

## **PART 6**

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# **Toward More Sustainable Food Systems**



## TOWARD MORE SUSTAINABLE FOOD SYSTEMS

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**S**ustainability is a key pillar of food system transformation. Environmental sustainability is needed to ensure food systems can be more productive, resilient, healthy, and inclusive both today and for future generations. Further, programmatic sustainability can ensure that programs and interventions not only deliver impact during their lifetime but also are able to ensure outcomes can still be attained after their end. Part 6 discusses sustainability from both environmental and programmatic perspectives, giving insights into how transformed food systems can be sustained over time.

The arid and semiarid lands (ASALs) in Kenya are on the frontlines of the climate crisis. Part 2 (Productivity) highlighted the diversity of agroecological zones of Kenya yet its relatively homogenous, maize-dominated production systems. When crops are grown outside their optimal environment, heavy reliance on chemical fertilizers and pesticides may be needed to boost yields. In the long run, such production practices can damage soil quality and reduce productive capacity.

Chapter 16 presents an analysis of Kenya's flour blending policy, which aims to promote the blending of sorghum and millet into maize flour, creating a more nutritious flour for Kenya's staple food, *ugali*. Sorghum and millet are better suited than maize to ASALs and have a higher nutritional value than maize-only flour, making flour blending a potential win-win for producers and consumers. However, Chapter 16 points out that low production and demand for blended flour present a major constraint to its widespread adoption. Simultaneous and complementary measures are needed to ensure success: improved technology adoption, better access to markets for farmers, and demand-side campaigns to increase the acceptance of blended flour among Kenyan consumers.

While environmental sustainability in food systems is often seen from the perspective of on-farm practices, sustainability must also be built into off-farm components of the food system. Food loss and waste (FLW) presents a major challenge to achieving environmental sustainability within the food system,

particularly in value chains with highly perishable produce, such as fresh fruits. Chapter 17 presents an analysis of FLW in the fresh mango value chain. Between 35 and 45 percent of mangoes are lost or wasted in Kenya. Reducing FLW can make the food system more sustainable by reducing pressure to increase yields as compensation for such FLW. Policies and programs aimed at reducing FLW should focus on improving harvesting practices and packaging, implementing cold chains, and developing small-scale processing for perishable foods. Investments can help overcome the challenge of poor transportation infrastructure, which increases transportation times and FLW. Further, regulations aimed at small and medium enterprises present a barrier to entry for small-scale processors, who are central to reducing FLW by taking perishable foods and processing them into products with longer shelf lives.

In terms of programmatic sustainability, the private sector is increasingly seen as a sustainable medium through which to deliver solutions to food system actors. This dynamic is particularly evident in the digital ecosystem, where private companies are driving innovation and potentially revolutionizing how services are delivered throughout the food system. However, Chapter 18 argues that digital solutions often struggle to scale up after their pilot phases, and may not have sufficiently transformative effects. This disconnect between pilots and scale-ups may be attributed to a lack of finance for digital innovators and competition with public service providers (for example, for extension services and input distribution). Further, many digital service providers do not have sustainable business models either because they are in the early stages of development or because it is difficult to balance donor funding and financial sustainability. Trust, digital literacy, and inclusion remain issues in scaling up digital services. Policymakers can help overcome these issues by setting clear regulations for digital services that enable trust and scaling, investing in digital literacy through innovation hubs and incubators, and continuing to invest in mobile and internet connectivity. While the private sector has the potential to deliver sustainable solutions, the public sector must ensure the enabling environment is in place for this to happen.

Part 6 addresses environmental and programmatic sustainability. The Kenyan government can play a large role in facilitating pathways to sustainability through systematic policy approaches, smart regulations, and investment in key infrastructure. Achieving sustainable food systems will ensure that food systems can be healthy, productive, resilient, and inclusive for future generations.

## AN ENABLING ENVIRONMENT FOR THE NATIONAL FLOUR BLENDING POLICY: A FOOD SYSTEMS ANALYSIS

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A national flour blending policy is about to be implemented in Kenya. This requires maize flour (the country's main staple) to be blended with at least 10 percent of either one or a composite of traditional crops, such as sorghum and millet.<sup>1</sup> The blending ratio is expected to increase gradually, with the goal of ultimately reaching 30 percent. The policy envisages achieving several goals. The first is to improve the nutritional quality of maize flour: sorghum and millet (and other candidate blending crops) have micronutrient characteristics that are absent in maize. The second is to promote more climate-tolerant crops and technologies: sorghum and millet can be grown in less favorable arid and semiarid lands (ASALs), in the very conditions that many farmers face in Kenya. This is particularly important given that maize is more susceptible than other staple crops to climate change. The third is to reduce the country's overreliance on imported maize and concerns about its food sovereignty.

Early considerations of composite flours in developing countries were driven by economic arguments, primarily to reduce large-scale wheat imports that used up scarce foreign exchange resources (Fellers and Bean 1988; Abdelghafor 2011). For example, the Food and Agriculture Organization of the United Nations (FAO) initiated its Composite Flour Program in 1964 (Fellers and Bean 1988) and supported these early efforts by developing composite flour technologies and products in many countries, including Brazil, Bolivia, Colombia, Senegal, and Sudan.

Various cereals, legumes, and root crops, such as maize, rice, sorghum, millet, barley, sweet potato, amaranth, and cassava, have been used to replace wheat in composite flours (Fellers and Bean 1988; Nwanekezi 2013). Over time,

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1 While the discussion in this chapter focuses on sorghum and millet as main candidates for maize flour blending, the policy also considers cassava and amaranth as target crops.

nutritional considerations have started to play a key role in many countries, identifying composite flours as supplementary foods to meet young children's daily micronutrient requirements and for the treatment of malnutrition in therapeutic and emergency feeding programs (Oduro-Obeng and Plahar 2017).

Studies have shown that composite flours are technically feasible (Nwanekezi 2013). However, composite flours to date have been limited primarily to the production of weaning, snack, confectionery, and other specialty foods that meet consumer demand in terms of preference, variety, nutrition, and low cost (Fellers and Bean 1988; Nwanekezi 2013). Specifically, composite flours for staple foods that involve large-scale flour processing have not evolved in most developing countries.

The flour blending policy is set to shake up the food system in Kenya significantly and is likely to increase the use of sorghum and millet by creating new market opportunities for the crops. However, two big issues need to be properly addressed for the policy to succeed: (1) lack of sufficient volume of sorghum and millet at the moment and (2) limited acceptance of and poor demand for these crops, as people have strong preference for white maize *ugali* (cornmeal). Using the food systems perspective, this chapter demonstrates how this policy change can best be leveraged and nudged toward achieving its stated goals. We emphasize that, if the flour blending policy is to succeed, it should not act alone. It needs to be supported by well-thought-out and articulated complementary interventions and measures at different stages of the food system, including targeting appropriate cultivars, agronomy, seed systems, market linkages, and demand. For example, farmers need access to the input and output markets for target crops. There is a clear need to promote consumer demand to provide incentives for their production.

The complex dynamics in food systems mean that apparently promising and well-meaning national flour blending policies could fail and could even have perverse or unexpected outcomes and impacts, such as soaring prices of target crops, which could undermine nutritional benefits for the poor. This complexity calls for recognizing the dynamic, ever-changing nature of food supply and consumption arrangements and the way they create winners and losers, and the powerful forces at play that do not necessarily support the agenda of maize flour blending—for example, potential opposition from market players for whom maize market shares would fall as a result of the policy.

In addition, while the private sector needs to respond to the new policy, there is a danger that potential benefits could be captured by market players and others who have the resources to exploit the opportunity more quickly and at greater scale—and this excludes smallholders (Lapar et al. 2003). This calls for

a new form of intervention that couples research and technology development and delivery with capacity building, as well as a wide range of partnerships. This will make it possible to navigate and coordinate changes across the whole of the food system to simultaneously maximize expected benefits and mitigate potentially unexpected negative consequences.

The chapter next briefly outlines the essence of the food systems perspective as relevant to this topic. It then presents a food systems analysis of the Kenyan flour blending policy, followed by conclusions.

## **The food systems perspective**

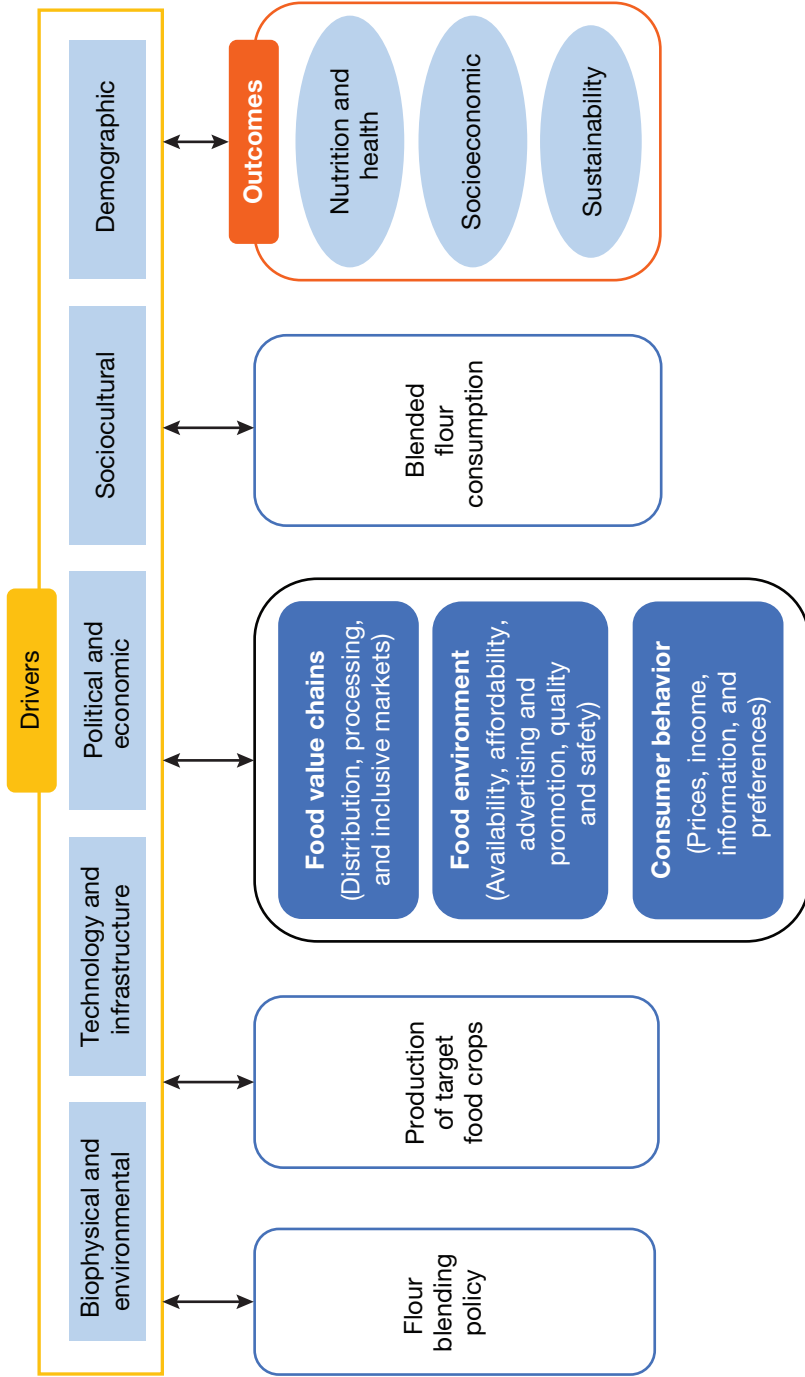
The food systems perspective is increasingly recognized as a useful analytical framework to enhance our understanding of systems thinking and the design of policies and strategic interventions toward achieving more desirable food system outcomes (HLPE 2017). Chapter 1 provides a schematic presentation of the food systems framework. The food systems approach describes the connections, feedback loops, and trade-offs among its elements and processes that potentially affect system outcomes through a multitude of mechanisms working simultaneously at various scales and levels (De Brauw et al. 2019; Melesse et al. 2020). At the core of a food systems analysis is understanding the relationships between system activities and outcomes, while navigating feedback loops linking these domains, managing trade-offs, and identifying drivers that shape the impact that the outputs of all activities have on system outcomes.

The food systems perspective has several things to offer. It provides a frame for thinking about the directionality of change at a broad scale within the food system, rather than at finer resolutions that may miss richer interactions across system components. It helps in articulating theories of change that draw on complex systems thinking, highlighting complementary measures needed to support core food system interventions. Importantly, it can guide mapping of the distribution of power among stakeholders, potentially revealing the role of dominant players in setting and maintaining the goals and dynamics of food system transformations.

## **A food systems analysis of the flour blending policy**

We now turn our attention to understanding the points of leverage and resistance that the flour blending policy is likely to face and the potential trade-offs that need to be taken into account and mitigated. A natural starting point is

FIGURE 16.1 The food systems framework as applied to the flour blending policy analysis



Source: Adapted from HLPF (2017); Mausch, Hall, and Hambloch (2020).

to recap the goals of the policy and key assumptions underpinning its impact pathway. We then explore some of their implications for responses.

### **Goals of the flour blending policy**

The national flour blending policy is an action-driven initiative that is an outcome of a series of intensive multistakeholder consultative process with experts drawn from government ministries and agencies, research and development partners, academia, and the private sector. The policy requires that maize flour be blended with at least 10 percent of either one or a composite of underused high-nutrition crops (Kenya, Crops Act 2013). It also specifies that this ratio should increase gradually, reaching 30 percent as consumer behavior changes in favor of the product.

To coordinate and oversee the implementation of the policy, the government has established a Flour Blending Secretariat that consists of a panel of high-level experts coordinated by the Ministry of Agriculture and Livestock Development. The Secretariat has been in operation since 2018. In consultation with multidisciplinary experts, it has developed an implementation framework that outlines six key focus areas: (1) production systems and commercialization; (2) agri-nutrition, health, and consumer behavioral change; (3) private sector engagement, small and medium enterprises (SMEs), and investment; (4) standards, food safety, policy, and regulations; (5) national government, county, and partner implementation partnerships; and (6) resource mobilization, funding, and strategic partnerships.

Figure 16.1 provides a schematic representation of the proposed policy in light of the food systems perspective. It illustrates core areas in the food system for potential interventions and investments. The framework also reflects a complex set of drivers that influence core activities and potential system changes to shape the outcomes of the food policy. These drivers can broadly be considered socioeconomic drivers (for example, markets, policies, science and technology, social organizations, individual factors) and environmental drivers (for example, land, soils, water, climate, and biodiversity).

The policy seeks to achieve three broad sets of outcomes. First, it aims to improve nutrition and health, particularly of poor and vulnerable communities. Kenya is still grappling with various forms of malnutrition, and nationally about 26 percent of children under the age of five are stunted (Mbugua et al. 2014). Maize, the most important staple crop in the country, is deficient in essential micronutrients. It is also highly prone to unacceptably high levels of aflatoxin contamination that could lead to high rates of child stunting and a variety of noncommunicable diseases (Mutegi, Cotty, and Bandyopadhyay 2018).

**TABLE 16.1** Nutrient composition of maize and target crops

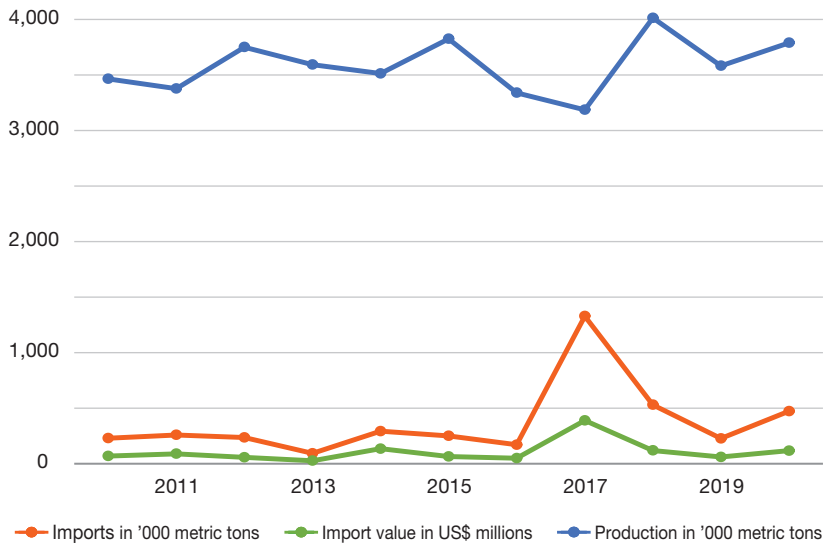
Crop	mg100 <sup>g-1</sup>			
	Protein	Calcium	Iron	Zinc
Sorghum	10.4	25	5.4	4.4
Finger millet	7.7	350	9.9	1.5
Pearl millet	11.8	42	11.0	2.0
Maize	9.2	26	2.7	0.5

**Source:** National Research Council (1996).

Blending maize with millet and sorghum flours can improve the nutritional quality of maize flour since these crops (and other candidate blending crops) represent rich sources of energy, amino acids, and several essential micronutrients (Table 16.1), and also are slow energy release, thus beneficial to diabetics. Sorghum and millet are also less prone to mycotoxin contamination.

Second, the flour blending policy would contribute to several economic outcomes, including employment generation and import substitution in the country. It aims to stimulate domestic agriculture, which means more jobs and income along the value chain of the candidate crops for blending. Maize flour processing and consumption represents a sizable economic activity in Kenya (Khamila et al. 2019). Packaged maize flour produced by large-scale millers has a market value of about US\$444 million a year (about 35 percent of the market), while *posho* maize flour produced by small and microenterprise mills, a critical part of the rural economy, is worth a staggering \$840 million. Maize is the most important staple food crop for about 96 percent of Kenyans. Household surveys indicate that it accounts for 9–18 percent of total household expenditures in the country. Moreover, the country relies heavily on government-subsidized imported maize to meet its domestic demand. FAOSTAT data value maize imports at about \$389 million for the year 2017 (see Figure 16.2), when a catastrophic drought caused shortages of maize and sent the domestic price soaring. Our calculations based on data obtained from several sources indicate that, if maize flour is blended with 10 percent of either millet or sorghum, Kenya's maize import volume could drop by up to 42 percent, thereby saving on average \$44.8 million a year. Further, the policy would reduce the country's overreliance on maize and strengthen its food sovereignty—that is, its ability to feed its population without relying on imports.

Third, the flour blending policy would contribute to improved sustainability by building resilient farm and food systems through promoting climate-tolerant crops and technologies. Sorghum and millet production is more resilient than

**FIGURE 16.2** Maize production and imports in Kenya, 2010–2020

Source: FAO/STAT (2022).

maize production in the face of high climate change risks in drylands (Kilambya and Witwer 2019). Interest in these crops has grown recently as potential crops for a “New Green Revolution” (Goron and Raizada 2015). This is particularly pronounced in ASALs, where recurrent drought is a serious threat and climate change makes maize a riskier crop (Schipmann-Schwarze et al. 2015).

The proposed impact pathway of the policy is as follows: flour blending increases or creates demand for underused cereals, thus providing incentive to smallholder farmers and other value chain actors to work together and develop long-term business relationships. The efficacy of the impact pathway would essentially depend on the willingness and capacity of value chain actors to invest in the coordination, collaboration, and communication needed to respond to the new market opportunities. The success of the policy would also depend on capacity to manage potential trade-offs among expected outcomes for various actors (Mausch et al. 2020; Melesse et al. 2020). Maximizing returns of smallholder farmers through, for example, improved prices may undermine poor consumers’ capacity to afford blended flours. Similarly, ecological sustainability considerations could also be at odds with the goal of maximizing farmers’ returns. Balancing these competing goals in reality would not be easy. This calls for critical reflection on the assumptions, levers, and resistances that underpin

the national flour blending policy, while meeting data and research needs for effective implementation of the policy.

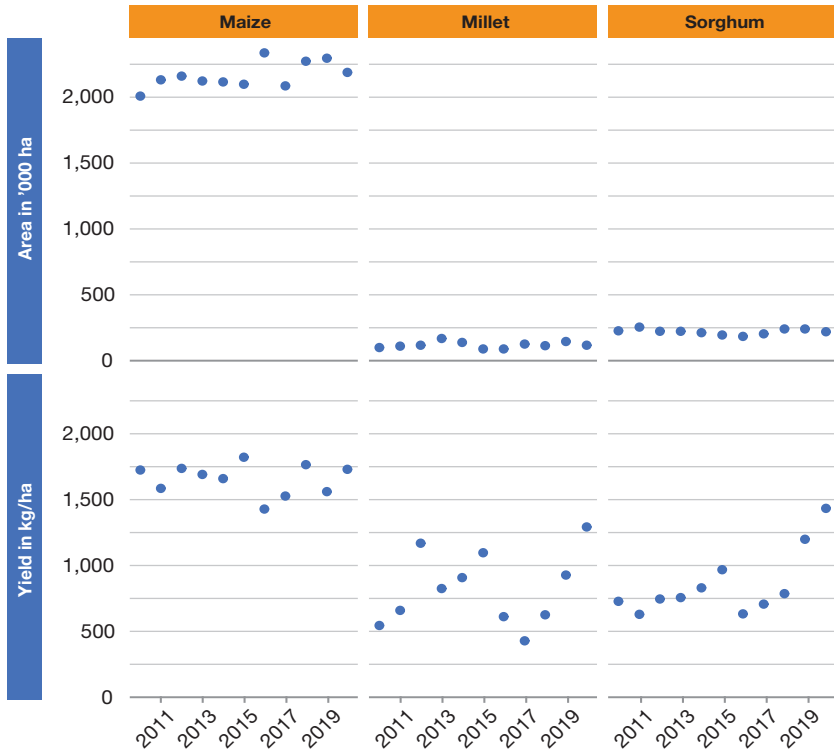
In the next sections, we discuss key aspects of science and technology questions (traits, varieties, seed systems, and agronomy), a host of issues around market system development to connect farmers to the new market, and further policy measures, such as education campaigns to encourage changes in consumption patterns and incentives for large-scale millers that are needed to best support the success of this policy.

## Food supply chains for sorghum and millets

### Production

Sorghum (*Sorghum bicolor* (L.) Moench), finger millet (*Eleusine coracana*), and pearl millet (*Pennisetum glaucum* (L.) R. Br.) are important food crops for many low-income households in Kenya. They are typically grown by small-scale, resource-poor farmers in ASALs, where maize and other crops' cultivation is risky because of high temperatures and low rainfall (Kilambya and Witwer 2019). In addition, sorghum and millet require minimal external inputs and provide for increased soil cover when intercropped with legumes. While sorghum and millet can be grown in most parts of Kenya, their current production is mainly concentrated in the Eastern and Western regions. Despite the growing importance of sorghum and millet in the face of climate change, their production is characterized predominantly by low levels of input use and concomitantly low yield (Schipmann-Schwarze et al. 2015; see also Figure 16.3). Facing only their own demand with limited market access, households have weak incentives to adopt the new technologies necessary to increase productivity for more commercially oriented production.

The flour blending policy seeks to open up new and viable market prospects that provide incentives for farmers to produce beyond subsistence and commercialize these underused cereals. However, ensuring a regular supply of adequate volumes and suitable quality of sorghum and millet at relatively reasonable and stable prices will be important. This has proven the biggest deterrent to the development of a wider use of staple composite flours in the developing world (Fellers and Bean 1988; Nwankezi 2013). Smallholders will likely need to improve their capacity to be able to adopt more productive and sustainable technologies, mitigate and manage different types of risks, and meet market quality standards (Karuho and Collins 2020). To achieve the immediate target of the policy—blending maize flour with 10 percent of either millet or sorghum,

**FIGURE 16.3** Area allocation and crop productivity in Kenya, 2010–2020

Source: FAOSTAT (2022).

production of millet and sorghum needs to increase by about 85 percent and 65 percent, respectively. Therefore, to produce the target crops at scale, small-holder farmers need to be leveraged through multiple interventions.

Developing effective seed systems and value chains is going to be critical for the timely and sustainable delivery of good-quality seed varieties that the flour market would demand. While more than 40 sorghum, more than 12 finger millet, and 3 pearl millet improved varieties have been developed and released to date through collaboration of the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), national agricultural research systems, especially the Kenya Agricultural and Livestock Research Organization, and universities in Kenya, seed systems for the crops are still undeveloped. Multiplication of sorghum and millet seeds has been minimal and is dominated by the public sector. Currently, there is no meaningful commercial seed delivery of these

crops for smallholder farmers. Generally, seed is failing to reach smallholders because of a combination of lack of sustainable and profitable demand for quality seeds and weak last-mile distribution. About 87 percent of sorghum seed and about 90 percent of millet seed used by farmers in Kenya are local cultivars produced on-farm and saved for cultivation (Muthoni and Nyamongo 2008). Given that improved varieties of sorghum and millets are grown primarily for own-consumption, demand is driven primarily by their agronomic characteristics, particularly high yields and early maturity (Orr et al. 2020). Further, it is important to realize that not all sorghum and millet varieties can be used with success in industrial processing; this may suggest a need to breed for varieties and hybrids with better industrial processing qualities.

Achieving widespread adoption of selected improved varieties would also require additional measures, including influencing the ways in which farmers obtain information and make choices. High prices of quality seed also present a major barrier to their use. Thus, there may be a need to find ways to lower the cost of producing quality seed, without reducing incentives for seed producers, so that quality seed can be provided at affordable prices to farmers.

Traditionally, sorghum and millet are among a few crops that have received policy attention, albeit limited (Orr et al. 2020). The extension system of the country is highly maize-oriented (Handschuch 2014). There is a felt need to revitalize and repurpose the system to inclusively serve smallholders producing sorghum and millet. One area that the extension system needs to focus on is changing farmers' perceptions and attitudes toward these crops. Sorghum and millet are considered poor people's traditional food crops. This perception can keep farmers away from producing and consuming these crops (Bonke and Musshoff 2020). Sensitization, awareness campaigns, and training of farmers on the importance of farming and consumption of sorghum and millet may be needed to change farmers' preference for currently cultivated crops and expand the production of the targeted crops at scale. In addition, the extension system needs to transition farmer support services from "production-push" to climate-smart agronomic practices and business development services (Ferris et al. 2014).

Finally, while these are sporadic, sorghum and millet have competing uses. Market opportunities for sorghum and millet include as staple foods, raw material for the brewery industry, animal feed production, and export markets. But are smallholder farmers going to be able to supply sufficient quantities to satisfy these uses? This would likely require innovations beyond sustainably increasing crop productivity—for example, helping farmers access irrigation and reduce postharvest losses with improved logistics.

### **Grain market linkages**

Commercial demand for millet is driven primarily by specialty markets (for example, food for children, expecting and nursing mothers, and healthy formulations for management of diabetics), while that for sorghum is limited to beer-making (Orr et al. 2020). The current commercial demand for the crops falls short of building significant capacity to absorb large grain volumes. The proposed flour blending policy is likely to lead to a significant increase in demand for sorghum and millet, which could create a lucrative market opportunity for smallholder farmers growing the crops.

However, many market constraints may preclude farmers from effectively participating in formal markets and hence from benefiting from this emerging market (Lapar, Holloway, and Ehui 2003; Barrett 2008). Further, business-minded actors may be strategizing how to derive maximum benefits from the policy. Individual smallholders may not be able to supply consistent and sufficient volumes of adequate quality to be attractive to market intermediaries. Semiarid drylands, where sorghum and millet are predominantly grown, are characterized by low population density, poor infrastructure, and limited access to markets, which can make transaction costs disproportionately high, increase seasonal price variations, and reduce incentives for both smallholder producers and buyers (Chamberlin and Jayne 2013; Melesse and Cecchi 2017). In such highly fragmented smallholder production systems, even if there is a surplus, it will be small and scattered, with ensuing problems of collection and increased cost of transport and of quality control. Thus establishing an efficient value chain would also require a very high level of planning and technological capability to ensure high and consistent quality. This is why estimates of food import requirements may not always be a function of production shortfalls in developing countries but may also of processors' inability to assemble adequate supplies from domestic sources to meet the needs of major urban centers. This is evident from the recent row when the international fast food chain, KFC, said it was unable to offer fries as it could not import its preferred pre-sliced potatoes, despite them being commonly grown locally and smallholder farmers having to sell them at low prices (Mwaura 2011).

Therefore, coordinated arrangements and marketing mechanisms are needed to better connect smallholder farmers into the supply chain. This may include reducing transaction costs, improving storage and market infrastructure, strengthening business services, and developing marketing mechanisms that distribute benefits equitably to farmers (for example, certification schemes) (Ferris et al. 2014). Market linkages need to be developed between sorghum and millet

farmers and grain aggregators, assembly traders, large traders, and off-taker schemes. In most cases, local aggregators and traders are likely to play a vital role in buying sorghum and millet from markets in remote areas, which bigger traders and processors may not be able to access (Karuho and Collins 2020). Market intelligence and information systems can make markets more transparent and improve farmers' understanding of markets so they can engage more effectively in value chains. Digitizing market data and leveraging the potential of digital ICTs can enhance farmers' access to real-time market information across value chains by lowering transaction costs.

Furthermore, ensuring well-functioning markets requires building the institutional arrangements and support services necessary for competitive markets (Barrett 2008). Key entry points can include facilitating collective action models, warehouse receipt systems, and contract farming. Collective action models (for example, producer and marketing groups) can help smallholders achieve commercially viable volumes and strengthen their market power for better terms. Warehouse systems can reduce the pressure on farmers to sell immediately after harvest when prices are usually at their lowest levels, and potentially smooth seasonal price variations, while offering smallholders a market-based risk management instrument (Coulter and Onumah 2002). In Kenya, the National Cereals and Produce Board manages warehouse receipt systems serving maize marketing. These systems could be broadened to cover sorghum and millet. However, the seasonal variation in prices for sorghum and millet is currently much lower than for other crops (such as maize) (Orr et al. 2020); this may greatly decrease the potential benefits of a warehouse receipt system for these crops unless storage cost is reduced considerably.

Contract farming may also help foster certainty in market prices to assure farmers consistent and attractive financial benefits from market participation (Kaganzi et al. 2009) (see Chapter 15). Contract farming could possibly help ensure sufficient supplies of millet and sorghum grains, at least in the early stages of the policy cycle. This is because it can confer several benefits that could induce more farmers to produce these grains, including guaranteed income and reliable market access, risk sharing, and provision of inputs and appropriate technology.

The challenge for farmers is that price negotiation requires knowledge of their own costs of production and of prevailing market prices. A potential model to consider may be that millers contract directly with farmer groups, and also be used to provide extension and other input services. On the other hand, farmers must be able to supply the market in terms of the quality and reliability of supply required by buyers. Farmers often fail to honor contractual supply

agreements, particularly in drought years, as growers prioritize household food security and are reluctant to sell (Orr, Mwema, and Mulinge 2014).

Finally, beyond traditional constraints to smallholder market participation, consideration should be given to smallholders' decision-making process and attitude to commercialization. Smallholders may not have commercial objectives and adequate technical competence to participate effectively in market development processes; gaining it may require a substantial change in farmers' attitudes and decision processes (FAO 2014).

### **Processing of blended flours**

Flour processed for direct food consumption is currently the predominant value-added product from sorghum and millet in Kenya, accounting for 88 percent of use of the crops in the country (Schipmann-Schwarze et al. 2015; Orr et al. 2020). There is a large informal processing sector that consists mainly of traders who buy sorghum and millet grain, take it to a mill, and sell it at open air markets as flour. However, blending of flours from these crops with maize flour is currently not widely practiced in Kenya. Certain types of composite flours are marketed at supermarkets for baby foods, like *uji* flour.<sup>2</sup> Since standard recipes for *uji* and other blended flours do not exist, both composition and content vary from processor to processor.

Millers need to restructure and upgrade their mills and ramps to fit flour blending standards. For example, they may need to make capital investments in blending and metering equipment, as well as in storage and handling facilities. Small millers (SMEs), who account for about 70 percent of the overall maize flour production in the country (Khamila et al. 2019), may be unable to take advantage of new composite flour technology because they may lack modern equipment and technical expertise. However, smaller millers may have a unique opportunity to establish themselves close to local and regional collection centers in high-potential sorghum and millet production areas. Additionally, while large millers mainly target the formal market and urban consumers, SMEs working at local levels could benefit the poor and farm household consumption. Thus, they need to be supported in capacity development on blended flour standards, processing, and marketing. Other relevant support to them could include subsidies on equipment, low-cost financing options, technical assistance, and food safety and risk awareness trainings.

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2 *Uji* flour is a mix of millet, sorghum, and several other crops, containing on average 30 percent millet.

Large millers are likely to be vital in the implementation process of the flour blending policy. Despite high potential gains from the new emerging market, millers are likely to be risk-averse and need to see value for their money before making investments to meet the demands of the new policy requirements. While the government pledges to provide subsidies and incentives to support the restructuring and upgrading of processing plants, millers are likely to be concerned about the long-term financial viability of blended flours. To mitigate this concern, a proof of concept is needed to demonstrate consumer acceptance and willingness to pay for blended flours, and whether premiums and market demand are large enough to induce millers to embed flour blending as a sustainable and profitable business.

Sorghum and millet appear to be among the better cereals for use in composite flour because of their predictable performance and compatibility with maize flour (Abdelghafor 2011), but availability may remain a concern for millers. Seasonal supply fluctuations and poor quality of grain may also pose challenges. Further, while sorghum and millet value chains are not well developed, smallholder value chains also behave in unpredictable ways (Orr 2018). There are some obvious reasons, like climatic events that lead to poor harvests, leaving smallholders with little to sell. For example, after poor rains in Eastern Kenya, only one-third of sorghum growers contracted by Smart Logistics for the sorghum beer value chain were willing to sell even part of their harvest (Orr 2018). Production of sorghum and millet for the new market could be scaled up by increasing their productivity through use of modern technologies and inputs, and allocation of more land for these crops, particularly in dryland regions of the country where other crops are less viable.

## **Demand for blended flours**

While blending maize flour with sorghum and millet will boost the nutritional value of *ugali*, the blended flour is, however, likely to come with a change in color, taste, texture, and cooking procedure. Two considerations would play a key role in determining wider consumer acceptance of composite flours. First, most Kenyans have strong preference for pure white maize *ugali* (stiff porridge) as their staple food. Some would even say that they have not eaten food unless they have had maize *ugali*. Current consumer attitudes and habits may thus create inertia among consumers, inducing them to continue favoring consumption of pure maize over blended flours (Webb and Byrd-Bredbenner 2015). Such consumer preferences may also limit proportions of sorghum and millet to be used in blended flours (Orr, Gierend, and Choudhary 2017), implying that

experimenting with blending formulation and pilot testing would be needed. Second, poor consumers may not be able to afford the relatively higher cost of blended flours.

Consumers make choices on what foods to eat based on their knowledge about nutrition and health benefits, their income, their conscious and unconscious preferences and motivation, and the price of food and availability (Sobal and Bisogni 2009). To increase consumption of blended flours, demand-side interventions may thus focus on changing relative prices or incomes or increasing consumer awareness of the nutrition and health benefits of target crops. Indeed, the flour blending strategy highlights the need for an elaborated plan for public awareness and image-building education to change consumer preferences, food habits, and perceptions to create enough demand for blended flours. However, this is easier said than done, especially for urban dwellers, the majority of whom have only known pure maize *ugali* and have never tasted *ugali* made of sorghum or millet flours. In addition, creating awareness to change consumer behavior at scale would require a huge investment.

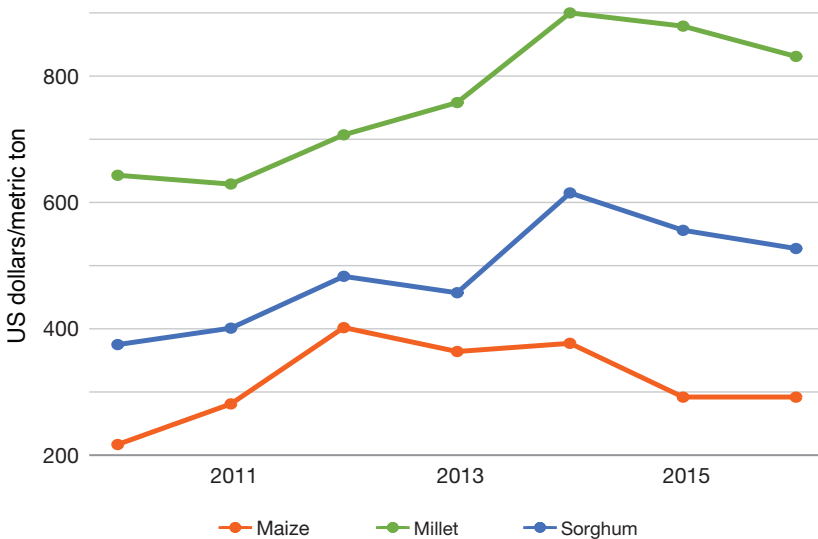
Behavioral change communications can improve consumers' nutrition knowledge. However, acquiring nutrition information is only one step on the impact pathway of changing dietary behaviors. New knowledge alone is rarely enough to bring about desired changes in consumer behavior and eating habits—creating the well-known intention–behavior gap (Axelson, Federline, and Brinberg 1985). The recipient of the new information must have the motivation, ability, and opportunity to process the new information. Thus, it remains a challenge to shift consumers from the mode of passive recipients of external information or victims of external influences to the mode of active role players to change their dietary patterns and behavior. It is important to address the *why* aspect of recommended behaviors, by explaining the mechanisms through which the consumption of sorghum and millet can lead to better nutrition and health outcomes (Schneider and Masters 2019). This calls for well-laid strategies based on comprehensive market analysis and understanding of consumer behavior to enhance awareness about blended flours (Melesse and van den Berg 2021).

Commonly, dietary behavioral change interventions have found it difficult to impact behavior at a large scale. Also, they give very little support to the emergence of food movements that address the underpinning cultural attitudes and beliefs around food and consumption to embrace new consumption patterns. New perspectives and modalities are likely to be required to enable behavioral changes at large scale (community or country), including changes in underlying structures and mindsets at multiple levels.

Working through social structures, networks, and groups can facilitate quicker scaling of nutrition messages and behavioral change. In this approach, great potential lies in mobilizing consumer groups that can provide a platform where local consumer knowledge and insights can be combined with scientific knowledge to identify levers and barriers for consumer behavioral change. For example, schools could be leverage points to promote demand for and consumption of blended flours, because children's eating habits can be shaped as future consumers and schools have high potential to be effective hubs for promoting and accelerating the diffusion of information to reach adults through children-to-parent communication. Leveraging the power of procurement at large institutions, such as schools, hospitals, universities, prisons, and early childhood centers, and in food aid for emergency situations and community-based feeding programs, can play a key role in creating both market and consumer acceptance for blended flours. Targeting religious groups and harnessing neighboring effects can also be an important entry point. Importantly, such efforts need to target actors who can play reinforcing roles in promoting consumption of nutrient-dense blended flours, including nutrition and cooking clubs, community leaders, teachers, extension officers, nurses and health officers, community health workers, local administrations, and farmer organizations.

Further, consumer behavior and choices are shaped not only by individual factors but also by the complex food environment and system drivers (HLPE 2017). The key elements of the food environment that influence consumer food acceptability and choices are physical and economic access to food (proximity and affordability), food promotion, advertising and information, policy, and food quality and safety. As a result, interventions aiming at behavioral change need to be supported by everyday prompts, including physical proximity, affordability, labeling, advertising, quality, and safety signals.

As much as preferences, economic costs are likely to be a decisive factor, because they determine whether consumers are willing and able to pay a premium for blended flour. Sorghum and millet grains are more expensive than maize grains. Currently, sorghum sells at a 15–20 percent price premium over maize, and finger millet sells at a premium of 20 percent over sorghum and 40 percent over maize (Gierend and Orr 2015; Orr, Mwema, and Mulinge 2017) (see Figure 16.4). This could be attributed to low production, which means policies and investments are needed to support increased production of millet and sorghum. The cost of blended flour could also be affected by whether milling costs are the same as for maize, and whether sorghum and millet yield flour at the same extraction rate and by-products have the same value as maize.

**FIGURE 16.4** Annual producer prices for crops in Kenya, 2010–2016

Source: FAOSTAT (2022).

Blended flours can be more expensive than the pure maize flour and hence receive little consumer support.

Further, market prices of blended flours may risk excluding poor urban households since they are dependent almost exclusively on the market for food and vulnerable to price increases. Thus, nutritional benefits may be felt mostly by high-income urban consumers who can buy commercially milled flours. On the other hand, it is important to recognize the unique position of farming households within the food value chain as both producers and consumers of food. While farmers may benefit through consumption of blended flours, the flour blending policy may raise grain and food prices in rural areas that traditionally have depended on sorghum and millet as staple foods. As a result, smallholder farmers may engage in selling the high-value crops (that is, sorghum and millet) and resort to lower-nutrition products for home consumption. This potentially creates trade-offs in rural vs. urban food security and nutrition goals. Thus, interventions that can benefit both producers and consumers are needed, such as increasing productivity and direct public investments in improving efficiency. Prices of sorghum and millet tend to remain relatively high because of scarcity. The policy could increase demand volumes to incentivize farmers

to increase production, which could bring prices down. Further decreases in prices may be achieved by addressing high input costs through selective subsidy schemes.

## **The political economy of flour blending**

Political economy is a critical factor that is not usually given proper consideration in food policy changes. Flour blending policy has been initiated as part of the Kenyan government's Big Four Agenda, which covers food security and nutrition, universal healthcare, affordable housing, and manufacturing. As it stands now, it has a strong policy push. The Big Four transformative projects are politically motivated, considered the current president's development blueprint. The previous government has pledged strong commitment to dedicating energy, time, and resources to ensure the success of the policy. As a result, the blending policy is as much a political as an economic policy, because commercial success is likely to be conditional on continued political support.

The strong dependence of the policy on what is effectively a partnership between government and business will make it vulnerable to policy changes. Additional complexity comes from the close links of business and politics in Kenya (Hornsby 2013) and the fact that priority-setting among policy objectives reflects the relative power of different ministries. The experience of the sorghum beer value chain in Kenya illustrates that conflicts between development and political objectives remain main sources of complexity and uncertainty in smallholder value chains (Orr 2018). In particular, political regime changes are a major source of uncertainty in developing countries.

Whether the blending policy will be supported and implemented as planned will depend on the level of support from the new administration. Signs are that agricultural policy may be leaning more toward maize production. In his inaugural speech, the president stopped consumption subsidies and announced maize production subsidies. Thus, the political economy around the blending policy is likely to be fraught with problems. Stakeholders may also remain skeptical of the stability of the current policy. As such, there is a need for appreciation on the part of policymakers of the complexity of the flour blending policy. The government needs to be realistic in its consideration of the policy so it can (1) integrate it into the national strategy and basic policies on agricultural production, agribusiness, incentives, regulations, and public communications and relations; (2) coordinate various ministries and agencies; and (3) allocate enough resources for the policy to succeed. Implementation of the flour blending policy needs robust support from county governments because

agriculture is a devolved function in Kenya and resource allocation is pegged to county resources and budgets.

Existing political economy structures and factors may also align incentives of food system actors against target crops and the flour blending policy. For instance, sorghum and millet are largely “orphan” crops with regard to the country’s dominantly maize-oriented extension system and public investment in agricultural development (Handschuh 2014), partly because drylands are less prioritized for maize production. Similarly, current arrangements and structures of grain markets are likely to work against sorghum and millet marketing since the prevailing market infrastructure and logistics in Kenya are set up primarily to accommodate the collection, processing, storage, and marketing of maize. Powerful, incumbent market actors (for example, maize importers and large millers) who are likely to lose some of their business may also lobby against the implementation of the policy and undermine political priorities and regulatory interventions. This may create lock-ins in the political economy. Engaging early with potential opposition or those who might lose from changes following the implementation of the flour blending policy may be a more effective strategy than simply pushing harder to scale the policy. This way, when the policy comes into play, it would not come as a shock and actors would not look for “work arounds.” In sum, it is important to underscore the need for careful consideration of political economy factors, power dynamics, incentive structures, and social and cultural norms in existing systems, analyzing how they might enable or hinder the success of the flour blending policy.

## Conclusions

Upcoming implementation of the national flour blending policy in Kenya is set to alter the food system landscape in the country and create a significant increase in demand for sorghum and millet. The policy seeks to create synergy between rural and urban development opportunities by linking urban consumption with rural agricultural production, prioritizing local markets and economic development. However, it remains to be seen who is going to benefit from the policy and which players along the value chain will adapt easily, and which others will be reluctant.

This chapter has applied a food systems perspective to analyze the flour blending policy, identifying knowledge gaps and challenges, as well as potential lock-ins and trade-offs, to inform strategic resource allocation and investments in the implementation of the policy. Our analysis reveals that a policy change of this sort deserves much more attention, and its success is likely to depend

critically on a coordinated response across the different domains of the food system. Overall, the proposed flour blending policy needs to be approached with caution and holistically from a food systems perspective, but also from a human-centered perspective.

The complex dynamics in food systems imply that the flour blending policy cannot usefully be scaled in isolation (Hambloch et al. 2022). Many constraints within the food system may interact and mutually reinforce each other, creating systemic lock-ins and trade-offs between outcomes of the policy (Conti, Zanello, and Hall 2021). This means that the flour blending policy would need to be accompanied by systemic complementary interventions across the various domains of the food system. Such systemic interventions must extend beyond addressing technological and economic constraints to consider institutional, sociocultural, and political factors. Notably, proactive and coordinated interventions will be needed in the production, market, and policy arenas to continuously mitigate undesirable effects and potential trade-offs to ensure the success of the proposed flour blending policy.

Overall, achieving the goals of the proposed flour blending policy is likely to require a substantial shift in policy, and complementary changes and incentives in several thematic areas, including (1) technology choices, (2) institutions, policies, and incentives, (3) individual preferences, attitudes, and cultures, (4) power and political economy, (5) infrastructure, and (6) research and innovation priorities. This chapter has highlighted a range of potential interventions at various nodes of the food system, including addressing limited access to quality seeds of target crops; reorienting the current extension system to include and serve these crops; building capacity of aggregation systems and farmer organizations for collective action; locating processors near high-production areas of the target crops; and promoting the crops to create demand through consumer campaigns and targeting public procurement for blended flour (for example, for schools, hospitals, the military, and food aid).

Further, while the government is the main driving force, we should not overlook the roles of other stakeholders in navigating the complexity of this national flour blending policy. For example, ICRISAT, a global agricultural development research organization with sorghum and millet among its mandate crops, can help here to provide technology to help smallholders better respond to this opportunity. It can also provide systems research insights and tools to help better engage with and prepare for the complex, interrelated, and unpredictable nature of emerging opportunities in food systems.

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