

Chapter 21

Nutrition-Sensitive Value Chain Development in a Changing Climate



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21.1 Introduction

Food security has improved over the past quarter century in developing countries, with the number of undernourished people declining from 900 million in 2000 to 815 million in 2017 (FAO 2017). Yet while a larger proportion of the world's population can now access enough food in terms of caloric requirements, it is not necessarily nutritious. The 2016 Global Nutrition Report states that micronutrient deficiency remains stubbornly high, with obesity rates increasing rapidly in low- and middle-income countries (IFPRI 2016). For example, wasting (low weight for height, a sign of undernutrition) affected 52 million children under 5 in 2016, yet 41 million children were overweight the same year (FAO 2017).

In sub-Saharan Africa and South Asia, regions which rank highest in malnutrition rates, climate change poses a severe threat to food security; changes in temperature, precipitation patterns and disease environments are expected to reduce yields by levels as high as 2% per decade (GLOPAN 2015). Whilst heat and water stress will increase the incidence of pests and diseases, higher temperatures will also increase spoilage of fresh, nutritious foods, and climate events such as flooding will prevent their transport to market (Vermeulen et al. 2012). Climate change can also exacerbate nutritional deficiencies – increased CO₂ concentrations reduce the nutritional quality of crops, such as the protein content of grain crops and soybeans (Myers et al. 2017; Taub et al. 2008).

Most studies focus on the effects of climate change on agricultural productivity levels, but few have analysed the impact of climate change on household nutrition (e.g., Kabubo-Mariara et al. 2016; Springmann et al. 2016). For example it is estimated that globally, reduced fruit and vegetable consumption (caused by reduced

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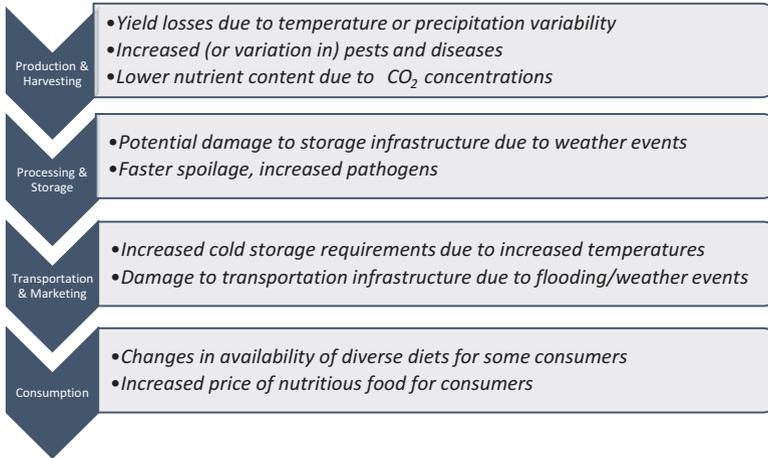


Fig. 21.1 Potential climate-related impacts to food value chains

crop availability and changes in consumption patterns) will result in 534,000 deaths (Springmann et al. 2016). Another study estimates that the number of malnourished children in developing countries is likely to increase by 8.8–10% due to climate change (Nelson et al. 2010).

By definition, food value chains include all actors and activities from producer to consumer, including: inputs into production, crop production, storage and processing, distribution and transportation, food retail and labeling, and consumption. The vulnerability of value chain activities to climate change could make production more expensive. Other factors could also affect costs, such as changes in energy or agricultural policies (Fig. 21.1). For example, rising temperatures and variable precipitation patterns will impact growing seasons, locations and water and nutrient demand, whilst also risking food safety, making storage and transportation even more critical (Fanzo et al. 2017).

Globally, agriculture and food systems need to adapt to meet the challenges of climate change if they are to support the diet of the growing global population. One promising option is the development of more nutrition-sensitive value chains that increase access to nutritious foods for local markets (e.g., Hawkes and Ruel 2012; Gelli et al. 2015). This approach relies on crop varieties that are tolerant to drought and heat, commodities with increased nutrient content, and reduced food losses.

This chapter provides a brief overview and examples of nutrition-sensitive value chains, and the research and findings thus far regarding how they can improve nutrition at the household level in Africa. The policy efforts supporting nutrition-focused agricultural practices in a changing climate will also be discussed.

21.2 Nutrition-Sensitive Value Chains

Achieving the second Sustainable Development Goal (to end hunger, achieve food security and improved nutrition, and promote sustainable agriculture) is challenging in a changing climate. Under most conditions, dietary choice does not align with what is optimal nutritionally (Allen and de Brauw 2017). There are, however, ways to improve the nutritional intake of consumers. Nutrition sensitive value chain interventions are a class of interventions that take place through a range of value chain actors to ensure more nutritious products reach consumers. Relative prices can shift either through improvements in the value chain or through regulation. Likewise, marketing campaigns and improved labelling can persuade the consumer to purchase more nutritious foods.

Decisions made on the supply side, for example regarding which foods to produce or with whom to trade, largely depend on the expected profit, which limits the nutritional composition of foods in the value chain. The nutrition-related or environmental consequences of value chain activity are rarely monetised. Producers are unlikely to shift production to more nutritious or environmentally sustainable foods if they will not result in increased profit. Previous research on nutrition-sensitive value chains, therefore looked for ways to ensure profitability, such as temperature-controlled supply chains for perishable foods, contracts that support the production of vegetables, and increased subsidies for infrastructure and inputs (Allen et al. 2016; Chege et al. 2015; Stifel and Minten 2017).

To create sustainable, climate-smart value chains consideration of synergies and trade-offs among economic, environmental and social objectives, including nutrition and health may be required (FAO 2013). For example animal source foods (meat, milk, eggs) are nutrient-dense, but producing them is both land and water intensive (Marlow et al. 2009). As the climate changes, these social, environmental, and economic trade-offs will shift with relative prices and the profitability of specific activities will change. Examples of this include the effect of variations in monsoon timing and strength in India (upon which both agriculture and energy depend), and the effects of biofuel policies in countries such as Ethiopia, that can lead to higher food prices and land use changes when compared to policies focused on agriculture and food security (Lobell et al. 2014).

Figure 21.2 illustrates the complex relationships that must be considered in nutrition-sensitive value chains: a delicate balance of economic (profit), social (including nutrition), and environmental impacts, including greenhouse gas emissions (figure adapted from FAO 2013). Though many of these social and environmental impacts are not monetised, pressure on resources (for example, through drought, floods and changes in soil productivity) and changes in consumer demand (for example, for products such as palm oil or animal source foods) can affect profitability and promote unsustainable production decisions.

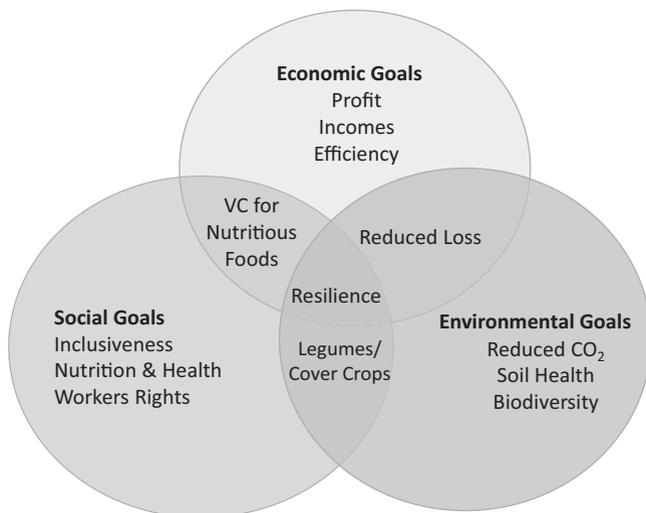


Fig. 21.2 Trade-offs and synergies for sustainable food chain development. (Source: Authors' Adaptation from FAO 2013)

21.3 Value Chains for Nutritious Foods: Lessons from the Field

Increasing the availability of nutritious foods is necessary to deal with substantial micronutrient malnutrition. In 2014, 32% of children below the age of 5 in sub-Saharan Africa were stunted (IFPRI 2016). Unfortunately, household-based interventions to improve the diet are often expensive (e.g., de Brauw et al. 2015). Such interventions are also complex. In Ethiopia, for example, increasing knowledge about nutrition was successful in improving dietary diversity, but only when households had sufficient market access (Hirvonen et al. 2017). Despite the challenges, value chain interventions have the potential to be cost-effective as they involve the private sector and, if successfully expanded, can reach a much larger set of beneficiaries than interventions focusing on individual households.

One intervention which would increase food security and diet diversity and that has potential for upscaling is the distribution, through input dealers, of nutritious crops that are more resilient to climate shocks. Beans are nutritious, but their productivity gains have lagged behind grain crops (Joshi and Rao 2017). In Malawi, the International Center for Tropical Agriculture (CIAT) and the Pan-Africa Bean Research Alliance (PABRA) have collaborated to study access to improved bean varieties. Though there is evidence of higher yields and dietary diversity for those who adopt the improved varieties, their initial use is associated with access to extension and mobile phones (Katungi et al. 2017).

Given the positive relationship between production diversity and dietary diversity shown in subsistence-oriented contexts, crop diversification could meet the dual needs for a more resilient crop mix (in the case of pests, disease, or extreme weather) and a

more diverse diet at the household level. However, this relationship is not always positive. Once strong access to markets or increased technology adoption in agriculture is attained with concurrent increases in agricultural income, the relationship between production diversity and dietary diversity does not appear to be as strong (Koppmair, Kassie, and Qaim 2016). Farmers that are able to specialise do so because they both have higher incomes and they are able to mitigate the risk of specialisation.

Local supply chains that support more diverse diets can address these challenges. For example, in several countries homegrown school feeding programs that source school food from local producers have been implemented (WFP 2017). Recent work in Malawi has focused on testing whether such programs, when combined with behavior change communication (to improve nutrition, support local agriculture, and improve attendance at schools), can be effective in addressing malnutrition. The results are currently being finalised, but there is already evidence that these types of interventions can lead to improved dietary intake in preschool children and growth in their younger siblings (Gelli et al. 2017).

Finally, one of the most promising initiatives to increase the content of micronutrients in diets is biofortification, which involves breeding staple crops, including sweet potato, maize, beans and cassava, for higher micronutrient levels (Bouis et al. 2011). HarvestPlus has released biofortified crops and is supporting their inclusion into value chains and the market system in the Democratic Republic of Congo, Rwanda, Nigeria, Uganda and Zambia. For example, they are working with food processors to develop and market products using yellow cassava fortified with Vitamin A in Nigeria, and orange maize in Zambia (HarvestPlus 2017). Randomised control trials have demonstrated that biofortification can be effective in reducing the prevalence of inadequate micronutrient intake (Hotz et al. 2012a, b).

21.4 Nutrition-Sensitive Value Chains in a Changing Climate

In 2017 the World Economic Forum highlighted the need for inclusive, sustainable and efficient food systems that deliver nutritious food. Climate change significantly impacts malnutrition, both directly, through heat stress and water constraints, and indirectly, through loss in production. These impacts could be as large as changes in other socioeconomic indicators such as access to electricity and educational attainment (Davenport et al. 2017). The effect on stunting, however, could be partially mitigated by investments in education and electricity (Davenport et al. 2017). To build food systems that are resilient to climate change, it is critical that limited resources are used efficiently and losses reduced across the value chain (FAO 2013).

At the farm level there are opportunities for agroforestry to promote nutritious crops while ensuring more sustainable production in terms of soil health and carbon sequestration. The Initiative for the Adaptation of African Agriculture to Climate Change (AAA Initiative) notes opportunities for more integrated management of pastoral and forest systems that, in turn, can improve management of limited resources; agroforestry in particular offers the opportunity for producers to diversify their production (and income), maintain soil fertility and water resources, and provide

carbon sequestration (AAA Initiative 2017). In addition to maintaining soil health and increasing pollination, forests also provide nutritious food (fruits, berries, mushrooms), cooking fuel and income opportunities (through the sale of forest products). In addition to maintaining soil health and increasing pollination, forests also provide nutritious food (fruits, berries, mushrooms), cooking fuel and income opportunities (through the sale of forest products); in southern Ethiopia proximity to a forest increased dietary diversity due to the increase in feed for livestock and resulting organic fertilizer for home gardens (Baudron et al. 2017).

It is critical that loss at the farm level is reduced by developing nutritious, resilient crop varieties that can tolerate climate variability. For example, researchers at the World Vegetable Center evaluated heat-tolerant and disease-resistant tomato varieties in Tanzania and found the rate of return to seed improvement to be as high as that reported for some staple crops (Schreinemachers et al. 2017). In the same region, access to improved pigeonpea varieties also increased income returns for farmers (Shiferaw et al. 2008).

Ultimately, to take full advantage, resilience at the farm level should be pursued together with activities such as increasing soil organic carbon and diversity of production and trade (FAO 2013). On farm, activities that promote nutrition-sensitive agriculture can improve soil organic carbon and incentivise crop diversity through strategic (and nutritious) cover crops, such as pigeonpea. Though rotation systems that use legumes and vegetables can increase rice yields in Africa, joint public-private sector strategies are needed to ensure quality legume seed production and distribution (Ojiewo et al. 2015).

After harvest, additional steps can be taken to reduce loss. Many nutritious foods (including fruit, vegetables, and dairy products) are perishable, therefore technology and good agricultural practices would increase the resilience of these value chains to climate shocks. Increased efficiency can also be achieved by providing storage and distribution infrastructure in value chains. This would also limit the impact of the production system on the environment, and vice versa (Gomez and Ricketts 2017).

Beyond adaption, opportunities also exist to introduce more nutritious crop varieties and increase uptake through location-specific interventions. The orange sweet potato from HarvestPlus and the International Potato Center (CIP) expanded to 14 sub-Saharan African countries through partnerships with Feed the Future and private companies, and exemplifies positive progress in interventions for nutritious foods. Indeed, by September 2016 orange sweet potato was estimated to have reached 2.89 million households (Low et al. 2017). However, the effectiveness of such interventions is dependent on consumer behavior and ultimately, consumer acceptance of the biofortified varieties. In the above example of the orange sweet potato, several consumer acceptance trials preceded large rollouts of specific varieties (e.g., Chowdhury et al. 2010). The importance of consumer behavior also extends to other nutritious crops; in Rwanda, the acceptance of high-iron beans was dependent upon location, income, and related nutritional information provided (Murekezi et al. 2017).

In addition, there are opportunities for public-private partnerships like the Feed the Future supported partnership in Ethiopia, to fortify wheat flour and provide iodised salt, with UNICEF and the Global Agriculture Information Network

(Gillespie et al. 2017). The advantage of a value chain approach that incorporates the private sector is that, if profitable, entrepreneurs will have an incentive to further develop them, but a focus on both consumer and producer is necessary to target (and affect) malnutrition (Allen and de Brauw 2017). Partnerships between the public and private sectors have been developed to increase access to fortified foods, which can be especially important in rural areas (Gomez and Ricketts 2017). Understanding economic mechanisms behind consumer choices as well as how those may change as a result of climate change or variability will be necessary to ensure that activities targeting more nutritious crop production and consumption are sustainable.

21.5 Implications for Development

A growing body of evidence demonstrates that climate change will strain current agricultural production systems, with negative consequences for food security. However, the ramifications of climate change and increased yield variability on nutrition are not so well documented. The most nutritious crops may be less desirable for producers as they often require more inputs and need to be stored quickly after harvest to mitigate against spoilage.

Value chain interventions are an attractive option because they can overcome constraints on the use of inputs and support the development of transport and storage facilities for healthier products. As the climate continues to change, it will be increasingly important to strengthen nutrition-sensitive value chains so that producers have inputs, markets, and price incentives for these products.

These interventions will need to be tailored to the constraints and opportunities of specific regions, and attention must be paid to any environmental trade-offs that might be required. A number of nutrition-sensitive chains could provide resilience to climate change, including chains for biofortified crops and varieties (such as beans) that are more tolerant to heat and moisture stress.

As noted, it will be important to consider social and environmental trade-offs when evaluating the cost-effectiveness of value chain interventions and related programs, including capacity development infrastructure. Finally, public-private partnerships that strengthen market linkages can also be developed to improve the nutritious content of food and account for its environmental footprint.

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