

# PRIORITIZING NUTRITION IN AGRICULTURE AND RURAL DEVELOPMENT:

## Guiding Principles for Operational Investments

Anna Herforth, Andrew Jones, and Per Pinstrup-Andersen

November 2012



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## Health, Nutrition, and Population (HNP) Discussion Paper

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# Health, Nutrition, and Population (HNP) Discussion Paper

## Prioritizing Nutrition in Agriculture and Rural Development: *Guiding Principles for Operational Investments*

Anna Herforth,<sup>a</sup> Andrew Jones,<sup>b</sup> and Per Pinstруп-Andersen<sup>b</sup>

<sup>a</sup> Consultant, The World Bank, Washington, DC

<sup>b</sup> Division of Nutritional Sciences, Cornell University, Ithaca, NY

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**Abstract:** Agricultural and rural development provides a critically important opportunity for reducing malnutrition. The purpose of this paper is to provide a set of guiding principles for incorporating nutrition goals into the design and implementation of agricultural and rural development projects, and to provide examples of current best-evidence options for operational investments. Several principles are likely to be important in all or most cases for nutrition-sensitive agriculture, which can be adapted to individual contexts. These include the following:

1. Incorporate nutritional concerns into the design and implementation of agricultural policies, projects, and investments
2. Target nutritionally vulnerable groups
3. Invest in women
4. Increase year-round access to diverse, nutrient-dense foods
5. Protect health through water management
6. Design poverty-reduction strategies explicitly to benefit nutrition
7. Create enabling environments for good nutrition through knowledge and incentives
8. Seek opportunities to work across sectors

To help assess which actions are most relevant for a specific situation, a set of key questions are included after each broad principle. The paper also highlights areas where agricultural investments may cause harm, and provides options for improving policy coherence.

The principles underscore investments in people and systems that have the potential to transform underlying conditions and positively influence the multiple, proximal determinants of proper nutrition. Further research and evaluation priorities include tracking impact on multiple outcomes at once (such as diet, nutritional status, productivity, and income); designing studies that can attribute impact to specific approaches; and collecting information on costs and cost-effectiveness. Although there is a need to strengthen knowledge around design and implementation strategies, there is good evidence that well-planned investments are likely to reach at least targeted income and dietary outcomes. Existing knowledge around the recommended principles is sufficient to move ahead in designing nutrition-sensitive agricultural interventions.

**Keywords:** agriculture, nutrition, food security, programs, policy.

**Disclaimer:** The findings, interpretations, and conclusions expressed in the paper are entirely those of the authors, and do not represent the views of the World Bank, its Executive Directors, or the countries they represent.

**Correspondence Details:** Anna Herforth, The World Bank, 1818 H Street NW, Washington, DC, [aherforth@worldbank.org](mailto:aherforth@worldbank.org); [www.worldbank.org/nutrition](http://www.worldbank.org/nutrition).

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## EXECUTIVE SUMMARY

Agricultural and rural development provides a critically important opportunity for reducing malnutrition, partly because a large share of the malnourished resides in rural areas and partly because agriculture is the source of food and other ecological services for both rural and urban people. Many factors influence human nutrition; the impact of agricultural and rural development on human nutrition is neither automatic nor predetermined. Both undernutrition (stunting, underweight, wasting, and micronutrient malnutrition) and overnutrition (overweight and obesity) are costly for human and economic development, and both are influenced by agriculture and the food system.

Abundant evidence shows that when farmers are malnourished, they are less productive; improving the nutrition of rural populations will improve agricultural productivity. Putting a nutrition lens on an agricultural investment can also improve gender equity in that investment — an increasingly common goal of the agriculture sector — because it shifts focus toward the labor, income control, and time use of women. It can also improve ecological sustainability in cases where crop diversification contributes to both human and ecosystem health. In many instances, it is also good business to produce nutritious foods, since demand for high-value horticultural and animal source foods is rising in urban areas, and could rise further with improved education and incentives. Food security is regularly used as a justification for agricultural activities, and because food security rests on the access to nutritious diets, greater attention to nutrition impact will help ensure that many agricultural investments remain true to their rationale.

The purpose of this paper is to provide a set of guiding principles for incorporating nutrition goals into the design and implementation of agricultural and rural development projects, and to provide examples of current best-evidence options for operational investments. While many agricultural approaches to improve nutrition have shown promise, there is no one-size-fits-all silver bullet approach. To choose among operational approaches, assessing the context in which agricultural operations will occur is essential. Further, both concerted action and policy coherence are needed to avoid unintended negative consequences on nutrition through agriculture policies and programs. Several principles are likely to be important in all or most cases for nutrition-sensitive agriculture; these can be adapted to individual contexts:

- 1. Incorporate nutritional concerns into the design and implementation of agricultural policies, projects, and investments.** The primary ways to achieve this principle are to include a nutrition objective as an explicit program or policy goal, and to measure nutrition-related outcomes. In measurement of impact, the highest priority should be given to measurement of determinants of nutrition most likely to be affected by agricultural projects, particularly household food consumption and diet (for example, through indicators such as dietary diversity); indicators will vary with respect to the project activities and goals. If child nutritional status (for example, height or weight for age) is the target for impact, it should be measured if sample size is sufficient, and if plausible pathways for improving nutritional status can be identified and measured.

2. **Target nutritionally vulnerable groups:** Within the population, target the poorest households: the project or policy should be targeted to reach the most vulnerable group(s) involved in or affected by agricultural incomes and food prices, particularly smallholder farmers, landless laborers, and the urban poor. Investments can reach vulnerable indigenous groups better if they are modified appropriately. Within households, target women of childbearing age and young children. Agriculture has the potential to greatly contribute to child nutrition within the 1,000-day window between conception and age two, not only by ensuring consistent access to diverse diets, but also safeguarding environmental resources and the health of household members.

3. **Invest in women:** Women have a large role in the food security and nutrition in the household. Agricultural investments can strengthen women's decision-making power and control of economic resources, for example through providing increased market opportunities for women's crops, increased access to land rights and other productive resources, and by supporting women's income generation with facilitation of high-quality child care and time-saving technologies. Agricultural project planners are accustomed to assessing market price and agronomic characteristics when selecting crops to be included in projects; gender characteristics could also be included as a criterion.

4. **Increase year-round access to diverse, nutrient-dense foods** through increased production and productivity, market access, and demand creation. A broader diversity of foods can be included in agricultural training, extension, seed provision programs, and exports. Improving the nutritional content of staple foods through biofortification, industrial fortification, and zinc and iodine fertilizers is also a promising tool for increasing micronutrient intake. Control of mycotoxins, including aflatoxins, also improves quality and safety of food with strong implications for health and nutrition. The impact of seasonal food shortages can be diminished through measures to increase consumption of nutrient-dense foods throughout the year, such as solar drying or other preservation technology, early or late-season crop varieties that extend the growing season, income-generation activities during off-seasons, and links with social protection measures.

5. **Protect health through water management,** primarily through safeguards to minimize potential harm from water-borne diseases and chemical contamination of water and through efforts to improve water use efficiency.

6. **Design poverty-reduction strategies to explicitly benefit nutrition.** At household level, the nutrition impact of household income can be enhanced through a focus on women and nutrition knowledge. At a larger scale, measured outcomes of agricultural growth should include food security and public health — considering the dual burden of undernutrition and obesity that is closely linked to the food system — in addition to productivity and economic growth. Poverty reduction, a primary goal of agriculture and rural development investments, can become more nutrition-sensitive through pro-poor investments in services and infrastructure.

**7. Create enabling environments for good nutrition through knowledge and incentives.** Evidence has shown that incorporating nutrition education into agricultural investments helps to translate production and income gains into nutrition improvements. Some nutrition-relevant information is best communicated by agricultural extensionists or project staff. Efforts that involve the entire family in revaluing the importance of women's time, resources, and nutrition and the care of children have been shown as more likely to shift behaviors to benefit nutrition. Policies can support or undermine poverty reduction and nutritious diets, and are a much larger factor that can be leveraged to enable households to put nutrition knowledge into practice.

**8. Seek opportunities to work across sectors.** Multisectoral action is critical to reducing all causal factors of malnutrition. There may be opportunities within each program to interact with programs in other sectors working to improve nutrition: examples include multisectoral planning and geographic overlap, establishing a national shared architecture for nutrition improvement, conducting joint nutritional impact assessments, and referring clients to other sector projects. Supporting multisectoral coordination often requires activities to increase the capacity of government ministry staff across sectors to understand and address malnutrition.

The principles put forth in this document underscore investments in people and systems that have the potential to transform underlying conditions and positively influence the multiple, proximal determinants of proper nutrition. Better information on impact and costs of *specific approaches* based on the above principles would be extremely helpful to inform better program design and best practice examples for scale-up. Research and evaluation priorities include tracking impact on multiple outcomes at once (such as diet, nutritional status, productivity, and income); better designing studies to attribute impact to specific approaches; and collecting information on costs and cost-effectiveness.

Although there is an urgent need to strengthen the understanding of how agricultural policies, projects, and investments can be designed and implemented to achieve nutrition goals, existing knowledge around the guiding principles in this document is sufficient to move ahead with designing nutrition-sensitive agricultural interventions. Rather than to rationalize inaction based on incomplete evidence on operational approaches, it would be sensible to base agricultural investments on principles of how agriculture can affect nutrition, strengthened by good evidence that well-planned investments are likely to reach at least targeted income and dietary outcomes. The next step is to put the principles outlined in this document into action, and learn from the results.

## INTRODUCTION

The triple burden of malnutrition consists of (1) insufficient intake of dietary energy and protein resulting in hunger, reduced learning ability, diseases, and premature death; (2) micronutrient deficiencies causing physical and cognitive deficits, anemia, blindness, and reduced resistance to a variety of health risks; and (3) excess intake of dietary energy resulting in overweight, obesity, and chronic diseases. Malnutrition continues to present a very serious set of global public health problems and is an important contributor to slow economic growth, widespread poverty, and high rates of morbidity and mortality in most developing countries. As the international development community reviews progress toward the MDGs, the need to ramp up efforts to tackle undernutrition is clear, given the critical role that nutrition plays in achieving many, if not most, of the MDGs. The new Scaling-up Nutrition (SUN) Framework and Roadmap<sup>1</sup> — endorsed by over 100 partners, including CSOs, academia, bilateral partners, UN agencies, the private sector, foundations, and the World Bank — identifies the need for action to address malnutrition through many sectors, particularly agriculture. Improving nutrition through agriculture has been the subject of over 40 recent policy documents, supported by over two dozen institutions (FAO 2012), including Food and Agriculture Organization (FAO), Department for International Development (DFID), the European Commission, USAID, USAID’s Infant and Young Child Nutrition Project (IYCN), ACDI/VOCA, Action Against Hunger (ACF), Save the Children UK, and World Vision, as well as a series of briefs and papers resulting from an international conference hosted by the International Food Policy Research Institute (IFPRI) on “Leveraging Agriculture For Improving Nutrition and Health” (2011)<sup>2</sup> and a new knowledge platform of the World Bank.<sup>3</sup>

Agricultural and rural development provides a critically important opportunity for reducing malnutrition, partly because a large share of the malnourished resides in rural areas and partly because agriculture is the source of food and other ecological services for both rural and urban malnourished people. Productivity increases in agriculture and other parts of the food system are essential to provide food for future generations, but merely producing more food does not ensure food security or improved nutrition. It is important to differentiate between food availability and food access. Many factors influence human nutrition, and the impact of agricultural and rural development on human nutrition is not automatic and predetermined. The nutrition impact may be positive or negative, and the magnitude of impact may be influenced by the design of agricultural and rural development projects and policies. Both undernutrition (stunting, underweight, wasting, and micronutrient malnutrition) and overnutrition (overweight and obesity) are costly for human and economic development, and both are influenced by agriculture and the food system.

To be successful, efforts to maximize the nutrition impact need to incorporate nutrition goals explicitly into the design and implementation of agricultural and rural development projects and policies. Furthermore, the pathways along which positive and potentially

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1. [www.scalingupnutrition.org](http://www.scalingupnutrition.org).

2. <http://2020conference.ifpri.info/>.

3. [www.securenutritionplatform.org](http://www.securenutritionplatform.org).

negative impacts are expected to flow should be identified in the planning stage. Nutrition goals are, of course, not the only goals of agricultural and rural development, and where conflicts exist between goals, trade-offs and prioritization must be considered. However, such consideration can only be undertaken if nutrition goals and related pathways are explicitly identified along with other goals. Allowing nutrition goals to remain implicit or simply ignoring the potential impact of alternative project formulations may forego large potential nutrition gains and may even harm nutrition outcomes. In many cases, trade-offs can be replaced with multiple wins.

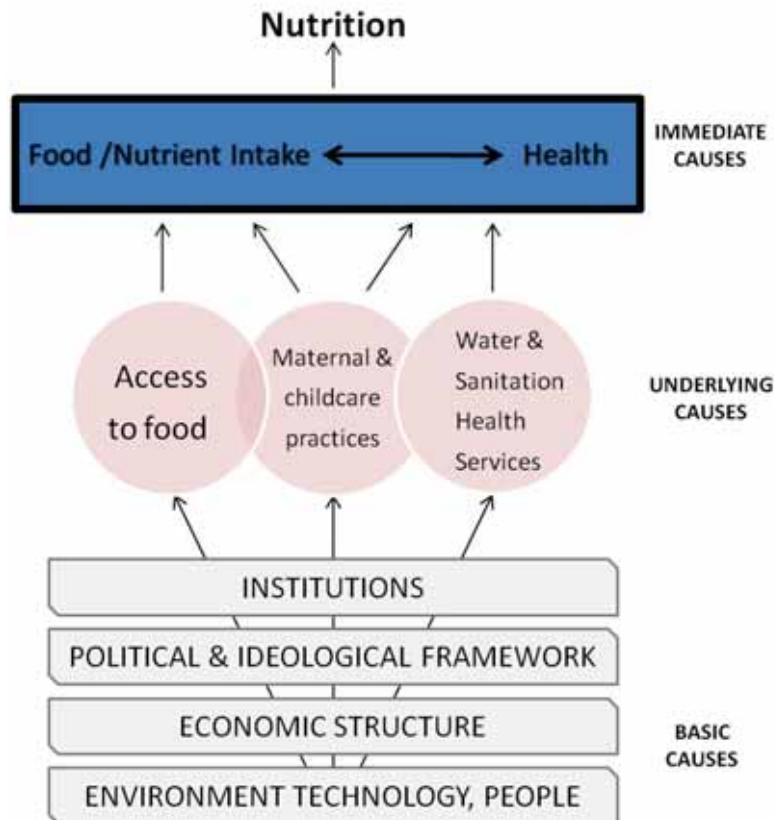
So what's in it for agriculture? Not just the moral satisfaction of working to reduce child malnutrition. Smallholder farmers are often among the populations most likely to be malnourished, and among them, women, who in many cases do the majority of the agricultural labor, are disproportionately likely to be malnourished. Abundant evidence shows that when farmers are malnourished, they are less productive (Sahn 2010; Haas et al. 1995; see also McNamara, Ulimwengu, and Leonard 2010). One analysis determined that every one percent increase in height is associated with a four percent increase in agricultural wages (Haddad and Bouis 1991). Therefore, improving the nutrition of rural populations will improve agricultural productivity. Putting a nutrition lens on an agricultural investment can also improve gender equity in that investment — an increasingly common goal of the agriculture sector — because it shifts focus toward the labor, income control, and time use of women. It can also improve ecological sustainability — another lens of the agriculture sector — in cases where crop diversification contributes to both human and ecosystem health. In many instances, it is also good business to produce nutritious foods, since demand for high-value horticultural and animal source foods is rising in urban areas, and could rise further with improved education and incentives. Efforts to improve nutrition through agriculture need to align with market signals, and there are many cases where policy changes would enable the agriculture sector to take advantage of emerging markets for nutritious foods. Finally, food security is regularly used as a justification for agricultural activities, but it cannot be achieved with a single-minded focus on food production increases. Because food security rests on the access to nutritious diets, greater attention to nutrition impact will help ensure that many agricultural investments remain true to their rationale.

The purpose of this paper is to provide a set of guiding principles for incorporating nutrition goals into the design and implementation of agricultural and rural development projects, and to provide examples of current best-evidence options for operational investments.

These principles and actions align with two general frameworks. The first is a World Bank framework that lays out five main pathways from agriculture to nutrition: three at the household level, including income generation, household consumption of food produced on-farm, and women's empowerment; and two at the macroeconomic level, including economic growth and reduced food prices (World Bank 2007). Nutrition education is also identified as an important factor modifying the effect of household-level determinants. The best evidence currently suggests a strong role for the household-level pathways, which is reflected in the principles highlighted in this document.

The second is the UNICEF Framework (1990) on the determinants of child nutrition (figure 1), which undergirds the recommended principles. The three underlying causes of child nutritional status are access to food, healthy environments and access to health services, and maternal and child care practices. Agriculture affects **food** security through its effect on availability of and access to foods to make up diverse diets and incomes. It influences women’s decision-making power, income, time, and knowledge — each of which affect maternal and child **care practices**. Agriculture can also have a large impact on **health**, through exposure to agrochemicals causing health risks, or mosquito-borne disease based on agronomic practices that depend on standing water. Agricultural development can also affect basic causes of malnutrition, such as poverty and environmental resources.

**Figure 1. UNICEF Framework on the Determinants of Child Nutrition.**



*Source:* Adapted from UNICEF 1990.

We propose that the following principles be used to guide the design and implementation of agricultural and rural development projects to maximize their nutrition impact. These principles, rather than prescribing or prioritizing exact interventions, are broadly applicable guidelines for action based on available evidence and experience of how agriculture affects nutrition.



1. Incorporate nutritional concerns into the design and implementation of agricultural policies, projects, and investments
2. Target nutritionally vulnerable groups
3. Invest in women
4. Increase year-round access to diverse, nutrient-dense foods
5. Protect health through water management
6. Design poverty-reduction strategies explicitly to benefit nutrition
7. Create enabling environments for good nutrition through knowledge and incentives
8. Seek opportunities to work across sectors

Two of the biggest questions facing program planners and project managers are “Which approach should I use?” and “How can I avoid causing harm to nutrition?” In answer to the first question, overall guiding principles are important in most or all circumstances, and are supported with specific examples of actions that are applicable in some circumstances. Emphasis is on operationally practical approaches given current knowledge and institutional capacity. A sample menu of options for specific nutrition objectives is provided in appendix 1. While many agricultural approaches to improve nutrition have shown promise, there is no one-size-fits-all silver bullet approach. To choose among operational approaches, assessing the context in which agricultural operations will occur is essential. To help assess which actions are most relevant for a specific situation, a set of key questions are included after each broad principle. Both concerted actions and policy coherence are needed to avoid unintended negative consequences for nutrition through agriculture policies and programs (SUN Framework 2010). In answer to the second question, the paper also highlights areas where agricultural investments may be in danger of causing harm, and provides options for improving policy coherence.

## GUIDING PRINCIPLES

### 1. INCORPORATE NUTRITIONAL CONCERNS INTO THE DESIGN AND IMPLEMENTATION OF AGRICULTURAL POLICIES, PROJECTS, AND INVESTMENTS.

#### **Include a nutrition objective as an explicit program or policy goal.**

While improving nutrition is often used to justify support for and interventions in agriculture, most agricultural policies and projects do not explicitly aim to improve the nutrition of communities and households. Activities and approaches that might improve nutritional outcomes, therefore, have played only a minor role in these interventions for decades (Pinstrup-Andersen 1981). The assumption underlying this nutritional gap in the design of agricultural policies and programs is that improvements to farmer yields and productivity will increase food availability and household incomes, and these increases will in turn lead to nutritional improvements within households. Resting on this assumption would result in only very slow improvements in nutrition. Enhancing household income and food production is certainly an important contributor to improving nutrition, especially for households dependent on agriculture for their primary livelihood. However, the multiple factors that influence nutrition, the social dynamics within households that can result in unexpected allocations of resources, and the many indirect ways that agriculture may impact nutrition, require purposeful planning and careful consideration of how exactly program inputs will lead to nutritional improvements.

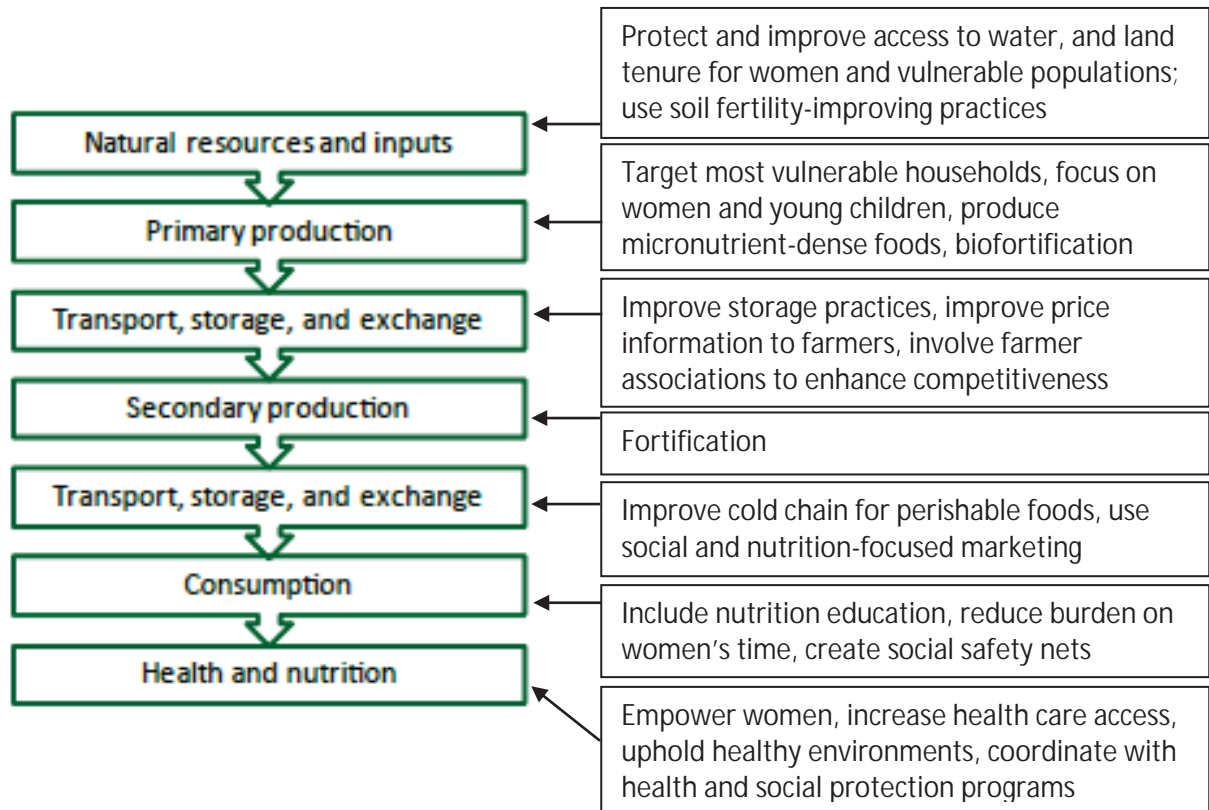
Including nutritional objectives in the design of programs and policies at the outset is a crucially important first step to ensuring that agricultural investments have a strong potential to benefit nutrition. Agricultural research is also likely to have a more positive nutrition effect if nutrition goals are considered while setting research priorities (Pinstrup-Andersen et al. 1976). While trade-offs between expected increases in food production and improved nutrition may exist, multiple wins are also likely in which both production increases and nutrition improvements are achieved. However, these wins will only be found if nutrition is explicitly prioritized. Examples of nutrition objectives are included in [appendix 1](#), such as increasing dietary diversity, increasing micronutrient intake, improving maternal and child feeding, and protecting health.

One approach to incorporating nutritional concerns into agriculture is along the value chain, which seeks to influence the supply chain from production to end use. Often referred to as “farm to fork,” the nutrition-sensitive value chain goes beyond the fork (consumption), incorporating the ability to utilize nutrients. A generic food supply chain and illustrations of nutrition-related policy interventions at each link are shown in figure 2. A recent review of existing value chain applications and case studies identified a clear, untapped potential for value chain approaches to improve nutrition. Among other recommendations, the authors suggest that value chains for improved nutrition should do the following: (1) add not only economic value, but nutritional value to produced goods; (2) consider the whole chain, across sectors and scale, to find solutions that add value for multiple actors and at different points in the chain; and (3) prioritize the growth and creation of demand such that agricultural producers are linked to markets where demand



exists for their products (Hawkes and Ruel 2012). This paper focuses primarily on those links in the value chain that are under the control of the farmer (that is, primary production, storage, exchange, and consumption); the actions at the secondary production and trade level are also necessary but beyond the scope of this paper.

**Figure 2. Points of Nutrition-Sensitive Policy Intervention along the Food System Value Chain.**



### Measure nutrition

Nutrition indicators go hand in hand with nutrition objectives. Measuring nutrition enables an understanding of progress and impact; it also helps to focus policies, projects, and investments toward specific targets so that consideration of nutrition is part of the planning process. Indicators should be chosen according to project aims and context. The highest priority should be given to measurement of determinants of nutrition most likely to be affected by agriculture, such as household food security, diet (particularly dietary diversity), women's workload, child care practices, women's control of income, women's health status, seasonality of income, and efficiency of water use. If child nutritional status is the target for impact, it should also be measured through child anthropometry (for example, height and weight measurements), given sufficient sample sizes. It is important to emphasize, however, that **an agricultural program which fails to show improvement in child nutritional status has not necessarily failed to affect nutrition; if it shows positive impact on underlying determinants of nutrition, such as those shown in figure 1, then it has succeeded in creating some of the conditions necessary (but not always sufficient) for good nutrition.**

***Key questions about selecting nutrition indicators***

- Which determinants of nutrition is the project most likely to impact?
- Which factors, if measured, would help to attribute any changes in nutrition to project activities?

## **2. TARGET NUTRITIONALLY VULNERABLE GROUPS**

### **Within the population, target the poorest households**

*Within the population*, the project or policy should be targeted to the most vulnerable group(s) involved in or affected by agricultural incomes and food prices, particularly smallholder farmers, landless laborers, and the urban poor. It may be tempting to target relatively better-off groups to see faster overall productivity gains. Such groups are less risk averse and are likely to have more access to resources such as land, seed and fertilizer, information and technology, and social support. However, the cost of production is not usually lower on large farms in countries with high capital costs and low labor costs (World Bank 2007b). Thus, **a focus on smallholders need not imply a trade-off between productivity increase and improved nutrition**. Although early adopters of new technology and improved production practices tend to be larger farmers, the experience from the Green Revolution showed that smallholders that operated in favorable natural environments followed quickly. Passing over smallholders, who tend to be among the most vulnerable, may not be justified on either production or nutrition grounds and can potentially have negative impacts on their nutrition, in cases where they are out-competed by larger farmers,<sup>4</sup> or if relative prices shift, so diets most accessible to the poor become less nutritious. Such diets are often imbalanced: either deficient in energy, protein, or essential micronutrients or containing a surplus of calories that can lead to overweight and obesity.

- Potential negative impacts can occur if unemployment or underemployment increases among low-income population groups that are already unemployed or underemployed; or if new technologies take hold but smallholder farmers cannot afford to adopt them (Schaezel 2010).

Indigenous groups, a special subpopulation of vulnerable groups, often have worse health and nutrition than national averages. Their poor health and nutritional status stems from many reasons, including social exclusion, cultural erosion, and loss of productive land. Past experience underscores the need to **modify agricultural investments to reach**

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4. Analysis of a cash cropping project in the Philippines showed that small farmers lost access to land when larger farmers chose to hire labor for the cash cropping, instead of renting it out for maize-based subsistence farming (see Bouis and Haddad 1990). The know-how, social connections, and financial resources of wealthier families allowed them to take advantage of new income-earning opportunities and keep their land, thus pushing poorer families off the land.

**indigenous groups appropriately.** Agricultural investments can more effectively include indigenous and pastoral groups by protecting land rights, for example. Current land acquisition in low-income countries by middle-income governments and multinational corporations may push poor smallholders, including indigenous farmers, off land they have cultivated but for which they do not have formal ownership rights (Cotula et al. 2009; Robertson and Pinstrup-Andersen 2010; Deininger and Byerlee 2011). Unless these farm families obtain alternative employment, the net effect may be expanded food production *and* increased food insecurity and malnutrition. Focusing on local crops or building on traditional agronomic practices is another way to target indigenous groups. Niche markets may be created for indigenous agricultural products, thereby expanding the diversity of foods available to the population at large, and lifting indigenous people out of poverty while maintaining their cultural integrity. Approaches that aim only to reduce poverty among indigenous people without regard for their distinct culture and knowledge systems may ultimately cause harm — if they displace viable possibilities for nutrition-friendly agriculture already available in indigenous systems, and potentially damage mental health and cause social isolation from loss of cultural heritage (Herforth 2009).

- Potential negative impacts can occur if indigenous land rights are not protected, if projects and policies unintentionally favor the expansion of farms that encroach upon indigenous land, or if promotion of specific commodity crops precipitates abandonment of nutritionally-rich indigenous foods.

### **Within households, target women of childbearing age and young children**

*Within households,* women of childbearing age and young children are most often at the greatest risk of malnutrition. Children exposed to poor nutrition in utero and in the first two years after birth may experience permanent setbacks to their physical and cognitive development.

Direct nutrition interventions, including iron and folic acid supplementation of pregnant women and adolescent girls, support for exclusive breastfeeding for the first six months of life and appropriate complementary feeding (infant food along with continued breastfeeding from 6 to 24 months of age) thereafter, and vitamin A supplementation of children 6 months and older are also needed to ensure adequate nutrition for these groups. However, those nutrition-specific interventions are not sufficient if adequate food is not available and accessible to women and young children or if household behaviors limit their consumption of adequate food for a healthy and active life. If food insecurity is high in the overall population, women of childbearing age and young children are likely to suffer most. Even while benefiting the entire household, **agricultural development investments can prioritize the provision of diverse diets in adequate quantities to women of childbearing age and young children.** Generalized productivity increases at the national, local, or even household level may fail to have any impact on these groups. The box below shows the many important roles of agriculture in reaching the critical 1,000 days between conception and age two. The fact that agriculture is of crucial importance to maternal and child nutrition does not diminish its importance for other age ranges or populations. Projects, however, that plan explicitly for impact on women and

young children (or at least avoidance of harm) will often have the greatest potential to reduce malnutrition.

### **Box 1. Agriculture Has a Large Impact on the First 1,000 Days**

Many of the essential inputs into good nutrition in the critical window from conception to age two come from agriculture, especially for farming households. Agriculture can influence (positively or negatively):

- **Consistent access to diverse diets for pregnant and lactating women, and young children**, seasonal reductions in diet quantity or quality are particularly harmful in the critical -9 to 24 month window;
- **Production of nutrient-dense complementary foods** for babies older than 6 months;
- **Water supply and quality**, critical in preventing disease among pregnant women and young children; unclean water causes diarrhea, one of the largest factors for faltering growth and child death;
- **Exposure to insect vectors and zoonotic disease**;
- **Exposure to contaminants** (teratogens/toxins) in agrochemicals;
- **Physical work during pregnancy** on tasks like fetching water, weeding, and harvesting (reduce work through labor-saving technologies);
- **Ease of mothers' participation in agriculture**, prioritize projects that can be done close to home with reduced labor and time inputs, or add high-quality childcare components to projects;
- **Coordination with health and social protection programs** to enable women to balance income generation with high-quality infant and child care.

*Source:* Authors.

In addition to those mechanisms suggested in box 1, a specialized way the agriculture sector can target these groups is to **link agencies producing food supplements or fortified complementary foods to smallholder farmers producing the commodities needed**. Where food aid or emergency supplementation is needed, sourcing the commodities locally from smallholder farmers can provide the benefit of improving livelihoods, dovetailed with emergency response for individuals suffering from severe malnutrition. Local or regional sourcing of food aid is beneficial to farmers who can produce a surplus and is often far more cost-effective than international shipping (Barrett and Maxwell 2005). The World Food Program is now increasing local sourcing of food aid in the Purchase for Progress (P4P) program. Besides basic staples, peanuts or other legumes may also be sourced from smallholder farmers for emergency food supplement production. Fortified peanut-based paste is highly effective for treating children suffering from severe acute malnutrition, and smallholder farmers could be sourced more frequently for the ingredients.

It is important to note here, however, that the vast majority of malnutrition is invisible. Undernutrition resulting in mild and moderate stunting, as well as micronutrient

deficiencies (“hidden hunger”), accounts for far more child deaths and lost developmental potential than does severe malnutrition. While providing peanut pastes and other food aid to severely malnourished children is a high-visibility intervention, many more children would be helped if an adequate quantity and diversity of food were consistently available and accessible to their households. The best route to good nutrition and health in childhood is to start life with a well-nourished mother, for whom food security is a critical input to her nutritional status. When children start to consume foods other than breast milk, access to adequate diets is a prerequisite for their good nutrition.

***Key questions about targeting***

- What is the nature of the prevailing nutrition problems (energy and protein deficiency, micronutrient deficiency, and/or overweight and obesity) in the country or region for which the project or policy is to be designed?
- What are the characteristics of the population groups that suffer from each of these problems, for example, smallholder farm families, landless laborers, indigenous groups, or urban poor?
- Is it reasonable to expect that the project could reach one or more of these groups?
- How is the project or investment expected to reach women of childbearing age and young children?

### **3. INVEST IN WOMEN**

#### **Prioritize investments that strengthen women’s decision-making power and control of economic resources**

The ultimate nutritional benefits of increased incomes are determined by who controls the income and how it is distributed within the household. Several studies from different regions of the world have documented that income controlled by women has a significantly greater positive effect on child nutrition and household food security than income controlled by men (Quisumbing et al. 1995; Katz 1994; Hoddinott and Haddad 1994; DeWalt 1993; Helen Keller International 1993; Kennedy and Cogill 1987). Women typically spend a higher proportion of their income on food and health care for children than do men (Hallman 2003; Thomas 1994; Garcia 1991; Guyer 1980). Improvements to gender equality and women’s decision-making power can significantly reduce child malnutrition rates. In South Asia, for example, evidence suggests that as women’s status improves, so do prenatal and birthing care for women, appropriate complementary feeding practices for children, treatment of illness and immunization of children, women’s nutritional status, and child nutritional status (Smith et al. 2003).

A 2007 World Bank report identified women’s empowerment as a key pathway through which agriculture can affect nutrition. Hawkes and Ruel (2006) similarly point to empowering women as a major lesson learned from several decades of experience in how agriculture affects nutrition. Empowering women through strengthened decision-making power and control of household resources may be particularly important for positively

influencing nutrition outcomes. Special attention should be paid to whether women are able to control decisions and sales of crops promoted by agricultural investments. Efforts promoting increased vitamin A intake and diversified diets through homestead food production in Bangladesh, Nepal, and Cambodia have demonstrated that when women have access to appropriate technologies and training (for example, seeds, chicks, vaccinations, training on garden cultivation, composting, and water management) they gain decision-making power within the family that impacts as positive economic and nutrition benefits to the household (Helen Keller International 2010; Bushamuka 2005). Likewise, Leroy and Frongillo (2007) report that several animal production projects that succeeded in improving diet or nutritional status depended on women being actively involved and playing a critical role in the projects. Empowering women with resources and strengthening their role as decision makers allowed them to better control their time use as well as the returns from their labor, both in terms of increased income and nutrition and health benefits for their families. See box 2 below for case studies.

Promoting **increased market opportunities for women's crops** is a way to improve women's discretionary income and decision making. Agricultural project planners are accustomed to assessing market price and agronomic characteristics when selecting crops to be included in projects; gender characteristics could also be included as a criterion. In many settings there are specific female-controlled crops. Projects focused on cash and major commodity crops have low potential to reach women farmers effectively: even if women are targeted with trainings and technologies, the household dynamics of income control usually result in male heads of households reaping the financial benefits from big-ticket crops. Part of the reason is that the size and frequency of payments may predict who controls income from the sale of agricultural goods. Income received in small, yet consistent amounts throughout the year may be more likely to remain in women's control than sporadic lump sum quantities (Herforth 2010a; Kennedy and Cogill 1987). Gender divisions of agricultural labor also can have important implications for who is responsible for a given crop. For example, in Senegal, extension agents initially contacted male farmers to participate in a dry season homestead gardening program, but the men's interest in the program soon faded because they were embarrassed to fetch irrigation water from the well, a task seen as "women's work" (Brun and Chevaussus-Agnes 1989). Women then took over responsibility for the gardens. Inclusion of crops controlled by women — which vary by context, but in many settings are minor crops such as vegetables — may help to ensure that production and consumption decisions and income from the crops will be controlled by women (Bezner Kerr and Chirwa 2004; Dankelman and Davidson 1988).

- Potential negative impacts can occur if projects inadvertently focus on crops or livestock that are primarily or exclusively under the control of men for use and sale, thereby increasing gender inequities or bypassing opportunities to target women effectively.



### **Box 2. Case Studies: Gardening as an Investment in Women for Improved Diets and Income**

**Helen Keller International's Homestead Food Production program in Bangladesh** demonstrated improvements in household vegetable production, household and child diets, and women's income control by promoting women-led homestead gardens, with suggestive evidence that the prevalence of night blindness has decreased and child growth improved (Bushamuka 2005; Bloem et al. 1996; Helen Keller International and AVRDC 1993). Incomes increased in households with gardens, and women were more likely to control production decisions, receive and control income from funds earned from garden sales, and spend that income on food than were women in control households.

In **Thailand, a home gardening initiative** to increase the consumption of the vitamin A-rich ivy gourd plant among preschool children, adolescents, and pregnant and lactating mothers was aided by the egalitarian marital relationships generally observed in Thailand (Smitasiri et al. 1999; Attig et al. 1993). Women there are seen as key decision-makers within households. The program saw increased intakes of vitamin A among all target populations in intervention households compared to control households.

In **Kenya**, Farm Concern International won a World Bank Consultative Group to Assist the Poor (CGAP) award for their work on **commercialization of traditional leafy vegetables**,<sup>1</sup> which targeted women explicitly and by virtue of the vegetables being a female-controlled crop; later analyses showed that this intervention was effective in increasing consumption of the micronutrient-rich vegetables (Herforth 2010b). Beyond gardening for home consumption, the project exemplified that capitalizing on income-generation potential from female-controlled crops was an important factor in motivating women to participate and improving women's access to income.

*Source:* Authors.

### **Increase access to time-saving and productivity-enhancing technologies for tasks performed by women**

Women in low-income households are typically fully occupied in a wide array of activities including care giving to children, the sick, and the old; collecting water and fuel; preparing food; and performing household chores. They are also the main agricultural producers in many countries. In Southeast Asia, women supply up to 90 percent of the labor required for rice cultivation (IFPRI 2011b). They account for 70 percent of farm labor and perform 80 percent of food processing in Africa (Cramer and Wandira 2010). In most contexts, however, time spent on paid and unpaid work is sharply divided between genders. In Tanzania for example, women devote much more time than men to unpaid activities such as household maintenance and care giving (Budlender 2008; Fontana and Natali 2008). They dedicate a similar amount of time as

men to primary agricultural work, but spend less time performing other types of paid work and engaging in learning and leisure activities. Similar trends are observed in many other developing countries (Charmes 2006; Gupta 2004). Women, therefore, have numerous, simultaneous competing claims on their time, few of which are rewarded with income that they control. These competing claims demand trade-offs that can have important nutritional consequences. Care of babies may be relegated to child siblings, children may be breastfed less often, time for food preparation may be limited resulting in less nutritious diets, agricultural production may suffer, and women may avoid off-farm income-earning opportunities (Ilahi 2000; Jones et al. 2012). Excessive maternal activity during pregnancy may also result in increased risk of poor birth outcomes such as low birthweight, small-for-gestational-age births, and preterm deliveries (Rao et al 2003; Pitchaya et al. 1998; Barnes, Adair, and Popkin 1991). One study in Brazil found that the mean birthweight of infants born to women who engaged in heavy agricultural work throughout their entire pregnancy was significantly lower as compared to mothers who did not (Lima et al. 1999). Increased physical activity levels may also leave mothers unable to meet the increased energy demands of lactation (Rashid and Ulikaszek 1999; Piers et al. 1995; Guillermo-Tuazon et al. 1992). Evidence suggests women's workload constraints even limit the likelihood that family members, children in particular, will routinely access health services or receive medical attention in a timely manner (Blackden and Wodon 2006).

Therefore, projects that require additional time by women may fail or face implementation difficulties because the additional time is not available (Smitasiri and Dhanmitta 1999; Popkin et al. 1980). Women may also have poorer access to time-saving and productivity-enhancing technologies geared toward the gender-specific tasks they perform (for example, weeding and hoeing, food processing, crop transportation) (Gill et al. 2010; Kes and Swaminathan 2006). Projects that demand more time from women should be accompanied by labor-saving, productivity-increasing measures for the activities traditionally performed by them, or at a minimum, should ensure that women are able to control resources accruing from their labor (through inclusion of training and market opportunities for crops and animals women sell, for example).

- Potential negative nutrition impacts can occur if agricultural investments demand additional time and labor from women at the expense of optimal infant and young child feeding and care, or at the expense of pursuing other income-generating activities that would result in women's control of income.

***Key questions about designing projects that account for women's time use***

- How is the project expected to influence gender-specific time demands imposed on the target group?
- Are time demands for women likely to reduce quality of child care?
- Are time demands for women likely to result in their increased income and decision-making power?
- Are there labor-saving technologies for women's tasks that could be included in the project to reduce the time women spend on agricultural or household tasks?



## **Support women's income generation with policies to facilitate high-quality child care**

Policies that expand employment and wage earnings of members of households with malnourished individuals are expected to have a positive effect on nutrition; however, potential negative effects associated with activities no longer being performed or poorly performed because of competition for time should be considered. This is particularly an issue for employment creation for women, who may have to forego other activities of great importance for nutrition such as breastfeeding, child care, agricultural work, cooking, and efforts to maintain good sanitation and hygiene. Because pregnant women and children less than two years of age are the demographic groups most exposed to irreparable health damage through malnutrition, a gender perspective should be included in estimates of the nutrition impact of employment creation. Further, policies that expand employment for women should aim to provide concurrent resources to support alternative high-quality child care; adequate maternity leave where applicable; and safe, healthy home environments.

## **Increase women's access to land rights and other productive resources**

Women may lack property rights and control over agricultural production decisions, and may not have equal access to credit institutions, agricultural inputs, extension services, or membership in users' groups or collectives (Quisumbing 2003; Naved 2003; Berger, DeLancey, and Mellencamp 1984). Agricultural plots controlled by women may not receive the same intensity of labor or fertility inputs as plots controlled by men, thus further contributing to the low productivity of women's agricultural labor (Alderman et al. 2003). Improving land tenure policies is an important strategy for empowering women. Smallholders or tenant farmers' livelihoods are much more vulnerable if they are at risk of being relocated off their land. Women are particularly at risk, since in many countries women have no legal right to land tenure, even after the death of a spouse. Without private control over land or security in land tenure, smallholders or tenants also have little incentive to maintain the natural resource base critical for food productivity.

## **4. INCREASE YEAR-ROUND ACCESS TO DIVERSE, SAFE, NUTRIENT-DENSE FOODS**

### **Increase production of diverse, nutrient-dense foods**

Projects aimed at improved productivity lower the unit-costs of production, and the cost savings may result in both higher incomes for the farm family and lower prices for the net food-buying consumer. Projects to increase the productivity of a single crop, however, may also reduce crop diversity. In the case of semisubsistence farms, this is likely to result in reduced dietary diversity and an increasing risk of micronutrient deficiency (Remans et al. 2011; Herforth 2010a; Dewey 1981). Similarly, reduced crop diversity may reduce the diversity of the foods available in the local market and thus reduce dietary diversity for the net food buyers.

Cost and price reductions for foods that account for a large share of the total expenditure in low-income households are likely to result in expanded consumption of those food(s) and also to release purchasing power for purchase of other goods. **Productivity increases and price reductions for foods with high content of bioavailable micronutrients** such as fruits, vegetables, pulses, and animal products may be powerful instruments to reduce micronutrient deficiencies. The goal of diversified production is not to promote specific foods and distort markets; rather, it is to correct the distortion already present in most countries and regions based on strong research, extension, and policy focus on a small number of staple crops. During the Green Revolution, availability of cereals per capita in Asia increased dramatically, with associated price reductions. Nonstaple production, however, increased at a much slower pace and in many cases did not keep pace with population growth (Welch and Graham 2005). The resulting shift in relative prices of staples to nonstaples reduced the ability of the poor to access diverse diets. The additional purchasing power released by the lower-priced staples can be used to acquire more nutritious foods only if they are available in sufficient quantities. Investments in nonstaple crop productivity and marketing channels is needed to correct the dietary imbalances that have arisen from a strong focus on staple crop production.

Market prices of various foods are not the only cost to households of obtaining diverse diets; there are often significant time costs as well. Women often bear the responsibility for food purchase, and may lack time to go to market, especially frequently enough to purchase perishable foods such as vegetables and fruits regularly. If markets are far from households or food prices are high, own on-farm production may be the only realistic way to provide consistent access to a diverse diet in the short term (Herforth 2010b). Projects emphasizing the improvements of several crops or diverse production systems are likely to be important for reducing micronutrient deficiencies, and are increasingly recommended instead of single-commodity approaches.<sup>5</sup>

- Potential negative nutrition impacts can occur if investments continue to support primarily starchy staples and neglect research and investment in other foods necessary to make up a diverse diet. This can limit ability of the poor to access diverse diets, and also may set the stage for increases in obesity and chronic disease, where sufficient fruits, vegetables, and pulses are not part of typical diets.

Expansion of agricultural investments to include more perishable foods may need to ensure markets through **improved market access** or **demand creation activities**. Farmers may be unwilling to start or continue growing perishable foods if no viable market exists, due to distance or impassability to physical markets (Mirle 2006). Acceptance and use of certain micronutrient-rich crops, such as orange-fleshed sweet potato or indigenous leafy green vegetables, has required demand creation or educational activities, focused on the value to health and nutrition of consuming them (Low et al. 2007).

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5. Many organizations have produced agriculture-nutrition policy documents that emphasize diversification, including nutrient-dense foods. These include the EC (2011), USAID's FANTA project (2001), and IYCN project (2011), FAO (2010, 2009, 2004, 2001), IFPRI (2011), the UN SCN (2010), ACF (2011), Bioversity International (2011), Save the Children UK (2012), and World Vision (2011).

- Potential negative impacts can occur if farmers are encouraged to grow crops for which there is no viable market. Even if the crops are useful for home consumption, farmers' ability to sell the excess produced is an important motivating factor for continued production.

While research to improve productivity of nonstaple crops is important, the agriculture community need not wait for research breakthroughs. Immediately, it is possible to **broaden the diversity of foods included in agricultural training, extension, seed provision programs, and exports.** Beyond increasing attention to production diversity in general, increased vegetable production could include well-adapted crops native to specific regions, such as regionally specific green leafy vegetables and semi-wild fruits. Such crops have been shown to contribute to nutrient adequacy where they are consumed (Kuhnlein et al. 2009; Gupta and Bains 2006; Gockowski et al. 2003; Grivetti and Ogle 2000), and provide examples of how agricultural diversification can be tailored to specific contexts.

Diversification of agricultural systems, particularly at the small farm level, also can contribute to improved soil fertility and pest control (Pinstrup-Andersen 2010), thereby enhancing the ecosystem services needed for food production. Legume intercropping, crop rotation, integrated livestock-crop systems, and agroforestry are some of the agronomic techniques that can serve both present and future food production through improving or maintaining the resource base. Legal title to land may be important in encouraging greater investments in long-term diversification.

***Key questions about increasing access to diverse diets***

- How is the project or policy expected to influence the absolute price(s) of the food(s) affected by the project, and how will relative prices among foods available to the target group(s) be affected?
- Do farmers reside close enough to their fields that diversifying production is likely to influence own-consumption?
- Do farmers reside close enough to markets that they would reasonably be expected to be able to purchase all dietary components (including perishable ones) on a regular basis?
- Do farmers have access to markets/traders where they would be able to sell perishable foods?

### **Improve nutritional content of foods produced**

Projects that change the quality, food safety, or nutrient content of the foods targeted can improve food security and nutrition. **Biofortification** is an obvious example of such a project. Orange-fleshed sweet potato (OFSP) dissemination and promotion in Mozambique has resulted in increased consumption of OFSP and increased serum retinol of children under five years of age, in a population where deficiency was prevalent (Low

et al. 2007). It has been made clear that the success of OFSP in reducing a form of undernutrition, as will be the case with other biofortified crops, was due to active promotion and education activities associated with the dissemination of the cultivar, as well as strong involvement of women. An experimental breed of high-iron rice, still under development, was shown in a controlled experiment to increase the daily iron intakes of a group of Filipino nuns by 20 percent, improving their iron stores (Haas et al. 2005). Other crops in development include iron and zinc-biofortified pearl millet, provitamin A-rich cultivars of maize and cassava, and iron-biofortified beans (to be released in 2012), and zinc-biofortified rice and wheat (to be released in 2013) (HarvestPlus). Golden rice, originally developed in Switzerland and currently being field-tested in Asia, contains high levels of provitamin A. Contrary to the other commodities mentioned above, golden rice was developed using transgenic methods and may therefore be faced with acceptance problems both at the national and the household level. Whether genetically modified or not, consumer acceptance may be an issue, particularly if a price premium is required to get farmers to adopt the crop varieties with higher content of certain nutrients or to compensate for lower yields.

The extent to which the foods to be improved are currently consumed or expected to be consumed by the target groups is an important consideration. While biofortification may be effective in reducing malnutrition, it is important to keep in mind that the ultimate long-term goal should be to help families assure access to a diversified diet that meets energy and nutrient needs (Bouis, Eozenou, and Rahman 2011). Promotion of biofortified crops, within development agendas as well as communities, should be done in such a way that it maintains or improves existing production diversity; that is, care must be taken in promotional efforts to resist the implication that biofortified crops could somehow make the promotion of the production and consumption of micronutrient-rich nonstaple foods unnecessary. In the short-to-medium run, biofortification offers opportunities to improve the nutritional status of low-income people who cannot afford a diversified diet.

**Village-level industrial fortification** is another example of improving the nutritional quality of agricultural commodities. Fortification of grain flour with iron and zinc, and vegetable oils with vitamin A, can be a tool to improve micronutrient intake in vulnerable groups, including smallholder farmers whose food production frequently is insufficient to cover family needs. The success of fortification for improving nutrition in rural households will depend on their access to the fortified foods.

**Zinc and iodine fertilizers** to increase the content of those nutrients in grains may also play a role in improved nutritional quality of foods. Depending on the zinc already present in soils, effect of zinc fertilizers on yield varies, but has been observed to double or triple zinc content of cereal grains in some cases (Rengel, Batten, and Crowley 1999). Fertilization with iodine-containing irrigation water has also met with great success where implemented (Cao et al. 1994). In areas where farmers are unlikely to see crop yield improvements using zinc and iodine fertilizers, a subsidy or legislation that these nutrients be added to commercial fertilizers may be required, particularly if consumers do not value the additional nutritional quality (Graham et al. 2007).

## Improve basic food safety

Interventions to improve food safety, such as regulations to meet the standards of the Codex Alimentarius will be important to avoid food-borne illness and parasitic infestation associated with food safety problems. One of the lowest hanging fruits is **control of mycotoxins including aflatoxins**. Aflatoxins are a serious threat to health and nutrition in developing countries (Williams et al. 2004). They occur predominantly in maize and peanuts, and can cause stunting,<sup>6</sup> immunosuppression, spontaneous abortion, liver disease, cancer; they can also interfere with micronutrient metabolism. Smallholders may be the least likely to adopt existing aflatoxin control measures because they lack resources and knowledge about the problem, and are likely highly susceptible to aflatoxin exposure.<sup>7</sup> Improved production, storage, transportation and processing are needed to eliminate aflatoxins and other mycotoxins.<sup>8</sup>

- Potential negative impacts can occur if food price increases associated with higher safety standards are large and reduce the ability of poor households to meet energy and nutrition needs, or if incentives for participation in food safety regulation are so low that poorer farmers evade testing their crops for aflatoxin because it may lead to serious lost income.
- Potential negative impacts can also occur if there is an insufficient mechanism for disposal or use of mycotoxin-contaminated stock, and it ends up being consumed in a highly concentrated form.

### *Key questions about improving nutritional quality and safety of foods produced*

- Does the project change the quality, food safety, or nutrient content of the food(s) targeted by the project?
- Will the price of the improved foods be higher, and will smallholder farmers adopt biofortified seed or micronutrient fertilizers without a price premium?
- Will promotion of biofortified crops support diversity in cropping systems?
- Where are the key entry points in the value chain for aflatoxin control?

## Decrease impact of seasonal food shortages through measures to increase consumption of nutrient-dense foods throughout the year

Seasonal food shortages can have lifelong consequences if experienced during the critical window of -9 to 24 months. Because pregnancy and the first two years of a child's life cover more than one year, in areas where seasonal food shortages are typical, it is likely

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6. In Benin, children age 16–37 months of age who had the highest levels of aflatoxin intake grew an average of 1.7 cm less over 8 months than those with the lowest exposure (Gong et al. 2004).

7. Information found on IFPRI's "Aflacontrol" site: <http://programs.ifpri.org/afla>.

8. A promising control measure is to inoculate soil with nontoxic local strains of *Aspergillus flavus*, which can effectively out-compete toxic strains present in the soil and reduce aflatoxin contamination at harvest by up to 99 percent (Probst et al. 2011).

that most children experience some period of deprivation during the critical window. Agricultural technologies can reduce the occurrence and impact of a “hungry season.” **Solar drying or other preservation technology to accompany vegetable and fruit production** can extend households’ direct access to diverse diets over the period when such foods are out of season, and not readily available in fields or markets.<sup>9</sup> Development and utilization of **early- or late-season crop varieties can extend the growing season** and allow smallholder farmers to attain better prices (that is, they can sell at the beginning or end of seasons, when prices are higher). **Income generation activities during off seasons** will assist households to purchase adequate foods. **Linking with social protection** measures that include conditional cash transfers during hungry seasons are also important.

*Key questions about decreasing seasonality*

- Do hungry seasons occur, and if so, when and how severe are they?
- What crops might be appropriate for enhanced preservation for prolonged food security and income generation?
- Could the project include alternative income-generating activities or link with social safety nets for the hungry season?

**Strengthen the ability of households to manage risk, particularly related to food price volatility**

Climate change, investments in the food commodity market by traders and speculators, and government food policies are increasing food price volatility, both seasonal and erratic, something that is likely to continue in the foreseeable future. Such price volatility contributes to temporal food insecurity and enhanced risks of malnutrition. The risks are particularly serious for households suffering from or very close to chronic food insecurity. Therefore, policies and projects to assist households in risk management are of increasing importance. **Two kinds of policies should be considered: (1) those that aim to reduce spatial and intertemporal fluctuations in food prices and the availability of food, and (2) those that aim to provide a social safety net.** The former includes policies to facilitate a well-functioning domestic food market, including infrastructure development, storage facilities, agricultural research and technology dissemination, and international trade, while the latter includes targeted public works programs and food or cash transfer schemes.

- Policies that amplify international food price volatility, such as export restrictions during periods of high food prices, affect transitory food insecurity and nutrition negatively in countries other than the one introducing the restrictions.

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9. I. F. James and B. Kuipers, 2003, show examples of low-input food preservation technologies.



## 5. PROTECT HEALTH THROUGH WATER MANAGEMENT

### **Minimize potential harm from waterborne diseases and chemical contamination of water**

As shown in figure 1, nutritional status is strongly influenced by access to clean water and to good sanitation, care, and hygiene. Agricultural investments typically have an impact on water use and systems, and therefore there is a need to plan for how that impact will affect nutrition. Poorly designed water management systems may result in increased water-borne diseases or chemical contamination of available water, which in turn influence nutrition. There are multiple examples of irrigation projects that increased prevalence of malaria, schistosomiasis, Japanese encephalitis, and other infectious diseases caused by hydrophilic vectors; an IFPRI report compiling instances of such unintended negative consequences states:

...It is often assumed that irrigation will bring health benefits to all, regardless of their socioeconomic standing within a community. In reality, the economic and social impacts of irrigation are diverse and widespread, and neither costs nor benefits are evenly distributed among community members...there is increasing recognition of the need to reduce the negative impacts of agricultural development on ecosystems and peoples' health. Unless well-targeted interventions are made, the most vulnerable — notably poor children and their mothers — will continue to benefit least from the promise of irrigation and suffer most from the adverse health impacts (Mutero, McCartney, and Boelee 2006).

Agricultural investments can also sometimes lead to water toxicity, precipitating other unintended negative health consequences. This has been reported with widespread pesticide use, which causes chronic human exposure to agrochemicals in water for drinking and household use (Nelson 2010; Stubbs, Harris, and Spear 1984). Water projects in Bangladesh present another example: arsenic contamination of shallow groundwater has afflicted whole communities, leading to arsenic poisoning and documented subclinical effects such as reduced intellectual function (Wasserman et al. 2004). While most of the exposure was due to tube wells constructed to provide drinking water, the use of shallow tube wells for irrigation still poses a public health problem: continuous irrigation with arsenic-contaminated water has been linked to increased soil levels of arsenic and contamination of food crops (FAO 2006).

- Potential negative impacts can occur if (1) projects increase standing water where parasitic disease-carrying vectors can breed, without also increasing access to health services and education for prevention; (2) projects increase use of a toxic water source.

### **Improve water-use efficiency**

Very low water-use efficiency in much of developing countries' agriculture is resulting in excessive water use, the drawdown of ground water levels, reduced flows of rivers and

streams, and pollution of water by chemicals. Agricultural projects aimed at improved water-use efficiency could achieve multiple goals including increased productivity, less natural resource degradation, and improved nutrition security. There are specific effects of water inefficiency on women's time in the many places women are responsible for collecting water. National surveys on time use from Sub-Saharan Africa confirm that water collection takes a great amount of women's time and energy compared to other domestic tasks (Blackden and Wodon 2006). As clean water sources become scarce, so does women's time. Effects of agriculture on water availability at present and in the future are particularly important as water tables are declining in many high malnutrition-burden countries, and will only become more critical as the effects of climate change transpire. The Intergovernmental Panel on Climate Change (IPCC) predicts decreases in rainfall for most of the high-burden malnutrition regions, including southern Africa, West Africa, the Middle East and North Africa, South Asia, and much of Latin America (IPCC 2007). A cohesive policy and development approach to food production, natural resource management, and human health and nutrition would be much more effective at reaching these goals than individual, sector-specific approaches (Pinstrup-Andersen 2010).

- Potential negative impacts can occur if projects to increase irrigation in the short-term result in longer-term water shortages (likely to accelerate due to climate change).

***Key questions about effects on water and sanitation***

- Is the project likely to affect the quantity and quality of water available to the households with malnourished individuals?
- Are increases in water use sustainable, without harming water supply for neighbors or future generations?
- How will the project affect women's workloads related to water procurement and use?

## **6. DESIGN POVERTY-REDUCTION STRATEGIES TO EXPLICITLY BENEFIT NUTRITION**

### **Enhance the nutrition impact of income through a focus on women and nutrition knowledge**

The reduction of poverty alone is insufficient to reduce malnutrition. Likewise, individual agricultural and rural development programs aimed at improving farmer incomes through cash cropping have not consistently demonstrated substantive nutrition benefits, especially for young children (World Bank 2007). In rural Kenya for example, shifting from maize to commercialized sugarcane production led to increases in household income and calorie consumption among participating farmers; however, there was no improvement in the nutritional status of preschool-aged children (Kennedy and Cogill 1987). Numerous other studies have similarly demonstrated that increased incomes resulting from agricultural programs may provide limited or no nutritional benefits, especially for young children. The extent of poverty alleviation is a particularly poor



indicator of reductions to “hidden hunger,” or deficiencies of essential vitamins and minerals such as iron, zinc, vitamin A, and iodine. Increases to household income may not adequately improve the quality of diets of vulnerable individuals within the household or may actually result in a shift away from nutrient-rich foods toward higher status foods, observed to compromise nutrient intake in young children (Kennedy and Oniang’o 1993). The nutrition effect of income changes is influenced not only by the amount of income change for a particular household or population group but also by the composition of the income, the flow of the income over time, household preferences, and who in the household controls the income (Pinstrup-Andersen and Herforth 2008). As stated above, a focus on women in poverty reduction is likely important, as is incorporating nutrition education and water and sanitation.

### **Shape agricultural growth to reduce the dual burden of undernutrition and obesity**

Agriculture and poverty alleviation strategies that increase household incomes can also increase rates of overweight and obesity. A recent analysis of 29 countries demonstrated that as agricultural incomes rise, stunting falls, but obesity rises surprisingly sharply, indicating that the rural poor are not insulated from obesogenic diets (Webb and Block 2010). Particularly in middle-income countries, but increasingly in sub-Saharan Africa, where the so-called “nutrition transition” is rapidly shifting diets toward foods high in fats and sweeteners and lifestyles toward decreased physical activity levels, the problems of underweight and overweight coexist (Ziraba, Fotso, and Ochako 2009; Hawkes 2006; Popkin and Gordon-Larson 2004). This dual burden may exist even within the same household (Caballero 2005; Doak et al. 2000). Agricultural investments and poverty reduction strategies then need to account for the different nutritional vulnerabilities of communities, households, and individuals, particularly in contexts where both undernutrition and overnutrition are threats to well-being. Agricultural policy attention in recent decades has focused on starchy staples and cash crops, neglecting concomitant investments in the dietary components typically lacking in populations suffering from obesity and chronic disease: vegetables, fruits, and legumes. Alternative priorities and new investments can forge a different path.

- Potential negative impacts can occur if agriculture or poverty alleviation projects cause a shift in food consumption toward lower dietary diversity or a diet lower in micronutrients, and in cases where obesity is an imminent risk, toward a diet higher in caloric density.

### **Contribute to nutrition-sensitive poverty reduction through pro-poor investments in services and infrastructure**

Efforts to understand the nutrition effects of agriculture programs and policies should attempt to identify the biggest constraint to good nutrition — this may not always be household poverty. Public goods, or the lack thereof, also contribute to poverty and malnutrition. Some of these may be beyond program planners’ scope of influence; the overlap between programs and policy is discussed below under the “policy coherence” subheading. Investments in **road and irrigation infrastructure, agricultural research**

to help solve problems facing smallholders, and **policies to strengthen local and national agricultural input and output markets** can also influence smallholder incomes and diets. Likewise, policies aimed at nonfood expenses of the malnourished, such as **school fees and health care costs**, may affect household purchasing power and the extent to which households can afford to acquire the food and the quality of the diet needed. **Availability and cost of health care** may be an important nutrition-related issue partly because of the competition for very limited household resources and partly because nutritional status is influenced by infectious diseases. Similarly, **policies to improve water quality, sanitation, and hygiene** may remove limiting factors to good nutrition. As shown in figure 1, access to sufficient food to meet nutritional needs is necessary but not sufficient to assure good nutrition. Assuring that malnourished individuals have access to more and better food may have little or no nutrition effect in an environment of unclean water, poor sanitation, and lack of health care. A comprehensive approach based on a good understanding of the particular situation is necessary to resolve nutrition problems.

***Key questions about designing poverty-reduction strategies to improve nutrition***

- What is the expected impact on the incomes of the target group(s)?
- Who in the household is most likely to control how the additional income is spent? Can they be influenced toward purchases that improve nutrition through enhanced nutrition knowledge?
- How might the project or policy be designed to reduce risk of obesity at the same time as it aims to increase income?
- Will the income be obtained continuously during the year or in one or more lump sums received sporadically? If the latter, could the target group(s) get access to savings and credit institutions?
- Are there important nonhousehold limiting factors to nutrition that could be eliminated with public investments?

## **7. CREATE ENABLING ENVIRONMENTS FOR GOOD NUTRITION THROUGH KNOWLEDGE AND INCENTIVES**

### **Incorporate nutrition education to translate production and income gains into nutrition improvements**

Effective agricultural and rural development projects are likely to alter household behavior; enhanced knowledge may guide behaviors to most effectively achieve household and individual goals. Projects that invest broadly in communities and individuals are more likely to demonstrate improvements to nutrition than those that focus narrowly on increased production or poverty reduction goals (Berti, Krasevec, and Fitzgerald 2004). In particular, those projects that include training and education programs, and are explicitly designed to increase women's access to productive resources and strengthen their influence over household decisions, have a greater likelihood of effecting positive nutritional change. Nutrition education has been shown to affect

allocation of household food budgets, and to reduce price elasticity of demand for foods rich in micronutrients (Block 2003). Engaging with existing community-based groups, such as farmer cooperatives and women's organizations, is often a useful entry point for nutrition training.

Promotion of healthy behaviors and nutrition education strategies have been shown to be effective in contributing to improved child feeding practices, health outcomes, and child nutritional status in the context of nutrition interventions (Dewey and Adu-Afarwuah 2008; Ruel et al. 2008; Caulfield, Huffman, and Piwoz 1999). Agricultural programs have also successfully employed nutrition education, packaged with production and income-generating activities, to improve both agricultural and nutrition outcomes. Numerous agricultural programs in Africa, Asia, and Latin America have demonstrated improvements to production and consumption of target foods by incorporating nutrition education into their intervention strategies; see box 3 below for the case study of education in the promotion of orange-fleshed sweet potato.

Nutrition education is often left to the health sector, but agricultural staff members have an important role in nutrition behavior change. **Some nutrition-relevant information is best communicated by agricultural extensionists or project staff**, such as the nutritional value of foods produced or the importance of giving those foods to young children. Collaboration and some cross-training between agriculture and health agents may provide synergies. For example, a home gardening program in India, which relied on volunteer extension workers with diverse expertise to communicate intervention messages (for example, agricultural extensionists, health workers from India's integrated early childhood program, and village-level workers), demonstrated increased production and consumption of several vegetables, and decreased signs of vitamin A deficiency in target households (Faber, Spinnler, and Venter 2002; Kidala, Greiner, and Gebre-Medhin 2000; Vijayaraghavan et al. 1997; Phillips et al. 1996; Greiner and Mitra 1995). They also found that volunteers trained in numerous aspects of the program were found to be more effective field workers than those trained more narrowly.

Because of their multiple roles within the household, which directly and indirectly influence nutrition, in particular their role as caregivers, women are uniquely positioned to translate enhanced knowledge effectively into improved nutrition outcomes (World Bank 2007). However, agriculture- and nutrition-related capacity-building activities should **involve the entire family in revaluing the importance of women's time, resources, nutrition, and the care of children**. The inclusion of men, grandparents, relatives, and neighbors in capacity-building activities may improve project outcomes (Bezner Kerr et al. 2008).

### **Box 3. Case Study: Promotion of Orange-Fleshed Sweet Potato**

In Mozambique for example, nutrition education was incorporated into a program promoting increased production, consumption, and purchase of orange-fleshed sweet potato (OFSP). Program staff used creative strategies such as community theater, songs, games, and recipe trials to educate caregivers on the importance of vitamin A in child diets and promote the increased feeding of OFSP to young children (Low et al. 2007). Participating households showed increased production of OFSP and child dietary intakes of vitamin A as well as significantly improved child vitamin A status compared to control children.

The success of the OFSP project in Mozambique was due in part to integrated extension agent pairs (a male agricultural agent and a female nutrition agent) embedded in villages to conduct group education sessions on a variety of agricultural and nutrition topics including production methods, storage, marketing, infant and young child feeding, and hygiene practices (Ibid.).

Promotion of OFSP in Kenya highlighted the need for education to reach both women and men. Women reported having some control over the OFSP crop, but often had to consult with their husbands about the use of income or access to land — even though sweet potatoes are typically viewed as a woman’s crop in Kenya (Hagenimana et al. 1999). Members of the women’s groups suggested including their husbands in project activities to sensitize them to the important nutritional benefits that food crops like OFSP contribute to their families.

#### ***Key questions about incorporating promotion of healthy behaviors***

- Could the project be combined with nutrition education and dialogue to help assure that improved nutrition is prioritized by household decision makers and individuals?
- Who controls and influences decision making about food and child care, and are all relevant decision makers included in nutrition education?
- What resources, knowledge, skills, and support do project staff require to be successful agents of change?

### **Improve policy coherence: policies can support or undermine poverty reduction and nutritious diets.**

The nutrition effect of agricultural and rural development projects is influenced by government policies; the interaction between policies and projects is critically important to enhance the net nutrition impact. Project design and implementation may either accept the policy environment or attempt to change policies to better support the achievement of project goals. Alternatively, governments may set policies and seek to promote projects that will support policy goals. Unfortunately, a cohesive approach to the design and implementation of policies and projects to achieve common goals is rare (Pinstrup-Andersen 2010; Pinstrup-Andersen, Pelletier and Alderman 1995).

Policies may influence the price of individual foods and nonfoods (such as health care and school fees), thus changing the relative prices of the goods and services available to the household. Changes in trade policies may increase food prices, resulting in increases in poor farmers' incomes, offset by decreases in the purchasing power of poor consumers (a group that typically includes smallholder farmers). Trade liberalization policies may increase access and exposure to energy-dense processed foods and associated promotion, resulting in increasing overweight, obesity, and chronic diseases (Hawkes 2010; Hawkes 2006). Agricultural subsidy and trade policies in OECD countries may reduce market opportunities for poor farmers in developing countries with negative effects on income (Anderson 2009). Biofuel subsidies may increase income-earning opportunities while at the same time reduce food production and increase food prices. The net nutrition effect depends on the specific situation.

**Commodity-specific taxes and subsidies may influence diet composition** toward better or worse nutrition, irrespective of whether such subsidies and taxes are directed toward producers or consumers. For example, price subsidies for vegetables and taxes on sugar and sweeteners may reduce micronutrient deficiencies and reduce the risk of overweight, obesity, and diabetes. Commodity-specific policies targeted at specific demographic groups with high levels of malnutrition may be effective in reducing malnutrition in the short run, but **investments in unit-cost reducing agricultural research and infrastructure** are likely to be more effective in the longer run. Trade policies such as export taxes or subsidies and import restrictions may influence food prices, incomes, and incentives to expand production. Policies to improve transportation and infrastructure may reduce the cost of acquiring food although price at the outset remains unchanged. Price changes will influence nutrition through changes in the household's purchasing power and through substitution among foods and between food and nonfood. Subsidies or taxes on inputs (such as fertilizers and pesticides) and outputs (such as maize, cassava, or vegetables) may influence the nutrition of both producers and consumers through income and price changes.

- Trade-distorting agricultural subsidies in high-income countries may negatively affect the nutritional status of the rural poor in developing countries by reducing the prices received by poor farmers in developing countries.

***Key questions about promoting policy coherence for nutritional outcomes***

- What policies exist that are expected to influence incomes, food prices, gender-specific labor demand, and nutrition?
- How will proposed projects interact with existing policies?
- Is it likely that existing policies could be changed, and what is the power of key interest groups?
- Can any of these interest groups be influenced to promote policy change?

## 8. SEEK OPPORTUNITIES TO WORK ACROSS SECTORS

### Interact with programs in other sectors working to improve nutrition

While in many places agriculture has important impacts on food, health, and care practices — the determinants of nutrition — it rarely is sufficient to eliminate malnutrition. Even when the program or investment is designed to be nutrition-sensitive, there are almost always other factors that may still be limiting (such as access to health services, child feeding practices, or water and sanitation). Few projects have the resources or scope in purpose to confront every factor that may potentially influence nutrition. Recognizing that each sector has a necessary but insufficient role to play in reducing malnutrition, **multisectoral planning** and **geographic overlap** of agriculture, social protection, and health projects may be needed for measurable progress. Two recent papers on multisectoral nutrition actions published by the European Commission (2010) and Save the Children (2012) showcase two examples of programs in Bangladesh where agriculture interventions (including homestead gardening and livestock provision) were combined with health, safety net, and care practices interventions, and resulted in reductions in seasonal food insecurity and improvements in maternal and child nutritional status. USAID’s Feed the Future Program is using geographic overlap of health programs with agricultural production activities as one strategy to address nutrition.

For multisectoral planning, Garrett and others have written several pieces distilling characteristics of successes in multisectoral coordination to address nutrition (Garrett and Natalicchio 2011; Garrett and El Hag El-Tahir 2008). There may be a need to **establish a national shared architecture for nutrition improvement**, such as a high-level policy group or a regularly meeting working group mandated to advise ministries, including agriculture, on potential nutrition consequences and costs of policies.<sup>10</sup> This approach suggests the importance of “**nutritional impact assessments**” done prior to the implementation of planned projects, similar to environment impact assessments routinely carried out for World Bank and national government projects.<sup>11</sup> The European Commission paper (2011) cites the example of how the EU Delegation in Mali has “applied a nutrition lens” to food security projects through assessing the likely impact of existing food security interventions on nutrition. The Delegation stresses the usefulness of identifying accompanying measures that would increase the chance of success, such as targeting vulnerable groups, ensuring women’s involvement while taking care not to increase their workload, coordinating with other activities, and including nutrition communication. Such a priori impact assessments and accompanying adjustments would be most likely if nutrition is made a high political priority, for example, through the creation of special joint offices. At the field level, program implementers can be informed and trained to make reference and **referrals to other sector projects** related to the ultimate goal of reducing malnutrition. **To enable nutrition-sensitive planning and multisectoral collaboration, capacity building is also necessary.**

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10. For an example of how this was done in Thailand, see Heaver 2002 and Tontisirin 1995.

11. IYCN (2011) has published a tool for this approach: a module that includes defining at-risk population groups and their nutritional status, listing project objectives and alternative approaches, estimating outcomes and assessing the alternatives, and designing a mitigation and review plan.



## **Increase the capacity of government ministry staff across sectors to address malnutrition**

Targeted workshops, training sessions, integration of nutrition into educational programs, and advocacy to increase awareness about malnutrition are important to increase staff capacity on nutrition. Levitt et al. (2009) highlight that lack of shared understanding of the nature and causes of malnutrition and food insecurity between agriculture and health sectors hampers dialogue and the ability to create and take ownership of common solutions. Capacity building in ministries of health, agriculture, and finance to understand the basic causes, prevalence, and types of malnutrition could lead to better generation of appropriate solutions and action. Nutritional training relevant to agricultural workers, particularly field-based extension agents, would increase capacity if included in their preservice training. Postsecondary and graduate training in nutrition is also important to build up capacity within-country.

### ***Key questions about multisectoral planning and capacity building***

- What are the main limiting factors to good nutrition in the planned implementation site?
- Could the agricultural investment take place in the same geographic area as other health, water and sanitation, and social protection programs also important for reducing malnutrition?
- Could staff in the agriculture project refer clients to those other resources, and vice versa? Would it be possible for agriculture, health, and social protection staff to combine field visits?
- What are the possibilities and incentive structures for creating a multisectoral working group on nutrition at institutional, country, or local level?
- Where are the opportunities to include relevant public nutrition information into the current training and activities of agriculture sector staff?

## AN AGENDA FOR RESEARCH AND ACTION

With some gaps and exceptions, agricultural interventions designed to positively influence nutrition overall have shown changes in intermediate outcomes (for example, income and dietary intake) in expected directions, as referenced in recent reviews and throughout this paper. Significant knowledge exists to recommend the broad principles in this document, as well as to suggest sample approaches based on their success in a certain context. Action on these suggested principles is likely to be important for nutrition impact in many contexts.

The medical, nutrition, and public health communities are accustomed to evaluating evidence from specific, targeted interventions (such as vitamin supplementation, facility-based management of childhood severe acute malnutrition, use of insecticide-treated bed nets during pregnancy) whose impacts function along relatively short casual pathways. Pathways from agricultural investments to improved nutrition outcomes do not operate in the same way. Even those investments with seemingly direct avenues of impact on nutrition (for example, improved diversity of food production leading to improvements in diet quality) are mediated by multiple factors such as gendered control of production and market decisions, household capacity to preserve foods, and behaviors and beliefs related to intrahousehold food allocation. The principles put forth in this document, therefore, do not emphasize the impact of single nutritional outcomes through circumscribed pathways. Rather, they underscore investments in people and systems that have the potential to transform underlying conditions and positively influence the multiple, proximal determinants of proper nutrition. As stated in the “measure nutrition” section under principle 1, intermediate outcomes such as improved diets, water, and women’s status are positive, nutritionally relevant impacts in themselves. Whether or not these result in *measurable* impact on nutritional status in a given context does not alter the fact that they are important for human nutrition.

That said, better information on impact and cost effectiveness of approaches based on the above principles would be extremely helpful to inform better program design and best practice examples for scale-up. Several recent reports have reviewed the available literature and summarized outcomes of agricultural projects on nutrition, and have highlighted the need for more evidence (Masset et al. 2012; Webb Girard, Self, and Olude 2012; Arimond et al. 2010; World Bank 2007; Berti, Krasevec, and Fitzgerald 2004; Ruel and Levin 2000). These conclude generally that agriculture affects nutrition-related outcomes through multiple pathways, and targeting several at once is the most likely to show impact on nutrition; and also that most available evidence is hampered by methodological issues in project evaluation. A recent DFID-commissioned review of nutrition-targeted agricultural interventions over the last 20 years found little impact on child nutritional status, but concluded that the lack of impact could easily be due to weaknesses in the evaluations rather than inherent weaknesses of the interventions themselves (Masset et al. 2012). A significant problem is the small number of reasonably well-designed studies that make up the evidence base. For example, the review shows an overall significant increase in vitamin A intake attributable to the home gardens, yet the authors conclude that because there are so few studies available, the evidence of home



gardens (or any other agricultural intervention) on vitamin A intake is not robust. The main take-home message, rather than pessimism about the potential for agriculture to affect nutrient intake, is that a greater number of well-designed evaluations are urgently needed.

This period of increased agricultural investment ideally could be used to generate missing evidence. Basing interventions on the principles identified in this paper, and learning from the outcomes, would maximize potential for nutrition impact based on what we know now, minimize the likelihood of harm, and inform future generations of agricultural investments.

## RESEARCH AND EVALUATION PRIORITIES

### **1. Track impact on multiple outcomes at once: proximal factors to nutrition, nutritional status, productivity, and income**

Agriculture projects have multiple goals, of which improved nutrition is (or should be) only one. The most useful evaluations would capture impact on all goals, to be able to evaluate trade-offs and multiple wins. For example, the HarvestPlus program evaluates varieties on nutrition *and* yield and taste characteristics, with the full realization that nutritious varieties will only be adopted at a large scale if they are also high-yielding. As noted above, it is important to capture impact on proximal factors to nutritional status, such as dietary quality.

Of special note because of its absence in the literature: when evaluating impact on diet and nutritional status, future evaluations should track results relevant to overnutrition as well as undernutrition. One recent analysis of 29 countries shows that while stunting declines more rapidly in countries favoring agricultural investment, obesity increases more with increasing agricultural income than nonagricultural income — suggesting that the type of agricultural investments made in recent decades fails to protect the poor from obesity (Webb and Block 2010). Yet no available project evaluation or literature review has considered obesity or unhealthy dietary patterns as an outcome.

### **2. Design studies better able to attribute impact to specific approaches**

The DFID-commissioned review by Masset et al. (2012) points out common (sometimes universal) gaps in available studies on agriculture and nutrition, which include poor description and control of selection bias, no analysis of program adoption determinants, and virtually no disaggregation of results by wealth or gender. Of the evaluations reviewed, only two had sample sizes large enough to see a 20 percent change in underweight or stunting, and none had the power to see more modest improvements. Several studies increased the plausibility of their results by analyzing intermediate outcomes (such as technology adoption and diet change), but many lacked even a basic theory of change. In addition to rigorous study design, it is important to understand and measure intermediate impacts along program impact pathways to understand what, if anything, about a given program results in an effect (Habicht, Pelto, and Lapp 2009).

### 3. Collect information on costs and cost-effectiveness

How much does nutrition-sensitive agriculture cost compared to business as usual? The answer may be less, more, or the same, depending on the specific situation and options. Costing information would facilitate planning for nutrition-sensitive activities in budgets. It is a difficult task because activities, as well as costs, are context specific. However a database of project costs in different contexts may be useful to provide some information. Estimates of cost-effectiveness would also be desirable for understanding the programmatic costs of achieving a change in a specific outcome. For the agriculture sector, cost-effectiveness of a nutrition-sensitive approach for achieving core *productivity and income goals* may be most relevant. To date, there is no such information. Cost-effectiveness for achieving *nutrition outcomes* has been attempted, but these estimates should be done with care and regarded with skepticism. The figures resulting from any such calculation will depend on how limited or broad a view of nutritional impact is taken.

At least three studies comparing the cost-effectiveness of micronutrient supplements, fortified food, and an integrated horticulture and public health program have concluded that *for the sole purpose of reducing micronutrient deficiencies*, the food-based approach is the least cost-effective. All of these studies note, however, that the conclusion only stands for the limited goal of reducing a specific micronutrient deficiency in the short term, and that it ignores the broader goals and benefits of the food-based approach, which are likely to confer additional social and health benefits that have gone unmeasured (Karim et al. 2005; Phillips et al. 1996; Popkin et al. 1980). Even agricultural programs carefully targeted toward a single specific nutrition outcome, such as orange-fleshed sweet potato (OFSP) promotion and its effect on vitamin A status of children, have other nutrition-relevant outcomes as well, such as effects on energy consumption, women's nutrition knowledge and empowerment, and household income. In contrast, a vitamin A supplementation program would not be expected to affect any nutrition-relevant outcome beyond vitamin A status. Since agricultural development may affect nutrition through multiple pathways, complete cost-effectiveness analyses would include impact on all the basic causes of malnutrition (as shown in figure 1). In existing literature, this has not been done.

## CONCLUSION

Agriculture and rural development investments have enormous potential to influence nutrition positively. They can do so most effectively if nutrition-relevant outcomes are clearly articulated in the design of a project or policy, and if activities and indicators follow suit. Half a century of agricultural research, beginning with the sea change in agricultural production in the 1960s, has greatly expanded food production, but nutritional challenges persist. While more food, lower food prices, and higher incomes are critically important for the welfare of people; they do not by themselves assure the elimination of undernutrition or the avoidance of overweight and obesity. Proper nutrition depends on nutritious diets, adequate care for mothers and children, clean drinking water, good sanitation, nutrition-sensitive behavior by households and individuals, as well as healthy home environments. Programmatic evidence and experience have consistently concluded that productivity and income increases, as well as new technologies and educational opportunities, will be much more likely to benefit the nutritionally vulnerable if they are expressly targeted, and if women are empowered by these changes. Attention to year-round, diverse food production and water management, supported with appropriate education and incentives, is critical for agriculture to effectively supply direct inputs to nutrition and health.

Although there is an urgent need to strengthen the understanding of how agricultural policies and projects can be designed and implemented to achieve nutrition goals, existing knowledge around the recommended principles is sufficient to move ahead with designing nutrition-sensitive agricultural interventions. Rather than to rationalize inaction based on incomplete evidence on operational approaches, it would be sensible to base agricultural investments on principles of how agriculture can affect nutrition, strengthened by good evidence that well-planned investments have the potential to improve both incomes and diets.

The principles suggested in this document echo themes about reaching nutrition through agriculture in other recent publications by DFID, the European Commission, and USAID's Feed the Future Guide, as well as in guidance notes by FAO, IYCN, USAID's Food and Nutrition Technical Assistance Project (FANTA), ACF, Save the Children UK, World Vision, and IFPRI.<sup>12</sup> All these organizations emphasize the need for incorporating nutrition into the design of projects, measurement of nutrition outcomes, targeting smallholder and women farmers (particularly with regard to women's time and income control), crop diversification strategies beyond staples, leveraging poverty reduction, the use of nutrition education, and complementarity with health and social safety net programs. Environmental sustainability of production, reductions in seasonality, continued investment in biofortification, and the need for ex ante nutrition impact assessments of projects appear in most of the recent publications.<sup>13</sup> It appears that there is an emerging consensus about what agricultural investments need to do to achieve nutrition results. The next step is to put the principles and context-dependent actions outlined in this document into action, and learn from the results.

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12. See reference section for citations of these documents.

13. For a detailed analysis see FAO 2012.

## **APPENDIX 1: MENU OF OPTIONS FOR ACHIEVING NUTRITION GOALS**

### **Increase dietary diversity**

- Diversify production systems to encourage dietary diversification (for example, broaden the diversity of foods included in agricultural training, extension, seed provision programs, and exports)
- Package agriculture projects with gender-sensitive nutrition education
- Enhance market opportunities for a diversity of foods, particularly micronutrient-dense vegetables, fruits, pulses, and animal-source foods
- Improve infrastructure needed to enable market access (especially for perishable foods)
- Implement preservation technologies (for example, drying)
- Reduce spatial and intertemporal fluctuations in food prices and the availability of food through food policies
- Improve income, particularly of women, coupled with nutrition education

### **Increase micronutrient intake**

- Diversify production systems to encourage dietary diversification
- Package agriculture projects with gender-sensitive nutrition education
- Implement preservation technologies (for example, drying)
- Grow biofortified crops
- Fortify foods
- Promote use of fertilizers with key micronutrients (zinc and iodine), through education and policy

### **Improve maternal and child care and feeding**

- Design projects to enhance women's control of income from agricultural activities and preserve their time available for child care
- Package agriculture projects with gender-sensitive nutrition education
- To increase women's income, focus on crops and livestock breeds that women disproportionately produce
- Prioritize technologies that improve productivity and introduce time savings for tasks that women traditionally perform (for example, weeding and hoeing, food processing, crop transportation)
- Strengthen women's access to productive resources, training and support services (for example, land, agricultural inputs, credit, extension services)
- Involve the entire family, not only women

### **Protect health**

- Improve water delivery systems (for irrigation and home use), paying close attention to water use efficiency
- Ensure that new agricultural techniques do not increase risk of parasitic or mosquito-borne disease or contamination of available water

- Improve basic food safety, including control of aflatoxin, and improved storage and transport
- Overlap agriculture, health, and social protection projects geographically

**Improve environment supportive of nutrition**

- Increase capacity of staff in ministries to address malnutrition
- Cross-train program staff and extensionists in relevant content areas. Agricultural extensionists, for example, could discuss the nutritional value of foods produced or the importance of feeding those foods to young children while remaining focused primarily on agricultural training and production goals
- Improve land tenure policies, particularly for women and indigenous groups
- Employ policies to reduce nonfood expenses of the malnourished, such as school fees and health care costs
- Enact commodity-specific taxes and subsidies that will improve access to nutritious diets
- Improve infrastructure to enable market access
- Provide social safety nets

## REFERENCES

- ACDI/VOCA. 2012. Nutrition Integration Fact Sheets, Washington, DC. <http://www.thousanddays.org/author/acdivoca/>.
- Alderman, H., J. Hoddinott, L. J. Haddad, C. R. Udry. 2003. "Gender Differentials in Farm Productivity: Implications for Household Efficiency and Agricultural Policy." In *Household Decisions, Gender, and Development*, ed. A. Quisumbing, 61–66. Washington, DC: International Food Policy Research Institute.
- Anderson, Kym, ed. 2009. *Distortions to Agricultural Incentives. A Global Perspective, 1955–2007*. Washington, DC: Palgrave MacMillan and the World Bank.
- Arimond, M., C. Hawkes, M. T. Ruel, Z. Sifri, P. R. Berti, J. L. Leroy, J. W. Low, L. R. Brown, and E. A. Frongillo. 2010. "Agricultural Interventions and Nutrition: Lessons from the Past and New Evidence." In *Combating Micronutrient Deficiencies*, ed. B. Thompson and L. Amoroso, 41–75. Rome: Food and Agriculture Organization (FAO).
- Arnott, S. 2011. "Growing Healthy Children: Addressing Child Undernutrition through Agriculture." New York: World Vision International. <http://voices.worldvision.ca/wp-content/uploads/2012/04/Food-Sec-Nutrition-Discussion-Paper-FINALver-2-feb-2011-21.pdf>.
- Attig, G. A., S.K. Smitasiri, K. Ittikom, S. Dhanamitta. 1993. "Promoting Home Gardening to Control Vitamin A Deficiency in Northeastern Thailand." *Food, Nutrition and Agriculture* 7: 18–25.
- Barnes, D. L., U. S. Adair, and B. M. Popkin. 1991. "Women's Physical Activity and Pregnancy Outcome: A Longitudinal Analysis from the Philippines." *International Journal of Epidemiology* 20 (1): 162–72.
- Barrett, C., and D. Maxwell. 2005. *Food Aid After Fifty Years: Recasting Its Role*. New York: Routledge.
- Berger, M., V. DeLancey, and A. Mellencamp. 1984. *Bridging the Gender Gap in Agricultural Extension*. Washington, DC: International Center for Research on Women.
- Berti, P. R., J. Krusevec, and S. Fitzgerald. 2004. "A Review of the Effectiveness of Agriculture Interventions in Improving Nutrition Outcomes." *Public Health Nutrition* 7: 599–609.
- Bezner Kerr, R., and M. Chirwa. 2004. "Participatory Research Approaches and Social Dynamics that Influence Agricultural Practices to Improve Child Nutrition in Malawi." *EcoHealth* 1 (Suppl 2): 109–19.



Bezner Kerr, R., L. Dakishoni, L. Shumba, R. Msachi, and M. Chirwa. 2008. "We Grandmothers Know Plenty: Breastfeeding, Complementary Feeding and the Multifaceted Role of Grandmothers in Malawi." *Social Science Medicine* 66 (5): 1095–105.

Bioversity International. 2011. *Improving Nutrition with Agricultural Biodiversity: A Manual on Implementing Food Systems Field Projects to Assess and Improve Dietary Diversity, and Nutrition and Health Outcomes*.  
[http://www.bioversityinternational.org/fileadmin/bioversityDocs/Research/Nutrition\\_\\_new\\_/Improving\\_Nutrition\\_with\\_agricultural\\_biodiversity.pdf](http://www.bioversityinternational.org/fileadmin/bioversityDocs/Research/Nutrition__new_/Improving_Nutrition_with_agricultural_biodiversity.pdf).

Blackden, C. M., and Q. Wodon. 2006. "Gender, Time Use, and Poverty in Sub-Saharan Africa." World Bank Working Paper 73, Washington, DC.

Block, S. 2003. "Nutrition Knowledge, Household Coping, and the Demand for Micronutrient Rich Foods." Nutrition Working Paper 5, BAPPENAS/Department Pertanian/USAID/Development Alternatives, Inc. Food Policy Advisory Team, Washington, DC.

Bloem, M. W., N. Huq, J. Gorstein, S. Burger, T. Kahn, N. Islam, E. Baker, and F. Davidson. 1996. "Production of Fruits and Vegetables at the Homestead Is an Important Source of Vitamin A among Women in Rural Bangladesh." *European Journal of Clinical Nutrition* 50: S62–67.

Bouis, H. E., P. Eozenou, and A. Rahman. 2011. "Food Prices, Household Income, and Resource Allocation: Socioeconomic Perspectives on Their Effects on Dietary Quality and Nutritional Status." *Food and Nutrition Bulletin* 32 (suppl1): 14S–23S.

Bouis, H. E., and L. J. Haddad. 1990. "Effects of Agricultural Commercialization on Land Tenure, Household Resource Allocation, and Nutrition in the Philippines." Research Report 79, International Food Policy Institute, Washington, DC.

Brun, T., J. Reynaud, and S. Chevaussus-Agnes. 1989. "Food and Nutrition Impact of One Home Garden Project in Senegal." *Ecology of Food and Nutrition* 23: 91–108.

Budlender, D. 2008. "The Political and Social Economy of Care: Tanzania Research Report 2." Geneva: United Nations Research Institute for Social Development.

Bushamuka, V. N., S. de Pee, A. Talukder, L. Kiess, D. Panagides, A. Taher, and M. Bloem. 2005. "Impact of a Homestead Gardening Program on Household Food Security and Empowerment of Women in Bangladesh." *Food and Nutrition Bulletin* 26: 17–25.

Cao, X. Y., X. M. Jiang, A. Kareem, Z. H. Dou, M. Abdul Rakeman, M. L. Zhang, T. Ma, K. O'Donnell, N. DeLong, and G. R. DeLong. 1994. "Iodination of Irrigation Water as a Method of Supplying Iodine to a Severely Iodine-Deficient Population in Xinjiang, China." *Lancet* 344 (8915): 107–110.

Caballero, B. 2005. "A Nutrition Paradox — Underweight and Obesity in Developing Countries." *New England Journal of Medicine* 352 (15): 1514–16.

Caulfield, L. E., S. L. Huffman, and E. G. Piwoz. 1999. "Interventions to Improve Intake of Complementary Foods by Infants 6 to 12 Months of Age in Developing Countries: Impact on Growth and on the Prevalence of Malnutrition and Potential Contribution to Child Survival." *Food and Nutrition Bulletin* 20 (2): 183–200.

Chakravarty, I. 2000. "Food-Based Strategies to Control Vitamin A Deficiency." *Food and Nutrition Bulletin* 21: 135–43.

Charmes, J. 2006. "A Review of Empirical Evidence on Time Use in Africa from UN-Sponsored Surveys." In *Gender, Time Use, and Poverty in Sub-Saharan Africa*, ed. C. M. Blackden and Q. Wodon, 39–72. World Bank Working Paper No. 73, Washington, DC.

Cotula, L., S. Vermeulen, R. Leonard, and J. Keeley. 2009. *Land Grab or Development Opportunity?* London/Rome: IIED/FAO/IFAD. [www.ifad.org/pub/land/land\\_grab.pdf](http://www.ifad.org/pub/land/land_grab.pdf).

Cramer, L. K., and S. K. Wandira. 2010. "Strengthening the Role of Women in the Food Systems of Sub-Saharan Africa to Achieve Nutrition and Health Goals." In *The African Food System and Its Interaction with Human Health and Nutrition*, ed. P. Pinstrup-Andersen, chapter 13. Ithaca, NY: Cornell University Press.

Dankelman, I., and J. Davidson. 1988. *Women and Environment in the Third World: Alliance for the Future*. London: Earthscan Publications and the International Union for the Conservation of Nature.

Deininger, K., and D. Byerlee. 2011. *Rising Global Interest in Farmland*. Washington, DC: World Bank.

DeWalt, K. 1993. "Nutrition and the Commercialization of Agriculture: Ten Years Later." *Social Science and Medicine* 36: 1407–16.

Dewey, K. G. 1981. "Nutritional Consequences of the Transformation from Subsistence to Commercial Agriculture in Tabasco, Mexico." *Human Ecology* 9: 151–87.

Dewey, K. G., and S. Adu-Afarwuah. 2008. "Systematic Review of the Efficacy and Effectiveness of Complementary Feeding Interventions in Developing Countries." *Maternal and Child Nutrition* 4: 24–85.

Doak, C. M., L. S. Adair, C. Monteiro, and B. M. Popkin. 2000. "Overweight and Underweight Coexist within Households in Brazil, China, and Russia." *The Journal of Nutrition* 130 (12): 2965–71.

European Commission (EC). 2011. *Addressing Undernutrition in External Assistance: An Integrated Approach through Sectors and Aid Modalities*.  
<http://capacity4dev.ec.europa.eu/topic/fighting-hunger>.

Faber, M., A. B. Spinnler, and S. L. Venter. 2002. "Increased Vitamin A Intake in Children Aged 2–5 Years through Targeted Home-Gardens in a Rural South African Community." *Public Health Nutrition* 5 (1): 11–16.

Fontana, M., and L. Natali. 2008. "Gendered Patterns of Time Use in Tanzania: Public Investment in Infrastructure Can Help." Paper prepared for the International Food Policy Research Institute Project on Evaluating the Long-Term Impact of Gender-focused Policy Interventions, Washington, DC.

Food and Agriculture Organization (FAO). 2001. "Incorporating Nutrition Considerations into Agricultural Research Plans and Programmes." Rome.  
<http://www.fao.org/docrep/005/y1181e/Y1181E00.htm>.

———. 2004. "Incorporating Nutrition Considerations into Development Policies and Programmes." Rome. <ftp://ftp.fao.org/docrep/fao/007/y5343e/y5343e00.pdf>.

———. 2006. "Arsenic Contamination of Irrigation Water, Soil and Crops in Bangladesh: Risk Implications for Sustainable Agriculture and Food Safety in Asia." Rome.

———. 2009. "Investing in Food Security: Linking Agriculture to Nutrition Security." Rome.  
[http://www.fao.org/fileadmin/templates/ag\\_portal/docs/i1230e00.pdf](http://www.fao.org/fileadmin/templates/ag_portal/docs/i1230e00.pdf).

———. 2010. "Assisting the Food and Agriculture Sector in Addressing Malnutrition." Rome.  
[http://www.fao.org/fileadmin/user\\_upload/agn/pdf/Food\\_and\\_Agr\\_sector\\_and\\_malnutrition.pdf](http://www.fao.org/fileadmin/user_upload/agn/pdf/Food_and_Agr_sector_and_malnutrition.pdf).

———. 2012. "Final Draft: Synthesis of Guiding Principles on Agriculture Programming for Nutrition." Rome.  
[http://www.fao.org/fileadmin/user\\_upload/wa\\_workshop/docs/Synthesis\\_of\\_Ag-Nutr\\_Guidance\\_FAO\\_IssuePaper\\_Draft.pdf](http://www.fao.org/fileadmin/user_upload/wa_workshop/docs/Synthesis_of_Ag-Nutr_Guidance_FAO_IssuePaper_Draft.pdf).

Garcia, M. 1991. "Impact of Female Sources of Income on Food Demand among Rural Households in the Philippines." *Quarterly Journal of International Agriculture* 30 (2): 109–24.

Garrett, J., and S. El Hag El-Tahir. 2008. *Nutrition beyond the Health Sector: A Profile of World Bank Lending in Nutrition from 2000 to 2006*. Washington, DC: World Bank.

Garrett, J., and M. Natalicchio, ed. 2011. *Working Multisectorally in Nutrition: Principles, Practices, and Case Studies*. Washington, DC: International Food Policy Research Institute.

<http://www.ifpri.org/sites/default/files/publications/oc68.pdf>.

Gill, K., K. Brooks, J. McDougall, P. Patel, and A. Kes. 2010. “Bridging the Gender Divide: How Technology Can Advance Women Economically.” Washington, DC: International Center for Research on Women.

Gockowski, J., J. Mbazoo, G. Mbah, and T. F. Moulende. 2003. “African Traditional Leafy Vegetables and the Urban and Peri-Urban Poor.” *Food Policy* 28: 221–35.

Gong, Y., A. Hounsa, S. Egal, P. C. Turner, A. E. Sutcliffe, A. J. Hall, K. Cardwell, and C. P. Wild. 2004. “Postweaning Exposure to Aflatoxin Results in Impaired Child Growth: A Longitudinal Study in Benin, West Africa.” *Environmental Health Perspectives* 112 (13): 1334–8.

Graham, R., R. M. Welch, D. A. Saunders, I. Ortiz-Monasterio, H. E. Bouis, M. Bonierbale, S. De Haan, G. Burgos, G. Thiele, R. Liria, C. A. Meisner, S. E. Beebe, M. J. Potts, M. Kadian, P. R. Hobbs, R. K. Gupta, S. Twomlow. 2007. “Nutritious Subsistence Food Systems.” *Advances in Agronomy* 92: 1–74.

Greiner, T., and S. N. Mitra. 1995. “Evaluation of the Impact of a Food-based Approach to Solving Vitamin A Deficiency in Bangladesh.” *Food and Nutrition Bulletin* 16: 193–205.

Grivetti, L., and B. Ogle. 2000. “Value of Traditional Foods in Meeting Macro- and Micronutrient Needs: The Wild Plant Connection.” *Nutrition Research Reviews* 13: 31–46.

Guillermo-Tuazon, M. A., C. V. C. Barba, J. M. A. van Raaij, and J. G. A. J. Hautvast. 1992. “Energy Intake, Energy Expenditure, and Body Composition of Poor Rural Philippine Women throughout the First Six Months of Lactation.” *American Journal of Clinical Nutrition* 56: 874–80.

Gupta, S. P. 2004. *India Vision 2020: Report of the Committee on India Vision 2020*. New Delhi: Planning Commission, Government of India.

Gupta, S., and K. Bains. 2006. “Traditional Cooked Vegetable Dishes as Important Sources of Ascorbic Acid and Beta Carotene in the Diets of Indian Urban and Rural Families.” *Food and Nutrition Bulletin* 27 (4): 306–10.

Guyer, J. 1980. “Household Budgets and Women’s Incomes.” African Studies Center Working Paper 28, Boston University, Boston.

- Haas, J. D., J. L. Beard, L. E. Murray-Kolb, A. M. del Mundo, A. Felix, and G. B. Gregorio. 2005. "Iron-Biofortified Rice Improves the Iron Stores of Non-anemic Filipino Women." *Journal of Nutrition* 135: 2823–30.
- Haas, J. D., E. J. Martinez, S. Murdoch, E. Conlisk, J. A. Rivera, and R. Martorell. 1995. "Nutrition Supplementation during the Preschool Years and Physical Work Capacity in Adolescent and Young Adult Guatemalans." *Journal of Nutrition* 125: 1078S–89S.
- Habicht, J-P, G. Pelto, and J. Lapp. 2009. *Methodologies to Evaluate the Impact of Large-Scale Nutrition Projects*. Washington, DC: World Bank.
- Haddad, L. J., and H. E. Bouis. 1991. "The Impact of Nutritional Status on Agricultural Productivity: Wage Evidence from the Philippines." *Oxford Bulletin of Economics and Statistics* 53 (1): 45–68.
- Hagenimana, V., M. A. Oyunga, J. Low, S. M. Njroge, S. T. Gichuki, and J. Kabira. 1999. "The Effects of Women Farmer's Adoption of Orange-fleshed Sweet Potatoes: Raising Vitamin A Intake in Kenya." Research Report Series No. 3, International Center for Research Women/Opportunities for Micronutrients Interventions (ICRW/OMNI), Washington, DC.
- Hallman, K. 2003. "Mother-Father Resources, Marriage Payments, and Girl-Boy Health in Rural Bangladesh." In *Household Decisions, Gender, and Development*, ed. A. Quisumbing, 115–20. Washington, DC: International Food Policy Research Institute.
- HarvestPlus. Information page on crops. <http://www.harvestplus.org/content/crops>.
- Hawkes, C. 2006. "Uneven Dietary Development: Linking the Policies and Processes of Globalization with the Nutrition Transition, Obesity and Diet-related Chronic Diseases." *Globalization and Health* 2: 4.
- . 2009. "Globalization and the Nutrition Transition: A Case Study." In *Case Studies in Food Policy for Developing Countries, Vol. III*, ed. P. Pinstруп-Andersen and F. Cheng, chapter 9. Ithaca, NY: Cornell University Press. <http://cip.cornell.edu/gfs>.
- Hawkes, C., and M. T. Ruel. 2006. "Understanding the Links between Agriculture and Health." Brief 4: Agriculture and Nutrition Linkages: Old Lessons and New Paradigms, International Food Policy Research Institute, Washington, DC.
- . 2012. "Value Chains for Nutrition." In *Reshaping Agriculture for Nutrition and Health*, ed. Shenggen Fan and Rajul Pandya-Lorch, chapter 9. International Food Policy Research Institute: Washington, DC.
- Heaver, R. 2002. "Thailand's National Nutrition Program: Lessons in Management and Capacity Development." World Bank HNP Discussion Paper, Washington, DC.

Helen Keller International. 2010. “Homestead Food Production Model Contributes to Improved Household Food Security, Nutrition and Female Empowerment — Experience from Scaling-up Programs in Asia (Bangladesh, Cambodia, Nepal and Philippines).” *Helen Keller International Nutrition Bulletin* 8 (1).

Helen Keller International (HKI)/Asian Vegetable Research and Development Centre (AVRDC) (Taiwan). 1993. “Home Gardening in Bangladesh: Evaluation Report of the Home Gardening Pilot Project.” New York: HKI.

Herforth, A. 2009. “Food Security, Nutrition and Health in Costa Rica’s Indigenous Populations.” In *Case Studies in Food Policy for Developing Countries, Vol. I*, ed. P. Pinstруп-Andersen and F. Cheng, chapter 2. Ithaca, NY: Cornell University Press. <http://cip.cornell.edu/gfs>.

———. 2010a. “Promotion of Traditional African Vegetables in Kenya and Tanzania: A Case Study of an Intervention Representing Emerging Imperatives in Global Nutrition.” Ph.D. thesis, Cornell University.

———. 2010b. “Nutrition and the Environment: Fundamental to Food Security in Africa.” In *The African Food System and Its Interaction with Human Health and Nutrition*, ed. P. Pinstруп-Andersen, chapter 7. Ithaca, NY: Cornell University Press.

Hoddinott, J., and L. J. Haddad. 1994. “Women’s Income and Boy-Girl Anthropometric Status in the Côte d’Ivoire.” *World Development* 22 (4): 543–53.

Ilahi, N. 2000. “The Intra-household Allocation of Time and Tasks: What Have We Learnt from the Empirical Literature?” Policy Research Report on Gender and Development, Working Paper Series No. 13, World Bank Development Research Group, Washington, DC.

Intergovernmental Panel on Climate Change (IPCC). 2007. “Climate Change 2007: The Physical Science Basis. Contribution of Working Group 1 to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.” In *Regional Climate Projections*, ed. S. Solomon, D. Qin, M. Manning, Z. Chen, M. Marquis, K. B. Averyt, M. Tignor, and H. L. Miller, 996 (chapter 11). Cambridge: Cambridge University Press. [http://www.ipcc.ch/publications\\_and\\_data/ar4/wg1/en/faq-11-1.html](http://www.ipcc.ch/publications_and_data/ar4/wg1/en/faq-11-1.html).

International Food Policy Research Institute (IFPRI). 2011a. “Leveraging Agriculture for Improving Nutrition and Health Outcomes: The Way Forward.” Washington, DC. <http://2020conference.ifpri.info/publications/the-way-forward/>

———. 2011b. “Agriculture, Nutrition, Health: Exploiting the Links.” Washington, DC.

Infant and Young Child Nutrition Project (IYCN). 2011. “Achieving Nutritional Impact and Food Security through Agriculture: Fact Sheet” and “Nutritional Impact Assessment



Tool.” Washington, DC: USAID.

[http://www.iycn.org/resource/?resource\\_categories=agriculture-tools](http://www.iycn.org/resource/?resource_categories=agriculture-tools).

James, I. F., and B. Kuipers. 2003. Wageningen, the Netherlands: Agromisa Foundation.  
<http://www.agromisa.org/>.

Jones, A. D., Y. C. Agudo, L. Galway, J. Bentley, and P. Pinstrip-Andersen. “Heavy Agricultural Workloads and Low Crop Diversity Are Strong Barriers to Improving Child Feeding Practices in the Bolivian Andes.” *Social Science & Medicine* (in press).

Karim, R., G. Desplats, T. Schaetzel, A. Herforth, F. Ahmed, Q. Salamatullah, M. Shahjahan, M. Akhtaruzzaman, and F. J. Levinson. 2005. “Seeking Optimal Means to Address Micronutrient Deficiencies in Food Supplements: A Case Study from the Bangladesh Integrated Nutrition Project.” *Journal of Health, Population and Nutrition* 23 (4): 369–76.

Katz, E. 1994. “The Impact of Non-Traditional Export Agriculture on Income and Food Availability in Guatemala: An Intra-Household Perspective.” *Food and Nutrition Bulletin* 15 (4): 295-302.

Kennedy, E. T., and B. Cogill. 1987. “Income and Nutritional Effects of the Commercialization of Agriculture in Southwestern Kenya.” Research Report 63, International Food Policy Research Institute, Washington, DC.

Kennedy, E. T., and R. Oniang’o. 1993. “Household and Preschooler Vitamin A Consumption in Southwestern Kenya.” *Journal of Nutrition* 123: 841–6.

Kes, A., and H. Swaminathan. 2006. “Gender and Time Poverty in Sub-Saharan Africa.” In *Gender, Time Use, and Poverty in Sub-Saharan Africa*, ed. C. M. Blackden and Q. Wodon, 13–38. World Bank Working Paper No. 73, Washington, DC.

Kidala, D., T. Greiner, and M. Gebre-Medhin. 2000. “Five-Year Follow-up of a Food-based Vitamin A Intervention in Tanzania” *Public Health Nutrition* 3: 425–31.

Kuhnlein, H.V., B. Erasmus, and D. Spigelski. 2009. *Indigenous Peoples’ Food Systems: the Many Dimensions of Culture, Diversity and Environment for Nutrition and Health*. Rome: Centre for Indigenous Peoples Nutrition and Environment (CINE) and Food and Agriculture Organization (FAO).

Kumar, S., and C. Siandwazi. 1994. “Maize in Zambia: Effects of Technological Change on Food Consumption and Nutrition.” In *Agricultural Commercialization, Economic Development, and Nutrition*, ed. J. von Braun and E. Kennedy, 295–308. Baltimore, MD: Johns Hopkins University Press.

Kurth, A. 1989. “Agricultural Development and Nutritional Status in Malawi.” *Journal of Tropical Pediatrics* 35: 250–4.

- Le Cuziat, G., and H. Mattinen. 2011. *Maximising the Nutritional Impact of Food Security and Livelihoods Interventions: A Manual for Field Workers*. New York: ACF International. <http://www.actionagainsthunger.org/publication/2011/07/maximising-nutritional-impact-food-security-and-livelihoods-interventions>.
- Leroy, J. L., and E. Frongillo. 2007. "Can Interventions to Promote Animal Production Ameliorate Undernutrition?" *Journal of Nutrition* 137: 2311–16.
- Levitt, E. J., D. Pelletier, and A. Pell. 2009. "Revisiting the UNICEF Malnutrition Framework to Foster Agriculture and Health Sector Collaboration to Reduce Malnutrition: A Comparison of Stakeholder Priorities for Action in Afghanistan." *Food Policy* 34: 156–65.
- Lima, M., S. Ismail, A. Ashworth, and S. S. Morris. 1999. "Influence of Heavy Agricultural Work during Pregnancy on Birthweight in Northeast Brazil." *International Journal of Epidemiology* 28: 469–74.
- Low, J. W., M. Arimond, N. Osman, B. Cunguara, F. Zano, and D. A. Tschirley. 2007. "Food-Based Approach Introducing Orange-Fleshed Sweet Potatoes Increased Vitamin A Intake and Serum Retinol Concentrations in Young Children in Rural Mozambique." *Journal of Nutrition* 137: 1320–27.
- Masset, E., L. J. Haddad, A. Cornelius, and J. Isaza-Castro. 2012. "Effectiveness of Agricultural Interventions that Aim to Improve Nutritional Status of Children: Systematic Review." *British Medical Journal* 344:d8222  
<http://www.bmj.com/content/344/bmj.d8222>.
- Masset, E., A. Cornelius, L. J. Haddad, and J. Isaza-Castro. 2011. "What Is the Impact of Interventions to Increase Agricultural Production on Children's Nutritional Status?: A Systematic Review of Interventions Aiming at Increasing Income and Improving the Diet of the Rural Poor." London: Department for International Development (DFID).  
[http://www.dfid.gov.uk/R4D/PDF/Outputs/SystematicReviews/Masset\\_etal\\_agriculture\\_and\\_nutrition.pdf](http://www.dfid.gov.uk/R4D/PDF/Outputs/SystematicReviews/Masset_etal_agriculture_and_nutrition.pdf).
- McNamara, P. E., J. M. Ulimwengu, and K. L. Leonard. 2010. "Do Health Investments Improve Agricultural Productivity?" International Food Policy Research Institute (IFPRI) Discussion Paper, Washington, DC.
- Mirle, C.. 2006. "Predicting the Effects of Crop-Based Agricultural Programs on Household-Level Consumption in Rural Bangladesh." Ph. D. thesis, Tufts University.
- Mutero, C. M., M. McCartney, and E. Boelee. 2006. "Agriculture, Malaria, and Water-associated Diseases." International Food Policy Research Institute (IFPRI) series, "Understanding the Links between Agriculture and Health," Washington, DC.

Naved, R. T. 2003. "Intrahousehold Impact of the Transfer of Modern Agricultural Technology: A Gender Perspective." In *Household Decisions, Gender, and Development*, ed. A. Quisumbing, 85–88. Washington, DC: International Food Policy Research Institute.

Nelson, R. 2010. "Pest Management, Farmer Incomes and Health Risks in Sub-Saharan Africa: Pesticides, Host Plant Resistance and Other Measures." In *The African Food System and Human Health and Nutrition*, ed. P. Pinstруп-Andersen, Chapter 6. Ithaca, NY: Cornell University Press.

Phillips, M., T. Sanghvi, R. Suarez, J. McKigney, and J. Fiedler. 1996. "The Costs and Effectiveness of Three Vitamin A Interventions in Guatemala." *Social Science & Medicine* 42: 1661–68.

Piers, L.S., S. N. Diggavi, S. Thangam, J. M. A. van Raaij, P. S. Shetty, and J. G. A. J. Hautvast. 1995. "Changes in Energy Expenditure, Anthropometry, and Energy Intake during the Course of Pregnancy and Lactation in Well-Nourished Indian Women." *American Journal of Clinical Nutrition* 61: 501–13.

Pinstруп-Andersen, P., ed. 2010. *The African Food System and Its Interaction with Human Health and Nutrition*. Ithaca, NY: Cornell University Press.

Pinstруп-Andersen, P. 1981. *Nutritional Consequences of Agricultural Projects: Conceptual Relationships and Assessment Approaches*. Washington, DC: World Bank.

Pinstруп-Andersen, P., and A. Herforth. 2008. "Food Security: Achieving the Potential." *Environment* 50 (5): 48–61.

Pinstруп-Andersen, P., N. R. de Londono, and E. Hoover. 1976. "The Impact of Increasing Food Supply on Human Nutrition: Implications for Commodity Priorities in Agricultural Research and Policy." *American Journal of Agricultural Economics* 58 (2): 131–42.

Pinstруп-Andersen, P., D. Pelletier, and H. Alderman. 1995. *Child Growth and Nutrition in Developing Countries: Priorities for Action*. Ithaca, NY: Cornell University Press.

Pitchaya, T., A. Geater, C. Virasakdi, and K. Ounjai. 1998. "The Effect of Heavy Maternal Workload on Fetal Growth Retardation and Preterm Delivery: A Study among Southern Thai Women." *Journal of Occupational & Environmental Medicine* 40 (11): 1013–21.

Popkin, B. M., and P. Gordon-Larson. 2004. "The Nutrition Transition: Worldwide Obesity Dynamics and Their Determinants." *International Journal of Obesity* 28 (S3): S2–S9.

Popkin, B. M., F. S. Solon, T. Fernandez, and M. C. Latham. 1980. "Benefit-Cost Analysis in the Nutrition Area: A Project in the Philippines." *Social Science & Medicine* 14C: 207–16.

Probst, C., R. Bandyopadhyay, L. E. Price, and P. J. Cotty. 2011. "Identification of Atoxigenic *Aspergillus Flavus* Isolates to Reduce Aflatoxin Contamination in Maize in Kenya." *Plant Disease* 95: 212–18.

Quisumbing, A. R. 2003. "Social Capital, Legal Institutions, and Property Rights: Overview." In *Household Decisions, Gender, and Development*, ed. A. R. Quisumbing 139–44. Washington, DC: International Food Policy Research Institute.

Quisumbing, A. R., L. Brown, H. Feldstein, L. J. Haddad, and C. Pena. 1995. "Women: The Key to Food Security." Food Policy Report, International Food Policy Research Institute, Washington, DC.

Rao S., A. Kanade, B. M. Margetts, C. S. Yajnik, H. Lubree, S. Rege, B. Desai, A. Jackson, and C. H. D. Fall. 2003. "Maternal Activity in Relation to Birth Size in Rural India." *The Pune Maternal Nutrition Study* 57: 531–42.

Rashid, M., and S. J. Ulijaszek. 1999. "Daily Energy Expenditure across the Course of Lactation among Urban Bangladeshi Women." *American Journal of Physical Anthropology* 110: 457–65.

Remans, R., D. F. B. Flynn, F. DeClerck, W. Diru, J. Fanzo, K. Gaynor, I. Lambrecht, J. Mudiope, P. K. Mutuo, P. Nkhoma, D. Siriri, C. Sullivan, and C. A. Palm. 2011. "Assessing Nutritional Diversity of Cropping Systems in African Villages." *PLOS One* 6 (6): e21235. doi:10.1371/journal.pone.0021235.

Rengel, Z., G. D. Batten, and D. E. Crowley. 1999. "Agronomic Approaches for Improving the Micronutrient Density in Edible Portions of Field Crops." *Field Crops Research* 60: 27–40.

Robertson, B., and P. Pinstrop-Andersen. 2010. "Global Land Acquisition: Neo-Colonialism or Development Opportunity?" *Food Security* 2: 271–83.

Ruel, M. T., and C. E. Levin. 2000. "Assessing the Potential for Food-Based Strategies to Reduce Vitamin A and Iron Deficiencies: A Review of Recent Evidence." Washington, DC: International Food Policy Institute.

Ruel, M. T., P. Menon, J. P. Habicht, C. Loechl, G. Bergeron, G. Pelto, M. Arimond, J. Maluccio, L. Michaud, and B. Hankebo. 2008. "Age-based Preventive Targeting of Food Assistance and Behaviour Change and Communication for Reduction of Childhood Undernutrition in Haiti: A Cluster Randomised Trial." *Lancet* 371: 588–95.

Sahn, D. E. 2010. "The Impact of Poor Health and Nutrition on Labor Productivity, Poverty, and Economic Growth in Sub-Saharan Africa." In *The African Food System and its Interaction with Human Health and Nutrition*, ed. P. Pinststrup-Andersen, chapter 11. Ithaca, NY: Cornell University Press.

Save the Children Federation. 2012. "A Life Free from Hunger."  
<http://www.savethechildren.org.uk/resources/online-library/life-free-hunger-tackling-child-malnutrition>.

Schaetzel, T. 2010. "Maximizing Nutritional Benefits of Agricultural Interventions: Do Good, but Above All Do No Harm." Infant and Youth Child Nutrition presentation, Washington, DC, October 21.  
[http://www.globalhealth.org/images/pdf/events/20101021\\_t\\_schaetzel.pdf](http://www.globalhealth.org/images/pdf/events/20101021_t_schaetzel.pdf).

Smitasiri, S., and S. Dhanamitta. 1999. Sustaining Behavior Change to Enhance Micro-nutrient Status: Community and Women-based Interventions in Thailand. Opportunities for Micronutrients Interventions (OMNI) Research Report Series No. 2, International Center for Research on Women, Washington, DC.

Smitasiri, S., K. Sangobwarchar, P. Kongpunya, C. Subsuwan, O. Banjong, C. Chitchumroonechokchai, W. Rusami-Sopaporn, S. Veeravong, S. Dhanamitta. 1999. "Sustaining Behavioural Change to Enhance Micronutrient Status through Community and Women-based Interventions in Northeast Thailand: Vitamin A." *Food and Nutrition Bulletin* 20: 243–51.

Smith, L. C., U. Ramakrishnan, A. Ndiaye, L. J. Haddad, and R. Martorell. 2003. "The Importance of Women's Status for Child Nutrition in Developing Countries." In *Household Decisions, Gender, and Development*, ed. A. R. Quisumbing, 41–50. Washington, DC: International Food Policy Research Institute.

Stubbs, H. A., J. Harris, and R. C. Spear. 1984. "A Proportionate Mortality Analysis of California Workers 1978-79." *American Journal of Industrial Medicine* 6 (4): 305–20.

SUN Framework for Action. 2010. [www.scalingupnutrition.org](http://www.scalingupnutrition.org).

Thomas, D. 1994. "Like Father, Like Son, or Like Mother, Like Daughter: Parental Education and Child Health." *Journal of Human Resources* 29 (4): 950–88.

Tontisirin, K., G. A. Attig, and P. Winichagoon. 1995. "An Eightstage Process for National Nutrition Development." *Food and Nutrition Bulletin* 16 (1): 8–16.

UNICEF. 1990. *Strategy for Improved Nutrition of Children and Women in Developing Countries*. New York: UNICEF.

UN SCN (Standing Committee on Nutrition). 2010. "Sustainable Food and Nutrition Security." In *Progress in Nutrition: Sixth Report on the World Nutrition Situation*, chapter 4. New York. <http://www.unscn.org/files/Publications/RWNS6/html/index.html>.

Vijayaraghavan, K., M. U. Nayak, M. S. Bamji, G. N. V. Ramana, and V. Reddy. 1997. "Home Gardening for Combating Vitamin A Deficiency in Rural India." *Food and Nutrition Bulletin* 18: 337–43.

Von Braun, J. 1988. "Effects of Technological Change in Agriculture on Food Consumption and Nutrition: Rice in a West African Setting." *World Development* 16: 1083–98.

Wasserman, G. A., X. Liu, F. Parvez, H. Ahsan, P. Factor-Litvak, A. van Geen, V. Slavkovich, N. J. Lolacono, Z. Cheng, H. Hussain, H. Momotai, and J. H. Graziano. 2004. "Water Arsenic Exposure and Children's Intellectual Function in Araihaazar, Bangladesh." *Environmental Health Perspectives* 112 (13): 1329–33.

Webb, P., and S. Block. 2010. "Support for Agriculture during Economic Transformation: Impacts on Poverty and Undernutrition." *Proceedings of the National Academy of Sciences*. doi: 10.1073/pnas.0913334108.

Webb Girard, A., J. L. Self, and O. Olude. 2012. "The Effects of Household Food Production Strategies on the Health and Nutrition Outcomes of Women and Young Children: A Systematic Review." *Paediatric and Perinatal Epidemiology* 26 (Suppl 1): 205–22.

Welch, R. M., and R. D. Graham. 2005. "Agriculture: The Real Nexus for Enhancing Bioavailable Micronutrients in Food Crops." *Journal of Trace Elements in Medicine and Biology* 18: 299–307.

Williams, J. H., T. D. Phillips, P. E. Jolly, J. K. Stiles, C. M. Jolly, and D. Aggarwal. 2004. "Human Aflatoxicosis in Developing Countries: A Review of Toxicology, Exposure, Potential Health Consequences, and Interventions." *American Journal of Clinical Nutrition* 80: 1106–22.

World Bank. 2007a. *From Agriculture to Nutrition: Pathways, Synergies, and Outcomes*. Washington, DC: World Bank.

———. 2007b. *World Development Report 2008: Agriculture for Development*. Washington, DC.

Ziraba A. K., J. C. Fotso, and R. Ochako. 2009. "Overweight and Obesity in Urban Africa: A Problem of the Rich or the Poor?" *BMC Public Health* 9 (465).







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1818 H Street, NW  
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Telephone: 202 473 1000  
Facsimile: 202 477 6391  
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