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The Role of Food Systems and Value Chains to Improve Diets in Low Income Settings

Diagnostics to Support Intervention Design in Malawi

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ABSTRACT

Governments and development partners looking to accelerate progress in addressing malnutrition have been examining how to use food systems and market-based interventions to improve diets, one of the main drivers of malnutrition in low-income populations. The value chain framework can provide a useful lens to examine the role of markets in food systems and their potential to improve diets. However, a value chain is, by nature, commodity specific, and the focus on value chains to date has been on efficiency and economic returns, with little explicit focus on consumers and nutrition. Understanding links among value chains, the overall business environment, and nutrition is complex, and very little rigorous evidence currently exists on these links. In this paper, we apply a mixed-method multisectoral diagnostic to examine potential interventions in food systems to improve diets of rural smallholder farmers in Malawi. We examine the entry points for interventions involving public and nonprofit (including both government and development partners) and private-sector perspectives. In addition, we explore the methodological and theoretical requirements for undertaking this type of multisectoral analysis.

Keywords: Food system, value chain, diets, nutrition, diagnostics, Malawi

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1. HIGHLIGHTS

〉 Understanding the links among food systems, value chains, business environment, diets, and nutrition is complex, and little rigorous evidence currently exists on these links. The five-step diagnostic presented in this paper links a set of nutrition problems facing target populations to possible constraints in the supply and demand of specific foods; these problems can then be addressed by interventions.

〉 Results of the diagnostic highlight the potential benefits of designing a strategy to address the multiple challenges of malnutrition through market-based interventions; facilitating the identification of interventions; identifying the pathways for improving diets; and defining the roles of different stakeholders, including both private and public sectors, involved in designing and implementing interventions.

〉 Multifaceted descriptive work is key for determining the synergies and trade-offs of different possible interventions.

2. BACKGROUND

Undernutrition is estimated to have caused over 3 million child deaths per year, and stunting in children under the age of 5 affects at least 165 million children (Black et al. 2013). Micronutrient deficiencies contribute to increased child and maternal mortality and morbidity, as well as to child stunting and cognitive development (Bailey, West, and Black 2015). In parallel, the prevalence of overweight and obesity has doubled since 1980 (from 6 percent to 12 percent, globally), and the pace of this increase has since accelerated (Stevens et al. 2012). Increasing rates of overweight and obesity are likely to have important impacts on the incidence of diabetes, cardiovascular disease, and other noncommunicable diseases.

A critical strategy for tackling the multidimensional aspects of malnutrition involves the promotion of food-based approaches to improve diets (Tontisirin, Nantel, and Bhattacharjee 2002). Improving diets can involve modifying food-consumption patterns, which in resource-poor settings are often monotonous and staple based, to be more diverse and nutrient rich (Arimond and Ruel 2004). Because food systems include all activities, resources, and infrastructure involved in food production, processing, transport, marketing, consumption, and disposal, they can play an important role in shaping diets (CFS 2014). Of particular relevance are food systems and food value chains in which smallholders play a key role as both consumers and suppliers of food. According to the Food and Agriculture Organization of the United Nations (FAO), smallholders produce four-fifths of the developing world's food (FAO 2011). Smallholders also play a key role in meeting the future demand for food from a growing, increasingly rich and urbanized population.

The food environment, defined as the "collective physical, economic, policy, and sociocultural surroundings, opportunities, and conditions that influence people's food and beverage choices and nutritional status" (Swinburn et al. 2013), is the interface among food systems, value chains, and consumers (Herforth and Ahmed, 2015). Five properties of the food environment are particularly relevant in terms of their influence on diets: food availability, affordability, acceptability, nutrient content, and

safety risk (Gelli et al. 2015). Food availability refers to physical availability, whereas affordability relates to price, cost, and consumer purchasing power, which are often determined along the value chains linking producers to consumers. Acceptability is related to the sociocultural norms associated with the consumption of food and the associated feeding practices and habits. Nutrient content and safety are two quality-related attributes of the food environment; the first is linked to nutrient and food component content,[1] while the second is linked to risks and exposure to pathogens or toxins.

Interventions and policies targeting specific elements of food value chains and the food environment are common in developing countries. The links among interventions in food systems, value chains, diets, nutrition, and health, however, are manifold and complex, involving a range of direct and indirect effects that are not yet well understood (Herforth and Ahmed 2015; Pinstrup-Andersen 2012; Popkin and Hawkes 2016). Short-term gains may be offset by longer-term risks, and there is little research on how to manage the many trade-offs involved. The value chain for nutrition (VCN) framework identifies three interlinked food system–based pathways through which the interventions in value chains could have an impact on diets (Gelli et al. 2015). These pathways are based on (1) leveraging demand; (2) supplying nutritious foods; and (3) enhancing nutrition-related value addition along a chain. These pathways are complex, span multiple domains, and are linked through interactions with the food environment, including food availability, affordability, acceptability, nutrient quality, and safety risk.

There is little rigorous evidence, however, on how interventions in value chains affect other dimensions of the food system or how they might affect diets, nutrition, and health, also considering feedbacks and indirect effects across the system (Ruel, Alderman, and the Maternal and Child Nutrition Study Group 2013). Development partners, including the World Food Programme (WFP), FAO, and the International Fund for Agricultural Development, are examining the potential for interventions in markets and food value chains to increase the sustainability of their operations (CFS 2016). The rationale for this approach hinges on seeking market linkages between demand-side portfolios (e.g., the food and cash

[1] Nutrient density lacks a formal definition but generally refers to the ratio of nutrient content to the total energy of a given food (Drewnowski 2005).

transfers that are provided as part of WFP's food assistance, including activities such as general food assistance, supplementary feeding, school meals, and livelihood and resilience building) and supply-side activities (e.g., providing technical skills and inputs to producer organizations to improve farming practices and increase output through supply-side partners) through the process of structured demand (Sumberg and Sabates-Wheeler 2011).

In this paper, we apply an innovative multisectoral diagnostic to examine potential interventions in food systems to improve the diets of rural smallholder farmers in Malawi. We examine the entry points for interventions involving public and nonprofit (including both the government and WFP) and private-sector perspectives. In addition, we explore the methodological and theoretical requirements for undertaking this type of multisectoral analysis. We build on new data from two household survey rounds that were timed to coincide with the postharvest and lean season in Malawi. We also undertake market surveys and household case studies within the same survey area. The paper is structured as follows: We begin by describing the country context and the methods necessary to diagnose and contextualize dietary problems in target populations, prioritizing nutritious foods based on their relative and potential contribution to diets. We then assess constraints and intervention opportunities along these food chains, mapping the evidence from the diagnostics to a framework based on constraints in supply and demand for these specific foods. We conclude with a discussion of the implications in terms of intervention design and research gaps.

Country Context

The FAO classifies Malawi as a low-income food deficit country with a high rate of chronic malnutrition—37 percent of children aged 6–59 months are moderately or severely stunted (MDHS, 2015). Agriculture is the mainstay of the Malawian economy, with 94 percent of rural and 38 percent of urban populations engaged in agriculture (Jones, Shrinivas, and Bezner-Kerr 2014), principally as smallholders with landholdings of less than one hectare. Smallholder production is concentrated in maize, which accounted for 80 percent of smallholder-cultivated land in 2011 (FAO 2008; IFAD 2011).

Analyses of the food-consumption patterns from the Malawi Integrated Household Survey indicate that although diets are dominated by maize, household food consumption also includes a range of nutritious foods; however, the balance across the diet is likely inadequate to meet requirements for key age groups (Verdusco-Gallo et al. 2015). Due to repeated production failures over the past two agricultural seasons, approximately 2.8 million people in Malawi were food insecure in the 2016 lean season, which was between October 2015 and March 2016 (GoM 2015; UNICEF 2015). Food insecurity was most acute between January 2016 and harvest time in March of that same year.

3. METHODS

This paper builds on the diagnostics described in Gelli et al. (2015) in order to understand the role of food systems and market-based interventions in improving diets. These diagnostics link a set of dietary problems of target populations to possible constraints in the supply and demand for specific foods; these problems can then potentially be addressed through coordinated, multilevel interventions. Step 1 focuses on the target consumers, characterizing their dietary patterns, diet quality preferences, and likely gaps and constraints in nutrient and food intake. It also examines the relative contribution of different foods to total intake, identifies missing foods, and describes issues related to food-sourcing patterns and potential market demand for foods. This assessment of diets then provides the entry point for value chain analysis and the identification of value chain constraints and opportunities related to nutrition and food security (step 2). Step 2 involves first capturing the key features of the value chains of the nutritious foods prioritized during step 1, including major actors, reach (local, national, regional, international), providers of inputs and services, market size, and sources of raw material. The selected commodities are then examined for major bottlenecks and potential risks in the production, processing, distribution, final sale, and other nutrition- or food safety–related value addition. In step 3, the findings of this analysis are mapped against a supply-and-demand framework to examine the implications of addressing specific food chain constraints for a basket of foods prioritized by the dietary assessment, as part of a coherent strategy aimed at improving diets of low-income populations.

Household Survey Data

Two rounds of longitudinal household surveys from an ongoing cluster randomized control trial of a preschool-based agriculture and nutrition intervention were analyzed for this study (Gelli et al. 2017). The baseline survey was undertaken in the postharvest season (September 2015), while the follow-up survey occurred during the peak of the lean season (February 2016). Data were collected from 60 communities randomly selected among food-insecure villages in the Zomba district of southern Malawi. Within each community, 20 households with children in the target 3- to 6-year-old age group were randomly selected

for interviews. Trained enumerators used electronic tablets with computer-assisted personal interview software to collect data. The food consumption and expenditure module of the household questionnaire included data on which foods the household had consumed in the past seven days. Quantity and units were recorded for food items purchased, as well as for food items consumed from own production. Value, in Malawian kwacha (K), was also recorded for food items purchased. The kilogram quantities of the different food items that the household had consumed over the past seven days were then converted into the nutrient content of energy, protein, iron, vitamin A, and zinc, using a food composition table adapted for Malawi; daily nutrient values were calculated using adult equivalents (Fiedler et al, 2012). Outliers were corrected for each food item using a procedure that included screening and replacing any outliers more than 3 standard deviations from the mean with the value of the mean. Prior to the recall interview, female caregivers were briefed on the purpose and methods of the interview. Household dietary diversity and food variety scores were calculated based on methods employed by Hatløy et al. (2000), Steyn et al. (2006), and Swindale and Bilinsky (2006). As a measure of the different foods consumed, the dietary diversity score was calculated as a count of the number of food groups that each household had consumed in the past seven days; 12 food groups were included in this measure, rated on a scale from 0 to 12. As a measure of the number of different food items consumed, the household food variety score was calculated as a count of the number of individual food items that the household reported consuming in the previous week. In the VCN framework diagnostic, food quantities consumed provided the entry point to quantify demand for specific foods on the market. When assessing demand, we considered household food preferences and aspirations, typical food-sourcing patterns, and market conditions observed by traders.

Market Surveys

Market surveys were undertaken in the five major markets in the study area: Zomba City, Thondwe, Songani, Jali, and Mayaka (Table 3.1). Each market was visited one or two times, during which 7–10 in-depth interviews were carried out, for a total of 47 market seller interviews. Efforts were made to include in the interviews each food type available in each market (e.g., leafy greens, avocado, chicken). Sellers

were selected at random within their food type category. Where multiple selected products were sold by the same seller (e.g., blackjack and pumpkin leaves or red beans and groundnuts), data were collected for all the selected products being sold that day by the seller. Interviews lasted approximately 20 minutes each. Before initiating dialogue, the data collector asked sellers for their agreement to participate in the interview; no seller opted out of an interview. On average, the sampled sellers had 9.1 years of experience in trading in agricultural markets.

Table 3.1 Traders interviewed in markets in the zomba district, Malawi

Market	Sex		Number of traders per food type					
	Female	Male	Live chicken	Groundnuts	Pulses	Avocado	Dried fish	Leafy greens
Jali	4	5	3	2	2	1	0	1
Mayaka	5	2	0	1	2	1	1	2
Songani	3	4	1	0	2	1	2	1
Zomba City	4	3	0	0	1	2	2	2
Thondwe	10	7	2	1	4	4	2	4
Total	*26*	*21*	*6*	*4*	*11*	*9*	*7*	*10*

Source: Authors.

In addition, nine key informant interviews were conducted with persons and organizations engaged in the trading, processing, and distribution of selected products (selected leafy greens, with a focus on amaranth; pumpkin and blackjack leaf [*Bidens pilosa*]; avocado/mango; live chicken; dried fish; pulses—mainly, cow peas and black and red beans; and groundnuts) or who had extensive knowledge of the overall conditions in which the production and trade of these products was carried out. These persons and organizations were located in southern Malawi, either in Blantyre or in and around Zomba, and were identified through discussions with project stakeholders.

Household Case Studies

In-depth interviews with household members within the study area were undertaken to generate qualitative household case studies on decision making regarding food production, marketing, and consumption. Nine households from three villages were purposively sampled from the household survey population based on a maximum variation approach to ensure that households differed on a variety of

characteristics. Household survey data were used to identify households with varying levels (low, middle, high) of food insecurity (using the Household Food Insecurity Access Scale). Additional criteria included proximity to markets and female-headedness. A total of 38 in-depth interviews were undertaken with women, men, and adolescents. The resultant data were translated, transcribed, and thematically coded using NVivo 11. Framework matrices were used for thematic and explanatory analysis.

4. RESULTS

Characterizing Diets and Prioritizing Foods

Table 4.1 summarizes the breakdown of average food quantities consumed per capita by food group across all households and for households in the lowest quintile (in both the postharvest and lean seasons) according to food consumption and expenditure data from the household survey. On average, per capita food consumption amounts to a total of approximately 1 kg of food per day; approximately 40 percent of that amount is in households from the lowest-expenditure quintile. We estimate that 36 percent of all households consume less than 1,800 calories per capita per day in the postharvest season, rising to 46 percent of households in the lean season. Compared to the average across all households, those in the lowest-expenditure quintile consume considerably less food. In households in the lowest-expenditure quintile, the estimated per capita daily consumption of pulses is 28 g and of animal-source foods, 18 g, compared to an average household consuming 60 g and 76 g of these foods, respectively.

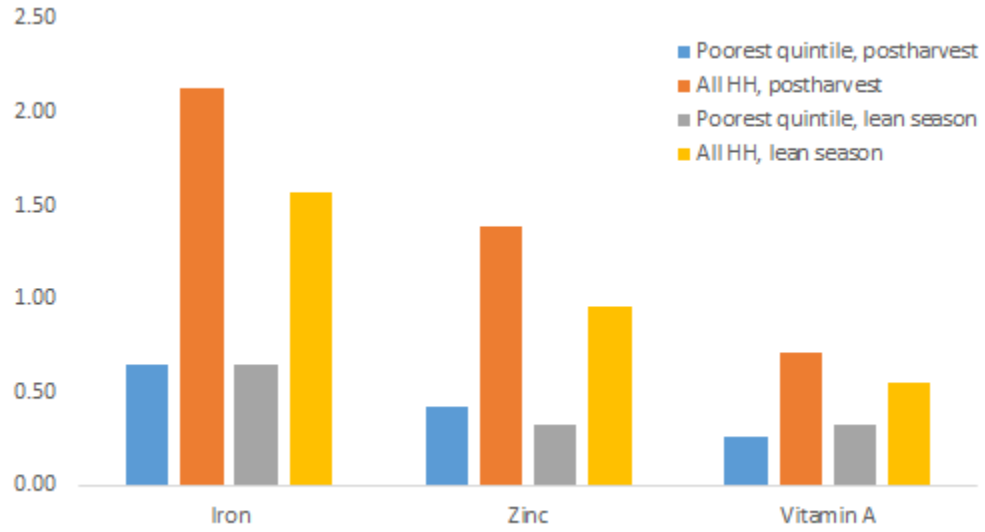
Table 4.1 Estimated average equivalent daily food consumption per adult (in grams and % of daily total) by food group: For all households and for households in the lowest-expenditure quintile in postharvest and lean seasons, Zomba district, Malawi

	All households		Lowest quintile	
Food group	**Postharvest**	**Lean season**	**Postharvest**	**lean season**
Cereals (g)	652 (66%)	581 (57%)	255 (68%)	238 (60%)
Roots and tubers (g)	39 (4%)	23 (2%)	5 (1%)	4 (1%)
Legumes, nuts, and seeds (g)	75 (8%)	67 (7%)	19 (5%)	18 (5%)
Vegetables (g)	137 (14%)	159 (16%)	57 (15%)	79 (20%)
Fruits (g)	40 (4%)	66 (6%)	19 (5%)	23 (6%)
Meats (g)	7 (1%)	4 (0%)	1 (0%)	0 (0%)
Fish and seafood (g)	14 (1%)	11 (1%)	5 (1%)	2 (0%)
Eggs (g)	8 (1%)	3 (0%)	1 (0%)	0 (0%)
Milk and dairy (g)	2 (0%)	2 (0%)	0 (0%)	0 (0%)
Oils and fats (g)	12 (1%)	7 (1%)	3 (1%)	2 (1%)
Sugar, honey, and sweets	23 (2%)	55 (5%)	4 (1%)	23 (6%)
Condiments (g)	16 (2%)	11 (1%)	7 (2%)	7 (2%)
Total (g)	*1,025*	*988*	*375*	*396*

Source: Authors.

Animal-source foods, including meat (3 g per day), eggs (1 g per day), and fish (5 g per day), are largely missing from the food-consumption patterns of the poorest households. Figure 4.1 summarizes nutrient availability for the key micronutrients in this analysis. Data from the seven-day recall of household consumption and expenditures suggest that low-income households face important deficits in nutrient intake, with these deficits appearing to be fairly constant throughout the study period. While households in the detailed case studies aspire to consume animal-source foods, these foods are expensive. Households are thus faced with pressures of eating versus selling for their own livestock (discussed in more detail below). In addition, social norms that require sharing of slaughtered animals in the community may dissuade consumption of larger livestock such as goats. Occasionally, households consume small stock, such as chickens, to cope with a lack of food. Some households in the survey mentioned occasionally purchasing very small quantities of animal protein, such as small dried fish, for the purpose of improving child diets.

Figure 4.1 Estimated nutrient availability for iron, zinc, and vitamin A of household food consumption by (AE) / EAR, across two seasons: For all households and for households in the lowest-expenditure quintile, Zomba district, Malawi



Source: Authors.
Notes: HH = households.

A further breakdown of nutrient consumption by individual foods consumed further highlights the role of maize as the main vehicle for nutrient delivery across both seasons (Figure 4.2). Notably, although food consumption is dominated by maize, a range of more nutritious foods are also being consumed in very small quantities; these foods include leafy greens, fruits (avocado, mango), chicken, dried fish, dried beans and peas, and groundnuts. However, maize consumption still accounts for approximately three-quarters of the energy, iron, and zinc availability and two-thirds of the protein availability across both seasons. Importantly, this is not because maize is particularly nutritious; rather, these figures are driven by the large share of maize consumed relative to other foods in the diet. The only exception to this trend is for vitamin A, where nutrient availability is driven by the intake of leafy greens, other vitamin A–rich vegetables, and mangoes.

Figure 4.2 Share of total nutrients consumed by food for all households for energy, protein, iron, zinc, and vitamin A and share of consumption from own production, across two seasons, Zomba district, Malawi

	Postharvest						Lean season						
Food	Calories	Protein	Iron	Vitamin A	Zinc	Share consumed from production	Calories	Protein	Iron	Vitamin A	Zinc	Share consumed from production	Δ (PH-LS)
Maize	0.73	0.68	0.75	0.02	0.75	0.59	0.80	0.77	0.78	0.06	0.82	0.15	-0.45
Rice	0.01	0.01	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.07	0.06
Other Cereals	0.03	0.03	0.03	0.01	0.03	0.32	0.01	0.01	0.00	0.00	0.01	0.09	-0.23
Cassava	0.01	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.10	-0.10
Potato	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	-0.07
Sweet Potato	0.00	0.00	0.00	0.02	0.00	0.18	0.00	0.00	0.00	0.00	0.00	0.12	-0.06
Beans and Soya	0.02	0.03	0.03	0.00	0.03	0.39	0.03	0.06	0.06	0.00	0.05	0.42	0.03
Peas	0.02	0.04	0.03	0.01	0.03	0.68	0.01	0.02	0.02	0.00	0.02	0.41	-0.27
Groundnut	0.02	0.04	0.02	0.00	0.03	0.18	0.01	0.01	0.01	0.00	0.01	0.19	0.01
Tomato	0.02	0.03	0.03	0.20	0.02	0.08	0.00	0.00	0.01	0.05	0.00	0.15	0.08
Pumpkin	0.00	0.00	0.00	0.00	0.00	0.84	0.00	0.00	0.01	0.06	0.01	0.74	-0.11
Leafy Green Vegetab	0.01	0.01	0.02	0.14	0.01	0.60	0.02	0.04	0.05	0.60	0.02	0.93	0.33
Other Vegetables	0.02	0.04	0.05	0.44	0.03	0.17	0.01	0.02	0.04	0.16	0.03	0.45	0.28
Banana	0.00	0.00	0.00	0.00	0.00	0.40	0.00	0.00	0.00	0.01	0.00	0.61	0.21
Mango	0.02	0.01	0.01	0.13	0.00	0.81	0.00	0.00	0.00	0.00	0.00	0.71	-0.10
Other Fruits	0.00	0.00	0.00	0.01	0.00	0.54	0.03	0.02	0.02	0.04	0.02	0.62	0.09
Eggs	0.00	0.00	0.00	0.01	0.00	0.36	0.00	0.00	0.00	0.00	0.00	0.54	0.18
Fish	0.01	0.05	0.01	0.00	0.02	0.03	0.00	0.02	0.00	0.00	0.00	0.03	0.00
Meat	0.00	0.01	0.00	0.01	0.01	0.39	0.00	0.00	0.00	0.00	0.00	0.51	0.12
Dairy	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.17	0.12
Fats and Oil	0.04	0.00	0.00	0.00	0.00	0.01	0.02	0.00	0.00	0.00	0.00	0.23	0.22
Sugar and Sweets	0.02	0.00	0.01	0.00	0.00	0.13	0.03	0.01	0.01	0.00	0.00	0.27	0.14
Condiments	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.04	0.04

Source: Authors
Notes: PH = postharvest; LS = lean season.

Data from the qualitative case studies indicate that although most of the households aspire to consume diverse foods, household budgetary limitations, market dynamics, and seasonal crop availability preclude regular consumption of a nutritious diet. Maize, particularly in the form of maize flour for use in *nsima* (thickened patties of maize porridge), dominates collective perceptions of household food security. Other food types are considered secondary, while maize flour is prioritized for production, purchase, or even as a preference for in-kind compensation for labor. Thus, maize plays a central role, whereas other preferred food items may be viewed as luxuries: "*I see that this is because it is in our culture. . . . Food is maize, but others require money*" (male respondent, Village 6). Consumption of nutrient-dense foods such as mangoes and avocados, while important sources of micronutrients, are contradictorily less preferred and are viewed as coping foods; they are primarily consumed in the lean season, when other foods are unavailable. Children are often prioritized with these less-preferred foods in order to "soothe" hunger: *"It helps when you have sugar, you can make tea and kids have that with the avocado. . . . If they were crying of hunger, they stop crying"* (female respondent, Village 5).

Food Sourcing

Figure 4.2 also reveals the production-to-consumption trends by food item in households over the seven-day recall period. The differing trends across the two seasons highlight that the role of markets varies considerably both by food item type and by season. While the production-to-consumption pathway is clearly important for a range of foods that make up the household diet in Malawi (particularly for nutritious foods such as fruits and leafy green vegetables), markets also play an important role, particularly for maize (the main staple food) during the lean season.

Households assess a wide range of criteria when deciding whether to consume or sell their own produce; such criteria include food security, financial needs, pricing and demand, and the need for insurance against shocks (Aberman and Roopnaraine 2018). Certain market behaviors based on food preferences may ultimately be detrimental to household diets. For example, households sell homegrown

fresh nutritious foods such as vegetables and legumes in order to acquire maize meal. Households commonly purchase maize or, in extreme cases, maize chaff in the lean season once their own production runs out. As a means of coping with scarcity while maintaining preferences, households purchase smaller quantities of maize flour from local markets, which is consistent with the results described in the previous section; this finding reflects the importance of markets for poor smallholder households. This buy-as-you-go approach encourages more frequent purchases but at much increased prices.

Wetland (*dambo*[2]) garden dry season cultivation is also an important source of food—and income, when sold—for households; such cultivars include legumes (pigeon peas, cowpeas, beans), green vegetables (rape, pumpkin leaves, mustard greens, cabbage, lettuce), tubers (sweet potato, cassava), and other vegetables (onions, okra, turnips, tomato). *Dambo* gardens play a pivotal coping role in household food security—particularly during times of drought—and are essential once upland crops are harvested, sold, or consumed (Wood and Thawe 2013).

In summary, the data indicate that, despite dietary patterns in Malawi being dominated by maize, a range of nutritious foods, including leafy greens, fruits (avocado, mango), chicken, dried fish, dried beans and peas, and groundnuts, are being consumed, albeit in very low quantities. These particular foods are thus the focus of the market and value chain analyses that follow.

Market Analysis

Marketing Context

Limited infrastructure for food marketing prevails across all sampled markets. With few exceptions, markets lack toilets and reliable access to water or sheds to protect against sun and rain. Other studies have identified poor handling practices (e.g., washing vegetables with dirty water) and direct exposure to sun (temperature abuse) during retail in Malawi as factors that contribute to contamination and microbial proliferation, as well as to the leakage of vitamin content and other nutrients (Mngoli and Ng'ong'ola-

[2] "Any permanently or seasonally wet land in valleys, depressions, or floodplains with open herbaceous vegetation, mainly grasses and sedges, and an absence of trees" (FAO 1996).

Manani 2014; Amoah et al., 2006). Even where improved marketing infrastructure is available, local actors often did not use it. Organizers of the Songani market, for example, described how sellers refuse to use existing cement-floored sheds to sell fish, fruits, and vegetables, preferring to sell on the ground along roads and footpaths, where they are physically closer to potential buyers. This phenomenon suggests that future infrastructure development should be combined with efforts to change the behaviors of buyers, sellers, and consumers. While the local government charges market sellers a fee of roughly US$0.15 (K100) per market day, the fees collected are absorbed to finance activities outside of the market, rather than being reinvested in the market infrastructure development.

The sale of crops from own production is common among these farming households, despite many being geographically remote and ultra-poor. For many of the foods examined in this study (e.g., avocados, live chickens, leafy greens), the majority of product available in the markets is sourced from nearby smallholders. In some cases, producers sell their own products (e.g., avocados and leafy greens) directly to consumers, to local businesses, and to larger scale intermediaries. In other cases, intermediary vendors purchase the product (e.g., live chickens) at the farm gate and sell in the market directly to the various types of buyers.

Barriers to sale for smallholder households are primarily related to the lack of profitability of transactions. Households reported weak negotiating power in markets, particularly over price setting. Households are usually price takers, while vendors or buyers set or negotiate the prices: “As poor people in the villages, we have no power to set prices for our products; whatever the price they set, we go by it” (female respondent, Village 1). Farmers cannot afford the wait to sell due to pressures from perishability of produce, seasonal availability, and the need for purchasing food for their own household. Other main barriers include the cost or time requirements of transport to the market, production side constraints (e.g., small harvests, land scarcity, and pests), and seasonal price variations. Households more isolated from markets and roads purchase fewer foods and have less diverse diets and higher food insecurity (Stifel and Minten 2017).

A pervasive complaint is of vendors pressuring households to sell, offering unfair prices, or tampering with weighing scales: "[Vendors] dupe us; they dupe us because, . . . for instance, if you went there with leafy vegetables, they will tell you that they buy vegetables at four for K5. But if you go in the afternoon, you will buy four for K20, while the same person bought from us at four for K5" (male respondent, Village 5). Haggling, or price negotiation, is more likely with those buying at the village level between other farming households. This negotiation is rarely reported as occurring with vendors, representing a power differential in bargaining. However, most households in our sample still use vendors because of the cost of transporting crops to market or the time required to sell on their own. Wholesale is deemed preferable to households because all produce can be sold at once. Households regard retail as more profitable but at a higher risk, as it requires selling in smaller amounts and at a greater time cost and does not guarantee that all crops will be sold.

In addition to those issues mentioned above, poor households knowingly adopt less advantageous market strategies to address food needs during the lean season. These strategies are usually related to selling produce or livestock when prices are extremely low. When possible, households adopt a coping strategy to "bank" crops (primarily, maize) as protection against the stresses of the lean season to consume or to sell when prices are high and food scarce.

In the case of pulses and other nonperishables (e.g., maize and groundnut), large-scale traders in Malawi have the capacity to source considerable volumes from smallholders and to engage with nongovernmental organizations (NGOs) and governments for the provision of staple crops for food aid. Interviews with traders did not uncover any investments or actions to identify and reduce aflatoxin levels in these crops. With the exception of pigeon pea, formal exports of many of these crops are limited due to government-imposed export restrictions in the case of maize and international restrictions in the case of groundnut, both due to aflatoxin levels (Pauw and Edelman 2015; Aberman and Edelman 2015). Larger-scale traders engage directly with independent local intermediaries, rather than with smallholders, which keeps costs low but also reduces options for addressing safety and traceability.

Evidence of business innovation involving smallholders and small businesses is clearer in the case of groundnut. Local businesses, such as the Blantyre-based Project Peanut Butter, provide quality groundnut-based products for NGOs and development agencies. The relatively high costs of these groundnut products, due to high overhead and imported dried milk and other food ingredients, for example, may present problems for other buyers. Unlike the commodity traders and conventional groundnut processors, Project Peanut Butter has in-house capacity to test for aflatoxin. Regardless, some years ago, the National Smallholder Farmers' Association of Malawi (NASFAM) showed the potential in organizing thousands of smallholders into a cooperative for the sale of high-quality products in national and international markets. Major advances were achieved in terms of addressing aflatoxin levels and building links with growers and buyers. The NASFAM case benefited from extensive external support, however, which may be difficult to replicate (Chirwa et al. 2005). Because NASFAM focuses on higher-value markets (e.g., export markets and sales to larger processors in Malawi), the potential for it to have a positive impact on local consumption (e.g., increased sale of high-quality peanuts in local markets or in consumption by farming households) is likely to be limited. Furthermore, NASFAM has not been able to export groundnuts to international markets in recent years. International NGOs have attempted to source groundnuts on a small scale through producer groups; however, those groups have struggled to respond to the relatively demanding terms (e.g., formal registration, access to bank accounts, ability to emit formal invoices, capacity to deliver relatively high volumes over time) of the NGOs.

Supply and Demand Conditions

Based on the analysis described above to characterize diets, we selected a bundle of nutritious foods for further analysis of supply and demand conditions. The supply and demand of the selected foods is influenced by variations in income during the year, as well as by marked seasonality in some cases, with strong fluctuations in price during the year. Table 4.2 presents insights from interviews with market traders on supply and demand conditions for the selected products.

Table 4.2 Overview of supply and demand conditions for selected foods in markets in Zomba district, Malawi, 2015

Food	Description
Leafy greens	Demand is low during the early months of the year, as households tend to grow leafy greens in their gardens. Demand picks up midyear, as income improves following the maize harvest and stocks from own gardens dwindle. Sellers who are also growers (without irrigation) have a small window in which to sell the greens (January–April). Demand is greatest toward the end of the year. Prices increase 25%–50% during periods of peak demand. Leafy green vegetable production is supplied mainly by farmers who sell their own produce in nearby markets.
Dried fish	Dried fish is available year-round; however, fish harvests generally decline during the hottest months of the year. Sellers purchase stocks of dried fish from fishermen and from fish traders. In some cases, sellers travel to Lake Chilwa by bicycle to purchase fish. Demand is lowest during the months prior to the maize harvest (February–March). Following the maize harvest in April, demand picks up, with June and July being the peak selling period. Prices vary markedly during the year, according to fish type, fish size, and fish availability, with prices fluctuating from 25% to over 200% during the year.
Dried beans and peas	Dried beans and peas are available throughout the year, with demand peaking in the months following the maize harvest and at the end of the year (for festivities). Supplies of these products are derived mainly from traders and farmers in neighboring communities. In some cases, larger-volume sellers hire trucks and purchase beans at the border between Malawi and Mozambique. Prices for red beans (the most common bean at the market during the time of data collection) vary by 25%–50% during the year.
Avocado	Avocado sales are marked by strong seasonality. For most of the year, there is little avocado on the market. Avocados begin to appear on the market just before the major maize harvest, when rural households have limited resources to purchase. Sales peak in April and May and then collapse. Small amounts of avocado that may appear after May are sold by traders who have access to fruits from other regions. Prices vary from 100%–300% during the short production season. Lack of access to motorized transport and storage options help explain the highly localized and seasonal trade in avocado.
Live chicken (local variety)	Live chicken is available throughout the year by local traders. However, demand is limited during most of the year. Rural households tend to purchase more chicken following the maize harvest, from April to July. Demand peaks in December, as rural households purchase chicken for end-of-year festivities. The price of chicken is roughly 75%–100% greater during peak season, as compared to off-season. The majority of sellers purchase their supplies of chicken directly from farmers in nearby communities.
Groundnut	Groundnut is available during most of year. In many cases, groundnuts sold in the markets are sourced directly from farmers in nearby communities and are then stored by market sellers for subsequent sale in local markets. Demand peaks during the final quarter of the year, as rural households have consumed most of their own production by then and seek to purchase seed for the next year's production. Price varies considerably between peak and off-season (roughly 300%).

Source: Authors.

Market Sellers' Needs and Capacities

Overall, volumes brought by market sellers to the local markets were low due to transport limitations—usually about as much as could be carried on a bike or in one's arms. Average volumes brought to market when interviews were carried out included roughly 115 avocados, 18 live chickens, and leafy greens that filled half the volume of a 50-kg sack. Higher quantities were reported for pulses, reflecting that some relatively larger volume sellers had options to store bags of beans and peas in houses located near the

market. Overall, market sellers reported few and relatively small costs for marketing—mainly, market fees (US$0.10–0.17 per day) and transport costs (a low of US$0.32 for leafy greens to a high of US$3.50 for pulses). Transport mainly involved the hiring of bicycles to carry products to the market. The larger scale sellers engaged in beans and peas were the only traders who reported the use of hired trucks. There was no indication that traders had engaged in coordination among themselves or with producers or market officials to reduce the costs and risks for selling.

Relations between market sellers and their suppliers (e.g., farmers, local intermediaries) generally did not entail more than the exchange of product and information regarding market conditions. In a few cases, sellers reported engagement with suppliers on production or packaging. This likely reflected that competition in the markets was based on price over all other considerations (e.g., quality, diversification of product offer, presentation). Groundnut sellers reported selling inputs (e.g., seed) to growers. In addition, sellers reported limited value-added to their products sold at the markets. In the case of beans and peas, fish, and groundnuts, drying was reported—likely because the seller purchased from nearby farmers following the harvest and then dried the products. Cleaning of product was common (though not ubiquitous) among sellers of more perishable products, such as avocados and leafy greens. Few traders engaged in labeling or bagging of their products for sale in the local markets. Only a small fraction of the sellers received credit for their operations, and this was usually a one-off credit for 3–6 months, with high interest rates for the purchase of products from farmers and traders.

Table 4.3 presents the biggest challenges for marketing the selected products, as reported by the interviewed sellers. The majority of the sellers reported lack of demand for their products, as well as the intensive competition among traders to sell their products. In the case of the Zomba market, there was mention of irregular demand, as many market shoppers were paid at the end of the month, meaning that sales during most other times were limited. Several traders reported lack of capital for purchasing inputs from farmers and traders, while lack of capital for the purchase of agricultural inputs was reported by three producers/sellers of leafy greens. Despite the major scarcity of transportation for all the sellers, only two sellers reported lack of access to transportation services as their biggest challenge.

Table 4.3 Most important marketing challenge as reported by sellers (n = 39) in Zomba district, Malawi

Challenge	Number of sellers reporting as biggest challenge
Low demand/excess supply	20
Lack of regular customers	11
Lack of capital/limited stock	7
Irregular demand (majority of sales at end of the month)	3
Low-quality product (e.g., discolored leaves due to lack of fertilizer, small fish size)	3
Lack of transportation	2
Total	39

Source: Authors.

Identifying Intervention Options

The diagnostic began with a focus on a range of foods relevant to diets. We identified priority foods that, if consumed in greater quantities, would provide important improvements in the overall quality of diets. The focus then shifted to identifying the constraints in demand and supply within single value chains of the nutritious foods (leafy green vegetables, fruits, beans, groundnuts, and animal-source foods) prioritized during the characterization of diets. The final step broadened the focus from a single food chain perspective to the range of priority foods relevant to diets, identifying intervention options based on prevailing supply and demand conditions (Table 4.4).

Table 4.4 Food system interventions to improve consumption of nutritious foods in low-income households in Zomba district, Malawi

Dietary change	Demand and supply characteristics	Consumer-related issues	Main constraints	Implications for intervention design
Groundnuts are consumed throughout year, but high levels of aflatoxin contamination are a major health risk.	Consumers are willing and able to purchase, and there is high availability in markets during all or part of the year.	Sorting and grading issues are likely to result in low-income consumers being exposed to higher levels of aflatoxin.	There are gaps in the regulatory environment and quality assurance, as well as limited capacity and weak incentives to invest in improved production.	Develop and test third-party quality assurance; strengthen capacity of processors to minimize food safety concerns.
Beans and legumes are consumed in low volumes; increased consumption would improve diet quality.	Consumers are willing to prioritize purchase when funds are available, but there is limited availability during some parts of the year.	Willingness to purchase and prioritize over other food (except maize), consumers with limited purchasing capacity during peak demand periods	Production bottlenecks limit availability during certain periods of the year; there are limited incentives for traders to engage in supplying local markets.	Innovate production technologies to expand availability; improve coordination and other measures (e.g., storage) with traders to reduce costs.
Animal-source foods (especially dried fish) and leafy greens are available, but consumption is low; increased consumption would improve diet quality.	There is low consumption, despite a generally high degree of availability in local markets.	Although preferred, there is low willingness to pay due to insufficient budget; nutritious wild foods are seen as coping foods and are not preferred.	Producers and sellers have limited opportunities to expand or add value to production due to limited effective demand.	Offer subsidies/social transfers to facilitate consumption in critical periods (e.g., lean season); support chain actors to reduce costs of production and trading; create information campaigns to increase acceptability.
Nutritious fruits (e.g., mangoes and avocados) are not consumed in significant amounts throughout the year due to limitations on both the supply and demand side; increased consumption would improve diet quality.	Low consumption due to budget constraints or because they are not preferred; there is also high seasonal availability.	Low willingness to pay for fruits, with a preference for the consumption of staples; fruits are relatively expensive during off-peak seasons, adding further deterrence to year-round consumption.	There is a lack of storage and transport facilities for highly perishable products; limited demand increases risk for production developments and other investments; few processors and distributors engaged in sector.	Create information campaigns to increase acceptability; support chain actors to process or store to extend shelf life; invest in local marketing infrastructure; offer subsidies/social transfers to facilitate consumption when in season (e.g., school meals).

Source: Authors.

- Although groundnuts are consumed throughout the year, high levels of aflatoxin contamination are a major health risk for consumers. In this quadrant, consumers are generally willing and able to purchase groundnuts, and there is high availability in markets during most parts of the year. The main consumer-related issues involve sorting and grading, which are likely to result in low-income consumers being exposed to foods with higher levels of aflatoxin. The main constraints along this food chain involve gaps in the regulatory environment and quality assurance around aflatoxin, as well as limited capacity coupled with weak incentives for smallholders to invest in improved production. Interventions likely to address these constraints include developing and testing third-party quality assurance and strengthening the capacity of processors to minimize food safety concerns.
- Beans and legumes are consumed in low volumes, and increased consumption would improve diet quality. Consumers are willing to prioritize the purchase of such foods when funds are available, but there is limited supply and availability during certain parts of the year. Although consumers are willing to purchase and prioritize beans and legumes over other foods (except maize), they face limited purchasing capacity during peak demand periods. Production bottlenecks limit availability during certain periods of the year, and there are limited incentives for traders to engage in supplying local markets. In this quadrant, intervention options include innovation in production technologies to expand availability and improved coordination and other measures (e.g., storage) with traders to reduce costs.
- Animal-source foods (especially dried fish) and leafy greens are available in markets, but consumption is low; increased consumption would improve diet quality. These foods (fish) are preferred by consumers. However, consumers show low willingness to pay due to insufficient budgets. In addition, nutritious wild foods are seen as coping foods and are not preferred. The main constraints involve producers and sellers with limited opportunities to expand or add value to production due to limited effective demand. In this context, subsidies or social transfers are required to facilitate consumption in critical periods (e.g., lean season); in addition, chain actors

should be supported to reduce costs of production and trading and information campaigns could be created to increase acceptability.

- Nutritious fruits (e.g., mangoes and avocados) are not consumed in significant amounts throughout the year due to limitations on both the supply and demand side; increased consumption would improve diet quality. Low consumption of these fruits is driven by household preferences; these fruits are not typically purchased due to budget constraints and high seasonal availability. This low willingness to pay for fruits is due to household preferences toward consumption of staples, as well as the fact that fruits are relatively expensive during off-peak seasons, adding further deterrence to year-round consumption. The main market constraints involve lack of storage and transport facilities for highly perishable products. In addition, limited demand increases risk for production developments and other investments. Only a few processors and distributors are engaged in the sector. Interventions include creating information campaigns to increase acceptability; supporting chain actors to process or store in order to extend shelf life; investing in local marketing infrastructure; and offering subsidies or social transfers to facilitate consumption when in season (e.g., school meals).

5. DISCUSSION

In this paper, we undertook a multisectoral mixed-method diagnostic analysis to identify potential interventions in food systems and value chains to improve the diets of low-income populations in Malawi. Several important considerations are apparent from the results of this study. Primarily, the results highlight the potential benefits of undertaking a strategic, layered approach, involving both the public and private sectors. The diagnostics highlight the potential role of information to optimize decision making related to food choices to potentially lead to short- and medium-term improvements in diets and nutrition. Longer-term interventions, such as improving capacity for product differentiation, processing, storage, and market infrastructure, can also simultaneously be addressed. However, addressing seasonal, short-term effects will be critical in terms of the problem of improving diets in Malawi. Food stores and spending power are highly limited in the lean season, when food insecurity peaks; thus, improving diets during this time should largely focus on subsidies and social transfers (e.g., food, cash or vouchers) for substantive, short-term improvements. In the harvest season, when farming households' financial constraints are less binding, the public-sector emphasis can shift to nutrition-related behavior change communication (BCC) to bridge any information on knowledge gaps around food choices and nutrition. During the planting season, production support activities around a basket of nutritious foods would strengthen the supply side.

A Strategic View Aimed at Improving Diets of Low-Income Populations

To highlight the potential benefits of a strategy aimed at improving the diet quality of low-income populations in Malawi, we draw on two concurrent studies using the same longitudinal data set included in this analysis. A quasi-experimental study was aimed at assessing the impact of lean season food transfers on household food security, diets, and the nutrition status of young children (Gelli, Margolies, et al. 2017). The effect of food transfers on food expenditure was estimated at K36 per day per capita, corresponding to an increase of 19 percent from baseline. There was also evidence of increased household micronutrient consumption. Highly significant effects were also found on children's dietary diversity

score, corresponding to an increase of 15 percent. The findings from this study suggest that during the lean season in food-insecure settings, where important declines in food security, diet quality, and nutrition status are present, food transfers can have a protective effect on household food security and on the diets of young children.

In parallel, a longitudinal cluster randomized control trial was designed to evaluate the impact of an early childhood development (ECD) center-based agriculture and nutrition intervention aimed at improving household production diversity; maternal nutrition knowledge and practices; and children's diets, anthropometry, and development (Gelli, Aberman, et al. 2017). This study found important impacts on diets and growth of the intervention at 12 months that extended beyond the ECD center, improving nutrition practices at the household level that benefited preschoolers and their younger siblings (Gelli et al. 2018). Interestingly, there was evidence from the midline survey at 6 months from baseline that the BCC from the integrated intervention had a positive effect on dietary diversity for children during the lean season, driven by consumption of fruits. The BCC had a smaller effect on dietary diversity than the food transfers did at 6 months (BCC impact coefficient 0.32, compared to food transfer impact coefficient 0.80). However, unlike the effects from food transfers, the effects of the integrated intervention were sustained at 12 months (as were the impacts on a range of other indicators on the program impact pathways).

This emerging evidence highlights the potential opportunity to modify existing social protection interventions in Malawi to optimize the impact on diets. For example, during the planting season, the current Fertilizer Input Subsidy Program, which provides fertilizer inputs for smallholders mainly focusing on maize, could be systematically broadened to provide inputs for nutritious crops including beans, sweet potatoes, and leafy green vegetables. During the lean season, the food transfers could systematically integrate intensive BCC to optimize household food choices, maximizing their potential effectiveness, as identified in a rigorous impact evaluation for Bangladesh (Ahmed et al. 2016). Also during the lean season, the existing school meals program food basket composition could be modified to provide locally purchased leafy green vegetables, thus providing demand from public programs on village

markets where these foods are highly available and where sellers face a lack of buyers. In the postharvest period, public procurement could continue, accompanied by BCC to improve food choices.

Conclusions

In conclusion, these diagnostics highlight the potential benefits of designing a strategy to address the multiple challenges of malnutrition through market-based interventions. These diagnostics facilitate the identification of interventions, the pathways for improving diets, and the roles of different stakeholders, including both private and public sectors, involved in designing and implementing interventions. This is in contrast to common value chain–related analytical approaches that consider a single product, food, or intervention, which does not allow for consideration of the complexity and interconnectedness of characteristics of the food system. Such multifaceted descriptive work is critical for determining the synergies and trade-offs of different possible interventions. However, because food systems and preferences may be highly localized, there may be a need to repeat descriptive work in multiple areas of a particular country. Further research is required to understand the applicability and relevance of these diagnostics in other contexts, including those where markets play a more significant role in shaping diets than in rural Malawi.

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