

Improving Nutrition through Agriculture

Viewing agriculture-nutrition linkages along the smallholder value chain

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Desk Review



Wageningen UR Centre for Development Innovation (CDI) works on processes of innovation and change in the areas of secure and healthy food, adaptive agriculture, sustainable markets and ecosystem governance. It is an interdisciplinary and internationally focused unit of Wageningen University & Research centre within the Social Sciences Group.

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REACH

ENDING CHILD HUNGER AND UNDERNUTRITION

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This report is a synthesis of existing global knowledge on improving nutrition through agriculture using a smallholder value chain approach. The smallholder value chain model used by the desk review concentrates on both producers and consumers and is centred around three pathways: improved nutrition resulting from increased production for own consumption, improved nutrition through increased income from selling agricultural products, and improved nutrition through increased income resulting from farmers' involvement in local or regional procurement programs. The report identifies key conditions for agricultural interventions to significantly contribute to nutrition as well as important knowledge gaps pertaining to agriculture-nutrition linkages.

Key words: nutrition, agriculture, gender, value chain, smallholders

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Preface

Continuing high numbers of malnutrition and recent food crises have led to renewed interest in the role of agriculture in improving nutrition. Agriculture has a crucial role to play in improving nutrition as it is the primary source of food and essential nutrients and an important livelihood source for many poor. Despite the potential of agriculture to alleviate malnutrition, improvements in production and income have not necessarily translated in improvements in the nutritional status. Nutrition improvement often typically has a more health focus and has never been made an explicit goal of agriculture production systems. However, reducing malnutrition cannot be solved merely from agriculture or health alone but requires better linking of the two sectors. The Ending Child Hunger and Undernutrition Partnership - REACH - was jointly established by the United Nations Food and Agriculture Organization, World Health Organization, United Nations Children's Fund and the World Food Programme and strengthens coordination across sectors – including agriculture and health – to address child under nutrition. REACH is a global partnership committed to meeting the nutrition needs of the world's most vulnerable children and women, through evidenced based analysis and innovative programming that builds government institutional capacity, strengthens policy planning skills and prioritizes scarce resources.

Currently, REACH and Wageningen University & Research centre (WUR) collaborate in an operational research initiative aiming at identifying food/agriculture-based interventions that contribute to improved nutrition and have potential for scaling up in the context of Sierra Leone. In support of this, CDI conducted a desk review of existing global knowledge on improving nutrition through agriculture using a smallholder value chain approach; the outcome of which is presented in this document.

This desk review can be seen as related to other activities in the field of food and nutrition security and agriculture-nutrition linkages that CDI is engaging in.

March, 2011

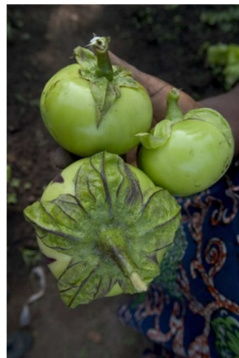


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Esther Wieggers, Marianne van Dorp and Senoe Torgerson
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⁴ The Graduate School VLAG (Advanced studies in Food Technology, Agro-biotechnology, Nutrition and Health Sciences) is a cooperative endeavour of two universities; Wageningen University and Maastricht University; and five research institutes: Food & Biobased Research, RIKILT- Institute of Food Safety, NIZO Food Research, TNO Quality of Life and the National Institute of Public Health (RIVM), The Netherlands, see www.vlaggraduateschool.nl

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Executive summary

Under the umbrella of REACH, a global partnership committed to meeting the nutrition needs of the world's most vulnerable children and women, CDI conducted a desk review of existing global knowledge on improving nutrition through agriculture using a smallholder value chain approach. The smallholder value chain model used by the desk review concentrates on both producers and consumers and is centred around three pathways: improved nutrition resulting from increased production for own consumption, improved nutrition through increased income from selling agricultural products, and improved nutrition through increased income resulting from farmers' involvement in local or regional procurement programs. The model moves beyond the traditional supply-side focus by including a set of demand-side activities. A focus on both supply and demand side issues within the smallholder value chain allows for identifying entry points along the value chain for food-based interventions that improve both the supply and demand for nutritious foods.

Supply-side initiatives included in this desk review encompass agricultural development and food security initiatives that focus on: increasing food availability and lowering food prices, homestead gardening and animal production, biofortification, processing and fortification, marketing, and local procurement for food assistance programs. Demand-side interventions reviewed by this study focus on local purchase of nutritious foods, food assistance, social cash transfer initiatives, intra-household allocation, food preparation, breastfeeding promotion and complementary feeding, and supplementary and therapeutic feeding.

Existing literature reviewed in this report underline the crucial role of agriculture in improving nutrition, especially through improved production for own consumption and increased income from selling crops. The review identified the following conditions for subsistence production to significantly contribute to nutrition: intra-household allocation of food is equitable and takes into consideration children's particular needs; poor dietary quality and related deficiencies of vitamin A, zinc and iron are addressed through effective promotional and educational strategies and through enabling improved year-round production of nutritious foods; women are empowered to make informed decisions on feeding and caring practices.

Identified conditions for smallholder commercialization interventions to substantially reduce malnutrition through increased income relate to the stability and control of income, the use of income, the level of complementary interventions and women's empowerment.

Finally, the review identified many knowledge gaps, especially related to the role of income in improving nutrition, whether gained through commercialization, local purchasing or other means. In particular, the role of local procurement programs in improving nutrition is lacking evidence but can become a promising vehicle when including poor, and especially female farmers, as regular suppliers and when complemented by parallel nutrition and women's empowerment interventions.

List of abbreviations and acronyms

CMAM	Community-based Management of Acute Malnutrition
CDI	Wageningen UR Centre for Development Innovation
IFPRI	International Food Policy Research Institute
ILRI	International Livestock Research Institute
FANTA	Food and Nutrition Technical Assistance project
FAO	United Nations Food and Agriculture Organization
GAIN	Global Alliance for Improved Nutrition
GAO	United States Government Accountability Office
HGSF	Home-Grown School Feeding
MCHN	Mother and Child Health and Nutrition
P4P	Purchase for Progress program
PROGRESA	Programa de Educación, Salud y Alimentación
REACH	Ending Child Hunger and Undernutrition
RUTF	Ready-to-Use-Therapeutic Food
SLARI	Sierra Leone Agriculture Research Centre
SUN	Scaling up Nutrition
UNICEF	United Nations Children's Fund
VLAG	Graduate School for Advanced Studies in Food Technology, Agrobiotechnology, Nutrition and Health Sciences
Wageningen UR (WUR)	Wageningen University & Research centre
WFP	World Food Programme
WHO	World Health Organization

1 Introduction

“Agricultural interventions are most likely to affect nutrition outcomes when they involve diverse and complementary processes and strategies that redirect the focus beyond agriculture for food production and toward broader consideration of livelihoods, women’s empowerment, and optimal intra-household uses of resources. Successful projects are those that invest broadly in improving human capital, sustain and increase the livelihood assets of the poor, and focus on gender equality” World Bank (2007:xiv).

Worldwide almost 1 billion people are undernourished and more than a quarter of all children under 5 years of age are underweight (FAO, 2010a; UNICEF, 2010). More than 80 percent of all undernourished children live in just 20 countries, most of which are found in sub-Saharan Africa and South Asia (UNICEF, 2010). In particular, children in rural areas are prone to underweight. In most developing countries, rural children are twice as likely to be underweight than urban children (ibid). Malnutrition in children can impair their physical, cognitive, and psychological growth and leads to increased child morbidity and mortality. Among adults, effects include lethargy and poor health, reduced productivity, decreased cognitive function and a loss of learning potential. These adverse effects are often long lasting and irreversible. In addition to undernourishment, approximately 2 billion people worldwide, or about one third of the world’s population, suffer from micronutrient deficiencies, also called the “hidden hunger” (FAO, 2010b). These micronutrient deficiencies, particularly of iron, iodine, zinc and vitamin A, are commonly associated with inadequate dietary intake and poor utilization, and affect mainly women and children (Lopriore and Muehlhoff, 2003). Vitamin and mineral deficiencies can cause birth defects, poor physical and mental growth, blindness, anaemia, impaired immune systems and contribute to some of the highest rates of child mortality in the world.

The unacceptably high numbers of malnutrition have led to a renewed attention to nutrition, especially towards reducing child undernutrition. In 2008, the Lancet published a set of articles on maternal and child undernutrition, arguing that effective targeted nutrition interventions exist and that these interventions, if implemented at scale during the so-called window of opportunity (the time span from early pregnancy into the 2nd year of life) have the potential to reduce undernutrition-related mortality and disease burden by 25 percent in the short term. Most of the targeted nutrition interventions recommended are typically within the domain of the health sector and include: breastfeeding promotion, improved complementary feeding practices, micronutrient supplementation and food fortification, health interventions aimed at reducing infectious diseases among infants and young children, and the effective management of severe acute malnutrition. The recommended strategies focus more on the immediate determinants of childhood malnutrition (i.e. inadequate food and nutrient intake, and poor health) and do not adequately consider key causes that underlie malnutrition such as poverty, food insecurity, gender inequity, and the lack of access to health and other services. Consequently, the long-term impacts and sustainability of the interventions recommended in the Lancet series is questionable (Leroy et al., 2009).

Recently, there is renewed interest in the role of agriculture to improve nutrition, especially for the most poor and vulnerable (World Bank, 2007; IFPRI, 2010). The interest in agriculture-nutrition linkages is not new and dates back to the early 1980s with a number of International Food Policy Research Institute (IFPRI) and World Bank publications. The renewed interest has, however, been fuelled by the recent food and financial crises that increased for the first time in years the number of undernourished people. Agriculture has a crucial role to play in improving nutrition. Agriculture is the primary source of food and essential nutrients as well as an important source of income, especially for the many poor. About two-thirds of the poor in developing countries live in rural areas and depend directly or indirectly on agriculture for their livelihoods (World Bank, 2007). Further, agriculture plays an important role in reducing rural poverty as it is a source of livelihood for many rural poor and because agricultural growth benefits the

poor most (DFID, 2003). Despite agriculture's great potential to improve nutrition, a majority of the world's malnourished are rural people who find themselves in a situation of low-productivity agriculture, poor health, and poverty (Ahmed et al., 2007). Clearly, improved agricultural production and the attained increased household income do not necessarily translate in improved consumption of adequate and nutritious foods. Partly this is because improved nutrition has never been made an explicit goal of agriculture production systems while nutrition, on the other hand, often had a more health focus. The persistence of malnutrition as a global public health concern makes clear that alleviating poor nutrition cannot be solved merely from agriculture or health/nutrition alone but requires better linking of the two sectors (World Bank, 2007; SUN, 2010).

It is in this context that REACH (Ending Child Hunger and Undernutrition) combined forces in reducing child undernutrition through both the health/nutrition and agriculture sector. Currently, REACH and Wageningen University and Research centre (WUR) collaborate in an agriculture-nutrition research initiative aiming at identifying food/agriculture-based interventions that contribute to improved nutrition and that have potential for scaling up in the context of Sierra Leone. The REACH-WUR initiative adopts a smallholder value chain approach and is conducting operational research in Sierra Leone to explore the interactions between the smallholder value chain and nutrition programming. To provide a foundation for the operational research and the scaling up of essential agriculture and nutrition actions, a rapid desk review of existing global knowledge on the linkages between the smallholder value chain and nutrition programming has been carried out. This paper is the outcome of the desk review and provides a synthesis of existing literature and policy documents on smallholder agriculture and nutrition linkages. The document is structured into 5 chapters. Chapter 1 provides a general introduction to the paper. Chapter 2 focuses on agriculture and nutrition linkages by summarizing the pathways through which agriculture can contribute to improved nutrition. In chapter 3 the REACH smallholder value chain is presented. Chapter 4 is a synthesis of agriculture and nutrition linkages along the REACH smallholder value chain model. It concentrates on agricultural development initiatives aimed at increasing agricultural productivity and food availability (and potentially lower food prices), increasing crop and dietary diversity (homestead gardening and animal production), and at improving micro-nutrient quality (biofortification). Further, this chapter will present some of the opportunities and constraints in terms of enhancing nutrition through food processing and fortification, local procurement for food assistance programs, and smallholder commercialization and marketing. Last but not least, this chapter will focus on the demand side of the value chain – the smallholder farmer as consumer of nutritious foods – as it relates to household decisions regarding purchase of food, allocation of resources to different household members, and knowledge of safe and nutritious food preparation and child feeding practices. In chapter 5 the overall conclusions will be presented.



2 Agriculture and nutrition linkages: a summary

A number of pathways through which agriculture can contribute to improved nutrition have been documented by Haddad (2000; 2010) and the World Bank (2007). These include:

1. Increased (nutritious) food production for own consumption. Food and (micro)nutrient consumption is directly affected by the types of foods households produce, especially in the case of subsistence agriculture;
2. Increased income from the sale of agricultural commodities and greater farm productivity. This pathway only contributes to improved nutrition if the greater farm income is translated into the purchase of adequate nutritious foods;
3. Increased empowerment of women as key contributors to household food security and to the health and nutrition status of household members. Through greater control and decision-making powers by women in both the productive and domestic domains, women's preferences and priorities are more reflected in the agriculture-nutrition chain;
4. Lower food prices resulting from increases in food supply. A decrease in food prices leads to an increase in *de facto* income. This could lead to improvements in nutrition if this means households are actually purchasing more nutritious foods;
5. Macroeconomic effects of agricultural growth (i.e. increased national income, macroeconomic growth and poverty reduction). Economic growth might contribute to improvements in food and nutrition status; however the impacts of growth can be distributed unevenly across households, with many poor not benefiting (Ahmed *et al.*, 2007).

These pathways generally overlap in time and are dynamic as a result of changes in agricultural policy, technologies, markets, and food consumption patterns (World Bank, 2007). Future ideas for improving agriculture-nutrition pathways generally fall within two differing paradigms: one that centres on the application of life sciences and technical change to improve nutrition and food safety (e.g. using biotechnology, proteomics, and nutrigenomics) and one that is based on the ecological management of food systems and more local and sustainable approaches (Hawkes and Ruel, 2006).

The extent to which agriculture has contributed to improved nutrition and the exact pathways by which this has been achieved is difficult to measure as few impact evaluations of agricultural interventions have explicitly included nutrition outcome indicators (World Bank, 2007; Haddad, 2010). Further, existing literature reviews on agriculture and nutrition linkages have not been conducted in a systematic manner with clarity for inclusion and exclusion of interventions and with interventions organized in clearly defined outcome and intervention categories (Haddad, 2010). As a consequence, it is difficult to assess to what extent agricultural interventions have contributed to improved nutrition.

The need for an integrative approach:

For a long time it has been assumed that agricultural programs would address rural poverty and malnutrition through increasing food production, reducing food prices, and increasing the income of households. Despite increases in food production, household food availability, income, and in many cases also in food consumption and diet quality, childhood malnutrition persisted. Clearly, increased agricultural production and household income are not sufficient to reduce malnutrition. To achieve greater impacts on nutritional outcomes, agricultural programs should incorporate a non-agriculture component like knowledge on maternal health-seeking and care-giving practices or collaborate closely with complementary non-agricultural interventions that provide nutrition education.

Source: World Bank (2007).

The 2007 World Bank review on the impact of agricultural programs and projects on nutritional outcomes concluded that agricultural interventions are most likely to have an impact on nutrition outcomes when they move beyond a focus on agriculture for food production toward broader consideration of people's livelihoods, gender equality, and investment in the livelihood assets of the poor (World Bank, 2007). The review identified a number of key lessons for agricultural interventions to better contribute to improved nutrition. These include the following:

1. ***Take an integrative approach to planning and implementation of interventions, including multiple sectors (including agriculture and health).*** For agricultural interventions to improve nutritional outcomes, agricultural, nutrition and health considerations should be incorporated in the project planning phases and close collaboration is needed with health and other development actors during the implementation phase. Ideally, nutrition should become an intrinsic value of agricultural programs, such as in the HarvestPlus program in which nutrient content is one of the criteria of plant breeding;
2. ***Take local agricultural and nutrition contexts into account when planning the intervention and collaborate with local partners that know these contexts.*** To better contribute to improved nutrition, the design of agricultural interventions should be based on a good understanding of the major nutritional problems experienced by the target communities and the cultural norms, motives and constraints that affect household consumption decisions;
3. ***Empowering women should be central to agricultural programs.*** Since women's status and decision-making power directly affect the nutritional and health status of their children, agricultural programs that aim to empower women by increasing their knowledge, access to productive resources, income and negotiating powers within the household generally will increase the likelihood of positive nutritional outcomes;
4. ***Incorporate nutrition education and communication strategies that target behaviour change in agricultural interventions.*** Agricultural interventions that equip beneficiaries with knowledge and understanding about the nutritional significance of the foods they produce and eat are more likely to improve nutrition as they enable them to make better production and consumption decisions, especially when targeting women.

3 The REACH smallholder value chain model

REACH is utilizing a value chain approach to identify entry points along the value chain of smallholders that offer the potential to increase income and improve the nutritional status of family members, particularly mothers and those children in the 'critical window of opportunity' into two years of age. The REACH smallholder value chain model (Fig 1.) is based on a food-based approach to nutrition. While it is beyond the scope of this document to address all the determinants of nutrition and food security, the REACH smallholder value chain concurs with the UNICEF framework for nutrition security that reducing infections rates among young children, enhancing caring practices and health-seeking behaviour, and improving access to safe water, sanitation, and health facilities are all necessary interventions that need to be implemented simultaneously to improve nutrition. Further, a sound institutional environment, good governance, education, and gender equality are among the basic conditions needed to achieve food and nutrition security.

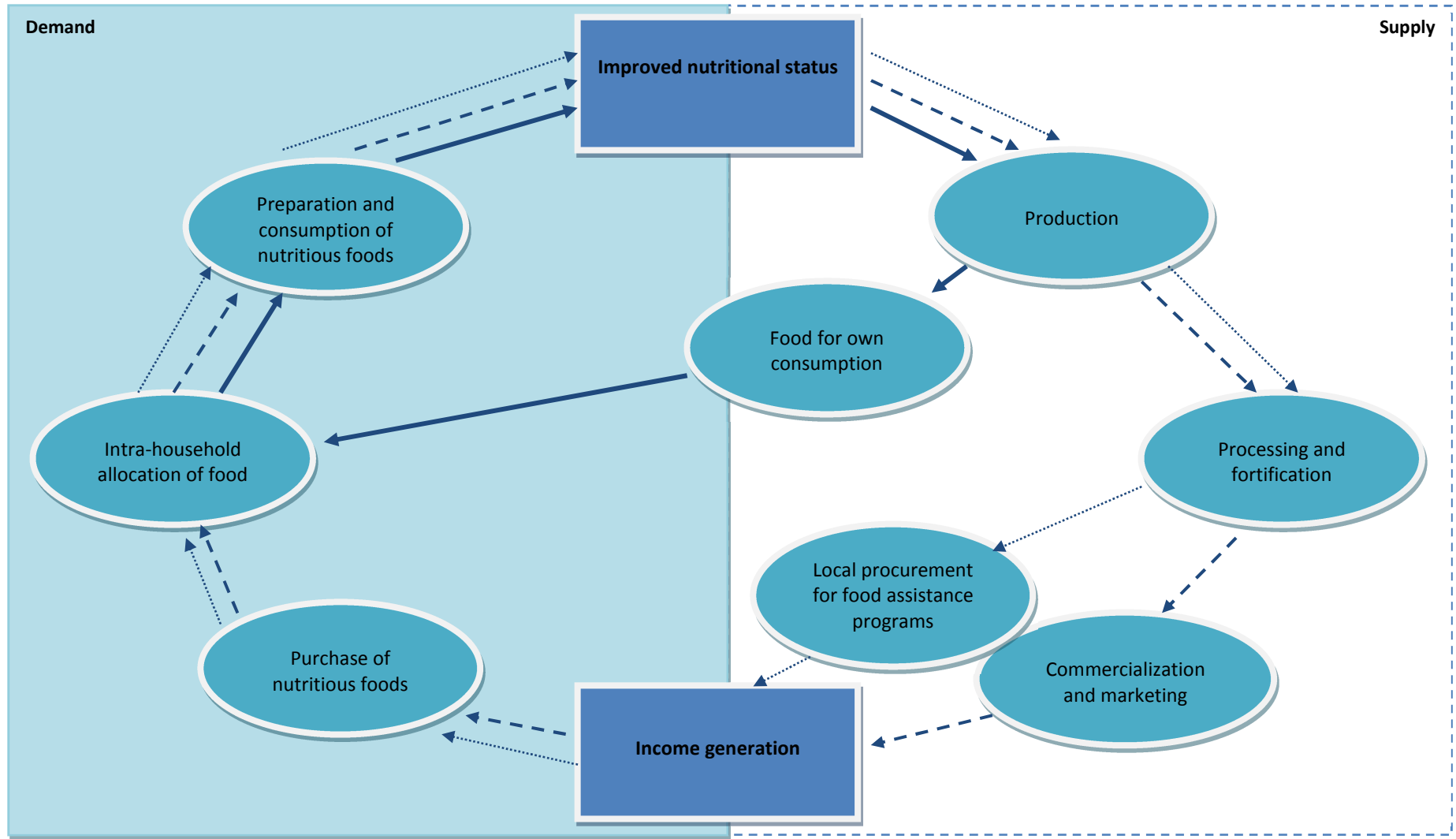
The smallholder value chain depicted in Figure 1 illustrates several pathways linking smallholder agricultural development to improved nutritional outcomes. The framework does not attempt to capture all the different pathways identified in the literature (see World Bank, 2007) but concentrates on three different primary pathways linking agriculture with food consumption and nutrition. The most direct pathway relates to subsistence-oriented production for the household's own consumption. The other two indirect pathways result from the sale of agricultural products to generate income and from local procurement of nutritious foods produced by smallholder farmers for use in food assistance programs.


Commonly, value chain approaches discuss processes and actors involved from the producer's perspective (i.e. the supply side). Not much attention is paid to the role of informed consumers in influencing the value chains and how changing demands for specific (more nutritious) foods influence processes and outputs of value chains, i.e. the demand side (IFPRI/ILRI, 2010). Recognizing the limitations of a traditional, supply-focused value chain model for identifying entry-points to improve nutrition, REACH expanded the smallholder value chain to include a set of demand-side activities. A focus on both supply and demand side issues within the smallholder value chain allows for identifying entry points along the value chain for food-based interventions that improve both the supply and demand for nutritious foods.

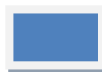
The supply side of the REACH smallholder value chain (Fig 1: right hand side of diagram) encompasses agricultural development and food security initiatives that focus on:


- Improving subsistence-oriented production for the household's own consumption and income-oriented production for sale in markets;
- Reducing food and nutrient losses along the value chain through processing and fortification;
- Stimulating smallholder market participation to increase their income;
- Procuring locally nutritious foods from smallholders for food assistance programs.


Figure 1: Components of the REACH smallholder value chain model linking supply and demand for nutritious foods at household level




 Smallholder value chain component

 Impact to smallholders

 Direct pathway relating improved nutrition to subsistence-oriented production for the household's own consumption

 Indirect pathway relating improved nutrition to income generated from the sale of agricultural products

 Indirect pathway relating improved nutrition to income generated from local procurement of nutritious foods produced by smallholder farmers

The ultimate goal of supply-side initiatives is to improve food availability at household level and to increase household income (i.e. food access). However, evidence has shown that improvements in food supply and household income alone are not sufficient to improve nutritional status. Thus to reflect a nutrition 'lens' on the smallholder value chain, the demand side of the equation (left hand side of the diagram) – the smallholder farmer as consumer of nutritious foods – must also be considered. The demand side relates to household decisions regarding purchase of food, allocation of resources to different household members, and knowledge of safe and nutritious food preparation and child feeding practices. Demand-side interventions focus on awareness, behavioural change, knowledge transfer and empowerment in order to increase demand for nutritious foods and improve dietary intake. Resources controlled by women, as well as nutrition education, are critical across the entire chain. Because the REACH smallholder value chain focuses on both demand and supply side issues, the value chain is articulated not as a linear process but as a circle which acknowledges that the smallholder farmer is both the target producer and a consumer of the nutritious foods produced. In this context, 'value' is defined not only in terms of economic impact (e.g. income earned) but also as a social impact through improved nutritional status.

The REACH smallholder value chain model places strong emphasis on gender and women's empowerment, especially given women's crucial role in agriculture production and family nutrition. Worldwide, women face a series of constraints across the value chain that limit their capacity to produce, generate income and ensure food and nutrition security of their household members. These constraints include amongst others:

- Inequalities in ownership of, access to, and control of productive assets such as land, water, credit, technology and equipment;
- Women's lower levels of education and unequal access to agricultural extension and training services;
- Women's lower decision-making powers and control over household income;
- Women's low levels of representation and participation in farmer organizations;
- Women's constraints to market engagement as food crops (commonly women's crops) usually need to be transported to local markets whilst cash crops (commonly men's crops) are often collected at the farm gate;
- Women risk losing control over income to men when projects geared to increasing women's crop or animal production are successful.

Different studies have demonstrated how investments in women and gender equality lead to improved health and nutritional status of mothers and their children as well as to increased investments in education of both sons and daughters (Quisumbing 2003; UNICEF, 2007).

4 Viewing agriculture and nutrition linkages along the REACH smallholder value chain model

This section will look at how the different REACH smallholder value chain components as depicted in Figure 1 will contribute to improved nutritional status and under what conditions.

4.1 Improved nutrition through agricultural production

Literature linking agricultural production to nutrition outcomes can be generally grouped in the following categories of interventions:

- Agricultural development programs aimed at increasing agricultural productivity and food availability (and potentially lowering of food prices);
- Interventions aimed at increasing crop and dietary diversity, including homestead gardening and animal production initiatives;
- Agricultural programs aimed at improving micro-nutrient quality like biofortification.

Increasing food availability and lowering food prices

Food availability is one of the underlying causes of nutrition security and still remains a challenge for many poor households. Most commonly, food availability is increased through increasing agricultural productivity. Particularly in the situation of subsistence or semi-subsistence households, food consumption is strongly influenced by the level and stability of own agricultural production. An increase in crops produced can result in an increase in food available for household consumption. Assuming that intra-household allocation of food is equitable and takes into consideration children's particular needs, an increase in food availability leads to an increase in the food intake of young children (World Bank, 2007). Depending on what crops are produced, increased production can affect energy intakes and/or micronutrient intakes. Agricultural interventions intended to improve food availability include, amongst others, stimulating technical change in agricultural production (new varieties, chemicals, machinery, etc.), securing property and water rights, minimizing post-harvest losses, and providing extension and financial services (Barrett and Lentz, 2010).

Increases in food supply resulting from improved agricultural production can result in lower food prices, which in turn can contribute to improved nutrition. An example is the Green Revolution, through which the resulting lower prices of food staples have had a substantial beneficial impact in alleviating malnutrition. The lower cereal prices have been especially beneficial to poor consumers who spend a large share of their income on food, while cereal producers have been more than compensated for the lower prices by increases in crop productivity (Pinstrup-Andersen, 2000). In developing countries that are better integrated into the international economy and where transport costs have been reduced, price formation depends less on local conditions and hence price effects of improved agricultural productivity is more likely to be diminished (Haddad, 2000). However, for many poor countries transport costs remain high and in these situations local increases in crop production will result in local decreases in food prices. While agriculture through the Green Revolution has rightly contributed to reducing food shortages and the protein-energy malnutrition problem by improving the availability and affordability of staple crops (Underwood, 2000; Pinstrup-Andersen, 2000), malnutrition persists and some question the Green Revolution's success. This is because the push for cereals has displaced other traditional crops that are rich in iron and other micronutrients and because at the time of the Green Revolution little thought was given to nutritional value and human health (Welch and Graham, 2000).

Crop diversification and nutrition: the example of mungbean in Asia

In the early-1970s, the World Vegetable Center AVRDC successfully introduced the intercropping of mungbean in Asia. Mungbean was introduced in the existing cropping pattern in order to supplement the largely cereal-based diets of the poor, gain additional income, improve soil fertility, and diversify crop rotation practices. Mungbean is high in protein, easy to digest, and when consumed in combination with cereals can significantly enhance the quality of protein in a meal. Through working with national research partners in a wide range of Asian countries to adapt mungbean varieties to local conditions, 112 improved mungbean varieties were released and disseminated, resulting in a 35 percent increase in Mungbean cultivation. Today, mungbean is a regular part of many Asian diets.

Source: IFPRI (2009).

Increasing diversity: homestead gardening initiatives and animal production

An increase in food availability does not translate into improved nutritional status if poor dietary quality and related deficiencies of vitamin A, zinc and iron are not addressed. Households may have secured access to sufficient food and calories but could still lack essential micronutrients with far-reaching consequences for their health and development status. Worldwide, crop diversification programs have been implemented to supplement largely cereal-based diets of the poor with foods such as pulses, in addition to generating additional income and improving soil fertility. Further, homestead gardening initiatives have been implemented in various countries at varying scale to improve the micronutrient status of women and children through increasing household availability, accessibility and consumption of nutritious, micronutrient-rich foods.

Homestead gardening initiatives are generally close to a house and take different forms, ranging from backyards, kitchens and containers to cultivation on rooftops and along roadsides. They are managed by family members, use low-cost inputs and their products usually include fruits, vegetables, herbs, condiments, and to a lesser extent legumes and sweet potatoes (World Bank, 2007). Although homestead gardening initiatives differ in their design, generally they focus on women and comprise the following components:

- Provision of inputs and technical training to increase year-round production and varieties of fruits and vegetables by women;
- Nutrition education and behaviour change communication to promote appropriate processing, storage, and cooking techniques and improve consumption of micronutrient rich foods (especially vitamin A-rich foods);
- Increase women's income through selling part of their produce, which has an empowering effect as women gain more control over financial resources.

Homestead Food Production programme in Bangladesh

Almost two decades ago, Helen Keller International introduced a large-scale national homestead food production (HFP) program in Bangladesh. The HFP aimed at increasing household production, availability, and consumption of micronutrient-rich foods and improving the health and nutritional status of women and children. The program was implemented by NGO partners and the Government of Bangladesh and introduced an integrated package of home gardening, small livestock production and nutrition education.

The HFP has improved food security for nearly 5 million vulnerable people in diverse agro-ecological zones of Bangladesh, including increased household production, improved diet quality, and improved intake of micronutrient-rich foods. However, its contribution to reducing deficiencies in vitamin A, iron, or zinc has still to be determined. Some of the factors that contributed to the program's success included: a focus on empowering women; inclusion of nutrition education, behavior change and communication; using existing structures and organizations and building on local practices; and strong technical assistance and capacity building components.

Source: Iannotti *et al.* (2009).

Impact evaluations of homestead gardening initiatives show different results. A review on homestead gardening programs conducted by Ruel (2001) found that homestead gardening alone will not affect nutrition, but when combined with effective promotional and educational strategies it is likely to have a positive impact on the nutritional status of household members. This is especially so when gender is mainstreamed in the program design and implementation. Other reviews showed that homestead gardening programs are very labour and resource intensive interventions, which makes it difficult to implement on a large scale (Berti et al., 2003). While many evaluations demonstrate positive effects of homestead gardening initiatives on household production, income, dietary quality, and intake of micronutrient-rich foods, little is known about its impact on reducing micronutrient deficiencies, such as vitamin A, iron, or zinc. Scepticism remains whether homestead gardening initiatives can significantly improve micronutrient status at scale because of the low bioavailability of these nutrients in fruits and vegetables. Because evaluations of homestead gardening initiatives generally focus on the intake of micronutrient-rich foods and do not adequately measure the impact on micronutrient status using anthropometric indicators and/or biochemical or clinical indicators to assess micronutrient deficiencies, they have not provided conclusive evidence to address scepticism (Iannotti et al., 2009). Further, while some homestead gardening programs have clearly shown an effect on reducing anaemia, impact on reduced stunting or wasting has not been demonstrated (Berti et al., 2003).

Homestead gardening initiatives have been broadened to homestead food production by including an animal production component, such as backyard poultry production, small animal husbandry, and fish ponds. Animal production was added to improve micronutrient nutrition since animal products are rich in iron and zinc with high bioavailability. Despite being a rich source of micro-nutrients, the animal production component has raised several concerns, including (Leroy and Frongillo, 2007; Iannotti *et al.*, 2009):

- Animal production is more labour and capital intensive compared to home gardens but little is known about potential negative effects of animal production on maternal time and workload;
- The effect of animal production on the consumption patterns (especially among young children), maternal income, and micronutrient status is unclear and needs further research;
- Animal production increases the risk of zoonotic disease such as highly pathogenic avian influenza (HPAI) and Newcastle disease but the current understanding does not allow for predicting the impact of promoting animal production on the spread of zoonotic infections;
- Animal products are rich in energy, saturated fat, and cholesterol and are associated with an increased risk of chronic diseases in well-nourished populations. However, the trade-off between the health benefits of animal products as a rich source of micronutrients and the risk of chronic disease is not well understood.

Improving micronutrient quality: biofortification

Perceptions regarding micronutrients have been shifting from a focus on a health approach, in which supplements play an important role, towards more sustainable food-based approaches, in which agriculture has a key role to play (Underwood, 2000). One of the potential contributions of agriculture in reducing micronutrient deficiency is through biofortification.

Biofortification refers to a process of breeding staple food crops that are rich in bioavailable micronutrients. The enhancement of essential nutrient content in staple crops can be achieved through conventional plant breeding or, in situations of limited genetic range for nutrient content, through transgenic means (West and Thompson, 2010). Within biofortification programs, agricultural scientists and nutritionists work together to establish nutritional breeding targets that are based on several factors (Hotz and McClafferty, 2007):

- Food intake of target populations;
- Losses of nutrients during cooking, storage, and processing;
- Bioavailability of nutrients;
- Probability and difficulty of breeding for specific nutrients.

Based on these targets, breeding programs are developed. Biofortification will first target vulnerable rural households who consume their own production. However, through effective marketing (including e.g. food assistance), advocacy, and consumer behaviour change strategies, consumption of biofortified products is expected to expand beyond the rural poor and undernourished (ILRI/IFPRI, 2010).

In 2003, HarvestPlus started biofortification of main staple crops, focusing on three micronutrients: iron, zinc, and vitamin A. To date, the program has bred seven staple crops that are rich in bioavailable micronutrients: 1) zinc-rich rice for Bangladesh and India; 2) zinc-rich wheat for India and Pakistan; 3) pro-vitamin A maize for Zambia; 4) pro-vitamin A cassava for Nigeria and DR Congo; 5) iron-rich pearl millet for India; 6) iron-rich beans for Rwanda and DR Congo; and 7) pro-vitamin A sweet potato for Uganda and Mozambique (ILRI/IFPRI, 2010). These crops are to be released within three years after studies on their impact on the nutritional status of target populations have been completed. A precondition for release of the cultivars is that they are significantly more nutritious. Further, their agronomic characteristics (e.g. productivity but also susceptibility to pests and diseases) should be of acceptance to farmers. One of the crops that has recently been evaluated for its uptake and impact is the orange fleshed sweet potato, a food crop with pro-vitamin A carotenoids. Results from Uganda and Mozambique show a high adoption rate and dietary intake among producers and rural consumers. Given that the orange fleshed sweet potato retains up to 70–80 percent of beta-carotene content after cooking, it is one of the most successful breeding outcomes that has been field tested and shows that biofortification of food crops with pro-vitamin A carotenoids can be an effective method to improve long-term vitamin A status of populations which adopt them (West and Thompson, 2010).

Orange fleshed sweet potato in Mozambique

Orange fleshed sweet potato has the potential to increase the intake of pro-vitamin A. Orange fleshed sweet potato is already widely available in several countries. In Mozambique, the orange fleshed sweet potato was introduced in an area with high prevalence of child malnutrition and vitamin A deficiency, especially among preschool aged children. The orange sweet potato was introduced through an integrated agricultural, nutrition extension and commercialization approach, comprising amongst others provision of plant materials to farmers, nutrition education, social marketing, and market development (e.g. pricing system rewarding quality, development of several processed products for selling on the market). A two-year quasi-experimental field intervention with orange fleshed sweet potato found a substantial increase in the intake and vitamin A status among preschool participants.

In addition to being rich in vitamin A, sweet potato is a labor extensive crop, making it especially suitable for households with members living with HIV/AIDS, who beside being constrained by labor have specific nutritional needs such as high vitamin A intake.

Source: World Bank (2007); West and Thompson (2010)

Once new cultivars have been tested and are ready for release, biofortification must be accompanied by a delivery strategy to ensure farmers and consumers accept the nutrient-rich staple crops. This strategy should at least comprise the following elements (ILRI/IFPRI, 2010):

- Sustainable extension and seed production systems in order to get the products into market;
- Strategic and innovative marketing strategies (e.g. using a public health lens) to generate demand among consumers;
- Attention to consumer acceptance, especially when the additional nutrient is visible (like pro-vitamin A; yellow rice and yellow maize might not in all situations be acceptable for human consumption);
- Advocacy campaigns to create an enabling public policy environment towards biofortification in both the agriculture and public health sectors.

Biofortification is a long-term process and its success depends upon the stability of the targeted micronutrient trait under various environmental conditions (Chakmak, 2009). Presently, biofortification is still in its early stages and, besides the orange fleshed sweet potato, knowledge of the impacts of biofortification on nutritional status is still insufficient (Haddad, 2010). In particular, knowledge gaps regarding human nutrition comprise the following (Haas, 2010):

- The expected level of nutritional impact from consumption of biofortified crops;
- The level of efficacy and effectiveness of biofortification interventions;
- The extent of benefits versus costs of biofortification in comparison to other intervention strategies.

To complement on-going breeding programs which aim to increase zinc concentration of cereal grains, the HarvestPlus program has initiated a global zinc fertilizer project (HarvestZinc project). Biofortification of cereal grains through using zinc fertilizers (also called agronomic biofortification) enhances the production of zinc-dense seeds and contributes to the overall yield. Increasing evidence has indicated that zinc fertilizers greatly contribute to zinc concentrations in cereals, and hence application of zinc fertilizers seems to be an important complementary approach to enhancing micronutrients through plant breeding (Cakmak, 2008). The effect of zinc fertilizers, however, depends upon the amount of zinc taken up and allocated or reallocated to the grains and is greatly influenced by timing and location of zinc fertilizers. Research on zinc fertilizers for rice cultivation in China showed the following (Slingerland *et al.*, 2008):

- Location: foliar zinc application showed no effect on zinc loading of grains whilst for root zinc application most of the zinc accumulated in the grains stems from concurrent uptake by the roots and not from zinc remobilization from the leaves;
- Timing: an application of root zinc fertilizer 15 days after flowering resulted in a greater amount of zinc in the stem and less in the grain than when applied at the flowering stage.

The potential of zinc fertilizers for improving zinc concentrations in cereals has, however, to be balanced against the low use of fertilizers among many resource-poor smallholder farmers, especially in Africa. Further, little is known about the level of nutritional impact resulting from consuming cereals that were produced with the application of zinc fertilizers.

Food processing and nutrition: the example of solar dryers

The Tanzania Food and Nutrition Center introduced portable solar dryers in rural, semi-arid communities to reduce women's time and labor burdens and to enhance nutrition. The project improved vitamin A intake among children in the target communities as foods dried in solar dryers retain more nutrients and because solar dryers allow for year-round availability of nutrient-rich foods. In addition, it reduced women's time input, allowing more time for child care and other activities.

4.2 Processing and fortification

Food processing serves to improve the digestibility and appeal of foods and to extend the availability of foods in terms of time and location. Food processing stabilizes food supplies and provides consumers with a greater diversity of food products. Food processing can lead to varying reductions in the amounts of nutrients but, on the other hand, can also enhance the bioavailability of micronutrients. To restore micronutrient losses in food processing, industrialized countries have for decades fortified foods with vitamins and minerals. Currently, also in Africa, Asia and Latin America government bodies and corporations are increasingly involved in food fortification programs.

Food fortification refers to the addition of vitamins and minerals to food during processing in order to alleviate micronutrient deficiencies and micronutrient-related diseases. Food fortification has the dual advantage of delivering nutrients to a wide population without the need for major changes in consumption patterns and of restoring the amounts of micronutrients lost during food processing. Mass fortification is the addition of micronutrients to staple foods and condiments that are commonly consumed by the general public and is mandated and regulated by the government sector. Universal fortification is the fortification of foods consumed by both humans and animals, such as iodization of salt while targeted fortification refers to fortifying foods for a specific target group, such as biscuits fortified with certain vitamins and minerals used within school feeding programs. Generally, food fortification takes place at the centralized/industrial level. Centralized food fortification requires that a food is fortifiable in technical terms, centrally processed to allow quality assurance and control, affordable, and delivered to the target group through reliable commercial or other distribution channels (West and Thompson, 2010).

Agencies such as the World Food Programme increasingly require commodities procured for distribution to be fortified with key vitamins and minerals, such as maize meal, wheat flour, edible oils, high energy biscuits, and fortified blended foods (corn soya blend and wheat soya blend). Countries such as Kenya, Nigeria, Cote d'Ivoire, Mali, Guinea, Zambia and South Africa have started fortification of wheat flour, maize flour, oil and sugar with iron, foliate, vitamin B and/or vitamin A. In these countries foods are fortified on a voluntary basis by pioneering companies, except for South Africa, Nigeria and Zambia, where fortification of selected foods is mandatory⁵. In Egypt, the Global Alliance for Improved Nutrition (GAIN) assists the government with fortifying subsidized cooking oil with vitamins A and D to reduce micronutrient deficiency among vulnerable households that are part of the government's food subsidy system. Another example is packets of so-called Ready-To-Use-Foods Therapeutic Foods used within relief projects to treat children suffering from severe acute malnutrition. These packets contain a high-energy food fortified with extra vitamins and minerals and can be eaten directly from the packet without having to mix it with water. In addition to centralized fortification programs, some foods are fortified at the household or community levels. An example is the provision of households with sachets that contain powdered mixes of micronutrients that are to be sprinkled into porridges and other dishes. Such products have proven to be an effective approach to fortification, especially for young children. However, in order to be effective these sachets have to be produced, transported, be available, affordable, and consumed on a regular basis (West and Thompson, 2010).

⁵ Source: Food fortification in Africa (www.fortaf.org)

Despite its potential for reducing micro-nutrient deficiency, food fortification has many limitations, including:

- The targeted population in need of improved nutrition normally comprises the poor who face limitations in accessing fortified foods because of low purchasing power and due to poor distribution channels, especially in rural areas (Allen *et al.*, 2006).
- The undernourished often suffer from multiple micronutrient deficiencies, which cannot all be addressed by fortified foods.
- Mass fortification may have limited value for nutritionally vulnerable groups as the fortification dosage is set at levels safe for consumption of sub-population groups with the lowest micronutrient requirements. Moreover, mass fortification has limited effect on addressing undernutrition among young children due to their small stomach size and heightened micronutrient needs.
- Fortification is less effective in situations of severe micronutrient deficiency or concurrent presence of infections (Allen *et al.*, 2006).
- In many African (and some Asian) countries where micronutrient deficiencies are most prevalent, food fortification is limited by a weak food industry and poor quality control of fortified products (Underwood, 2000).
- Low incentives (i.e. no market pressure, lack of supportive law and public health not often seen as business imperative) put off companies from developing new products⁶.

Fortification of foods with nutrients is only effective when consumed by the target population in sufficient quantities, processed centrally, supported by an enabling environment and when technical problems associated with fortifying foods can be overcome (Brouwer *et al.*, 2003). Given its limitations, fortification alone cannot reduce micronutrient deficiency but should be seen as important component of a mix of strategies needed for improving nutrition.

4.3 Commercialization and marketing: translating income into nutritional outcomes

Efforts aimed at improving smallholder organization, decreasing transaction costs of marketing, and improving access to appropriate technologies and productive assets are carried out to stimulate smallholder market participation and subsequently raise their income (Barrett and Lentz, 2010). These increases in income could in turn be translated into improvements in the nutritional status of household members. More household income should enable families to purchase essential food items that are not produced by the household and to spend more on education, childcare, clean water, hygiene and preventive and curative health care. At the community level, increased income levels could eventually result in better access to higher quality health care and improved drinking water and sanitation systems (Alderman *et al.*, 2005). In practice, however, different studies have shown that an increase in household income does not necessarily result in an increase in household food security and/or nutritional wellbeing (Haddad, 2000; World Bank, 2007). Partly, this is because interventions aimed at increasing smallholders' income seldom explicitly also target enhancing food and nutrition security.

The translation of increased household income into improved nutrition depends much upon who controls the income. Income controlled by women is more likely to result in improved nutrition as women are primarily responsible for feeding the family and generally spend more of their income on food and health care as compared to men (Kennedy and Cogill, 1987; Bonnard, 2001; World Bank, 2007).

⁶ Source: GAIN (www.gainhealth.org)

Further, women usually earn in small regular income flows, which are more likely to be spent on purchasing food items. Men, on the other hand, tend to earn larger more sporadic earnings, which are generally used for non-food items such as school fees, equipment, and investments (Bonnard, 2001). Income derived from smallholder commercial farming is commonly under the control of men and thus more used for purchasing non-food items. Control of income also determines the equality in food distribution among household members, and in particular among more nutritionally vulnerable individuals (World Bank, 2007). While increased income may lead to improved food consumption of men and children (especially boys), food intake by women often remains unchanged (Bouis and Novenario-Reese, 1997).

Smallholder commercialization can also have none or adverse effects on the nutritional status of households, as households depend more on purchasing from local food markets and less on food available from their own production. Especially when prices fluctuate and income flows are not stable, commercialization can exert a negative influence on nutrition (Jaleta *et al.*, 2009). Further, increased household incomes can have negative effects on nutrition if the earned income is not adequately used for purchasing essential food items. Higher-income households prefer spending more of agriculture-derived income on non-food items, excluding health and education (Bouis and Haddad, 1990). Another potential adverse impact of smallholder commercialization on nutrition relates to the higher labour demand of commercial crops, particularly of women, which has consequences for time spent on child care (Kennedy and Cogill, 1987).

Various studies have also shown positive effects of household income on nutrition status. For example, Hendriks and Msaki (2009) studied the impact of smallholder commercialization on food consumption patterns in South Africa by looking at dietary diversity, nutrient intakes and consumption patterns. They identified a significant improvement in energy, iron and vitamin A but plead for caution to attribute improved household food consumption to increased household income. Their study has not been able to show whether (or to what extent) it is income from agriculture that has contributed to improved nutrition or whether it is because the agriculture development program itself increased, through crop diversification and investment in irrigation, the amount and diversity of food available for household consumption. Further, Hendriks and Msaki stress that before promoting smallholder commercialization as a means to improve nutrition in rural communities, insights should be gained about how much income is needed to ensure adequate nutrition for all household members. Also, little is understood about the benefits of consumption changes resulting from improved income in terms of energy and micronutrient intakes of the poor. According to a review of the World Bank (2007), additional income has often no or limited effect on energy intakes as households tend to substitute their traditional staple foods with higher quality, more expensive foods such as fruits, vegetables, meat, and fish that may significantly improve the micronutrient content of their diet, but not necessarily increase their energy intake. The extent to which increased income benefits nutrition thus depends on the nutrient content of higher-value substitute foods purchased by the household and the extent to which these substitutes offset the nutritional deficits existing within the household (*ibid*).

While agricultural interventions that support smallholder commercialization could reduce malnutrition through increased income, evidence has shown that income growth alone does not sufficiently improve nutrition but should be combined with nutrition interventions (Haddad *et al.*, 2003; World Bank, 2007). Such interventions should address underlying causes of malnutrition such as improving access to water, sanitation and health facilities, reducing infection rates among young children, and awareness and behavioural change.

In summary, income derived from smallholder commercialization can be translated into improved nutritional status for all household members, but this depends on:

- The amount and degree of stability of income earned;
- The use of income (essential food items vs. non-food items);
- The nutrient content of higher-value substitute foods purchased by households and the extent to which these substitutes offset the nutritional deficits existing within the household;
- The level of additional workload placed on women as a result of commercialization;
- Who controls the income;
- Whether smallholder commercialization programs are complemented by parallel nutrition interventions.



4.4 Local procurement for food assistance programs

Food assistance programs are implemented to alleviate immediate food insecurity and comprise different forms, such as direct food aid delivery, cash distribution, vouchers, agricultural input supply, school feeding programs, and supplementary and therapeutic feeding programs (Barrett and Lentz, 2010). Most commonly, food assistance takes the form of food aid provided through intercontinental transfer of food from developed countries to countries in need and increasingly through purchasing in countries affected by crises (local procurement) or in a country within the same region (regional procurement). The main donor of food aid is the United States, which has since the mid-1950s provided more than half of all global in-kind food aid. Often transoceanic transfer of food aid has been criticized as distorting local markets and being inefficient (intercontinental food aid deliveries take too long and often arrive too late). Further, food aid is budgeted in monetary units, meaning production failures resulting in higher staple food prices leads to lower aid volumes, often at times of higher food needs (*ibid*). In 1996, European policy endorsed the procurement of food aid within the benefiting country or from a neighbouring country as this is believed to

contribute to agriculture development and livelihoods in the supplying countries (NRI, 2005). Moreover, local procurement was preferred for its multiple efficiencies compared to intercontinental food aid procurement: lower procurement costs, reduced delivery time and more timely emergency response, provision of foods preferred by recipients, and allowing food aid agencies to procure more flexibly according to cost and needs (Coulter, 2007). Recently, the United States also has allocated some funding for local and regional procurement, mainly to reduce food aid costs and delivery time and only when there is a local or regional marketable surplus (GAO, 2009).

One example of an initiative supporting local procurement is the WFP-led Purchase for Progress (P4P) program. P4P connects smallholder farmers to agricultural markets in order to improve their livelihoods. As an alternative to purchasing food through large competitive tenders, WFP, through P4P, is testing different local procurement methods that are more suited to the situation of smallholder farmers (e.g. direct contracting, warehouse receipt system, new forms of competitive purchases). By becoming a committed buyer, P4P acts as an incentive for smallholders to increase crop productivity and quality. Another example of local procurement is home-grown school feeding (HGSF). HGSF is a school feeding program that provides food produced and purchased within a country to the extent possible. HGSF programs create a market for smallholder farmers by purchasing locally and through removing market access barriers such as lack of information and storage and transport constraints. In addition, HGSF programs support the most vulnerable with input packages at subsidized prices to enable them to produce for the school feeding market (Espejo *et al.*, 2009). HGSF programs are implemented to improve household income by providing the poorest farmers with an opportunity to sell their produce as well as supporting increased school enrolment, attendance, retention, and overall literacy attainment. Stimulating local production and income through HGSF initiatives is challenging. For example, the Netherlands-supported Ghana School Feeding program, which also had the ambition of local procurement of food and thus of stimulating local food production, experienced that it was very difficult for the program to have substantive effects on local food production by smallholder farmers (Eenhoorn and Becx, 2007).

Overall, impacts of local purchasing programs are under-researched and only a few impact assessments of local procurement have been carried out (Coulter, 2007). Detailed data to demonstrate short and long term effects of local procurement on improving incomes of smallholder farmers and creating employment and business opportunities along the value chain are lacking. A few examples of positive benefits include studies in Ethiopia and Uganda. In Ethiopia, local procurement greatly contributed to the development of a blended food industry, which created opportunities for suppliers of raw materials and packaging (Walker *et al.*, 2005). In Uganda, Sserunkuuma (2005) noted higher incomes for farmers that supplied WFP directly as a result of better prices and investments in agricultural technologies. The Uganda study, however, did not indicate the level of income increase as a result of local procurement nor specified who is benefiting from increased income. Nevertheless, Sserunkuuma's study did suggest that it is not always the very poor who benefit as only a small number of farmers' organizations in Uganda were capable of meeting WFP's contractual obligations. Often, food aid grain sales are concentrated among a few suppliers and inclusion of farmer groups within tender processes have mostly been unsuccessful (Walker *et al.*, 2005). Further, Coulter (2007) noted that local and regional procurement can contribute to the development of rural and urban livelihoods in the countries concerned, however, only when well managed and where there is adequate local/regional supply so that it does not cause large price rises for consumers.

Research conducted by the United States Government Accountability Office in 2009 showed that local and regional procurement enhances cost-efficiency and timely delivery of food, and also may be more suited to local preferences. In the period 2001 to 2008, local procurement in sub-Saharan Africa cost almost 34 percent less than purchasing and shipping in-kind food assistance from the United States to the same countries. Further, WFP data from 2004 to 2008 for 10 sub-Saharan African countries shows that local and regional procurement took only 35 and 41 days, respectively, compared to 147 days for in-kind international food aid delivery. The cost- and time-saving effect of local and regional procurement depends, however, on the following factors (GAO, 2009):

- The number of reliable local/regional suppliers;
- Donor funding conditions that may restrict where and when to purchase;
- The extent to which national legal systems enables buyers' ability to enforce contracts with local/regional suppliers.

Some of the adverse impacts of local procurement on vulnerable populations include the increase of food prices for rural consumers as a result of the increased demand driving up prices. To date, not much data is yet available on adverse market impacts (Coulter, 2007). In Uganda, scaling up of WFP's local procurement activities resulted in an increase in maize prices, but did not, however, undermine the ability of poor households to purchase food since maize is not a traditional staple food in Uganda and because prices of root crops (i.e. more traditional staples) are lower than maize (Sserunkuuma, 2005). The adverse effects of local procurement on food prices depends, amongst others, on the scale of procurement, the mode of implementation, and whether the market is adequately integrated with neighbouring markets in order to absorb an increased demand (GAO, 2009). Accurate market intelligence, such as production levels and commodity prices, could avoid food price increases. However, many developing countries have poorly functioning and unintegrated markets which present challenges for scaling up local and regional procurement initiatives without affecting local market prices.

Concerns have also been raised about the quality of food procured in developing countries and evidence has yet to be collected systematically on how local and regional procurement initiatives affect a donor's ability to adhere to food quality standards (GAO, 2009). Research conducted by Walker *et al.* (2005) showed an improvement in the quality of grains supplied for local purchase, but this has had little knock-on effect on the quality of grain that circulates within the regular trade channels. Sserunkuuma (2005) noted that in Uganda, WFP local procurement has contributed to improved quality of maize by requiring higher standards than those for locally traded maize. However, the quality standards are still below those acceptable in regional markets, especially regarding standards for moisture content. Particularly in Uganda, where post-harvest quality management is difficult due to the bimodal rainfall pattern, lower standards affect both consumer health and prospects of local traders to export Uganda's maize (Walker *et al.*, 2005).

Choosing between local procurement and transoceanic imports of in-kind food aid: a few considerations

1. When local procurement has an inflationary impact on local food markets, it may not be the preferred option. However, in a context of free-market trade policies, well-integrated and reasonably competitive domestic markets, an increase in demand will increase supply with only minimal food price inflationary effect.
2. When deliveries are seriously delayed due to defaulting traders that are to provide food under local procurement programmes, local procurement might not be the best option.
3. The resource cost of local or regional procurement should not be higher than the cost of transoceanic importing of in-kind food.

Source: Tschirley (2006)

There is little evidence that local or regional procurement has contributed to improved nutrition among the suppliers through an increase in household income. Indeed, improved nutrition has not (yet) been an explicit objective of local procurement initiatives. Consequently, specific nutrition outcome indicators have not been included in impact assessments. Given that food assistance grain sales are generally concentrated among a few suppliers, local procurement initiatives will only have a positive effect on nutrition when poor, and especially female farmers are better able to become suppliers on a regular basis and when complimented by parallel nutrition interventions.

4.5 Demand-side issues within the smallholder value chain

Initiatives focusing primarily on the supply-side as described above are insufficient to significantly improve nutritional status and must also consider the smallholder farmer as consumer of nutritious foods, i.e. address the demand side. In the REACH smallholder value chain model, the demand side relates to household decisions regarding the local purchase of nutritious foods, the intra-household allocation of food, and the preparation and consumption of nutritious foods. Other demand-side issues addressed in this review include consumer-led demand side financing initiatives and food assistance.

4.5.1 Local purchase of nutritious foods

With a change towards market-oriented interventions, rural households consume more food from the local marketplace and less from the household's own production (World Bank, 2007). Resulting increases in income through, for example, farmers' involvement in smallholder commercialization programs or local procurement initiatives enable rural households to purchase more nutritious foods and diversify their diets. However, the extent to which local purchase of foods does lead to better diets and improved nutritional status depends upon the demand for nutritious foods among rural poor as well as on the availability and affordability of these foods within the local market. Consumers' knowledge and awareness about nutritious foods and their acceptance and willingness to pay all determine the demand for nutritious foods. Nutrition education and awareness raising are crucial to generate demand among consumers as are social marketing strategies of nutritious foods. Block's study on maternal nutrition knowledge and the demand for micronutrient-rich foods in Indonesia found that while rural mothers with and without nutrition knowledge spent similar budget shares for food, 'knowledgeable' households allocated significantly larger proportions to micronutrient-rich foods and less to rice than 'non-knowledgeable' households (Block, 2004). Further, research in Burkina Faso showed that households which received nutrition information through various media were more likely to purchase and consume healthy foods and attended health centres than households not exposed to nutrition information (Lopriore and Muehlhoff, 2003). While much attention is paid to the need for nutrition education and social marketing (see World Bank, 2007), little information is available on the impact and cost-effectiveness of different education and marketing approaches to increase demand for nutritious foods.

4.5.2 Consumer-led demand side financing: social cash transfers

Demand-side financing strategies are interventions that place purchasing power into the hands of consumers to improve equity in access to certain resources such as health care, nutritious food, and schooling (Ensor, 2003). Examples are voucher schemes, conditional cash transfer programs, community-based health insurance, health equity exemption funds, etc. Vouchers (for example for agricultural inputs or machine use) and unconditional cash transfers have the potential to improve access to food through regular income which increases purchasing power or through increased agricultural production (Reilly *et al.*, 1999). It is assumed that foods are widely available in local markets for purchase, greater use of inputs will enhance productivity, and that increasing the income of extremely poor households will result in

more food purchased or produced. Further, to ensure benefits for all household members, some equity in the intra-household allocation of food is assumed (Miller *et al.*, 2010). To ensure the latter, many cash transfer programs target mothers as recipients as women are more likely than men to use the cash to benefit all household members.

Conditional cash transfers programs also provide monetary transfers to poor households but conditional upon their complying with certain requirements. These requirements usually include maternal and child preventive health, nutrition, and care services and school enrolment and attendance. The overall aim of these programs is to reduce household vulnerability in the short term and break the intergenerational transmission of poverty by investing in human capital (Leroy *et al.*, 2009). Conditional cash transfer programs are expensive government-implemented initiatives that, in order to be successful, rely on available health and education delivery mechanisms that are of sufficient quality. Consequently, most conditional cash programs are implemented in Latin America with only limited reach in sub-Saharan Africa.

Save the Children (Sridhar and Duffield, 2006) reviewed several social cash transfer programs in Latin America and Africa for their effectiveness in improving the nutritional status of children. According to the review, cash transfers to targeted households have positive impacts on children's diet and nutritional status that tend to exceed those reported from other typical community-based nutrition programs. In particular, the Mexican cash transfer program PROGRESA was successful in enhancing the nutritional status due to a combination of factors:

- Large cash transfer (constituting approximately one-third of a household's income);
- Transfers are regular and made to women;
- Targeting is transparent and objective;
- Cash transfer was combined with the provision of free healthcare.

Government implemented cash transfer schemes are just emerging in Africa. African cash transfer programs are based on the Latin American conditional cash transfer schemes but have been adapted given the widespread poverty, limited infrastructure and other resource constraints in most African countries (Miller, 2010). The Malawi Social Cash Transfer Scheme was launched in 2006 and provided cash transfers to extremely poor households as a means of improving food security. Recipients were urged to use the regular cash transfers to purchase nutritious foods and farm inputs and store part of their harvest. Unlike the Latin American schemes, transfers under the Malawi program were not accompanied with formal, monitored conditions or nutritional supplements for recipient children. Evidence from the Malawi cash transfer program showed that the cash transfers enabled recipients to increase their expenditure on food, livestock and productive assets and reduce negative effects of seasonality on food consumption. Nutritional impacts included gains in height, reduced stunting, and fewer illnesses among children, significant improvements in dietary diversity, and increased regular consumption of a wider variety of complex proteins (*ibid*).

Social Cash Transfer and Nutrition impact: Programa de Educación, Salud y Alimentación (PROGRESA)

In 1997, PROGRESA was launched and rapidly expanded over the following years. By 2000, PROGRESA reached over 40 percent of the total rural population. The main objectives of the cash transfer program were to improve health and nutritional status of poor households, especially mothers and children, and to improve school enrolment, attendance and educational performance. PROGRESA assisted poor households through both supply- and demand-side interventions in education, health and nutrition. Large cash transfers (i.e. on average one-third of a household's income) were disbursed regularly through an electronic card given to the mother on the condition that targeted households fulfilled certain requirements related to health and education.

The first condition required every family member to receive preventive free health services, including prenatal check-ups for pregnant women, additional health checks for lactating women, regular visits of children under 60 months to health centres for growth monitoring and promotion and immunisations, and the provision of nutritional supplements to children aged 4–24 months and pregnant and lactating women. Other household members were required to receive annual health check-ups and all adult household members had to participate in regular meetings facilitated by medical staff to discuss health, hygiene, nutrition issues and best practices. The second condition concerned education, and targeted families had to enrol their children and ensure regular school attendance.

Evaluations of PROGRESA showed significant increases in nutrition monitoring and immunisation rates, reduced population prevalence of stunting and improved dietary diversity. The effects of PROGRESA tended to be larger in poorer households with more educated fathers.

Source: Sridhar and Duffield (2006).

Leroy *et al.* (2009) reviewed a wide range of evidence on the impact of conditional cash transfer programs on child nutrition outcomes and the pathways through which these programs improve child nutrition. While conditional cash transfer programs significantly improve child anthropometry, they have very little impact on micronutrient status. The review highlights knowledge gaps related to the functioning of conditional cash transfer schemes, the implementation of the different program components, and especially to the mechanisms or pathways by which these programs improve nutrition.

4.5.3 Food assistance

Food assistance programs comprise different forms and range from direct food aid delivery to provision of cash and agricultural inputs. This section concentrates on food-assisted maternal and child health and nutrition programs and school feeding programs. Yearly, the United States Agency for International Development spends approximately US\$100 million on food-assisted child health and nutrition programs, which aim to reduce food insecurity and childhood undernutrition. Food-assisted maternal and child health and nutrition programs traditionally work by identifying children under five years of age who are underweight and targeting interventions toward them. Although widely implemented, these programs and other large-scale government-sponsored programs targeted to underweight children have shown little effect in reducing childhood undernutrition (Ruel *et al.*, 2008). Global consensus suggests that changing who is targeted and relatively small changes in how these programs are implemented can greatly increase their effectiveness at preventing child malnutrition. The International Food Policy Research Institute (IFPRI) and Cornell University, World Vision-Haiti and USAID's Food and Nutrition Technical Assistance (FANTA) project conducted a study which compared two methods of targeting and delivering food-assisted MCHN programs in Haiti (see Ruel *et al.*, 2008). The first program used a recuperative approach which provided nine months of food and other health and nutrition assistance to children six months to five years of age who were identified as underweight. The second program used a preventive approach which targeted all

children 6-23 months of age with similar food and health and nutrition services until they were 24 months of age. The results showed in communities receiving interventions either through a preventive or recuperative program, that the prevalence of undernutrition was lower in communities receiving the preventive program, and confirm that interventions aiming to prevent undernutrition can be much more effective than those targeting children once they have become undernourished.

Another form of food assistance programs are school feeding programs. School feeding programs are implemented across the world primarily to enhance school enrolment and attendance rates, improve school performance, and reduce hunger and malnutrition. WFP is the largest implementer of school feeding, reaching over 22 million schoolchildren in more than 70 countries (WFP, 2009). School feeding programs use school meals as a means to attract children to school, especially young children, and to improve health and nutrition. Overall, school feeding programs aim to address the so-called short term hunger, i.e. the fact that large numbers of children in developing countries go to school without breakfast, as well as other nutritional problems such as protein-energy malnutrition and lack of micronutrients. The basic concept is to provide nutritious food to children in public primary schools on every school-going day in the form of breakfasts, midmorning snacks or lunch meals, possibly prepared from locally grown food stuffs. Another mode of food provision is through take-home rations of food given to participating children for consumption by the family. In the case of take-home rations, school feeding programs aim at improving the food security situation of poor families to which the school children belong (Bennet, 2003; Nubé, 2005).

The impact of school feeding programs on the educational and nutritional status of children differs strongly and is highly context-specific (Nubé, 2005). With respect to education, effects of school feeding programs on selected educational parameters and equalities between boys and girls are overall positive and based on a strong evidence-base. With the exception of alleviating short term hunger, evidence of school feeding programs improving the nutritional status of participating children is weak (Bennet, 2003; Nubé, 2005). Different factors limit the effect of school feeding programs on nutrition. For example, households may prepare less food at home when a child receives a meal at school and thus school meals replace home meals instead of adding to children's diets (also called substitution effect). Further, school meals may not adequately address the complex nutritional deficiencies in the children's diets. Also, school feeding programs may not reach the nutritionally most vulnerable children.

4.5.4 Intra-household allocation

Intra-household resource allocation is an important determinant of nutrition outcomes, in particular the allocation of different types of food among different household members, including the more nutritionally vulnerable members (World Bank, 2007). Intra-household resource allocation refers to both the processes by which resources are allocated among individuals within a household and the outcomes of those processes (Haddad *et al.*, 1997). Resource allocation processes are complex, dynamic, context-specific and a product of power relations, rights and responsibilities among household members that is ascribed to by the norms in society. In addition, the level of nutrition knowledge and awareness of both husband and wife influences the allocation of foods among household members. Intra-household allocation of foods in many developing countries often favour men, especially when it concerns high-value prestige food - usually the nutrient-rich foods women and young children need most for reproduction and growth (IFPRI/ILRI, 2010). Interventions that positively affect nutrition and equity issues include women's empowerment, behaviour change communication and nutrition education involving both husband and wife as well as community leaders, elders, mothers-in-law, and others who influence beliefs, practices, and decision-making.

4.5.5 Food preparation and consumption

Another key demand-side issue is knowledge of safe and nutritious food preparation and child feeding practices. Especially in resource-poor environments, low-quality and monotonous diets based upon a few plant-based staple foods are the norm. Consequently, the risk of micronutrient deficiencies is high, especially among infants, young children, adolescent girls and women of reproductive age. Improving dietary diversity, i.e. increasing the number of foods consumed across and within food groups, is key to ensuring adequate intake of essential nutrients and is often strongly associated with nutrient adequacy, especially in developed countries (Arimond *et al.*, 2009). For decades, different approaches have been developed to improve diets of vulnerable populations. Nutrition-related education and communication strategies directed at behaviour change among farmers and consumers are a crucial element of these. To improve food preparation and consumption of nutritionally adequate diets, households require knowledge about the nutritional significance of the foods they eat and the skills and motivation to make informed choices on caring and feeding practices (Brouwer *et al.*, 2003). Generally, nutrition education includes instructions on food preparation, food safety, child-care, feeding practices, and how to identify and address nutritional deficiencies. Nutrition education and communication initiatives often target women, given their responsibility for food preparation and child care. Nevertheless, targeting both men and women is likely to have a still greater effect, as often women have low decision-making powers on food allocation and household expenditure. To enhance its impact, education approaches must go beyond the audience of caregivers and families, but also address the perceptions of health workers, opinion leaders, program managers and decision-makers (WHO and UNICEF, 2008). Further, nutrition education and awareness is more effective when conducted over an extended period of time. It takes time for behavioural change to become part of individual and community norms and in absence of longer term support households often revert to previous behaviour (Lopriore and Muehlhoff, 2003). To ensure an enabling environment in which gained knowledge on food preparation, consumption, care and health can be put into practice, nutrition promotion approaches have been developed. Unlike traditional nutrition education approaches, which are restricted to the transfer of nutritional knowledge and skills, nutrition promotion goes beyond the nutrition message and adopts a more wider approach to malnutrition by addressing some of the underlying causes and facilitating change in the environment (i.e. policy change, community involvement, empowerment).



Complementary feeding

Interventions to improve food preparation and child feeding practices also include complementary feeding education. Poor complementary feeding practices contribute to child malnutrition; complementary foods are often introduced too early or too late, are not sufficiently energy- and nutrient-dense, and expose young children to risk of microbial contamination (Lopriore and Muehlhoff, 2003). Dewey and Adu-Afarwuah (2008) compiled results from 42 efficacy trials and effectiveness studies on complementary feeding interventions. According to their review, there is no single best practice for improving complementary feeding, as the needs of the target population and their options for accessing appropriate foods vary greatly. Complementary feeding practices are influenced by a range of factors, including: knowledge level of proper complementary feeding and food preparation techniques; cultural preferences and food taboos; household food security; intrahousehold resource allocation; time available to caregivers for complementary feeding, which can affect quality and safety of foods prepared as well as feeding frequency; and availability of specialised nutrition foods on the market (e.g. fortified complementary foods). Interventions that seek to improve complementary feeding should take these factors into account. According to Dewey and Adu-Afarwuah's review, carefully designed complementary feeding programs that include pre-tested educational messages disseminated through different channels have had beneficial effects on growth and developmental outcomes, especially the case when nutrient-rich, animal-source foods were promoted in the educational messages. According to Bhutta *et al.* (2008), carefully designed complementary feeding interventions that use specific educational messages and simultaneously distribute food supplements with micronutrient fortification have most favourable impact on stunting in food insecure areas.

Educational approaches, including counselling and behaviour change communication are essential to improving infant and young child feeding practices. WHO and UNICEF (2008) listed several factors for educational approaches to improve complementary feeding, including:

- The assessment of enabling factors and barriers to behaviours and behavioural change through formative research;
- The development of feeding recommendations and messages that are feasible and the identification of effective delivery channels;
- The promotion of a limited set of consistent and practical actions that are communicated through different channels;
- Emphasis on the use of nutrient-rich animal-source foods;
- Creation of demand for improved feeding practices among the target population through knowledge transfer, the creation of recipes, and cooking demonstrations;
- Incorporation of food safety, cultural beliefs and intra-family food distribution aspects;
- Inclusion of information about appropriate food preparation that maximizes nutritional content for young children and recommended consumption practices that optimise absorption;
- Integration of the interventions into existing primary health care platforms as well as the use of delivery platforms provided by sectors other than health such as agriculture and education;
- Inclusion of family and community members (elders, community leaders) who influence household decision-making related to child feeding practices.

For complementary feeding education to be effective, recipes should be based on locally available and affordable micronutrient-rich foods. Smallholders can directly contribute to improved complementary feeding programs by producing nutrient-dense foods to be used in recipes for making appropriate complementary foods, such as porridge with vegetables or fruit. Further, smallholders can produce inputs to be procured locally by national food companies for fortified/processed complementary food products. Overall, there is a lack of literature on examples of smallholders supplying inputs to local or national food companies to be used for complementary food products. In addition, not much evidence is available on the impact of local procurement for complementary foods on the nutritional status of individuals from smallholder farm families and on stimulating demand and production of nutritious foods for use in complementary food products.

Supplementary and therapeutic feeding

In specific circumstances, food (primarily specialized food products) is distributed through selective feeding programs, namely supplementary and therapeutic feeding, to address acute malnutrition and/or supplement diets of vulnerable population sub-groups. Supplementary feeding programs provide supplementary foods to vulnerable population sub-groups such as pregnant and lactating women and young children (e.g. ages 6-23 months, 6-36 months, 6-59 months) in the form of take-home rations and/or onsite feeding. Supplementary feeding may be targeted to individuals with moderate acute malnutrition from selected vulnerable population sub-groups (typically pregnant and lactating women and children 6-59 months old suffering from moderate acute malnutrition) or extended to all persons of a given vulnerable population sub-groups (typically pregnant and lactating women and/or children ages 6-23 months) under specific conditions (e.g. during the lean season, in geographic areas where wasting levels are above the emergency threshold, as part of an immediate emergency response, among others) through 'blanket' supplementary feeding. Ready-to-Use Supplementary Foods (RUSF) are special foods used to supplement the diets of children to treat moderate acute malnutrition and/or to improve dietary quality and prevent malnutrition. Recent research in Niger demonstrated that supplementing diets of high risk children with RUSF prevents wasting among children aged 6-60 months (Isanaka *et al.*, 2009).

Therapeutic feeding programs target children who suffer from severe acute malnutrition (severe wasting) through in-patient medical and feeding services or outpatient modalities. Community-based management of acute malnutrition (CMAM) is an outpatient approach that mainly relies on the provision of ready-to-use therapeutic foods or other nutrient-dense foods for treatment of cases without medical complications. Ready-to-use-therapeutic foods (RUTF) are energy-dense fortified foods, generally pastes, with 50% of protein content from milk products ingredients. RUTFs can be fed directly to severely wasted children without medical supervision, as they provide sufficient nutrient intake for complete recovery and do not need to be mixed with water. They can be distributed to caregivers of children with severe acute malnutrition (SAM) and can be stored for three to four months without refrigeration. The approach is less disruptive to family life and work obligations, as the child may undergo treatment at home upon receipt of these products. In several countries, such as Congo, Ethiopia, Malawi and Niger, RUTF paste is already locally produced. Local production of RUTFs can help stimulate local production of key ingredients among smallholders, as in the case found in Ethiopia. In Ethiopia, RUTFs are locally produced by a national food processing company. One of the main constraints in producing local RUTFs was the low quality of groundnuts, a key ingredient. Locally grown ground nuts were infested by aflatoxin, a highly toxic fungus associated with child stunting, and many smallholders had abandoned groundnut production due to low profitability. To avoid relying on expensive imported groundnuts, the company started to work with smallholders by providing inputs, extension services and offering better prices. Over time, the farmer groups allied to the company were able to supply non-contaminated groundnuts on a regular basis and consequently increased their income from groundnuts⁷.

⁷ Case study taken from Hawkes and Ruel (2011).

5 Concluding remarks

This paper has looked at existing global knowledge on improving nutrition through agriculture using a smallholder value chain approach. The REACH smallholder value chain model adopted by this paper concentrates on both producers and consumers and is centred around three pathways: improved nutrition resulting from increased production for own consumption, improved nutrition through increased income from selling agricultural products, and improved nutrition through increased income resulting from farmers' involvement in local or regional procurement programs. Although a general lack of impact evaluations of agricultural interventions that explicitly include nutrition outcome indicators limit studying nutrition and agriculture linkages, existing literature reviewed in this paper indicate that agriculture has a crucial role to play in improving nutrition, especially through improved production and increased income from selling crops. Improved agricultural production for own consumption can significantly improve the nutritional status of household members under the following conditions: intra-household allocation of food is equitable and takes into consideration children's particular needs; poor dietary quality and related deficiencies of vitamin A, zinc and iron are addressed through effective promotional and educational strategies and through enabling improved year-round production of nutritious foods; and women are empowered to make informed decisions on feeding and caring practices. Interventions that support smallholder commercialization and marketing can substantially reduce malnutrition through increased income when the following conditions are met:

- The level of income is stable and controlled by women;
- Income is first and foremost used for purchasing essential food items that are nutritious and that offset the nutritional deficits existing within the household;
- Smallholder commercialization initiatives are complemented by parallel nutrition interventions targeting amongst others consumers' knowledge and awareness about nutritious foods and their acceptance and willingness to pay for nutritious foods;
- Intra-household allocation of food is equitable and women are empowered to make informed decisions on feeding and caring practices.

The pathway for improved nutrition through increased income resulting from farmers' involvement in local procurement programs is lacking evidence as to date improved nutrition has not been an explicit objective of local procurement initiatives. Nevertheless, available literature indicates that local procurement can only become a vehicle for improved nutrition when including poor, and especially female farmers as regular suppliers and when complemented by parallel nutrition and women's empowerment interventions.

Owing to insufficient studies on nutrition and agriculture linkages, many knowledge gaps exist, especially related to the role of income in improving nutrition, whether gained through commercialization, local purchasing or other means. When looking at agriculture-nutrition linkages along the REACH smallholder value chain model, knowledge gaps comprise the following:

- The nutritional impact of interventions targeting smallholder market participation (i.e. sustainable commodity value chain development, strengthening smallholder organizations and cooperatives, rural credit programs, irrigation, etc.) and how these interventions can effectively contribute to improved nutrition;
- The impact of local and regional purchasing programs on household income, the nutritional status of individual household members, and the adverse market impacts for rural consumers;
- Time allocation effects of production and income generation activities for women on the nutritional and health status of family members;
- Effects of increased food production on food prices and better diets;
- Impact of homestead gardening initiatives on reducing micronutrient deficiencies, including vitamin A, iron, and zinc (because of the low bioavailability of these nutrients in fruits and vegetables) and on reducing stunting or wasting;

- The nutritional impact of consuming biofortified crops and the extent of nutrition benefits versus costs of biofortification in comparison to other intervention strategies;
- Farmers' incentives to adopt and consumers' willingness to purchase and consume biofortified varieties;
- The functioning of conditional cash transfer programs, the implementation of the different program components, and especially the mechanisms or pathways by which conditional cash transfers improve nutrition;
- The impact of providing raw materials for complementary food products on improved nutrition among smallholder farm families and on stimulating the demand and production of nutritious foods for use in complementary food products.

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This report is a synthesis of existing global knowledge on improving nutrition through agriculture using a smallholder value chain approach. The smallholder value chain model used by the desk review concentrates on both producers and consumers and is centred around three pathways: improved nutrition resulting from increased production for own consumption, improved nutrition through increased income from selling agricultural products, and improved nutrition through increased income resulting from farmers' involvement in local or regional procurement programs. The report identifies key conditions for agricultural interventions to significantly contribute to nutrition as well as important knowledge gaps pertaining to agriculture-nutrition linkages.

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