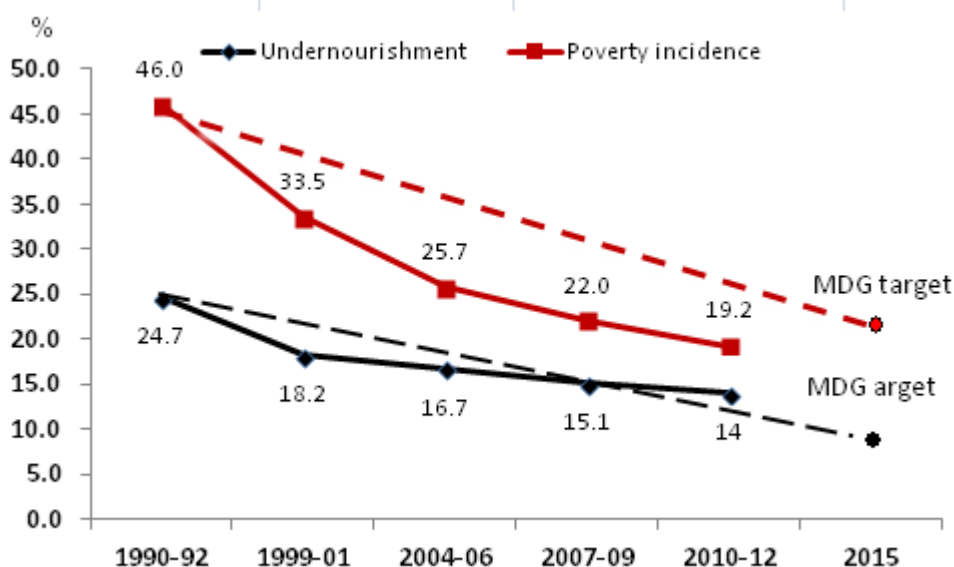
Table 2—Prevalence of stunting and underweight among children under 5 years old (%)

		1980s	1990s	2000s
World	Stunting	39.99	38.64	29.43
	Underweight	22.62	24.92	19.57
East Asia & Pacific	Stunting	39.81	31.99	19.35
	Underweight	22.21	15.75	9.64
South Asia	Stunting	63.97	55.90	47.33
	Underweight	52.81	48.35	41.57
Europe & Central Asia	Stunting	NA	23.30	12.87
	Underweight	NA	7.98	3.67
Latin America & Caribbean	Stunting	29.42	19.54	13.99
	Underweight	9.90	6.13	3.99
Middle East & North Africa	Stunting	30.62	27.91	21.89
	Underweight	10.86	11.38	9.06
Sub-Saharan Africa	Stunting	39.31	42.91	42.22
	Underweight	22.41	26.12	24.77

Note: Stunting is the prevalence of stunting among children under 5 years old (%). Underweight is the prevalence of underweight among children under 5 years old (%)

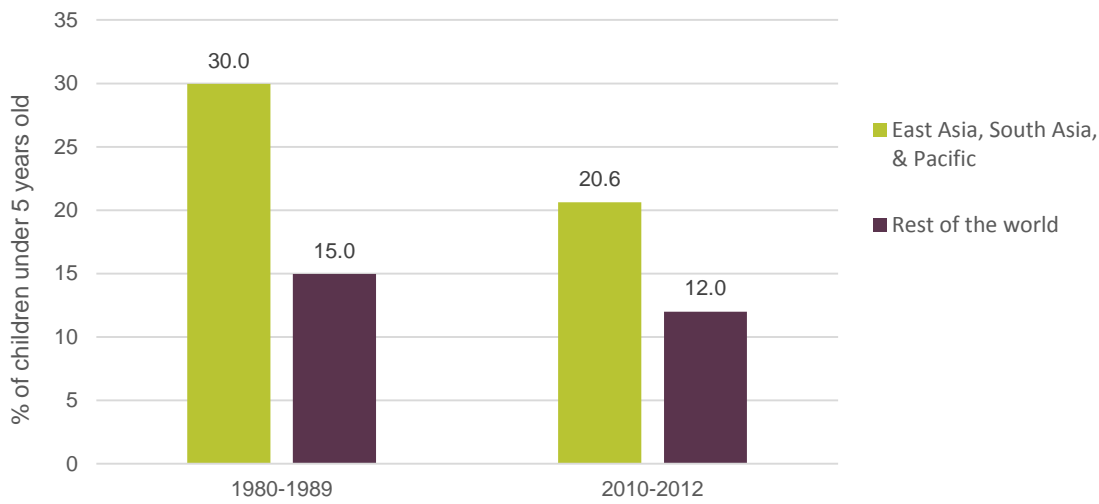
Source: Data from IFPRI, based on data from World Bank, World Development Indicators. Geographic regions are classified according to the World Bank classification.

Figure 10—Stunting among children under 5 years old



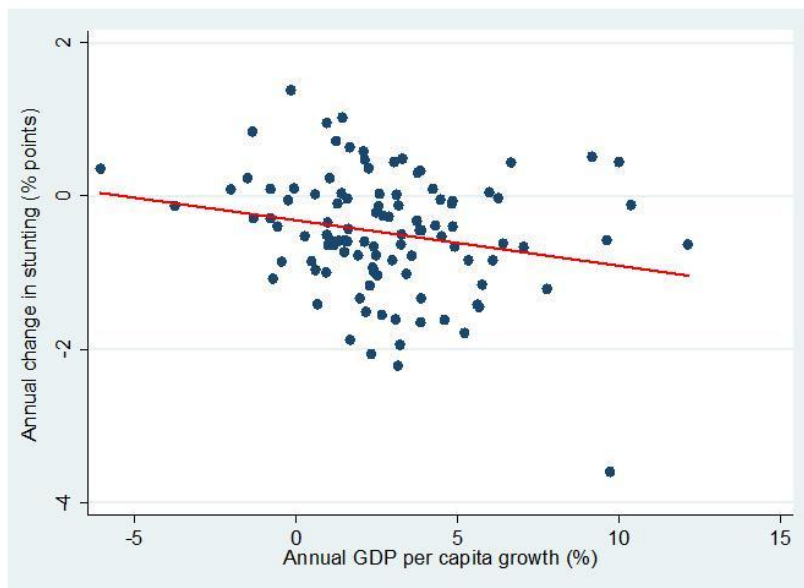
Source: Author's calculations using data sources as in Table 2.

Figure 11—Underweight among children under 5 years old



Source: Author's calculations using data sources as in Table 2.

Figure 12—Childhood stunting and economic growth



Source: Author's calculations using data sources as in Table 2 and economic growth data from World Bank, *World Development Indicators*.

Table 3—Regression results for the fitted line in Figure 12

	Stunting	Underweight
GDP growth	-0.059**	-0.040
per capita	(0.026)	(0.024)
Constant	-0.318***	-0.276***
	(0.104)	(0.098)
<i>N</i>	106	107
<i>R</i> -sq.	0.049	0.025
adj. <i>R</i> -sq.	0.040	0.016
<i>F</i> -stat	5.327	2.741
<i>p</i> -value for <i>F</i> -stat.	0.023	0.101
Standard errors in parentheses		
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.		

Source: Author's calculations.

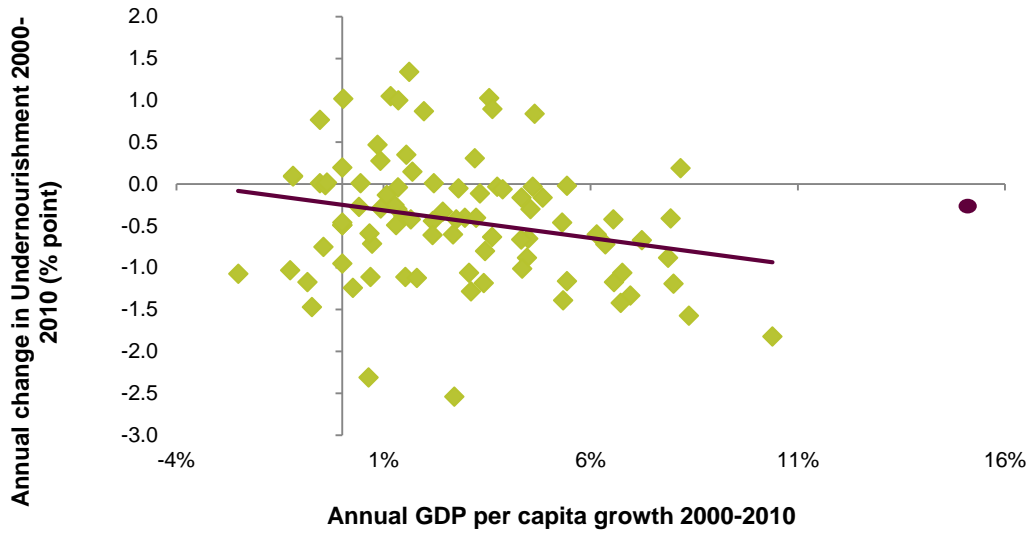
5. DETERMINANTS OF UNDERNOURISHMENT

The FAO's landmark 2012 report, *State of Food Insecurity in the World*, emphasizes the importance of economic growth as a 'necessary but not sufficient' condition for reductions in undernourishment. The relevance of economic growth is confirmed by Figures 13 to 16. The line appearing in each chart is a regression equation fitted to the data, with statistical details provided in Table 4. The relationship is statistically significant for the developing countries as a whole and for Asia, but not for Africa or Latin America. The quality of fit is poor. A better explanation of changes in undernourishment is surely possible.

Table 4 shows the relevance of disaggregating GDP growth into its major sectoral components: agriculture, industry and services. The equation utilizes the identity that the growth rate of GDP is equal to the sum of the sectoral growth rates, each multiplied by its share of GDP. The value of this decomposition of GDP is that if the composition of GDP growth matters for its effects on the reduction of undernourishment, the coefficients estimated for the various sectors will be significantly different. It is thus possible to study whether the sectoral composition of growth is important for undernourishment by testing the null hypothesis that the true sectoral coefficients are the same. An *F*-test for this restriction is provided in the final row of Table 4 (*p*-value for null). The hypothesis is rejected for both the prevalence and depth of undernourishment. Growth of agriculture is overwhelmingly more important than growth of industry or services. Indeed, agriculture is the only component of GDP for which a significant effect can be found. The negative and significant coefficient for agriculture means that higher growth of agricultural output is associated with larger reductions in undernourishment.

Table 4 also includes a variable for the real price of food, constructed from consumer price data. The relevance of this variable is that GDP and its sectoral components relates to incomes. But undernourishment surely also depends on the consumer price of food relative to other goods. Undernourished people are likely to have high budget shares for food – higher than the national average. This implies that their consumption of food may be particularly sensitive to changes in food prices relative to other prices. The results in Table 4 strongly confirm the importance of this variable. Higher food prices mean higher levels of undernourishment.

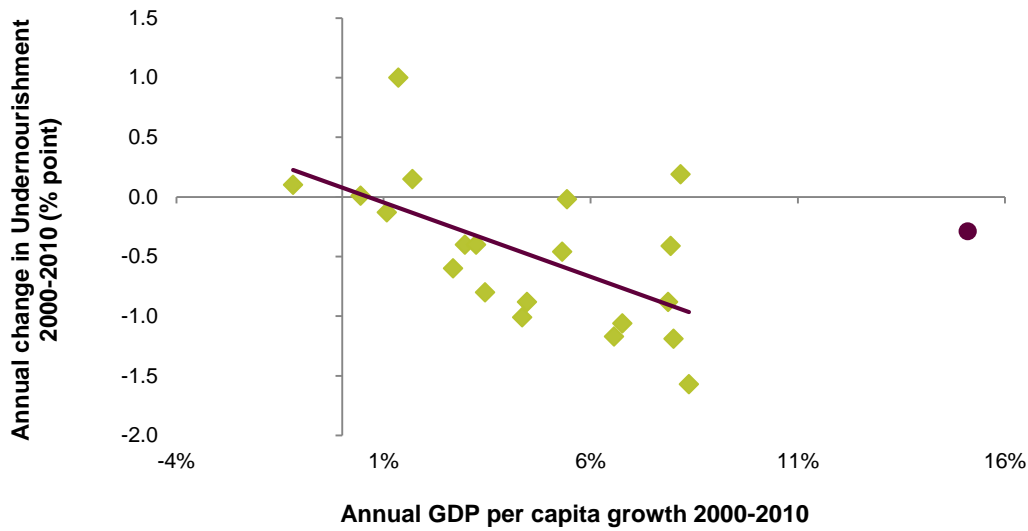
Figure 13—Reduction in undernourishment and economic growth: Developing countries



Note: The dot to the far right is China, which was excluded from the data used in the regression.

Source: Author's calculations using data from FAO *Food Security Indicators*, 2012 and World Bank, *World Development Indicators*, various issues.

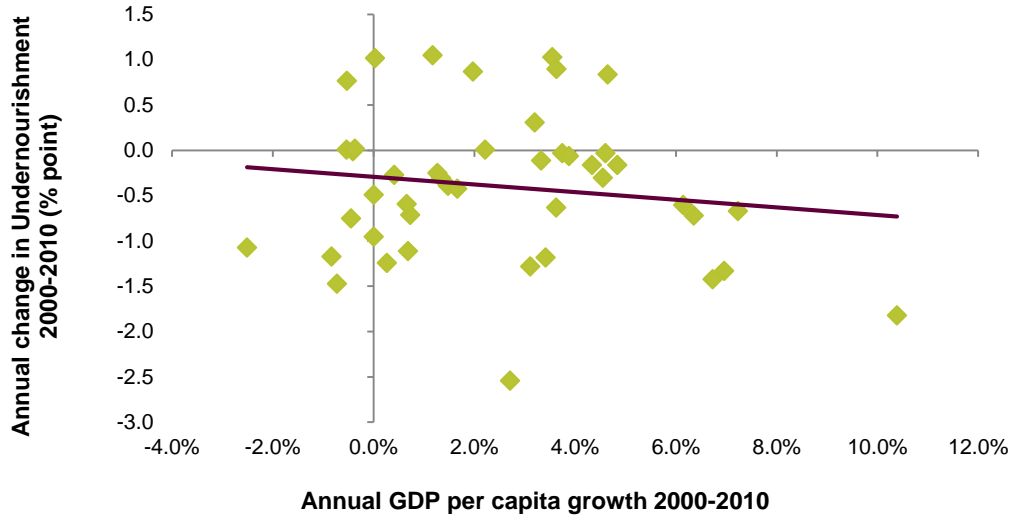
Figure 14—Reduction in undernourishment and economic growth: Asia



Note: The dot to the far right is China, which was excluded from the data used in the regression.

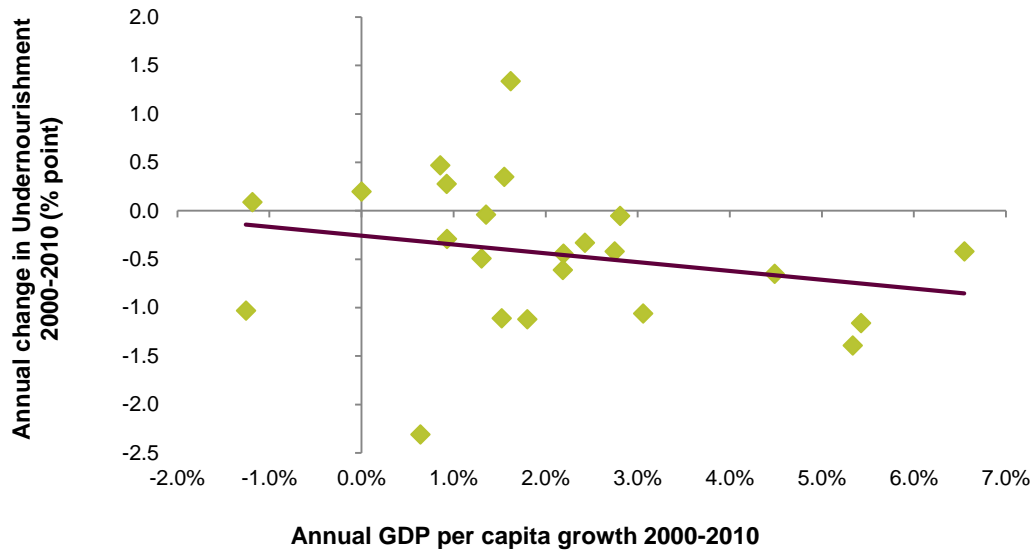
Source: Author's calculations using data from FAO *Food Security Indicators*, 2012 and World Bank, *World Development Indicators*, various issues.

Figure 15--Reduction in undernourishment and economic growth: Africa



Source: Author's calculations using data from FAO *Food Security Indicators*, 2012 and World Bank, *World Development Indicators*, various issues.

Figure 16--Reduction in undernourishment and economic growth: Latin America



Source: Author's calculations using data from FAO *Food Security Indicators*, 2012 and World Bank, *World Development Indicators*, various issues.

Table 4--Regression results for fitted lines, Figures 13 to 16

	Developing Countries	Asia	Africa	Latin America
Real GDP growth p.c.	-7.068** (2.969)	-13.744** (5.789)	-4.958 (4.731)	-7.929 (8.207)
Constant	-0.223* (0.118)	0.157 (0.330)	-0.252 (0.176)	-0.303 (0.242)
<i>N</i>	85	17	42	23
<i>R</i> -sq.	0.064	0.273	0.027	0.043
adj. <i>R</i> -sq.	0.053	0.225	0.002	-0.003
<i>F</i> -stat	5.666	5.637	1.098	0.934
<i>p</i> -value for <i>F</i> -stat.	0.020	0.031	0.301	0.345
Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.				

Note: The regressions for 'Developing countries' and 'Asia-Pacific' exclude China because it is an extreme outlier.

Source: Author's calculations using data from FAO *Food Security Indicators*, 2012 and World Bank, *World Development Indicators*, various issues.

It might be conjectured that the particular manner in which the FAO undernourishment data have been constructed artificially lends itself to the results described above. Table 4 shows, in the last two columns that very similar results are obtained if changes in poverty (the headcount measure of poverty incidence and the poverty gap measure) are used as the dependent variables instead. The poverty data used are from the World Bank's 'Povcal' database and relate to the \$1.25 per day poverty line at 2005 purchasing power parity. Growth of agriculture and lower food prices are strongly associated with both reductions in undernourishment and reductions in poverty incidence.

Table 5.--Undernourishment, poverty and economic growth

	Change in undernourishment		Change in poverty	
	Prevalence of undernourishment	Depth of undernourishment	Poverty incidence	Poverty gap
Agriculture	-0.445* (0.231)	-4.711** (2.006)	-0.998*** (0.346)	-0.593** (0.242)
Industry	-0.175 (0.191)	-1.595 (1.657)	-0.258 (0.286)	0.056 (0.200)
Services	0.168 (0.105)	1.839* (0.914)	0.029 (0.157)	0.041 (0.110)
Real price of food	4.815** (2.349)	36.342* (20.415)	7.495** (3.519)	1.867 (2.461)
Constant	-5.355** (2.415)	-39.973* (20.983)	-8.148** (3.617)	-2.372 (2.530)
<i>N</i>	41	41	41	41
<i>R</i> -sq.	0.252	0.289	0.368	0.182
adj. <i>R</i> -sq.	0.169	0.210	0.298	0.091
<i>p</i> -value for model	0.0299	0.0133	0.0020	0.1144
<i>p</i> -value for null	0.0259	0.0058	0.0217	0.0565

Source: Author's calculations using data from FAO, World Bank and ILO.

The food security literature emphasizes the distinction between the *availability* of food, meaning aggregate supplies available, and *access* to food, meaning the capacity of households to purchase food. These two variables are used in Table 5 as explanatory variables for changes in undernourishment. Availability of food is measured by FAO data on domestic supplies of available food (output plus imports minus exports minus wastage minus storage). Access to food is measured by World Bank data on the headcount measure of poverty incidence described above.

The results indicate that an increase in food availability is the more significant determinant of a reduction in undernourishment. Changes in poverty incidence have the expected positive coefficient but the coefficient is not significantly different from zero. Readers unfamiliar with regression analysis may be more persuaded by the scatter diagram in Figure 11. The relationship between reductions in

undernourishment and changes in food availability (measured here as calories supplied as a proportion of the requirements for dietary adequacy) is clear. The results point to the value of improved agricultural productivity as a driver of reductions in undernourishment.

This point is made even more forcefully by Table 6, which exploits the statistical fact that the estimated regression equations shown in Table 5 must pass through the means of the data. This means that the mean value of the dependent variable (average annual change in undernourishment) is exactly equal to the sum of the mean value of each independent variable multiplied by its estimated coefficient plus the estimated constant term.

Increases in the average availability of food explain almost all (98.5 per cent) of the average reduction in the prevalence of undernourishment. Poverty reduction contributes to 12.3 per cent of the reduction. The negative contribution of the constant term (-10.6 per cent) means that if availability of food and access to food each did not improve undernourishment would increase. This constant term captures the impact of independent variables not included in the regression.

Figure 17--Undernourishment and food availability

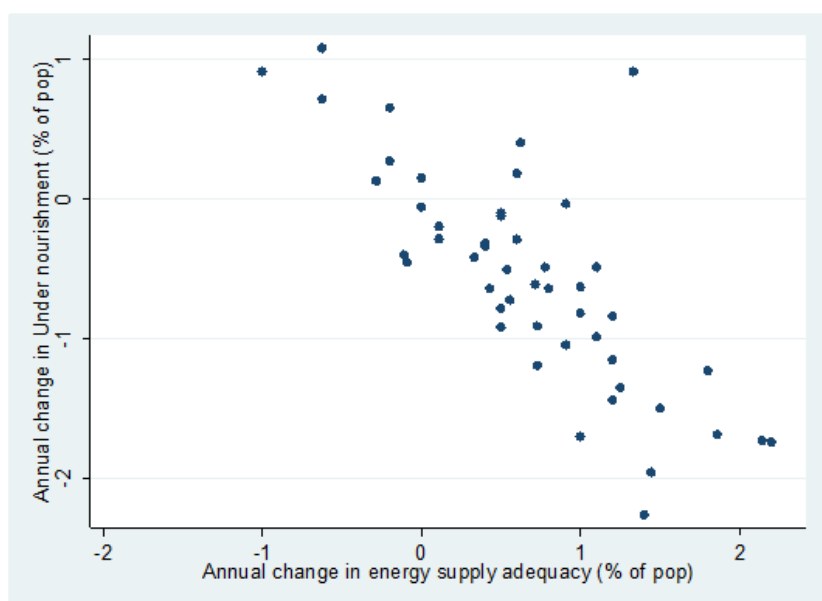


Table 6--Undernourishment, food availability and food access

Dependent variable: Change in Undernourishment		
	Prevalence of undernourishment	Depth of undernourishment
Independent variables:		
Change in food availability	0.828***	-6.824***
(aggregate supplies)	(0.110)	(1.062)
Change in food access	0.062	0.554
(poverty incidence)	(0.060)	(0.582)
Constant	0.060	1.541
	(0.108)	(1.037)
<i>N</i>	49	49
<i>R</i> -sq.	0.108	0.535
adj. <i>R</i> -sq.	0.591	0.515
<i>p</i> -value	0.0000	0.0000

Source: Author's calculations using data from FAO and World Bank.

6. CONCLUSIONS

The countries of Asia have made larger reductions in the proportion of the population that is undernourished than developing countries as a whole. Nevertheless, Asia still accounts for 62 per cent of all undernourished people in the world and 13.9 per cent of the Asian population remains undernourished. Stunting in children remains a major problem. Within Asia 34.4 per cent of children under

five years old are stunted and 20.6 per cent are underweight. These numbers are both higher than the global average for low and middle income countries.

The evidence clearly indicates that expansion of agricultural output within developing countries themselves is strongly associated with reductions in the rate of undernourishment. It is not sufficient to rely solely on aggregate economic growth or reductions in poverty incidence to deliver improved food security. But the evidence also shows that higher food prices significantly increase the rate of undernourishment. What are needed are means of raising agricultural output without at the same time raising food prices.

Two policy strategies are available and both are currently in use within Asia and elsewhere. The first is investment in the infrastructure and knowledge required to raise agricultural productivity. The second is policy interventions designed to raise agricultural product prices. In food importing countries this is frequently associated with a policy drive for food self-sufficiency. Both policies are capable of increasing agricultural output. But the first does so without raising food prices. The second uses increased food prices as its central instrument.

Agricultural protection aimed at achieving food self-sufficiency is often described as a policy for improving food security. It is not that. It delivers benefits to many food insecure people who are net sellers of food. But these numbers are far exceeded by the number of food insecure people who are net buyers of food and who are made more food insecure by increased food prices.

The policy implication is that food security can be improved by raising agricultural productivity through investments in infrastructure and research, supplemented by food safety nets to assist those unable to benefit from market based economic development. Agricultural protection should be avoided because it produces a net increase in food insecurity.

REFERENCES

- Olivier Ecker and Clemens Breisinger (2013). 'Revisiting Food and Nutrition Security: A Comprehensive Overview', *Journal of Agricultural Economics and Development*, 2 (7): 280-289.
- Ugo Gentilini (2007). *Cash and Food Transfers: A Primer*, World Food Programme, Occasional Papers No. 18.
- Derek Heady and Shenggan Fan (2008). 'Anatomy of a Crisis: The Causes and Consequences of Surging Food Prices', *Agricultural Economics*, 39 (3): 375-391.
- ShikhaJha, Ashok Kotwal and Bharat Ramaswami (2012). 'The Role of Social Safety Nets and Food Programs'. Paper presented to Symposium on Food Security in Asia and the Pacific, University of British Columbia, Vancouver, September.
- William Martin and Kym Anderson (2011). 'Export Restrictions and Price Insulation During Commodity Price Booms', *American Journal of Agricultural Economics*, 94 (2): 422-427.
- Lynnette Neufeld, J Chowdhury and MT Ruel (2012). 'Strengthening Nutrition within the Food Security Agenda'. Paper presented to Symposium on Food Security in Asia and the Pacific, University of British Columbia, Vancouver, September.
- Mark W. Rosegrant, et al (2010). 'Food Security, Farming, and Climate Change to 2050,' International Food Policy Research Institute, Washington DC.
- C. Peter Timmer (2008). 'Causes of High Food Prices'. ADB Economics Working Paper Series, No. 128, Asian Development Bank, Manila.
- C. Peter Timmer (2010). 'Behavioral Dimensions of Food Security'. *Proceedings of the National Academy of Sciences (PNAS)*, Agricultural Development and Nutrition Security Special Feature.
- United States Department of Agriculture, *Guide to Measuring Household Food Security* (Revised 2000), <available at: <http://www.fns.usda.gov/fsec.files.fsguide.pdf>>
- Peter Warr (2005). 'Food Policy and Poverty in Indonesia: A General Equilibrium Analysis', *Australian Journal of Agricultural and Resource Economics*, 49 (4): 429-451.

Peter Warr (2008). 'World food prices and poverty incidence in a food exporting country: A Multihousehold General Equilibrium Analysis for Thailand', *Agricultural Economics*, 39 (3): 525-537.

Peter Warr (2011). 'Food Security vs. Food Self-Sufficiency: The Indonesian Case' *The Indonesia Quarterly*, vol. 39, no. 1 (First Quarter), 56-71.

Peter Warr and Arief Yusuf (2013) 'Food Prices and Poverty in Indonesia', *Australian Journal of Agricultural and Resource Economics* (forthcoming).

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