



Sustainability of the agri-food supply chain amidst the pandemic: Diversification, local input production, and consumer behavior

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1. Introduction

The emergence, spread, and unprecedented impacts of COVID-19 provide opportunities for devising lasting solutions for alleviating human suffering. The pandemic has halted economic growth, reversed progress towards realizing the different sustainable development goals and induced human physical and mental suffering. As clearly put by [Bhavani and Gopinath \(2020, p. 881\)](#), the global spread of coronavirus should serve as a wake-up call for “humanity to reflect, rethink and redesign food systems that are safe, healthy, sustainable, and beneficial to all.” Although this statement is applicable across nations, it is particularly relevant to “developing” countries where agriculture is the primary economic activity.

The pandemic has exposed underlying inefficiencies and vulnerabilities in global supply chains (Leach et al., 2021). First, food loss and waste occasioned by restricted movement, lockdowns, and border closure are a danger to the environment (FAO, 2020; UNEP, 2020). Second, the pandemic struck at a time when 690 million people go to bed hungry each day with about 740 million, being food insecure and 2 billion people not having regular access to safe, nutritious, and sufficient food. The projections show that if this trend continues, the number of people who go to bed hungry will increase to 840 million in 2030. It also estimates that the pandemic will add 83–132 million undernourished people in the world in, 2020, depending on the economic crisis scenario (FAO, IFAD, UNICEF, WFP and WHO, 2020). Unfortunately, developing countries, especially in sub-Saharan Africa, shoulder much of the food insecurity and malnutrition burden (Akombi et al., 2017). Furthermore, sub-Saharan Africa countries have high poverty levels, and, therefore, the COVID-19 containment measures were expected to worsen the situation (Ayanlade and Radeny, 2020). Finally, the impacts were expected to be dire in the agriculture sector due to the double tragedy of climate change and overreliance on global supply chains for input and food imports (Nchanji and Lutomia, 2021a; Shimeles et al., 2018). Such challenges and situations offer important lessons for thinking strategies for developing resilient and sustainable food systems now and in the future.

The pandemic impacts have also catalyzed discussions around sustainability discourse, with much attention paid to enabling developing countries to upend the deteriorating situations. The mainstream definition of sustainability in agri-food chains encompasses systems that safeguard and generate economic, social, and environmental outcomes for present and future generations (FAO, 2018). This indicates that sustainability is a multi-dimensional concept. However, Schmitt et al. (2016) note that this definition is rigid and does not provide a definitive understanding of sustainability in the context of dynamic agri-food chains. For this reason, sustainability should comprise a variety of concepts to accommodate the dynamic and complex nature of food systems.

In this regard, Schmitt et al. (2016) highlighted sustainability attributes to be assessed based on a set of indicators. The attributes and indicators are expected to be adapted on a case-by-case basis, relevance, analytical soundness, based on a phenomenon, measurability, country, and relatedness. It is in line with these arguments that the sustainability definition is expanded to capture health and ethical dimensions (Schmitt et al., 2016).

Economic sustainability attributes include affordability, value-addition, economic development, efficiency, and resilience. Environmental sustainability in agri-food systems captures pollution, resource use, biodiversity management, food loss, waste, and consumer behavior, while social sustainability encompasses producer-consumer interactions and relationships, food security, and labor (Schmitt et al., 2016). On the other hand, the health dimension comprises food safety and food quality/nutrition, and ethical sustainability concerns animal welfare in terms of feeding and health.

This chapter shows how sustainability in agri-food supply chains has been hampered or enhanced during the pandemic. We demonstrate this by applying pathways that producers and consumers in sub-Saharan Africa pursued during the pandemic, as Schmitt et al. (2016) argued. The chapter focuses primarily on two Sub-regions in sub-Saharan Africa: Eastern and Southern Africa. The data used are drawn from a survey conducted by the International Centre for Tropical Agriculture in collaboration with National agricultural research partners in nine countries. Six countries in Eastern Africa countries; Burundi, Democratic Republic of Congo (DRC), Ethiopia, Kenya, Tanzania, and Uganda, and three countries in Southern Africa; Malawi, Zambia, and Zimbabwe. Because of small samples per country and acknowledgment that they are not representational of the status of agri-food systems' sustainability in the focus countries, we classify them as cases and present them under different sustainability themes: localized input supply and food system sustainability, diversification and Resilience, and consumer behavior.



2. Case description

2.1 Diversification and resilience

Sustainability is achieved when food chains are resilient to disruptions generated by external forces, including pandemics and business cycles. This underlines the relationship between sustainability and resilience, concepts that are critical in supply chain management with or without crises (Edgeman and Wu, 2016). Marchese et al. (2018) observed that resilience and sustainability are related in different ways because one is a component of another; that is, they influence each other (Fahimnia et al., 2019), and they both play critical roles in supply chains (Negri et al., 2021). The first form of relationship depicts sustainability as a process that leads to resilience as the ultimate goal of supply chain management (Marchese et al., 2018). The second type of association between the two terms is that resilience is

the precursor for fulfilling the sustainability goal of supply chains. The supply chain is considered sustainable in the second form when its activities are resilient or less vulnerable to disruptive events. Taking these relationships into account, resilience as one of the attributes in assessing the economic pillar of sustainability.

The inseparable relationship between resilience and sustainability has been strengthened by recent findings by [Snow et al. \(2021\)](#) in an agri-food study done in New Zealand and Australia. The study found evidence that the high resilience of agri-food systems to the impacts of the ongoing global coronavirus pandemic was driven by social, economic, and environmental subsystems. First, social and cultural interactions catalyzed rapid acceptance, adoption, and adaptation to “a new normal and realities” regarding adherence to coronavirus containment protocols. Second, the agricultural industries’ agility and other actors’ ability to align value chain activities to new realities significantly minimized losses and uncertainties ([Snow et al., 2021](#)). Third, the agricultural industries assimilated losses and disruptions in both input and output markets through product diversification and short supply chains, creating business cases for local manufacturing and value addition, which had positive implications on environmental, health, and economic pillars of sustainability. Furthermore, [Snow et al. \(2021\)](#) link the resilience of rural food systems to the impacts of COVID-19 containment measures on the innovative capacity of rural communities in the two countries. Thus, resilience and sustainability are inseparable constructs in the context of the ongoing pandemic because their attributes are premised on actions that reduce the effects of external disruptions on food supply chains.

In light of disruptions occasioned by COVID-19 in most developing countries, the FAO suggested strategies for reducing food loss and waste. Among these strategies was food processing in rural agricultural communities for perishable food products such as vegetables, fruits, and milk ([FAO, 2020](#)). Localized production, food processing, and consumption of perishable food not only contribute to social sustainability (food security) but also to environmental (minimizes greenhouse gas emission) and economic (minimizes food and income losses) sustainability ([Audsley et al., 2010](#); [Mbow et al., 2019](#); [Shukla et al., 2019](#); [Nchanji et al., 2021a,b](#); [Michalský and Hooda, 2015](#)). These observations are reinforced by an illustrative case study in Southern and Eastern Africa.

In [Table 1](#), livestock production activities of 275 out of 351 (78%) livestock-keeping households in Eastern and Southern Africa were not

Table 1 Number and percentage of livestock producers that were affected by COVID-19 by Sub-region.

Affected	Eastern	Southern	Total
No	189	86	275
Percent	85.52	66.15	78.35
Yes	32	44	76
Percent	14.48	33.85	21.65
Total	221	130	351
Percent	100	100	100

Table 2 Frequencies and percentages of the status of the impact of coronavirus on livestock production, depending on farm level processing of livestock products

	Milk	Butter	Yogurt	Cheese	Meat
Not affected (freq.)	144	48	26	26	170
Percent	87.8	100	100	66.67	73.91
Affected (freq.)	20	0	0	13	60
Percent	12.2	0	0	33.33	26.09

disrupted by the spread of coronavirus. However, the distribution of those who were affected by the pandemic was unevenly skewed in Southern Africa. In other words, a significantly higher percentage of livestock rearing households that were affected were located in Southern Africa (34%) than in Eastern Africa (14%). This finding suggests that major spatial aspects underpin differentiated impacts of the pandemic. Besides geography influencing the spread and magnitude of the effect of coronavirus, [Bański et al. \(2021\)](#) posit that socioeconomic conditioning determines the severity of impacts of the pandemic. Furthermore, as earlier stated by [Snow et al. \(2021\)](#), a high level of ingenuity among local communities precipitated the resilience of New Zealand and the Australian agriculture sector to coronavirus disruptions. These findings could also explain the distributional effects of the COVID-19 on livestock owners in Southern and Eastern Africa.

The results presented in [Table 2](#) shows that all (100%) of milk producers that had butter and yogurt as processed products reported no disruptions of livestock production activities during the pandemic. This indicates that the

number of farmers affected by the pandemic was associated with the value addition of milk. Farmers who were already processing milk into different food products or those that made immediate changes in farm-level milk processing reduced their exposure to the effects of COVID-29 and containment measures. These results demonstrate the integral role of processing in creating, delivering, and safeguarding the resilience and sustainability of the food supply. Processing extends the shelf-life of perishable food products, which helps bridge production and consumption gaps (Knorr et al., 2020) created when supply chains are disrupted by emergencies of higher magnitude, such as the current pandemic.

Unlike butter and yogurt, cheese processing is relatively expensive and possibly more affected by disruptions, as shown in Table 1. Cheese production relies heavily on the market for the supply of processing technology. The technology is sophisticated and unaffordable to most farmers. With COVID-19 restrictions, milk producers found it challenging to access cheese processing machinery and materials, explaining why about one-third of cheese processors reported that they were affected by the pandemic. Furthermore, as reported elsewhere, the pandemic disrupted labor supplies as governments issued stay-at-home orders, social distancing, and banned social gatherings (OECD, 2020). Cheese processing requires technical skills, and farmers possibly faced challenges accessing labor.

Furthermore, 12% and 26% of milk and meat producers were also affected by the pandemic. This could be explained by mobility challenges that prevented the timely delivery of perishable food products to markets. These results underline processing as a crucial source of resilience to delivery disruptions, an important attribute for sustainable supply chains.

Furthermore, Béné (2020) identified several pathways for building the resilience of the local food system in the context of COVID-19 shocks. Among the pathways is diversification which the authors define as the ingenuity or ability of value chain actors to make changes to a set of food products they sell in the market. Diversification is potent for the local food system's resilience to the effects of the pandemic. Food processing as a form of product diversification reduces supply chain disruptions, helping mitigate the effects of disruptions on economic, social, and environmental outcomes of agri-food chains (Béné, 2020). Results presented in Fig. 1 corroborate these observations. First, the results show that farmers in Eastern Africa had a diverse portfolio of processed livestock products than those in Southern Africa. For example, the percentage (27%) of farmers who processed milk into butter, cheese, and yogurt in Eastern Africa was significantly higher than in

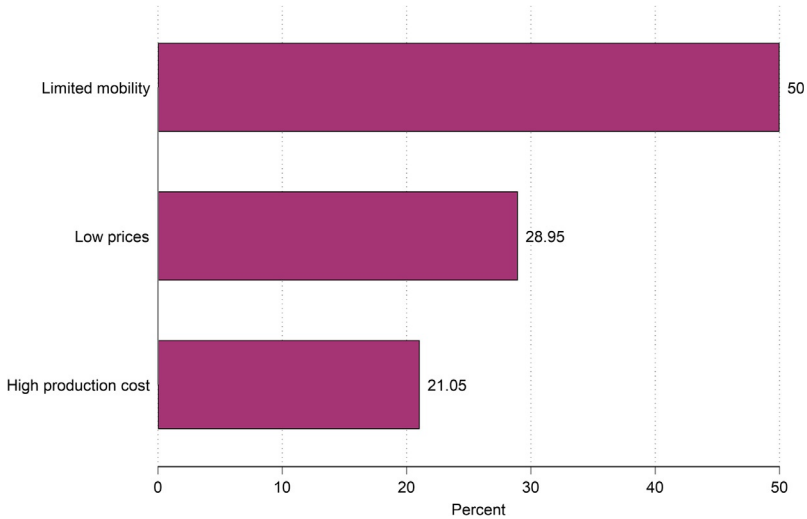


Fig. 1 Diversity of livestock products during the pandemic, depending on the different Sub-region.

Southern Africa (Fig. 1). Second, most farmers in Eastern Africa had milk as one of the livestock products, suggesting one reason they had diverse processed products. Product diversification thus created resilience capacities for dairy systems.

2.2 Localized input supply and food system sustainability

The outbreak and spread of COVID-19 and the unprecedented restrictions to curb infections disrupted the provision of essential farm inputs across the globe. Sub-Saharan Africa countries largely depended on farm inputs and machinery imports and were expected to be affected by the pandemic (Nchanji and Lutomia, 2021a). Nchanji and Lutomia (2021a, b) reported challenges accessing seed and fertilizer as some of the consequences of lockdowns and other COVID-19 containment measures in Sub-Saharan Africa. In another study, Nchanji and Lutomia (2021b) affirmed that localized access to seed strengthened the resilience capacity of supply chains to the effects of the pandemic. Bean farmers that used seed sources from local areas were less affected by the pandemic than those that relied on certified seed. Dolgui et al. (2020) and Ivanov et al. (2014) observed that supply chain disruptions caused material delivery delays and shortages which have ripple effects on production and other downstream activities. Here, aggregated

data collected from nine countries in Eastern and Southern Africa is used to demonstrate the potential role of localized access to inputs on sustainable livestock production.

Before showing how localized access to inputs is associated with resilience to disruptive external forces, the effects of the pandemic as identified by livestock producers are provided. Half of the livestock keepers affected by the pandemic reported limited mobility (transportation and movement challenges) as the leading disrupters of production activities (Fig. 2). On the other hand, 28% and 21% of affected livestock farmers reported low prices of livestock products resulting from low demand, disrupted people's movements, and a supply glut in the production hubs. At the Sub-region level, the mobility challenge was more profound in Southern Africa, while farmers in Eastern Africa identified high production costs and low prices as the main challenges (Fig. 3). Producers in Eastern Africa who reported high production costs and low prices were significantly higher than Southern Africa. This is expected because of a wide portfolio of processed products in Eastern Africa. Low demand for raw products—milk—could have motivated processing to increase shelf-life due to low demand and oversupply in local markets resulting from movement restrictions. In contrast, significantly higher percentages of producers in Southern Africa than in Eastern Africa reported movement challenges.

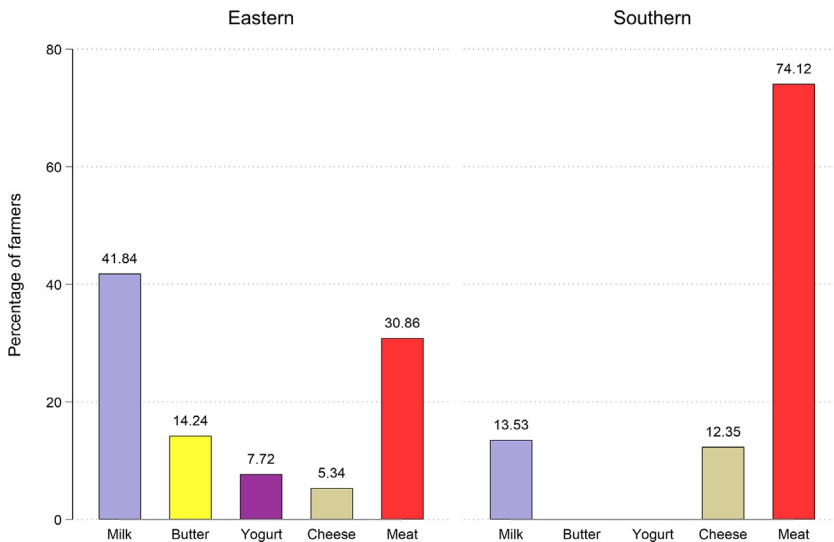


Fig. 2 Main livestock production-related effects of COVID-19 in Eastern and Southern Africa.

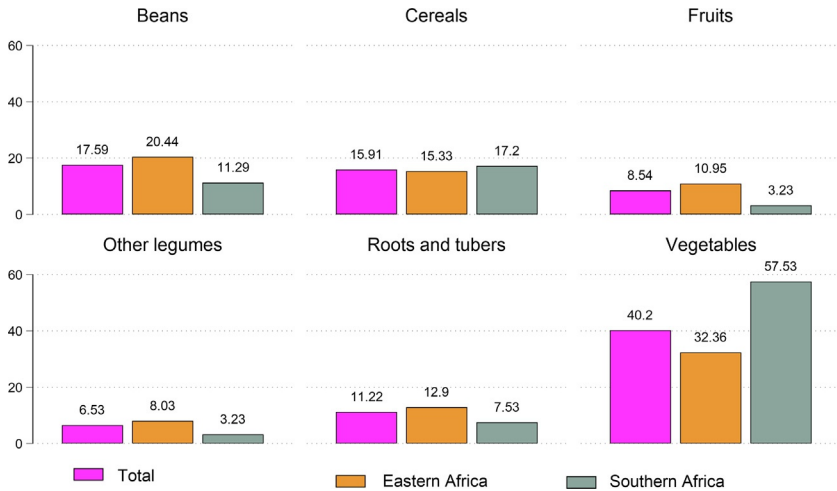


Fig. 3 Percentages of distribution of effects of COVID-19 on livestock production by Sub-region.

Notably, limited mobility, low prices, and high production cost directly affected public transportation, which disrupted access to input and output markets. For this reason, short supply chains, as recommended by [Nchanji and Lutomia \(2021b\)](#) using the same data, could also explain the significant differences in the number of affected farmers in the two sub-regions. Findings presented in [Table 3](#) show more diverse sources of fodder in Eastern Africa than in Southern Africa. Except for stover, percentages of farmers in Eastern Africa that obtained commercial feed and fodder from diverse sources were higher than those in Southern Africa. This could be a possible reason why farmers in Eastern Africa were less affected by the pandemic. Therefore, the experiences of farmers during the pandemic show that diversity in access to inputs increases the resilience and sustainability of supplies during precarious periods.

[Pan et al. \(2020\)](#) posited that the livestock industry has long industrial chains and is characterized by large feeding volumes. Therefore, it was inevitable that measures taken by governments to combat the pandemic would seriously upend the livestock industry. The results in [Table 3](#) suggest that localized access to inputs, including on-farm production of improved fodder, can increase the diversity of livestock products ([Table 2](#)) and reduce farmers' reliance on livestock industry input supply chains. Thus, multiple access to animal feed reduced farmers' vulnerability to external pandemic-induced shocks such as feed shortages and high input costs. In addition,

Table 3 Frequencies and percentages of multiple responses of feed sources disaggregated by Sub-region

Feed source	Eastern	Southern	Total
Grows improved fodder	47	0	47
Percent	10.31	0	6.7
Crop residue	169	84	253
Percent	37.06	34.29	36.09
Modern animal feed	22	2	24
Percent	4.82	0.82	3.42
Grass from bush/forest	121	90	211
Percent	26.54	36.73	30.1
Stover	97	69	166
Percent	21.27	28.16	23.68
Total	456	245	701
Percent	100	100	100

diversification of feed sources suggests developing short supply chains for livestock inputs, reducing the environmental footprint associated with long livestock supply chains.



3. Consumer behavior

The environmental pillar of sustainability encompasses several attributes. The most discussed environmental attribute in food systems literature is pollution in terms of both negative and positive externalities of food production, distribution, and consumption. Another attribute is supply chain inefficiencies such as food losses and waste which are environmental hazards. The third attribute is consumer behavior, often taken as customer actions with direct or indirect connections with environmental outcomes. Besides being an environmental sustainability attribute classified, consumer behavior can also be an attribute of health and social pillars of sustainability. [Kneafsey et al. \(2013\)](#) argue that consumers' food purchasing behavior is motivated by myriad reasons, including health and food quality consciousness, environmental concerns, and economic and social justifications in

support of local farmers. To this effect, several studies have demonstrated the connection between consumer behavior and the four sustainability pillars.

The pandemic has halted progress towards environmental sustainability due to concerns about reusable food packaging material, safety and hygiene during the pandemic period. Consumers' fear and concerns for getting infected by coronavirus by touching surfaces and objects resulted in the rising use of non-reusable plastic and lifting the ban on single-use plastics in countries that had made progress towards a sustainable food supply chain (Boyact-Gündüz et al., 2021; Menjivar, 2021). Sreeenonchai and Arunrat (2021) explain how consumer behavior contributed to food security during the pandemic periods in Thailand through case studies. Mobilization by village leaders in a village in Khon Kaen province enabled households to survive the pandemic without relying on external food support. Through the support of the development foundation, the village leaders encouraged farmers to plant rice and vegetable organically; this changed consumer behavior leading to the establishment of food banks. In Thailand, two ethnic group leaders coordinated the exchange of fish and rice even before the coronavirus outbreak. These lasting relationships between the two ethnic groups created self-reliance, encouraged food safety, social interactions, excluded middlemen, which contributed to the fulfillment of four pillars of sustainability during the pandemic period (Sreeenonchai and Arunrat, 2021). These are just cases that demonstrate connections of agri-food chain sustainability pillars precipitated by changes in behaviors.

Gardening is considered a form of consumer behavior because of the varied reasons why urban and peri-urban consumers utilize open spaces and home gardens. Unlike rural households that own and access land primarily for agricultural purposes, households in inner cities and urban fringes utilize land for varied reasons. For instance, Lautenschlager and Smith (2007) found that urban dwellers' participation in home gardening was motivated by their concerns about the future of the environment. Kiesling and Manning (2010), Scott et al. (2015), and Soga et al. (2017) identified connection with nature, need to stay healthy physically and mentally, and enhancement of image and aesthetic value as some of the reasons for home gardening. Uhlmann et al. (2018) report the need for food, social connections, and economic motivations for urban gardening. These reasons depict gardening in cities and peri-urban areas as drivers of sustainability.

Pandemic-induced effects of stay-at-home, work-from-home, movement restrictions and social distancing are new realities in urban areas. Together with resultant job losses and closure of food markets, the measures

have caused changes in consumer behavior. In times of economic uncertainty, urban households have been compelled to change income sources and food sources to secure their livelihood. Data collected from urban and peri-urban consumers in Eastern Africa is used to illustrate this behavior.

In Table 4, consumers owned home gardens for three main reasons; reduce the financial burden on food and for cash income (economic sustainability), provision of fresh and safe food, and social connection (social and health sustainability), and healthy lifestyle (health sustainability). As a result of the pandemic, consumers changed the sizes of home gardens as they were more concerned about food safety (need for fresh and healthy foods), supplementing food supplies, reducing the financial burden on food, and earning income. The changes in consumer behavior could have been

Table 4 Frequencies and percentages of multiple responses of reasons why urban and peri-urban consumers own home gardens

Reason	Total		Eastern		Southern	
	Freq.	%	Freq.	%	Freq.	%
Before the pandemic						
Reduce financial burden on foods	209	42.3	109	36.2	100	51.8
Fresh and healthy foods	172	34.8	115	38.2	57	29.5
Bring in cash income	53	10.7	38	12.6	15	7.77
Healthy lifestyle, leisure and recreation	31	6.28	20	6.64	11	5.7
Social bonding within the community	17	3.44	12	3.99	5	2.59
Aesthetic value	8	1.62	6	1.99	3	1.55
Environmental sustainability approach	4	0.81	1	0.33	2	1.04
Before pandemic						
Change in garden size during the pandemic						
Fresh and healthy foods	48	28.6	33	35.1	15	20.3
Supplement food supply	46	27.4	19	20.2	27	36.5
Reduce financial burden on food	36	21.4	20	21.3	16	21.6
Bring in cash income	17	10.1	9	9.57	8	10.8
Healthy lifestyle, leisure and recreation	9	5.36	5	5.32	4	5.41
Social bonding within the community	9	5.36	5	5.32	4	5.41
Environmental sustainability approach	3	1.79	3	3.19		

informed by disruptions of food supply from production hubs due to transport restrictions and the closure of food markets. These disruptions caused limited economic access to food and compromised food safety due to delayed delivery of perishable food products. For these reasons, home gardening contributed to sustainable urban food systems during the pandemic.

However, owning and utilizing home gardens in urban areas is necessary but insufficient for sustainable consumption. Galanakis et al. (2021) predicted that plant-based meat alternative innovations are nascent developments that will inevitably transform the food sector in the near future. In fact, COVID-19 is a wake-up call for expedited changes in consumer behavior regarding the consumption of plant-based meat alternatives. Pulses are important plant-based meat alternatives capable of bridging the impact of COVID-19 on urban food security. However, food banks in urban areas may not be sufficient or accessible to poor populations during the pandemic because of the closure of informal markets and hoarding. This challenge could be overcome by encouraging bean production in urban areas, which, besides contributing to environmental sustainability by reducing inorganic fertilizer use via natural nitrogen fixation (Jensen et al., 2012), could increase plant-based meat alternatives in urban areas. Fig. 4 shows that the common bean was the second most grown crop in urban and peri-urban

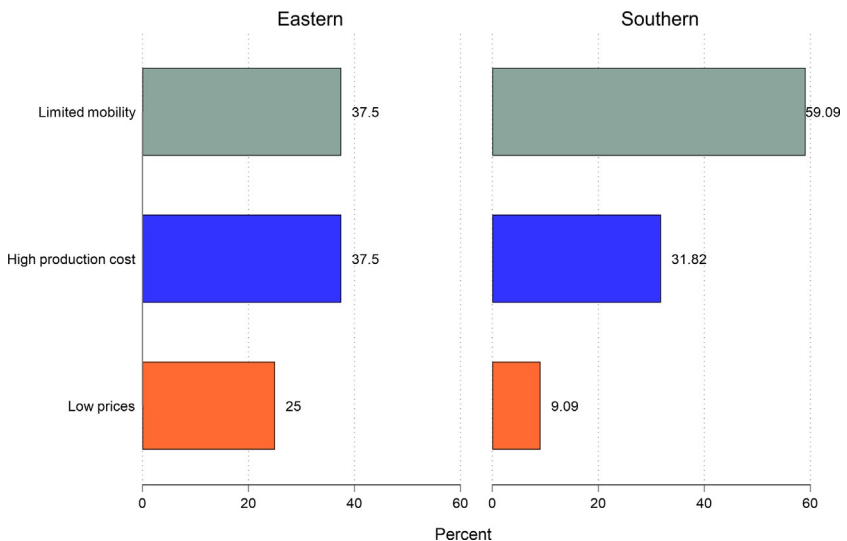


Fig. 4 Percentage of crops under urban and peri-urban home gardens.

Table 5 Comparison of frequencies of bean consumption before and during COVID-19 by Sub-region.

Frequency	Eastern (N = 307)		Southern (N = 158)	
	Before	During	Before	During
Once	19.22	15.64	54.43	56.33
Twice	23.78	24.76	28.48	27.22
Thrice	17.59	18.57	10.76	9.49
More than thrice	39.41	41.04	6.33	6.96

areas in Eastern and Southern Africa, suggesting the possibilities of shifting towards sustainable urban production and consumption.

The effect of home gardening on sustainable consumption of plant-based meat alternatives was evident in Eastern Africa than in Southern Africa. This finding explains why urban households in Southern Africa were relatively worse-off in food security as reported by [Nchanji and Lutomia \(2021a\)](#). In [Table 5](#), the percentages of urban households that consumed beans twice, thrice, and more than three times per week during the pandemic increased by between 1 and 2% from their pre-pandemic frequencies of bean consumption. In contrast, the percentages of consumers in Southern Africa that ate beans once, twice, thrice or more than three times per week reduced by between 1 and 2%. These results could be linked to more farmers in Eastern Africa growing beans than those in Southern Africa ([Fig. 4](#)). Thus, the results reveal that the pandemic somehow enhanced the transition of urban food systems into sustainable consumption in Eastern Africa.



4. Discussions

The first case presented in this chapter emphasizes the diversification of food products as a strategy for sustainable agri-food supply chains. Diversification involves the transformation of food products into storable, longer shelf-life products. As illustrated in the first case study, the diversification pathway towards sustainable food systems can emerge in three ways. First, food processing is central to eliminating food loss and waste resulting from disruptions of the supply chain. Second, this eliminates post-harvest inefficiencies and delivers environmental sustainability. Furthermore, food processing increases the competitiveness of local food systems, making them perform

strongly amid supply chain disruptions. Competitive food systems guarantee reliable markets, stable prices, and higher profits for producers, resulting in economic sustainability. Third, food processing, especially during precarious times like pandemics or natural disasters, improves access, availability, stability, and utilization of safe and nutritious food, leading to the achievement of health and social pillars of sustainable agri-food systems. Therefore, diversification of food products through farm-level processing during crisis empowers producers and consumers by sustaining access to food products at a low environmental cost.

In the second case, local production of inputs delivered resilience to the effects of COVID-19 on livestock production. Feed production at the local level reduces reliance on long supply chains that are often shaken by crises. On-farm feed production, besides ensuring the stable supply of feed, also reduces livestock production-related greenhouse emissions. The industrial processing of feed is a major generator of emissions into the atmosphere and the highest contributor to carbon emission through the transportation of finished inputs. In addition, feeds account for more than half of the total cost of dairy production cost. Therefore, on-farm production of feed is a cost-saving strategy that reduces the utilization of expensive commercial inputs. Cost efficiency is an important strategy for ensuring higher economic returns for farmers and affordable prices of dairy products. Thus, besides environmental benefits, the local production of diverse feeds helps in realizing economic sustainability. These benefits are more relevant during pandemics when livestock supply chains are disrupted.

The third case uncovers the crucial role of consumer behavior in the development of sustainable agri-food systems. The findings reveal that sustainable consumer behavior during pandemics goes beyond responsible consumption. Instead, consumers need to rethink and devise consumption models that alleviate the food consumption-related effects of the pandemics and increase the availability and consumption of alternative products with social, economic, health, and environmental impacts. Lasting solutions to sustainable urban food systems depends on consumers engaging in activities that develop resilient and sustainable food systems. For instance, gardening improves consumption practices and contributes to a sustainable food supply. However, the pandemic's disproportionate effect on the supply of perishable food products and environmental concerns about agriculture provides an opportunity for consumers to adopt plant-based meat alternatives that adequately contribute to food and nutrition security while ensuring a low environmental footprint.



5. Conclusions and recommendations

Achieving sustainable agri-food supply chains in sub-Saharan Africa needs refocusing and attention drawn to product diversification through local processing of perishable food products. Second, local input production like animal feed can reduce the effect of supply chain disruption on production, distribution, and consumption. Third, consumer behavior is crucial to connecting sustainability pillars through a change in consumption models. Taken together, these conclusions imply that production and consumption should be shortened to ensure availability, accessibility, affordability, social connections, reduction in losses and waste, health and safety, as well as the reduction in emissions. In other words, short food supply chains have the potential of realizing the economic, environmental, health, and social pillars of agri-food chain sustainability.

In line with the conclusions, reducing farm-level food loss and waste should be prioritized during the pandemic. Interventions such as training in primary and secondary value addition and the introduction of improved and affordable food processing technologies are recommended. Local communities also need to be supported to establish food processing infrastructure. Second, the promotion of local production of inputs through financial support to farmers and public-private partnerships is recommended to shorten input supply chains. Lastly, gardening in cities and urban fringes should be reinvigorated to focus not only on food supply but also the introduction of crops with multiple benefits.

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