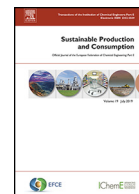




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# COVID-19 challenges to sustainable food production and consumption: Future lessons for food systems in eastern and southern Africa from a gender lens

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## ABSTRACT

Despite fears that sub-Saharan Africa would be severely impacted by COVID-19, the implications of the pandemic on sustainable production and consumption have not been studied in detail. Notwithstanding, implications vary depending on country, region, and strictness of coronavirus containment measures. Thus, the impact of COVID-19 on food and nutritional security was expected to be dire in sub-Saharan Africa because of its enormous reliance on global food systems. This article explored the implications of COVID-19 on sustainable production and consumption by focusing on common beans, vegetables, fish, and fruits produced and consumed in rural, peri-urban and urban areas. Two surveys were conducted to collect quantitative data from 619 producers in rural areas and 307 consumers from peri-urban and urban areas of ten Eastern and Southern African countries. Descriptive statistics (frequencies and percentages) and chi-square test for independence were used to analyse the data. The results show that the pandemic disrupted bean production and consumption across the two sub-regions. However, Southern African farmers and consumers were disproportionately more affected. While farmers in Eastern Africa reported input market challenges, those in Southern Africa identified challenges related to marketing farm produce. We also report that home gardening in urban and peri-urban areas enhanced urban food systems' resilience to the impacts of the pandemic on food security. The study argues that short food supply chains can sustain rural and urban livelihood against adverse effects of the pandemics and contribute towards sustainable production and consumption. Therefore, local input and food distribution models and inclusive institutional and legal support for urban agriculture are crucial drivers for reducing food and nutritional insecurity, poverty, and gender inequality. They are also critical to supporting sustainable production and consumption.

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## 1. Introduction

Globalization is central to the development of food systems but also a source of concern in terms of how value generated by food systems are sustainably shared among supply chain actors in different countries and regions. Specifically, the unprecedented disruptions of supply chains have been attributed to rapid globalization over the years. Although globalization has created global supply chains that have been engines of phenomenal economic growth in recent decades, it has not adequately addressed the associated environmental, social damages, and uncertainties that have periodically hampered supply efficiencies. For these reasons, alternative

models for food production and distribution that emphasize sustainability have been developed. Short food supply chains (SFSCs) are among several models developed to make food production and consumption sustainable in the face of rapid globalization. The SFSCs concept is generally and continuously accepted as crucial to achieving the triple sustainability pillars of social equity, economic development, and environmental protection (Bui et al., 2021). SFSCs converges the three pillars, allowing food systems to be efficient and competitive in terms of increased food production, distribution, and consumption. This model has multiplier effects on local economies, such as diversity of food products, job creation, minimized food losses and waste, limited rural-urban migration, and matched food production and consumption (Bui et al., 2021).

SFSCs are relevant today where food systems are under pressure due to the worldwide spread of COVID-19. The agri-food supply chains have been impacted by the pandemic, as highlighted in

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growing literature (World Bank, 2021b; Nchanji et al., 2021a). The effects were expected to be more pronounced in developing countries, especially in Sub-Saharan Africa, due to high dependency on agriculture and global agricultural supply chains (Sharma et al., 2020). From the supply side, COVID-19 containment measures have disrupted food exports, created farm labor shortages, and transport and logistic challenges, impacting production and supply of perishable commodities, including fresh vegetables, fruits, milk, fish, and meat (Lambert et al., 2021; Nchanji et al., 2021a). Farmers are also facing challenges accessing markets, resulting in food losses and waste (OECD, 2020). Farm production implications are interruptions of input supply, reduction in productivity, and low farm income. From the demand side, disruptions of agri-food supply chains have implications on the purchasing power of consumers, food availability, food prices, and food security and safety (Nchanji and Lutomia, 2021). Furthermore, job losses and reduced remittances were expected to reduce the purchasing power of poor households in sub-Saharan Africa, causing food shortages, limited access to food through high food prices, and exacerbation of the already dire food security situation in the region. Taken together, the impacts of COVID-19 have implications on economic, social, and environmental dimensions of sustainability which SFSCs can address.

The immediate impacts of COVID-19 and anticipated future effects of health and economic crises on global supply chains are a major highlight and justification for investing in sustainable supply chains that are resilient and adaptive to unprecedented global economic and health uncertainties. Despite the downsides of COVID-19, the pandemic has put supply chain sustainability in the spotlight (Karmaker et al., 2021). The pandemic offers lessons for rethinking current food supply models for sustainable transformation of the supply chain landscape in the long term. Central to supply chain transformations are sustainability considerations that would accrue benefits for both producers and consumers in developing countries. Besides enabling agricultural producers to access local input and output markets, SFSCs would reduce the negative footprint of long supply chains and generate significant economic outcomes (Hedwall, 2020). For consumers, SFSCs would increase access to food, check food prices during crises, and improve access to safer and quality food. Furthermore, SFSCs would emphasize the importance of local markets in shielding vulnerable groups of people and households from food insecurities resulting from government response to any future pandemic.

Past and recent literature demonstrate benefits of SFSCs in achieving the three pillars of sustainability during uncertain times (Babbitt et al., 2021; Trollman et al., 2021; Harapko, 2021; Jarzębowski et al., 2021). However, issues relating to gendered aspect of social sustainability are often ignored in literature; thus, the implications of COVID-19 on agri-food systems in developing regions from a sustainable perspective has not been studied in detail, a gap that is addressed in this study. Four research questions addressed in this article are: What were the immediate impacts of the COVID-19 pandemic on producers and urban and peri-urban consumers? How did the impacts differ spatially and socially? How sustainable were localized access to seed and home gardens in alleviating the impacts of the pandemic? What are the implications of SFSCs on the future attainment of three pillars of sustainability in developing countries?

We, therefore, contribute to SFSCs discourse by providing cross-cutting evidence of the potential role of SFSCs in ameliorating the ravaging effects of current and future pandemics in developing countries. The novelty of this study is fivefold. First, we expand the way SFSCs operate by focusing on how localized input production can contribute to sustainable production and consumption. Secondly, we emphasize that localized access to common bean seed would reduce environmental impacts generated by long input sup-

ply chains and environmental footprints associated with farm-level use of inputs. Thirdly, we provided empirical data on the role of urban agriculture during the pandemic and extended understanding of the social sustainability of SFSCs from a gender lens. Fourthly, we demonstrated the likely interdependencies between the three pillars of sustainability through the SFSC lens. Lastly, we provide implications of COVID-19 and SFSCs on the attainment of four SDGs (SDG 1- no poverty, 2 – zero hunger, 5 – gender equality, and 12 - responsible consumption and production).

The rest of the paper presents a theoretical framework for the study, methods used in data collection and analyses, a results and discussion section and a conclusion with policy implications that foster supply chain sustainability.

## 2. Theoretical framework

This study is anchored on four theoretical concepts; food security, food production and consumption, SFSCs, and sustainability. Food security literature abounds, and although the definition of the concept is often contextual, there is an agreement that food security is the availability and access to safe food of acceptable quantity and quality at all times for populations (Gibson, 2021). The concept is further expanded to food and nutrition security in acknowledgment that individuals or populations may still be undernourished despite being food sufficient. This is evidenced by higher growth in the prevalence of malnutrition than the prevalence of food insecurity in sub-Saharan Africa (FAO, 2020a).

The food and nutrition security concept depends on the second concept covered in this study: production and consumption. Production involves using combinations of resource factors and technology to produce marketable and consumable food products. Consumption is the use of food products in a manner that satisfies the needs of end-users. In both theoretical and empirical literature, food has to “travel” from “farm to fork”: Food goes through different stages to reach consumers (Jackson, 2014). The concentration of food production in specialized agro-ecological zones and rapid urbanization have increased the physical and social distance between producers and consumers. In other words, complex systems link production and consumption, and the interconnections among the links are not always straightforward because of physical distances. The stages include farming, manufacture and processing, transportation, and selling food products, collectively referred to as supply chains. The supply chains are complex and transcend national and regional borders, and the activities generate environmental penalties (Quijas & Balvanera, 2013). Furthermore, the distribution of benefits is not always socially and economically equal, which introduces the third concept of sustainability. Sustainability is the ability of food systems to economically, socially, and environmentally generate food and nutritional security without compromising the ability of the food systems to generate the same benefits for future generations (FAO, 2018). This study adopts this definition of sustainability.

However, given the complexity of production, distribution, and consumption behaviours, food production, and consumption create negative environmental externalities such as pollution, land, soil degradation, and waste. Food distribution from farms to markets generates additional environmental costs through transportation in form of greenhouse gases. Every stage between production and consumption generates food losses and waste, which complicates the efficiency of the food chain in delivery of healthy, safe, and quality food. The inefficiencies along food supply chains impact farm incomes, economic access and availability of food, and supply chains' resilience to uncertainties. Taken together, long food chains negatively impact economic, environmental, and social attributes of sustainability.

In recent decades, the SFSC concept has soared in the developed world as agri-food systems are under constant pressure of globalization. The concept responds to the desire to have sustainable food systems that align with producers' and consumers' benefits, national food policies, and sustainable development goals. Sustainability literature defines SFSCs as the reduction of physical distance between production and consumption via direct sales, local production and consumption, few intermediaries, and information exchange (Chiffolleau & Dourian, 2020). The concept involves re-configuration of supply chains and their activities for sustainability takeoff. SFSCs expands traditional food supply systems from its traditional role of food provisioning and economic returns to performances that capture social and environmental dimensions (Pagell & Wu, 2009). It recognizes that agri-food systems have to transform to ease social, economic, and environmental pressures resulting from increasing population, agglomeration, globalization, and deficiency of environmental resources.

Several studies have demonstrated multiple benefits of SFSCs. Mundler and Laughrea (2016) reported that SFSCs strengthen social capital, which, in turn, create new networks that engage producers and consumers, leading to rural and urban development. Economic benefits of SFSCs include redistribution of value-added, new employment opportunities, reduction of market risks, fair access to markets by both farmers and producers, wider income portfolio for farmers, product diversification, and better price setting mechanisms (Kneafsey et al., 2013). Small-and-medium-sized producers benefit more from SFSCs. At the same time, direct sales ensure food quality and traceability guarantees and adoption of best practices packaged as sustainable agriculture (Kiss et al., 2019). Some researchers also point out that SFSCs secures access to healthier food, encourages knowledge transfers, counters population migration pressure, and sustains food stores for smallholder farmers and markets (Falguieres et al., 2015; Aguiar et al., 2018; Maria et al., 2019). SFSCs shorten food distribution, reducing greenhouse gases from transportation. Thus, SFSCs contribute to social, economic, and environmental sustainability and are specifically relevant today due to disruptions of production and consumption caused by COVID-19.

### 2.1. COVID-19 and Food Security Threat in Sub-Saharan Africa

Even before COVID-19, a large share of the world population, especially in developing countries, was food insecure and malnourished. The outbreak of coronavirus in China in late 2019 and its unprecedented global spread has disrupted progress towards eliminating hunger. Despite some progress, the FAO global food security report states that many developing countries were not on track to eliminate hunger by 2030 (FAO, 2020a). The prevalence of undernourishment in the region was 22 percent of more than 234 million people, which is more than twice the world average prevalence rate. Thus, the major concern is that COVID-19 may worsen the already dire food security and nutrition problems in Sub-Saharan Africa. With dimming economic growth in 2020 and low growth prospects in 2021, it was feared that around 83 to 132 million people in developing countries would be undernourished due to the COVID-19 pandemic. However, this is not only linked to the existing high rates of food insecurity and undernutrition, but due to underlying drivers of vulnerability such as economic slowdown, climate extremes, poverty, and conflict (FAO, 2019).

The pandemic has disrupted agriculture and food systems in a complex number of ways. Border closures have hampered or slowed down the seed systems' ability to deliver seed on time. Lockdowns have caused low availability of inputs leading to high input prices (OECD, 2020; Nchanji and Lutomia, 2021). On the other hand, mobility restrictions have caused labor shortages, especially during the peak season of labor demand, such as plant-

ing and harvesting. Farm gate consequences of COVID-19 are transmitted downstream. FAO (2020b) notes that COVID-19 containment measures like lockdowns, transport restrictions, and blockages on transport routes disrupt linkages between food production and consumption hubs resulting in food systems inefficiencies in terms of increased food loss and waste. For instance, limited access to markets and food losses strain farm incomes, negatively affecting producers. Besides, agri-food chains have also experienced logistic challenges sourcing food from rural to urban areas. Most informal markets that poor and vulnerable people depend on for food supplies have been closed, affecting agri-businesses and urban households. Additionally, high food prices occasioned by logistic challenges and job losses due to the pandemic, have reduced urban households' purchasing power and economic access to food. These occurrences are points of concern about the pandemic's role in exacerbating food security and the nutritional situation in agriculture-dependent economies in Sub-Saharan Africa.

Therefore, addressing food security and nutritional implications of COVID-19 in Sub-Saharan Africa presents unique opportunities for strengthening the contribution of the agricultural sector to the achievement of sustainable development goals of no poverty (SDG 1), zero hunger (SDG 2), gender equality (SDG 5), and sustainable consumption and production (SDG 12). SFSCs are indispensable in enabling agriculture and food systems to respond to the immediate impacts of COVID-19 and building resilience to future pandemics and crises. Short input chains would substitute or reduce reliance on the global system to provide seed and fertilizer through localized input production. It would also change food trade components and structure to meet the evolving consumer demand for food. Central to the SFSCs agenda emphasizes that agriculture in sustaining food production and consumption and cushioning poor and vulnerable households from diverse pandemics, and leveraging the critical role of circular economy in sustainable development (Kiss et al., 2019). This brings to fore the importance of urban agriculture in sustainable food systems in Sub-Saharan Africa. Besides enabling city households to overcome short-term and long-term impacts of food security and nutrition crises, urban agriculture would significantly reduce greenhouse emissions through shortened agri-food chains (Altieri, 2019).

## 3. Methods and data

### 3.1. Area of study

Data used in this study were collected in Burundi, the Democratic Republic of Congo (DRC), Ethiopia, Kenya, Tanzania, and Uganda in Eastern Africa and Malawi, Mozambique, Zambia, and Zimbabwe in Southern Africa from May to July 2021. These countries are intensive bean production and marketing hubs in Africa under the Pan-Africa Bean Research Alliance (PABRA) program in Sub-Saharan Africa. Table 1 provides the locations of 10 countries in the region.

### 3.2. Data collection

Quantitative data were collected from rural farmers and urban and peri-urban consumers in ten countries in Eastern and Southern Africa. Questionnaires were developed by the PABRA and the National Agricultural Research Systems (NARS) in respective countries to collect data. The questionnaires are available online in the appended supplementary information sheet. Consultants were recruited to assist in data collection in areas that were inaccessible because of COVID-19 restrictions. The survey questions were designed using the Alchemer web survey application, previously known as Survey Gizmo. Links to the survey were generated and shared on social media platforms or email to respondents that

**Table 1**  
Sample sizes.

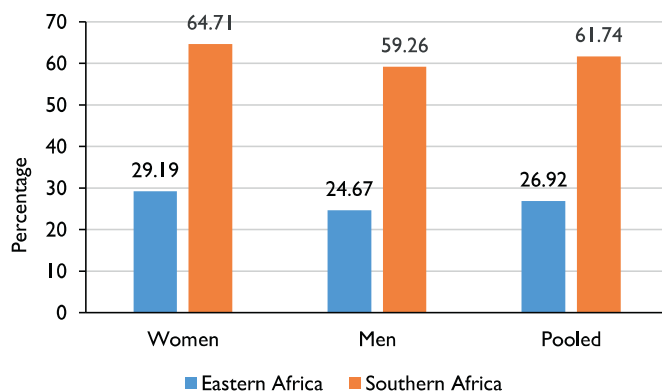
Sub-region	Country	Farmers	Consumers	Total
Eastern	Burundi	41	37	78
	DRC	42	45	87
	Ethiopia	37	35	72
	Kenya	41	35	76
	Tanzania	110	112	222
	Uganda	41	43	84
	<b>Total</b>		<b>312</b>	<b>307</b>
Southern	Malawi	37	34	71
	Mozambique	36	36	72
	Zambia	40	48	88
	Zimbabwe	36	40	76
	<b>Total</b>	<b>149</b>	<b>158</b>	<b>307</b>
Sample size		<b>461</b>	<b>465</b>	<b>926</b>

could not be physically reached. A click on the link directed respondents to survey questions in the Alchemer web application, where responses were entered and transmitted to the principal investigator and research assistants. Face-to-face administration of the survey was also done in strict adherence to government advisories where possible. Face-to-face interviews were carried out using the preloaded mobile-based questionnaire, and on completion, answers were uploaded into the Alchemer web application to obtain standard digital data. A total of 461 producers and 465 urban and peri-urban consumers completed the surveys. The sample sizes by country and region are provided in Table 1 above.

The producer survey established what crop farmers planted during the pandemic, types and sources of common bean seed they planted in the 2020 main season, COVID-19 impacts on bean production, digital platforms that farmers belonged to, access to markets, prices, and food consumption in terms of frequency and patterns of consumption. Besides, demographic information (age and sex) of producers was also collected. This information was used to answer three questions: "What were the immediate impacts of the COVID-19 pandemic on producers and urban and peri-urban consumers? How did the impacts differ spatially and socially? How sustainable were localized seed systems in alleviating the impacts of the pandemic? The consumer survey collected information about demographic characteristics of urban and peri-urban consumers, weekly bean and perishable food consumption patterns and frequencies during the pandemic, ownership of home gardens and crops planted, food production changes on home gardens during the pandemic, and rationale for changes, and sources of bean consumed. This information answered the question: How sustainable were home gardens in alleviating the impacts of the pandemic? Localized seed systems and home gardens questions were also designed to contribute answers to the question "what are the implications of SFSCs on future attainment of three pillars of sustainability in developing countries?"

### 3.3. Data analysis

The digital data were exported to Excel and Stata version 16 for statistical analysis. The data were then analysed with descriptive statistics because of the exploratory nature of the surveys. An exploratory analysis of the entire producer and consumer datasets was performed to observe how each variable was distributed. This step was crucial in understanding possible relationships among variables and identifying variables that would adequately answer the research questions. Exploratory data analysis involved the generation of frequency distributions and percentages of the answers to survey questions. The third step of data analysis involved data visualization of variables of interest to convey insights drawn from survey data. Contingency tables and bar plots were used to visualize fundamental relationships between variables in the dataset.



**Fig. 1.** Percentages of bean producers affected by COVID-19 by region and gender (women Chi-square = 36.59,  $p < 0.01$ ; men Chi-square = 36.86,  $p < 0.01$ ; pooled Chi-square = 72.89,  $p < 0.01$ ).

Non-parametric tests were used to highlight whether answers to survey questions exhibited systematic relationships. For instance, a chi-square test of independence was used to test whether the impacts of COVID-19 on bean production significantly differed spatially (by region) and socially (gender). Furthermore, the chi-square test of independence tested systematic relationships between seed sources and whether or not COVID-19 affected bean production and food consumption by country and region. The importance of the Chi-square test was to show the dependence of categorical features in datasets. Chi-square is parsimonious on the data and more appropriate to handle variables collected on nominal and ordinal scales (Mumby, 2002). Therefore, it is a robust test appropriate in analysing categorical (group) variables because it does not require equality of variances and homoscedasticity of data assumption like parametric tests (McHugh, 2013). It also provides considerable information allowing derivation of detailed information about the computed statistics. The working null hypothesis of chi-square tests performed was that the variables were independent, while alternative hypotheses were that the tested variables were not independent. Because of smaller samples collected in each country, the null hypothesis was tested at 90% confidence; that is,  $\alpha = 0.10$ .

## 4. Results

### 4.1. What were the Immediate Impacts of the COVID-19 pandemic on producers, and did the impacts differ spatially and socially?

The impact of COVID-19 on bean production for men and women farmers varied by country across the two sub-regions, as shown in Fig. 1. Bean production was significantly impacted by the pandemic in Southern Africa (62%) than in Eastern Africa (27%). At sub-region levels, no gender differences were found for producers that were affected by the pandemic. However, significantly higher proportions of women bean producers in Southern Africa (65%) than in Eastern Africa (29%) reported that bean production was affected by COVID-19. Similarly, the difference between the proportions of men bean producers in Southern (60%) and Eastern Africa (25%) was significantly different. These results reveal that the pandemic impacted bean production in Southern Africa more than in Eastern Africa. The pandemic could have exacerbated the already existing bottlenecks in Southern Africa than in Eastern Africa. For instance, even before the pandemic, agricultural production in most Southern Africa countries struggled with the ravaging effects of climate change.

Burundi producers' responses indicated that bean production was not affected by COVID-19; thus, they are excluded from the

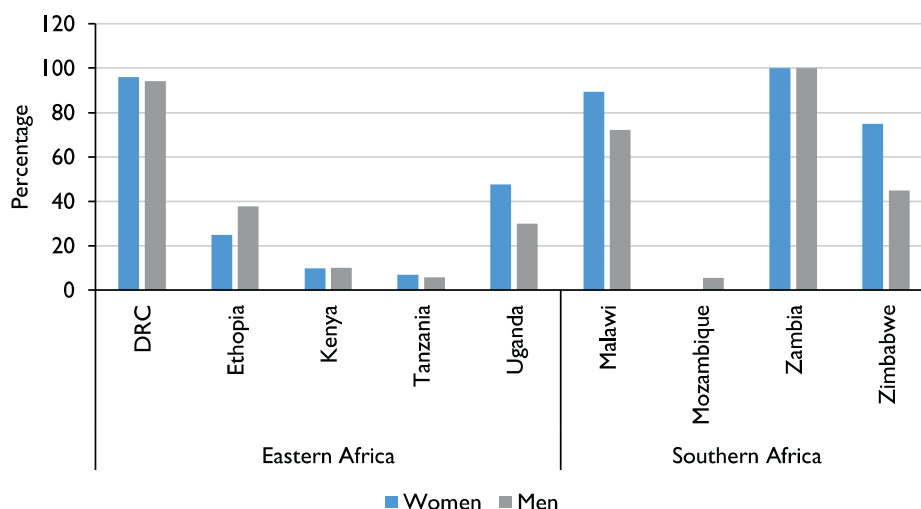


Fig. 2. Percentages of men and women bean producers that were affected by COVID-19 by country.

**Table 2**  
Regional comparison of percentages of challenges experienced by bean producers during the pandemic.

	Eastern Africa		Southern Africa		Chi-square
	Freq.	Percent	Freq.	Percent	
Seed unavailability	41	28.28	23	10.7	90.19***
Higher prices for inputs	22	15.17	26	12.09	
Agronomic/extension information	19	13.10	30	13.95	
High prices for hired labor	13	8.97	1	0.47	
Delay in planting	13	8.97	5	2.33	
Low price in the market	11	7.59	27	12.56	
Delayed harvest	8	5.52	1	0.47	
Lower demand in the market	7	4.83	29	13.49	
Fertilizer unavailability	5	3.45	4	1.86	
Transporting harvest challenges	4	2.76	50	23.26	
Difficult to access credit facilities	2	1.38	19	8.84	

\*\*\* p<0.01.

analysis. Fig. 2 displays percentages of men and women farmers that reported COVID-19 impact on bean production. The effect of the pandemic on bean production was higher in DRC than in other countries: About 94% of men and 96% of women DRC, Eastern Africa. A marginally significantly higher proportion of Ethiopian male households (38 %) than women households (25%) were affected by COVID-19. In Southern Africa, all surveyed households in Zambia were affected by the pandemic regardless of their gender.

Additionally, over seventy percent of men and women households were affected by the pandemic in Malawi. A marginally higher proportion (75%) of women bean farming households than men households (45%) in Zimbabwe were affected by the pandemic. Coronavirus outbreak struck most Southern African countries when farmers were preparing for a new cropping season or marketing the previous season’s produce. However, bean production was least affected in Kenya, Tanzania, and Mozambique. An explanation for this could be attributed to the fact that when the first cases of coronavirus were reported, crop production was already underway in these countries.

Affected farmers were further asked to identify challenges they experienced in bean production during the pandemic. The bean production challenges are presented in Table 2. The challenges significantly differed by region. While most Eastern Africa producers reported input market problems (seed unavailability and high labour prices), their counterparts in Southern Africa identified output market difficulties (transportation of bean output and lower demand in the market) as the main challenges experienced in bean production during the pandemic (Table 3). In other words, COVID-

19 containment had more significant disruptions on input supply systems in Eastern Africa than in Southern Africa. In contrast, bean products’ output market channels were most affected in Southern Africa than Eastern Africa. Furthermore, agricultural information exchange systems were also impacted by the pandemic across the two regions. Around 13 percent and 14 percent of Eastern and Southern Africa farmers reported challenges in accessing extension services. This highlights the crucial role of extension agents in providing technical information and advisory for sustainable crop production.

Furthermore, we provide a gender comparison of challenges experienced by men and women farmers in countries where there were significant differences in the impact of COVID-19 on bean production by seed type planted. The results presented in Table 3 show that COVID-19 had varying challenges to bean production across the countries, albeit the challenges were not significantly different for men and women producers. The number of challenges was higher in DRC than in Kenya and Ethiopia, explaining why COVID-19 impacted more DRC farmers than other Eastern Africa countries. According to both men and women producers in DRC, seed unavailability and higher input prices were the most critical consequences of COVID-19 on bean production. Seed unavailability possibly caused both men (10%) and women (11%) producers in DRC to delay planting. In Kenya, 60 percent of women farmers reported higher input and labour prices during the pandemic. High input prices could be attributed to disruptions to the input supply chain, which caused temporal unavailability of inputs, thereby pushing prices upwards. In addition, women are resource-

**Table 3**  
Percentages of challenges experienced by bean farmers during COVID-19 by gender.

	DRC			Ethiopia			Kenya		
	Women	Men	Chi-square	Women	Men	Chi-square	Women	Men	Chi-square
Seed unavailability	41.38	57.14	5.77			0.64			4.95
Higher prices for inputs	20.69	17.86					40.00		
High prices for hired labour	1.72				10.00		20.00	25.00	
Delay in planting	17.24	10.71							
Delayed harvest	8.62	7.14							
Low price in the market	5.17	3.57					20.00		
Fertilizer unavailability		3.57							25.00
Difficult to access credit facilities	1.72								
Lower demand in the market	1.72						20.00	25.00	
Difficulties accessing extension	1.72			100.00	90.00				
Transporting harvest challenges									25.00

**Table 4**  
Percentages of types of bean seed planted by the effect of the pandemic on bean production and country.

	Affected				Not affected				
	Certified	Mix	QDS	Saved	Certified	Mix	QDS	Saved	Chi-square
<b>Eastern Africa</b>									
Burundi	0.00	0.00	0.00	0.00	4.88	9.76	0.00	85.37	0.00
DRC	30.00	70.00	0.00	0.00	0.00	100.00	0.00	0.00	0.84
Ethiopia	17.65	41.18	0.00	41.18	5.00	5.00	0.00	90.00	10.16***
Kenya	50.00	25.00	0.00	25.00	37.84	0.00	0.00	62.16	10.24***
Tanzania	14.29	28.57	57.14	0.00	4.85	21.36	12.62	61.17	13.91***
Uganda	18.75	25.00	6.25	50.00	29.17	8.33	4.17	58.33	2.40
<b>Southern Africa</b>									
Malawi	20.00	6.67	0.00	73.33	14.29	28.57	0.00	57.14	2.83
Mozambique	0.00	0.00	0.00	100	0.00	3.33	0.00	96.67	0.03
Zambia	17.5	30.00	40.00	12.50	0.00	0.00	0.00	0.00	
Zimbabwe	47.62	52.38	0.00	0.00	40.00	60.00	0.00	0.00	0.21

\*\*\* p<0.01.

poor and have lower access to productive resources such as credit facilities for investment in bean production.

On the other hand, equal proportions of men producers in Kenya identified high input prices, fertilizer unavailability, lower demand in the market, and transportation of harvest to points of sale as the main bean production challenges caused by coronavirus. The results suggest differences in gender roles in bean production in Kenya as women appear to be more involved in production while men in marketing. In Ethiopia, farmers reported problems in accessing extension services.

#### 4.2. How sustainable were localized access to seed in alleviating the impacts of on bean production?

Table 4 presents percentages of types of seed planted by whether bean production was affected by the pandemic or not and country. The results show producers that planted certified seed or a mix of certified and saved seed across two sub-regions tended to be affected by COVID-19. In Eastern Africa, for instance, all farmers in DRC who reported that bean production had been affected planted certified seed (30%) and a mix of certified and saved seed (70%). Three-quarters of affected farmers in Kenya either used certified seed or a mix of certified and saved seed. Another important observation in Table 4 is that farmers not affected by the pandemic mostly used saved seed. For instance, 85 percent of Burundian farmers used saved seed, explaining why they all indicated that the pandemic did not affect their production activities. In addition, farmers were harvesting during this time.

On the other hand, several seed-type scenarios explained the pandemic's effect on households in Southern Africa. Both affected and non-affected farmers in Zimbabwe planted either certified seed or a mix of certified seed and saved seed. In Zambia, a majority (70%) of affected households used quality declared seed and a mix of saved seed and certified seed. In Malawi and Mozam-

bique, both affected and non-affected households used saved seed. Nonetheless, the impact of COVID-19 on bean production in Southern Africa did not significantly differ by type of seed planted. However, the impact of COVID-19 on bean production significantly differed by type of seed planted by surveyed farmers in Kenya, Ethiopia, and Tanzania. Furthermore, results presented in Table 2 suggest that farmers who depended on the market for seed supply were disproportionately affected by COVID-19 due to an increase in transport, which either increased seed prices or limited access to seed.

#### 4.3. What Were the Immediate food consumption Impacts of COVID-19 on urban and peri-urban consumers, and did they differ spatially and socially?

This section presents findings of the impact of COVID-19 on food consumption in urban and peri-urban. First, we present impacts on bean consumption because the grain is one of the most consumed legumes in Eastern Southern Africa. Legumes are storable and thus supply, and prices could remain stable during crises (GAIN, 2020; WFP, 2020). Bean is an essential source of protein and is often regarded as a "poor man's meat" is presently consumed by wealthy, poor, and vulnerable households in sub-Saharan Africa (Maphosa & Jideani, 2017). Bean consumption is crucial in smoothing protein intake by especially impoverished urban households because of the disruptions in the supply of perishable products. In addition, we also provide findings of the impact of the pandemic on the consumption of perishable foods: vegetables, fish, and fruits.

##### 4.3.1. Bean consumption

The percentages of households that consumed beans before and during the pandemic did not significantly differ by gender in most countries across the sub-regions and presented in Table 5.

**Table 5**

Percentages of urban and peri-urban households consuming bean before and during COVID-19 by gender.

	Before			During		
	Women	Men	Diff.	Women	Men	Diff.
<b>Eastern Africa</b>						
Burundi	100	100	0	100	100	0
DRC	95	80	-15	85	100	15
Ethiopia	100	100	0	100	100	0
Kenya	100	100	0	90.48	85.71	-4.77
Tanzania	93.88	95.24	1.36	91.84	90.48	-1.36
Uganda	62.16	16.67	-45.49**	78.38	83.33	4.95
<b>Southern Africa</b>						
Malawi	92	100	8	28	44.44	16.44
Mozambique	100	100	0	94.74	100	5.26
Zambia	97.06	100	2.94	76.47	78.57	2.1
Zimbabwe	83.33	93.75	10.42	20.83	0	-20.83*

\*, \*\* p&lt;0.1 and p&lt;0.05 respectively.

**Table 6**

Differences in percentages of urban and peri-urban women and men households consuming bean before and during COVID-19 by gender.

	Women			Men		
	Before	During	Diff.	Before	During	Diff.
<b>Eastern Africa</b>						
Burundi	100	100	0	100	100	0
DRC	95	85	-10	80	100	20
Ethiopia	100	100	0	100	100	0
Kenya	100	90.48	-9.52	100	85.71	-14.29
Tanzania	93.88	91.84	-2.04	95.24	90.48	-4.76
Uganda	62.16	78.38	16.22	16.67	83.33	66.66**
<b>Southern Africa</b>						
Malawi	92	28	-64***	100	44.44	-55.56***
Mozambique	100	94.74	-5.26	100	100	0
Zambia	97.06	76.47	-20.59**	100	78.57	-21.43*
Zimbabwe	83.33	20.83	-62.5***	93.75	0	-93.75**

\*, \*\*, \*\*\* p&lt;0.1, p&lt;0.05 and p&gt;0.01 respectively.

While significantly higher proportions of women (62%) than men (17%) in Uganda reported that their households consumed beans before the pandemic, the difference in proportions was not significantly different during the pandemic. In contrast, while bean consumption proportions for women and men households in Zimbabwe were almost the same before COVID-19, marginally higher (21 percent) of women households consumed beans than men.

Further analysis was done to establish the gender that was better off or suffered in terms of bean consumption. Thus, we tested differences in percentages of urban and peri-urban women and men households that consumed beans before and during the pandemic. The results presented in Table 6 show that men and women households in Southern Africa suffered significant bean consumption shortfalls during the pandemic than those in Eastern Africa. For instance, bean-consuming men and women households in Malawi significantly declined by 64 percent and 56 percent. The percentage of Zambian men and women households that consumed beans during COVID-19 was 21 percent lower than pre-COVID-19 proportions. Households in Mozambique registered the largest reduction in bean consumption, with women proportions declining from 83 percent to 21 percent, while none of men households consumed beans, down from nearly 94 percent before COVID-19. In contrast, in Eastern African countries, the proportions of men and women households in Uganda that consumed beans during the pandemic were not significantly lower than those before the pandemic. Bean consumption in Eastern Africa largely remained unchanged during the pandemic from pre-pandemic levels for both men and women. Additionally, all men households in DRC consumed beans during the pandemic compared to 80 percent before the pandemic.

These results reveal that the impacts of COVID-19 on bean consumption varied by country and sub-region. This corroborates recent findings by Nchanji et al. (2021) that showed food consumption shortfalls during the pandemic were direr in Southern Africa. A possible explanation for this situation could be that a larger proportion (98.72 percent) of urban and peri-urban households in Southern Africa depended on the market as the main source of bean grain compared to 78 percent in Eastern Africa (Fig. S1 ). Closures of informal food markets to combat the spread of coronavirus possibly reduced economic access to grain for urban households that were dependent on markets for food supplies (FAO, 2020). Second, transport restrictions could have disrupted logistic operations, slowing down the movement of bean grain from production hubs to consumption hubs (Nchanji et al., 2021a; Nchanji and Lutomia, 2021).

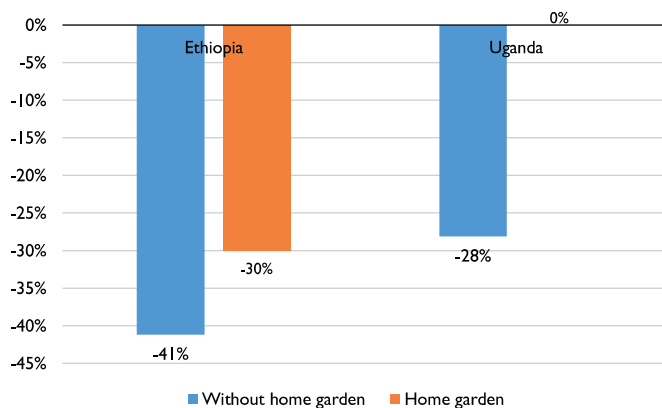
#### 4.3.2. Vegetable consumption

The percentages of men and women households that consumed vegetables are presented in Table 7. The results show that while vegetable consumption remained largely unchanged for men and women in Eastern and Southern Africa, the percentages of women households that consumed vegetables in Ethiopia and Uganda significantly dropped during the pandemic. Nearly 52 percent and 43 percent of Ethiopian and Ugandan women households consumed vegetables during COVID-19, representing a 37 percent and 24 percent drop from pre-COVID-19 proportions. While the explanation of the vegetable consumption situation among Ethiopian women households cannot be attributed to the COVID-19 containment measure because the country did not declare stringent restrictions to combat the pandemic (Pilling, 2020), total lockdown and restricted transportation in Uganda could have hampered women ac-

**Table 7**

Differences in the percentages of urban and peri-urban men and women households that consumed vegetables before and during COVID-19.

	Women			Men		
	Before	During	Diff.	Before	During	Diff.
<b>Eastern Africa</b>						
Burundi	100.00	95.65	-4.35	92.85	92.85	0.00
DRC	92.50	95.00	2.50	60.00	60.00	0.00
Ethiopia	88.88	51.85	-37.03***	100.00	100.00	0.00
Kenya	100.00	100.00	0.00	100.00	100.00	0.00
Tanzania	95.91	95.91	0.00	88.89	88.89	0.00
Uganda	67.57	43.24	-24.33**	83.33	50.00	-33.33
<b>Southern Africa</b>						
Malawi	96.00	100.00	4.00	100.00	100.00	0.00
Mozambique	100.00	100.00	0.00	100.00	100.00	0.00
Zambia	100.00	97.06	-2.94	100.00	100.00	0.00
Zimbabwe	100.00	91.67	-8.33	100.00	81.25	-18.75*

\*, \*\*, \*\*\*  $p < 0.1$ ,  $p < 0.05$ ,  $p < 0.01$  respectively.**Fig. 3.** Differences between percentages of households that consumed vegetable before and during COVID-19 by ownership of the home garden.

cess to informal fresh markets. In Southern Africa, almost all surveyed men and women households consumed vegetables before and during the pandemic. However, there was a decline in the number of men and women households that consumed vegetables in Zimbabwe. Even so, the drop in vegetable consumption was marginal.

Vegetables are the most planted crops in urban and peri-urban areas. For this reason, we also focused on the possible role of home gardens on vegetable consumption. We limited our analysis to countries that showed significant differences in the proportions of vegetable consumption. The results presented in Fig. 3 show a significant decline in vegetable consumption for households without homes in Ethiopia (-41%,  $z = 2.57$ ,  $p < 0.05$ ) and Uganda (-28%,  $z = 2.60$ ,  $p < 0.05$ ). In contrast, vegetable consumption decline among Ethiopian women households with home gardens did not significantly differ (-30%,  $z = 1.54$ ,  $p = 0.121$ ). For women households in Uganda with home gardens, vegetable consumption during pandemic steadied at its pre-COVID-19 levels. In other words, ownership of home gardens enabled women households to smooth vegetable consumption. On the other hand, women without home garden were possibly unable to access fresh produce markets either due to stay at home orders, market closure, or restricted transportation. This finding is another crucial illustration of the role of urban farming in sustainable urban food systems.

#### 4.3.3. Fish consumption

Table 8 displays percentages of urban and peri-urban households that consumed fish before and during the pandemic. Men's and women's fish consumption was affected during the pandemic.

Fish consumption was higher among women households than men before and during the pandemic, except for Kenya and Zambia before COVID-19 and Zimbabwe during the pandemic. Nonetheless, the proportions of men and women households that consumed fish pre and during pandemic did not significantly differ by gender in the two sub-regions except for Burundi in Eastern Africa and Mozambique and Zimbabwe in Southern Africa. Significantly higher proportions of women households than men households in Burundi consumed fish both before and during the pandemic. While marginally higher proportions of men households in Zimbabwe consumed fish pre-pandemic, their fish consumption significantly differed during the pandemic. Contrary to this finding, whereas fish consumption for men and women households in Mozambique did not significantly differ before COVID-19, marginally more women households than men households consumed fish during the pandemic.

Further interrogation of results presented in Table 8 revealed that reductions in fish-consuming households were more pronounced in Southern Africa than in Eastern Africa. In Eastern Africa, reductions in numbers of women households that consumed fish during the pandemic were only significant in Uganda, where they significantly dropped by 35 percent from 57 percent pre-COVID-19 to 21 percent during the pandemic. On the other hand, fish consuming households in Kenya reduced to 7 percent during COVID-19, down from 64 percent before COVID-19, representing a 57 percent decline. It is critical to recognize that Uganda and Kenya imposed and enforced the most stringent COVID-19 containment measures in Eastern Africa, lockdowns, and movement cessation. Most fish consumed in urban areas in Kenya and Uganda is sourced from lakes in rural counties, and, therefore, restricted movement may have hampered fish distribution. In Southern African countries, men and women households in three out of the four countries were significantly affected. The decline in fish-consuming households was largest in Zimbabwe and Zambia. While the proportion of women households in Mozambique that consumed fish during COVID-19 was not significantly different from the pre-COVID-19 proportion, men households marginally reduced fish consumption during the pandemic, as shown in Table 9. Generally, these results show that men households in Southern Africa were disproportionately affected by the pandemic in terms of fish consumption than women households.

#### 4.3.4. Fruits consumption

Comparison of proportions of households that consumed fruits showed no statistically significant differences between men and women households in Eastern Africa both before and during the pandemic (Table S1). Similar results are reported in Southern



**Table 8**  
Comparison of percentages of urban and peri-urban households fish consumption before and during COVID-19.

	Before COVID-19			During COVID-19		
	Women	Men	Chi-square	Women	Men	Chi-square
<b>Eastern Africa</b>						
Burundi	43.48	7.14	5.50**	26.09	0.00	4.36**
DRC	80.00	60.00	1.03	77.50	80.00	0.02
Ethiopia	7.41	0.00	0.63	0.00	0.00	
Kenya	52.38	64.29	0.49	28.57	7.14	2.41
Tanzania	71.43	63.49	0.78	67.35	52.38	2.55
Uganda	56.76	56.00	0.10	21.62	16.67	0.08
<b>Southern Africa</b>						
Malawi	96	100.00	0.37	88.00	77.78	0.55
Mozambique	78.95	64.71	0.91	73.68	35.29	5.36**
Zambia	97.06	100.00	0.42	73.53	57.14	1.24
Zimbabwe	79.17	100.00	3.81*	25.00	37.50	0.71

\*, \*\* p<0.1 and p<0.05 respectively.

**Table 9**  
Differences between percentages of households that consumed fish before and during COVID-19 in urban and peri-urban areas by gender of respondents.

	Women			Men		
	Before	During	Diff.	Before	During	Diff.
<b>Eastern Africa</b>						
Burundi	43.48	26.09	-17.39	7.14	0.00	-7.14
DRC	80.00	77.50	-2.5	60	80.00	20
Ethiopia	7.41	0.00	-7.41	0.00	0.00	0
Kenya	52.38	28.57	-23.81	64.29	7.14	-57.15***
Tanzania	71.43	67.35	-4.08	63.49	52.38	-11.11
Uganda	56.76	21.62	-35.14***	56	16.67	-39.33
<b>Southern Africa</b>						
Malawi	96	88.00	-8.00	100	77.78	-22.22
Mozambique	78.95	73.68	-5.27	64.71	35.29	-29.42*
Zambia	97.06	73.53	-23.53***	100	57.14	-42.86***
Zimbabwe	79.17	25.00	-54.17***	100	37.5	-62.5***

\*, \*\*\* p<0.1 and p<0.01 respectively.

**Table 10**  
Differences between percentages of households that consumed fruits before and during COVID-19 in urban and peri-urban areas by gender of respondents.

	Women			Men		
	Before	During	Diff.	Before	During	Diff.
<b>Eastern Africa</b>						
Burundi	65.217	52.173	-13.044	57.14	57.14	0.00
DRC	50.00	37.50	-12.5	20.00	20.00	0.00
Ethiopia	37.04	29.63	-7.408	12.5	12.50	0.00
Kenya	100.00	95.24	-4.762	100.00	100.00	0.00
Tanzania	73.47	79.59	6.121	57.14	66.67	9.53
Uganda	32.43	16.21	-16.22	33.33	16.67	-16.66
<b>Southern Africa</b>						
Malawi	76.00	32.00	-44.00***	100.00	44.44	-55.56***
Mozambique	36.84	26.32	-10.525	52.94	41.17	-11.77
Zambia	97.06	47.06	-50.00***	78.57	42.86	-35.71*
Zimbabwe	79.17	0.00	-79.17***	93.75	6.25	-87.50***

\*, \*\*\* p<0.1 and p<0.01 respectively.

Africa, with the exception of Zambia, where significantly higher proportions of women households consumed fruits than men households. Nonetheless, there was a general reduction in the number of men and women households that consumed fruits in Southern Africa than in Eastern Africa, as shown in Table 10. With the exception of Mozambique, the differences in proportions of households in urban and peri-urban areas in Malawi, Zambia, and Zimbabwe that did not consume fruits were highly significant regardless of gender. In contrast, no significant differences in household fruit consumption were reported by men and women households in Eastern African countries. These findings suggest sub-regional differences in the impacts of COVID-19 on fruit consumption.

Besides, seasonality differences in production could also be linked to the sub-regional consumption of fruit differences.

#### 4.4. How sustainable were home gardens in alleviating the impacts of the pandemic on bean consumption?

We also provide a comparison of proportions of consumers that consumed beans by the source of grain. Results in Table 11 show that percentages of urban and peri-urban men and women households that consumed beans before and during the pandemic did not significantly differ across the regions for households with home gardens as a source of grain. In fact, all women and men

**Table 11**  
Percentages of urban and peri-urban households that consumed bean before and during the pandemic by region and gender.

Region	Gender	Home garden (N=75)			Market (N=416)		
		Before	During	Diff.	Before	During	Diff.
Eastern	Women	91.67	88.89	-2.78	89.81	89.81	0
	Men	100	96.55	-3.45	89.87	89.87	0
Southern	Women	100	100	0	93.94	55.56	-38.38***
	Men	100	100	0	98.18	56.36	-41.82**

\*\*, \*\*\*  $p < 0.05$  and  $p < 0.01$  respectively.

households in Southern Africa that depended on home gardens consumed beans before and during the pandemic. While proportions of households in Eastern Africa that consumed beans obtained from the market remained unchanged during the pandemic regardless of gender, those of their counterparts in Southern Africa countries significantly declined. For instance, the proportions of women households that consumed bean obtained from the market declined by about 38 percent during COVID-19 from 94 percent. On the other hand, men households consuming beans from the market declined from 98 percent before COVID-19 to 56 percent during the pandemic.

The results presented in Table 11 reveal the potential role of urban agriculture in sustaining urban food systems' resilience to unforeseen circumstances. In this context, ownership of home gardens contributed to food consumption and increased the capacity of households to reduce risk to bean availability and access in the face of unprecedented health crises and economic shocks. Furthermore, a significant decline in the number of households that consumed beans from markets during the pandemic in Southern Africa could be attributed to low purchasing power due to loss of incomes and high food prices in urban areas emanating from the cessation of movement and logistic challenges occasioned by the pandemic. Households without a home garden possibly forfeited income generation benefit of the gardens, which could have provided cash for the purchase of beans to smooth consumption. Additionally, households that owned home gardens possibly generated additional income from the sale of other food crops, thereby enabling them to sustain bean consumption, reduce financial burden, and supplement bean supply during the pandemic. This observation is affirmed by about 83 percent and 88 percent of urban and peri-urban home garden owning households in Eastern and Southern Africa that increased their garden sizes to supplement food supply, reduce the financial burden on food, earn income, and have access to fresh and healthy food (Table S2).

## 5. Discussion

In this article, we highlight some of the immediate impacts of COVID-19 on bean production and consumption in Eastern and Southern Africa with the aim of illustrating how SFSCs could be crucial in improving the resilience of agri-food systems in the region and contribute to sustainable food production and consumption (Nassary et al., 2020). First, we focus on the common bean, one of the staple legumes in Eastern and Southern Africa. Common bean is the most grown leguminous crop in Eastern and Southern Africa. It is mainly intercropped with food staples such as cereals. Beans have multiple benefits that are important for the sustainable transitioning of food systems in the two sub-regions. First, besides being a cheap source of food that is rich in protein, fiber, vitamins, and minerals (Jha et al., 2015; Castro-Guerrero et al., 2016), common bean is a natural nitrogen fixer, and upscaling its production may reduce consumption of synthetic nitrogen fertilizers, thereby reducing agricultural, environmental footprint (Jensen et al., 2012). Beans also have the potential to reduce farm-level use of chemicals

in control of pests and diseases, weeds and reduce soil degradation when intercropped with cereals or used as rotation crops (Nassary et al., 2020). Beans are also important in meeting the increasing demand for healthier and safe food products.

We also focused on urban agriculture's role in providing perishable food products that have been severely affected by COVID-19. We mainly focused on ownership of home gardens and their implication on sustainable vegetable and fruit consumption in urban and peri-urban areas. The cultivation of vegetables and fruits, using a short-chain model, is expected to reduce food losses and waste associated with the pandemic management strategies. It would reduce long distances involves in moving food products from rural to urban areas resulting in lower emissions into the atmosphere. In addition, urban agriculture could also contribute to the sustainable use of treated wastewater (Corbould, 2013). Taken together, SFSCs would sustainably improve food and nutritional security, incomes, and environmental quality. Additionally, like other differences in gendered exposure and vulnerability to everyday and occasional realities and occurrences, the implications of COVID-19 on food consumption in urban and peri-urban areas are expected to be uneven between men and women. For this reason, we also unpacked gendered differences in the frequency of bean consumption during COVID-19.

The analysis revealed unprecedented immediate impacts of global spread of coronavirus on production and consumption in Eastern and Southern Africa. Over sixty percent of bean farmers in Southern Africa and slightly over one-quarter of farmers in Eastern Africa were affected by the pandemic. Gender comparison revealed that both men and women farmers in Southern Africa were significantly affected than their Eastern African counterparts. While most farmers in Eastern African countries identified input market-related challenges such as unavailability of seed and high input and labour prices as major COVID-19 effects on bean production, those in Southern Africa reported output market challenges such as transportation of crop harvest from farm gate to points of sale, lower market demand, and low output prices. The type of seed planted contributed considerably to the differences in impact of the pandemic on bean production between farmers affected and not affected by COVID-19. The disruptions could be attributed to the direct impacts of coronavirus and containment measures.

Disruptions at the farm gate were transmitted to urban consumers through complex pathways. While most Southern Africa farmers reported experiencing problems transporting beans to markets, urban consumers who depended on food markets for bean supply reduced the frequency of bean consumption during the pandemic. This is evidenced by a significantly higher decline in the number of men and women consumers who reduced bean consumption during the pandemic. In contrast, bean consumption did not significantly differ for consumers that owned home garden and planted beans. However, in Eastern Africa, only Ugandan consumers significantly reduced bean consumption during the pandemic. There were significant reductions in number of women consumers in Kenya and Uganda and among men consumers in Zimbabwe that consumed perishable foods. No significant dif-

ferences were observed between the proportions of consumers that consumed vegetables pre-COVID-19 and during COVID-19 for households that owned home gardens. This shows that home gardens played a crucial role in sustaining vegetable consumption in Uganda and Ethiopia. For fish consumption, significantly higher proportions of men consumers in Mozambique, Zambia, Zimbabwe, and Kenya reduced fish consumption during the pandemic. On the other hand, during the pandemic, the proportions of women consumers who ate fish were significantly lower than the pre-COVID-19 proportion for women consumers in Uganda, Zambia, and Zimbabwe. While the pre-pandemic number of fruit consumers in Eastern African countries was not significantly affected, their counterparts in Southern African countries except Mozambique significantly reduced.

The findings corroborate emerging literature on immediate impacts of COVID-19 on agriculture and food systems and confirm concerns that the pandemic would disproportionately impact developing countries because of pre-existing vulnerabilities in agriculture and food systems (FAO, 2020c). FAO (2020a, 2020c) projected that the COVID-19 pandemic would impact developing countries, especially in Sub-Saharan Africa and Southern Asia, because of the food insecurity and malnutrition that were already high even before coronavirus. FAO identified social and economic channels as likely pathways that exposed regions to the impacts of the pandemic. Economic fallout resulting from loss of job and remittance incomes and high food prices were expected to reduce individual and household purchasing power of adequate, safe, and nutritious foods, especially among poor and vulnerable groups (FAO, 2020a, 2020b). While production and consumption of food staples were expected to remain stable during COVID-19, production and demand for fresh produce like vegetables and fruit were expected to be disrupted by seasonality in production and supply, price sensitivity, and perishability. Thus, transport restrictions, cessation of movement, and reduced operational levels or closure of informal market were expected to negatively affect farm incomes due to accumulation of surpluses in production hubs and availability and economic access to fruits among urban consumers. These concerns have been confirmed by emerging empirical literature across countries and developing regions globally (Pan et al., 2020; Stephens et al., 2020; Varshney et al., 2020; Willy et al., 2020; Nchanji and Lutomia, 2021).

The results demonstrate the role of SFSCs in ameliorating the impact of the pandemic and crises on food systems. The results suggest localized seed and input supply systems may be crucial to enhancing agricultural production's resilience to future pandemics. In Eastern Africa, farmers who relied on the market for seed supply were disproportionately affected by the pandemic. The physical distance between certified seed and farm gate sources appears to have had implications on bean production. Disruptions created by pandemics could have worsened pre-COVID-19 challenges that farmers experienced in accessing farm inputs. Long distances reduced access to high-quality inputs and also increased input prices through unavailability of adequate volumes during cropping seasons and higher transaction costs.

Furthermore, most affected Southern Africa farmers reported challenges in moving crop produce and lower market demand and prices. This suggests that lockdowns and border closures could have impacted internal transportation and cross-border trade of food products. These results are strong testaments of the potential role of SFSCs in overcoming the consequences of relying on external inputs on agricultural production as well as on global warming. SFSCs emphasize localized food production and distribution. The model also supports resilient farm-based livelihoods and sustainable production methods, as well as consumption of healthy foods (Renting et al., 2003; EIP-AGRI Report, 2015). In other words, by encouraging localized input supply systems, SFSCs would provide

alternative ways of promoting sustainable farming systems and contribute to improved farm incomes and local economic growth (Jarzebowski et al., 2020).

Another important lesson from the analysis is the potential role of home gardening in sustainable urban food consumption and production. Households that had home gardens were able to sustain pre-COVID-19 levels of bean consumption. Cities considered hotspots of coronavirus were locked down, with vulnerable groups disproportionately affected by informal market closure. However, urban farming promises to increase food availability to keep pace with rapid urbanization in Sub-Saharan Africa, where most dwellers have limited access to select food stores that remained operational during the pandemic.

Urban households with home gardens were able to smooth bean consumption during the pandemic than those with no home gardens. In fact, farmers who increased the sizes of home gardens were motivated by the need to supplement food supplies, reduce financial burden on food because of high prices, have access to healthy food, and earn additional income. Home gardens essentially sustained bean consumption, suggesting its role in food and nutritional security. Second, the results highlight the economic benefits of urban home gardens in terms of financial savings, job creation, and disposable income (Lal, 2020). Besides contribution to economic wellbeing and food and nutritional security of urban consumers, home gardens have the potential of supporting the achievement of UN SDG on sustainable production and consumption through environmental and ecological benefits, including efficient utilization of treated waste and gutter water, and reduction of high chemical usage in conventional urban agriculture. Legume-based production systems in the cities alongside fresh produce contribute to soil conservation and reduce the need for synthetic chemicals, resulting in environmental benefits. At the same time, home gardens are important pathways for shortening food distribution distances from production areas to cities. It encourages local food production, resulting in the reduction of carbon footprints of food supply systems (Kulak et al., 2013; Lee et al., 2015; Thornbush, 2015; Nicholls et al., 2020; Ritchie, 2020). In other words, urban agriculture may stimulate the role of circular economy in achieving the UN's SDG No. 12.

## 6. Conclusions and Implications

The COVID-19 pandemic has already disrupted agriculture and food supply systems in Sub-Saharan Africa countries in the last years. Most of the impacts are linked to the effects of containment measures on labour mobility and input and output markets. Overall, bean farmers in Southern Africa were disproportionately affected than those in Eastern African countries. While most farmers in Eastern African countries identify input supply challenges during the pandemic, their counterparts in Southern Africa reported food supply challenges. This shows that COVID-19 implications on production may not be uniform across countries and regions, possibly varying depending on pre-COVID-19 underlying challenges and social vulnerabilities. Furthermore, home gardening in cities improved consumers' resilience to food and nutritional shortfalls. The findings also showed possible gender differences in men and women consumers' resilience to the pandemic's impacts on production and consumption.

Theoretically, the results emphasize the need to go beyond relationships between producers and consumers in SFSCs and focus on the gendered implications on the food system. Women and men's choices or preferences for SFSCs may be heterogeneous and either support or oppose other sustainability dimensions, especially during emergencies or crises of COVID-19 magnitude. This has implications on how gender and other social considerations may reconcile economic or environmental pillars of sustainability in SF-

SCs. COVID-19 consequences may be uneven, with women farmers, youth, and children suffering more than men. This could widen existing gender inequalities. However, every tragedy has a silver lining. For this reason, COVID-19 impacts signal opportunities for changes in agri-food systems, including shortening of food supply chains in both rural and urban areas, to improve resilience to future pandemic and crises. SFSCs would secure livelihoods, incomes, food, and nutritional needs of rural and urban households and contribute to sustainable consumption and production behaviour.

The COVID-19 provides an important lesson for the future of sustainable development in Sub-Saharan Africa. Thus, we suggest the three policy interventions for sustainable production and consumption in rural and urban areas. First, promoting and implementing short food supply chains in rural and urban areas is encouraged and fast-tracked. Second, inclusive institutional and legal support instruments should be adopted to support urban farming. These two recommendations would shorten the food supply chain and change urban food production and consumption landscapes, thereby resulting in sustainable development. Lastly, economic partnerships among countries in the region need to be re-worked to enhance agriculture and food systems' contribution to sustainable eradication of hunger, poverty, and gender inequality. This can be attained through increased funding of agricultural research for innovative and efficient food systems.

However, the major flaw of this study is that despite considering the gender dimension, it did not collect and analyse individual perceptions and socio-economic characteristics of producers and consumers to establish how they influenced their production and consumption behaviours during the pandemic. Second, the nature of data collected limited multivariate analyses. Thus, the results presented herein may not highlight peculiar features in the data or may not be exhaustive in quantifying positive or negative behaviours during the pandemic that may have impacted sustainable production and consumption and the overall concept of SFSCs. Notwithstanding, future research should quantitatively measure environmental effects of home gardening on greenhouse gas emissions, as documented in manufacturing literature, and associated behavioural changes and their implications food waste in cities. Second, welfare effect of SFSCs during the pandemic should also be a focus area of future studies. In both scenarios, fully-fledged regression should be applied to identify peculiar features regarding sustainable production and consumption during the pandemic.

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## Declaration of Competing Interest

None.

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## Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.spc.2021.05.016.

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