



FOOD SECURITY AND NUTRITION

PERSPECTIVE PAPER

*Benefits and Costs of the Food Security and Nutrition
Targets for the Post-2015 Development Agenda*

Susan Horton

John Hoddinott

The role of development partnerships in agriculture and agribusiness in promoting prosperity, reducing poverty and enhancing sustainable livelihoods in the Pacific region

Submission 4

Attachment 3

INTRODUCTION	1
THE EVOLUTION OF THE NUTRITION GOALS	1
ADVANTAGES AND DISADVANTAGES OF THE STUNTING GOAL	2
SOME ADVANTAGES OF THE STUNTING GOAL.....	2
SOME DISADVANTAGES.....	4
AN ECONOMIC PERSPECTIVE ON THE STUNTING GOAL	5
SENSITIVITY ANALYSIS: MODELING BENEFITS OF LONGER TIME IN WORKFORCE	8
CONCLUSIONS: A STUNTING GOAL?	9
REFERENCES.....	10

Introduction

Nutrition has always been a key development indicator. Good nutrition allows for healthy growth and development of children, and inadequate nutrition is a major contributing factor to child mortality. Good nutrition is also important for cognitive development, and hence educational success, both of which are important determinants of labour productivity and hence economic growth. Good nutrition also implies balance – neither undernutrition nor overnutrition.

In what follows we will first briefly review the evolution of nutrition goals, from the Millennium Development Goals (MDGs) to 2015, to the World Health Organization targets to 2025, and the proposed Sustainable Development Goals (SDGs) to 2030. We then comment briefly on the proposed SDG for nutrition, and provide an economic perspective on the goal (using Hoddinott et al, 2013), suggesting that the benefit:cost ratio of nutrition investments is very attractive.

The Evolution of the Nutrition Goals

Stunting – low height for age – is an excellent nutrition indicator to include in the SDGs. It improves on the earlier nutrition indicator used in the MDGs. MDG 1 had two quantitative targets and one qualitative: halving the poverty rate; halving the number “hungry”; and a more aspirational goal regarding access to employment. “Hunger” in turn was defined in terms of the number of children who were underweight (using the WHO Child Growth Standards), hence the specific goal was to halve the proportion of children underweight over the period 1990 to 2015.

Over the decade or so since the MDGs were set, our understanding of undernutrition and its measurement has advanced further. Underweight (weight for age) is a composite measure, which aggregates two different aspects of undernutrition, namely weight for height (or wasting, a measure of current nutritional status) and height for age (or stunting, a measure of long-run nutritional status). The underweight goal has served its purpose to focus attention on nutrition. Going forward we can improve on the original MDG target in two ways. First, stunting is a better indicator than underweight. And second, in a world with some regions with growing population, a goal of halving the proportion who are hungry, is a weaker goal (easier to achieve) than one of halving the current number who are hungry.

Just to illustrate why stunting is a better indicator than underweight, imagine a child who is born and grows up in early childhood consuming a diet largely consisting of starchy staples, and whose mother faced the same diet during her pregnancy. Such a diet is devoid of the variety of foods needed to provide the minerals and vitamins required for healthy growth. This child is likely to end up stunted by age two (short for his/her age), after which catch-up in height is more difficult. This child may also be (according to Barker, 1992) “programmed” for a diet of scarcity, and more vulnerable to obesity if faced with high fat and high added-sugar foods. The MDG goal (halving underweight) will incorrectly

categorize this child as of normal weight, whereas the proposed SDG goal (stunting) will correctly categorize this child as suffering from long-run undernutrition. Lutter et al (2011) demonstrate that using the underweight goal for Latin America would have suggested in 2008 that all 13 countries were on track to meet MDG 1 (expressed in terms of underweight); however if stunting had been used instead of underweight, 5 of the 13 countries would not be on track to meet the goal.

The most recent draft of the SDGs available from the Open Working Group (2014) as of July 19 2014 includes two lofty (but hard-to-measure) goals (end hunger; and end all forms of malnutrition), and two measurable goals (achieve the WHO goals for stunting and wasting). The World Health Organization nutrition goals for 2025 (WHO, 2014), as adopted by the World Health Assembly, are to:

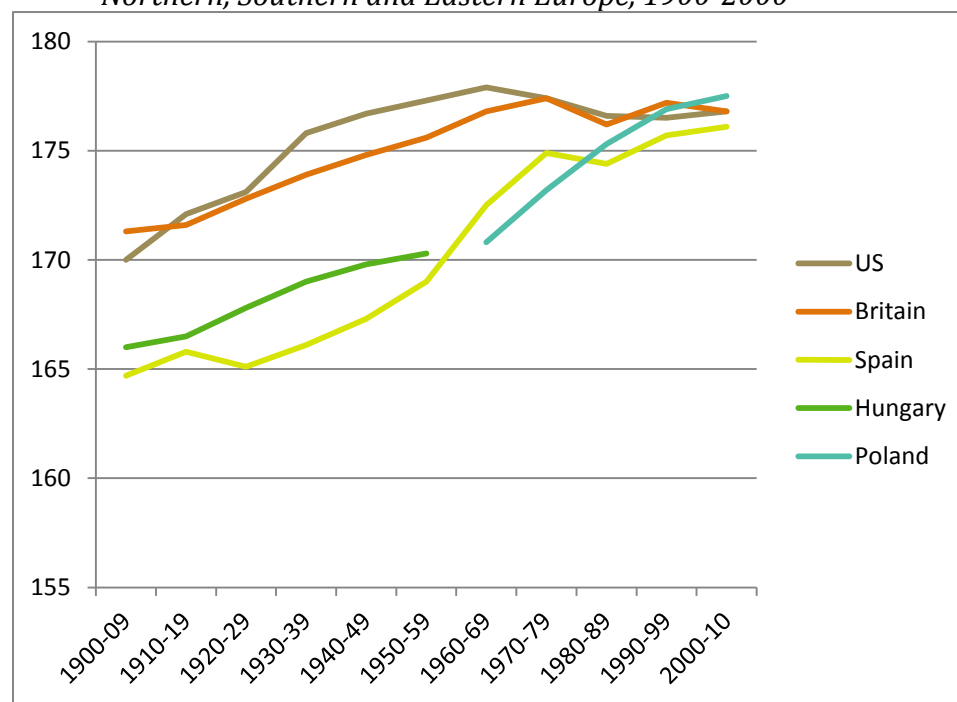
- Reduce by 40 per cent the number of children under 5 who are stunted.
- Achieve a 50 per cent reduction in the rate of anemia in women of reproductive age.
- Achieve a 30 per cent reduction in the rate of infants born low birth weight.
- Ensure that there is no increase in the rate of children who are overweight.
- Increase to at least 50 per cent the rate of exclusive breastfeeding in the first six months.
- Reduce and maintain childhood wasting to less than 5 per cent.

Advantages and Disadvantages of the Stunting Goal

Some Advantages of the Stunting Goal

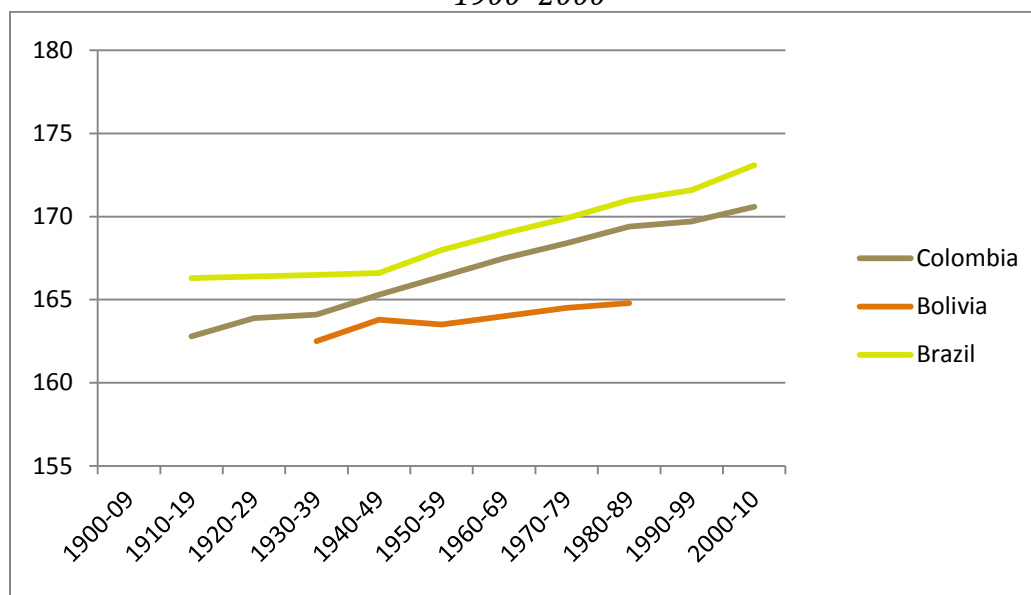
- Child growth depends on dietary intake (quality and quantity) for the first 1000 days, i.e. for the mother during pregnancy, and for the child during the first two years of life;
- Growth also depends on health status, and is affected by improvements in sanitation and reduced infection;
- Growth also is affected by quality of care, and children who have both better nutrition/health and care, do better than those with only one of these inputs;
- Hence growth is a good indicator of the quality of the early life environment;
- Growth is readily measurable (although it relies on reasonably good age data), and is less invasive than nutrition indicators which require samples of bodily fluids;
- Child height at age two is a good predictor of achieved adult height;
- Achieved adult height is associated with wages: from a survey of 8 high income countries (Gao and Smyth, 2010) the median increase of hourly wages per 1 cm of additional height was 0.55%; and from a survey of 8 low and middle income countries, the median was 4.5% (Horton and Steckel, 2013); and
- Achieved adult height also tracks economic development quite well (Figures 1, 2 and 3 from Horton and Steckel, 2013, which show that height tracks the economic “takeoff” for a range of countries)

Figure 1 - Trends in adult male height (in cm), representative countries from North America, Northern, Southern and Eastern Europe, 1900-2000



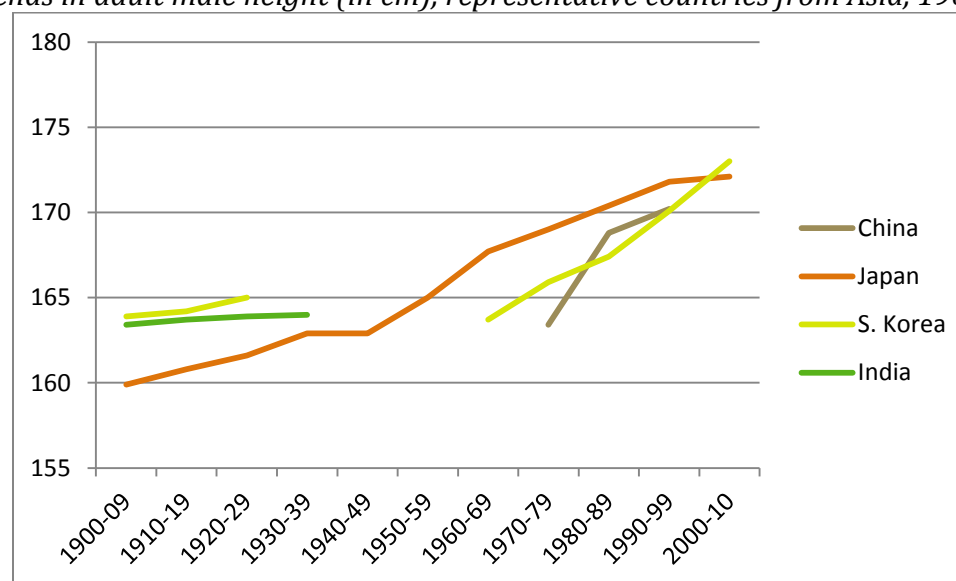
Source: Horton and Steckel (2013)

Figure 2 - Trends in adult male height (in cm), representative countries from South America, 1900 -2000



Source: Horton and Steckel (2013)

Figure 3 - Trends in adult male height (in cm), representative countries from Asia, 1900-2000



Source: Horton and Steckel (2013)

Some Disadvantages

- Height deficits in children cannot be overcome in one generation: even with excellent nutrition and the best health environment, the mother's own achieved height can limit the height of her offspring, i.e. heights do not adjust instantaneously to improved environments. One can imagine that there is survival value in mothers not giving birth to children who are considerably larger than the mothers themselves were at birth;
- Height is a measure of long-term nutritional status, and it is helpful to interpret in conjunction with information on weight for height;
- Some children have normal height but are thin for their height (wasted) because of famine or near-famine conditions: wasting is more closely linked with immediate mortality outcomes than stunting;
- Likewise, children may have normal height but be obese;
- Height for age in adolescents can be somewhat difficult to interpret: the adolescent growth spurt typically later in poorer countries; however this is not an issue when setting an under-five stunting target.

Finally, it will be important to recalibrate the WHO goal when setting the SDG goal. It seems a little unambitious for the SDG goal to simply lengthen the time horizon from 2025 to 2030, without also increasing the target reduction. However the WHO goal (a 40% drop in the number over 15 years) is very ambitious considering that the MDG goal was a 50% drop in the proportion over 25 years and that between 1997 and 2012 only five countries (Nepal, Bangladesh, Lesotho, Vietnam and Ethiopia) achieved annual reductions in stunting of 1.2 percentage points per year or more (Headey and Hoddinott, 2014). According to UNICEF (2014), there were 169 million stunted children in 2010, hence the 2025 goal would be to reduce this to 101 million.

An Economic Perspective on the Stunting Goal

A few studies have made estimates of the contribution of stunting to GDP, of which one (Hoddinott et al, 2013) calculates the benefit:cost ratio of nutrition interventions aimed at reducing stunting). Hoddinott et al (2013) point out the channels through which height can affect future income. There is a direct effect on wages (taller individuals may earn more, more so in low and middle income countries where physical productivity matters in some manual occupations). There are also indirect effects through improved cognition and hence wages (individuals with higher cognitive scores earn more, and also via their increased schooling achievement, also earn more). There are also potentially increased health costs associated with chronic disease in adulthood, for which undernutrition in childhood can be a risk factor.

Hoddinott et al (2013) take advantage of longitudinal data on approximately 1450 individuals in Guatemala who were followed up in adulthood, two to three decades after they participated in a controlled trial of a nutrition supplement in childhood. A detailed resurvey of these individuals obtained data on their hourly earnings, hours worked, marital status, migration patterns, household consumption and other variables. Those individuals who were not stunted at three years of age, were found to have household consumption 66% higher in adulthood, using econometric methods to control for other confounding variables. This is taken as an estimate of the returns to better nutrition (avoiding stunting). (Hoddinott et al, 2013, apply 90% of 66%, i.e. a 59.4% increase, in their model, just to be a little conservative).

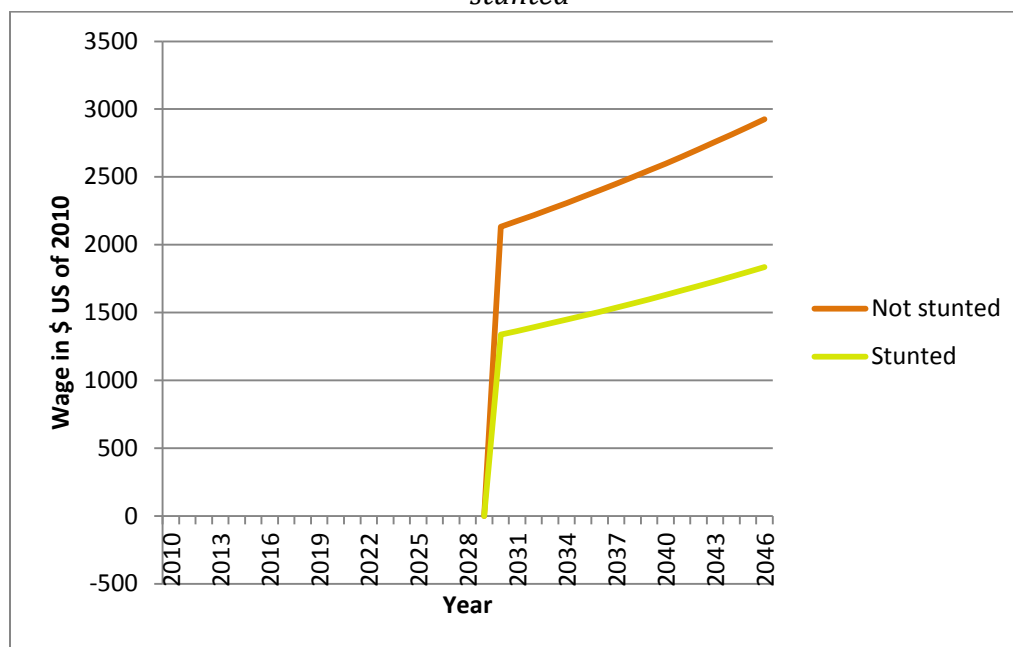
Hoddinott et al (2013) compare these returns to the cost of improving nutrition, using costs from an evidence-based package of interventions (Bhutta et al, 2013). The intervention package is expected (using an epidemiological model) to reduce stunting by 20%. (The other 80% reduction requires changes to the underlying determinants of nutrition, for example increased agricultural production, increased empowerment of women, investments in sanitation etc, which tend to be more costly than direct nutrition interventions). Hoddinott et al (2013) model the application of the package of direct nutrition interventions in 17 countries with a high burden of stunting (nine countries in Africa and the Middle East, five in South Asia, and three in East Asia, whose combined population in 2012 exceeded 2.5 billion).

The costs are calculated for a cohort of children born in 2015, who receive the interventions up until age two, who enter the labour market at age 21, and for whom the benefits are modeled until they reach age 36¹. The dollar value of the benefits is based on current per capita income, projected growth rates of GNP, and the 59.4% benefit from improved nutrition. Costs and benefits are discounted at 5% (and for sensitivity analysis also at 3%). In Figure 4, we show the future benefit for a country similar to Bangladesh, (the country with the median benefit: cost ratio), comparing future labour market outcomes for a child who was not stunted, with those for a child who was. When these benefits are

¹ Beyond this point, future benefits start to be less significant due to discounting, and this also allows for early mortality of some of the population. We model the future benefits, and benefit cost ratios out to ages 50 and 60 in a sensitivity analysis presented in Table 2.

discounted back to 2010 (the year when the child was born), these give the values (PV Benefit) in Table 1, which can be compared to the costs of a nutrition intervention occurring in the child's first year of life, costing around \$100/child in each of the 17 countries.

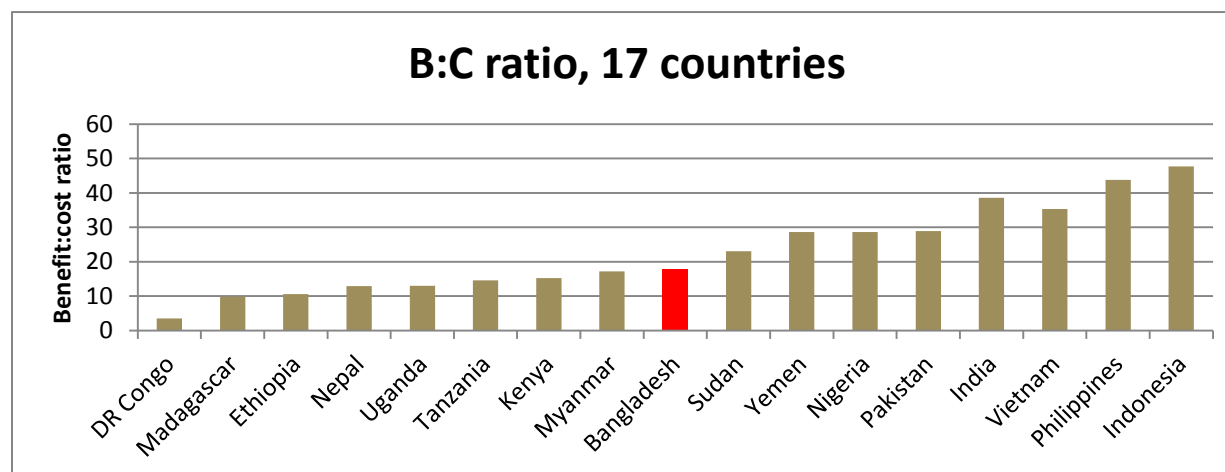
Figure 4 - Wage path for children born in 2010 who are not stunted, compared to those stunted



Note: This example assumes growth of per capita GDP in real terms of 2% per annum over the 36 years considered, in a hypothetical country similar to Bangladesh.

The benefit: cost ratios calculated range from 3.5:1 (Democratic Republic of the Congo) to 42.7 (Indonesia) when a 5% discount rate is used (Figure 5). The variations depend on the country's current level of income, projected growth rate, the current rate of stunting, and other parameters. Countries which are growing faster and/or have higher incomes have higher benefit:cost ratios, because the absolute dollar value of the benefits (due to higher wages) are greater, while there is less variation in costs of the nutrition intervention.

Figure 5 - Benefit:cost ratio for nutrition investments, 17 countries



Source: author, based on Hoddinott et al (2013)

Table 1 below summarizes the estimates for the 17 countries. The total cost will depend on the number of children in each country.

Table 1 - Benefit:cost ratio per child for nutrition investment in 17 countries
 (From Hoddinott et al, 2013).

Goal: 40% stunting reduction	3% discount rate			5% discount rate		
	PV Benefit	PV Cost	B:C ratio	PV Benefit	PV Cost	B:C ratio
Indonesia	8884	94.83	93.7	4522	94.83	47.7
Philippine	8152	94.83	86	4150	94.83	43.8
India	7358	97.11	75.8	3745	97.11	38.6
Vietnam	6583	94.83	69.4	3351	94.83	35.3
Pakistan	5519	97.11	56.8	2810	97.11	28.9
Yemen	5449	97.11	56.1	2774	97.11	28.6
Nigeria	4928	102.99	47.8	2508	102.99	24.4
Sudan	4632	102.5	45.2	2358	102.5	23
Bangladesh	3408	97.11	35.1	1735	97.11	17.9
Burma	3274	97.11	33.7	1667	97.11	17.2
Kenya	3070	102.5	30	1563	102.5	15.2
Tanzania	2945	102.5	28.7	1499	102.5	14.6
Uganda	2613	102.5	25.5	1330	102.5	13
Nepal	2461	97.11	25.3	1253	97.11	12.9
Ethiopia	2138	102.5	20.9	1088	102.5	10.6
Madagascar	1918	102.99	19.3	1012	102.99	9.8
DRC	713	102.5	7	359	102.5	3.5

Would the Bhutta et al (2013) investment package be sufficient to achieve a 40% (or greater) reduction in numbers stunted between 2010 and 2030? For Bangladesh, the median country in terms of benefit: cost ratio, the stunting rate in 1990 was 63.4%, which fell to 41.4% in 2010 (UNICEF, 2014), i.e. a 35% (22.0 percentage points) reduction in stunting. If the Bhutta et al (2013) investment package caused a 20% reduction from 41.4% and the same trend reduction of 35% (from 1990 to 2010) continued for another 20 years, this should be enough to reduce the proportion of stunting by close to 50% between 2010 and 2030. Bangladesh had 6.334 million stunted children in 2010 (41.4% of 15.3 million children under 5). In 2025, the number of children under 5 is projected to be 14.2 million, and if the proportion stunted falls to 20.7% (half of 41.4%), then there would be 2.9 million stunted children in 2025, which achieves the WHO goal. This is however very much a preliminary estimate, which would require a more detailed analysis to substantiate.

Can we generalize this informal estimate to other countries? Bangladesh is an unusual case, in that it has a trend rate of reduction in stunting (even without adding nutrition interventions) which is higher than the average for low and lower-middle income countries. Clearly the biggest concern regarding numbers of stunted children will be what happens in Sub-Saharan African countries where the underlying trends are currently in the wrong direction as proportions of children stunted are decreasing slowly, but absolute numbers stunted are increasing, because numbers of children under 5 are increasing.

Sensitivity Analysis: Modeling Benefits of Longer Time in Workforce

The results presented in Table 1 assume that individuals work only until the age of 36 or that the benefits of improved nutrition stop at age 36. Under this conservative assumption the benefit:cost ratios are generally large and justify interventions to reduce stunting.

Table 2 summarizes the results when this assumption is relaxed. The methodology is the same as described above, except that the benefits, in terms of the increase in income, continue until either age 50 or 60. Unsurprisingly the benefits and benefit-cost ratios are larger than in Table 1. For Bangladesh, the median country, the benefit:cost ratios when benefits up to age 50 are included, are 23.8 and 62.2 for the 5% and 3% discount rates respectively. For the optimistic scenario of working career to age 60, the corresponding benefit:cost ratios are 24.5 and 77.7. Note that we have not factored in premature mortality, so that the results to ages 50 and 60 are somewhat on the optimistic side.

Table 2_Benefit:cost ratio per child for nutrition investments in 17 countries for individuals working to age 50 or 60

	Benefits to age 50		Benefits to age 60	
	3%	5%	3%	5%
DRC	12.3	4.7	15.4	4.9
Madagascar	34.2	13.1	42.7	13.5
Ethiopia	37.0	14.1	46.2	14.6
Nepal	44.9	17.2	56.1	17.7
Uganda	45.2	17.3	56.4	17.8
Tanzania	51.0	19.5	63.6	20.1
Burma	59.8	22.8	74.6	23.5
Kenya	60.0	22.9	74.9	23.6
Bangladesh	62.2	23.8	77.7	24.5
Sudan	80.2	30.6	100.0	31.5
Nigeria	84.9	32.4	105.9	33.4
Yemen	99.5	38.0	124.2	39.2
Pakistan	100.8	38.5	125.8	39.7
Vietnam	123.1	47.0	153.7	48.5
India	134.4	51.3	167.7	52.9
Philippines	152.5	58.2	190.3	60.0
Indonesia	166.2	63.5	207.4	65.4

Conclusions: A Stunting Goal?

Stunting is a better goal than underweight. It is an excellent measure of the health, diet and care provided to children during the 1000 days from conception to age two. Although it is not quite as predictive of mortality as underweight, it is much more predictive of economic outcomes (cognitive scores, education and wages). Stunting data need to be complemented with additional information provided about the extremes in weight for height, namely wasting in countries facing short-term crises, and overweight/obesity in all countries, even the low and middle income ones.

Economic models suggest that the returns to investments in nutrition have high benefit cost ratios, and that this should be a top development priority. A very rough estimate suggests that reducing numbers stunted by 40% by 2030 globally would be a “stretch” goal – optimistic, but possibly achievable with strong effort. A higher target might prove problematic unless trends in Sub-Saharan Africa change.

References

- Barker, D.J.P. (1992). The Fetal and Infant Origins of Adult Disease. Chichester, West Sussex: BMJ Books, Wiley-Blackwell.
- Bhutta, Z. A., J. K. Das, A. Rizvi, M. F. Gaffey, N. Walker, S. Horton, P. Webb, A. Lartey, R. E. Black for Lancet Maternal and Child Nutrition & Interventions Review Groups Evidence based interventions for improving maternal and child nutrition: what can be done and at what cost? Lancet 382 (9890): 452-477, 2013.
- Gao, W. and R. Smyth, (2010). Health human capital, height and wages in China: Journal of Development Studies 46, 466-484.
- Headey, D. and J. Hoddinott, (2014). Understanding the Rapid Reduction of Undernutrition in Nepal, 2001–2011. IFPRI Discussion paper 01384, Washington DC.
- Hoddinott, J., H. Alderman, J. R. Behrman, L. Haddad and S. Horton. The economic rationale for investing in stunting. Maternal and Child Nutrition 9(S2): 69-82, 2013.
- Horton, S. and R.H. Steckel. (2013). Malnutrition: global economic losses attributable to malnutrition 1900-2000 and projections to 2050. In B. Lomborg (ed.) How much have global problems cost the world?. Cambridge: Cambridge University Press.
- Lutter, C.K., C. M. Chaparro and S. Muñoz. (2011). Progress towards Millennium Development Goal 1 in Latin America and the Caribbean: the importance of the choice of indicator for undernutrition. Bulletin of the World Health Organization 89:22-30.
- Open Working Group (2014). Proposal of the Open Working Group for Sustainable Development Goals, July 19 2014. Available at <http://sustainabledevelopment.un.org/focussdgs.html> (Accessed October 5, 2014).
- UNICEF. (2014). Child Nutrition interactive dashboard. Available at <http://data.unicef.org/resources/2013/webapps/nutrition> (Accessed October 5, 2014).
- WHO (2014). Introduction: Global Nutrition Targets Policy Brief Series. WHO: Geneva. Available at http://www.who.int/nutrition/topics/globaltargets_policybrief_overview.pdf (Accessed October 6, 2014).

This paper was written by Susan Horton, CIGI Chair in Global Health Economics, University of Waterloo, Canada and by John Hoddinott, H.E. Babcock Professor of Food & Nutrition Economics and Policy at Cornell University and Deputy Director in the Poverty Health and Nutrition Division at International Food Policy Research Institute. The project brings together 60 teams of economists with NGOs, international agencies and businesses to identify the goals with the greatest benefit-to-cost ratio for the next set of UN development goals.

For more information visit post2015consensus.com

C O P E N H A G E N C O N S E N S U S C E N T E R

Copenhagen Consensus Center is a think tank that investigates and publishes the best policies and investment opportunities based on how much social good (measured in dollars, but also incorporating e.g. welfare, health and environmental protection) for every dollar spent. The Copenhagen Consensus was conceived to address a fundamental, but overlooked topic in international development: In a world with limited budgets and attention spans, we need to find effective ways to do the most good for the most people. The Copenhagen Consensus works with 100+ of the world's top economists including 7 Nobel Laureates to prioritize solutions to the world's biggest problems, on the basis of data and cost-benefit analysis.

