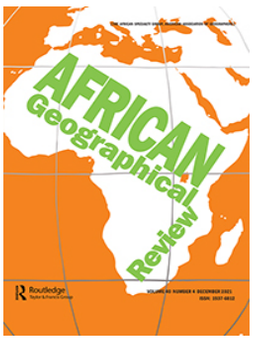

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RESEARCH ARTICLE

COVID-19 and Ghana's agri-food system: an assessment of resilience

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ABSTRACT

Strength, Weakness, Opportunities, and Threats (SWOT) intertwined with a food security resilience framework was used to understand Ghana's agricultural food system resilience to COVID-19 from a production perspective using a qualitative approach. Agricultural production remained fairly resilient but plagued with labor mobility challenges that delayed production. Specific results showed self-sufficiency in the production of roots and tubers, deficiency in the production of cereals and poultry. Opportunities do exist in rice production. Fall Army Worm invasion threatened cereal production. The government is encouraged to increase funding investment through public-private partnerships to build warehouses and increase production in meeting domestic supply needs.

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COVID-19; agri-food system; SWOT analysis; SDG 2; Ghana

1. Introduction

The ramifications of the COVID-19 outbreak continue to demand global attention. Rightly so, the World Health Organization (2020), described it as a pandemic. Emanating from Wuhan, Hubei province in China during the last quarter (November) of 2019 (Huang et al., 2020), the COVID-19 virus spread to all parts of the globe, except Antarctica (Chakraborty & Maity, 2020). The pandemic is not entirely new to the world. However, this time the scale and depth of the crises remained pronounced by globalization. The elaborate value chains developed since the onset of globalization meant that production, distribution, processing, and consumption in one part of the world depended on what happened in other parts of the world. And in fact, the damage caused by the H1N1 witnessed in 2009, Ebola in 2014, and Zika in 2016 were less damaging when compared with COVID-19. And unlike COVID-19 the containment of former outbreaks within geographic areas was successful.

The potential hope in all these is that because the world successfully dealt with past outbreaks, lessons learnt could be leveraged to address COVID-19 (Koonin, 2020). This requires the sharing of global good practices in the fight against associated risks related to COVID-19. However, despite progress made with the development and deployment of vaccines especially in the global north, the pandemic has had dire consequences on all sectors of the global economy. Economic recessions, job losses, agitations, panic, panic-buying, misinformation, fear-mongering, and challenges in agri-food and supply chain systems have been observed. Many developing countries, largely the agrarian-based and predominantly informal ones witnessed devastating consequences on their incomes and production. Indeed, the informal sector of the African continent, particularly sub-Saharan Africa (SSA) has been hard-hit.

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Ghana similar to other countries in SSA, responded to the COVID-19 pandemic with measures to contain the spread, scaled-up contact tracing efforts, tested contacts found for the virus, quarantined and isolated them if necessary for treatment, in instances when they proved positive to the virus. To support these efforts, there was the imposition of restrictions on public gatherings, closures of the country's borders to the rest of the world in addition to temporal restrictions (lockdown) on movement in Greater Accra Metropolitan Area and the Greater Kumasi Metropolitan Area and its surrounding districts beginning in March, 2020. This culminated into a three-week partial lockdown which ended on 19 April 2020. These mandatory restrictions including the partial lockdown in diverse ways affected the agricultural food system in Ghana. This triggered several questions in the Ghanaian agricultural policy space requiring sound debate, analyses, and potential suggestions for policy actions. The case of Ghana is not a complete departure from what was witnessed in neighboring countries in the Western, Southern, Northern, and Eastern African countries. This article, therefore, uses the case of Ghana to bring to the fore critical issues for consideration within the broader perspective of African countries.

In the broader scheme of things, critical questions being asked especially with regard to Ghana's food security preparedness during the pandemic include the existing stocks of food, urban resilience, and ability of the distribution and marketing infrastructure to distribute stocks. Additionally, the stability of food commodities prices, its affordability to the poor, and ultimately the capacity of the food production system to cultivate and store foodstuffs in the 2020 and 2021 production seasons to secure Ghana's food security in 2022 are up for discussion. As a net importer of commodities like wheat, rice, and poultry products, it is imperative to understand how the country coped with the disruptions in the global value chains for these products. To get a bird's eye view of the picture so far, and the preparedness of the various regions in the country to ensure that food production continued, this study investigated how COVID-19 affected the agri-food system taking into consideration the production within the period – 2020, particularly in the context of mixed sentiments concerning how the pandemic affects input suppliers, producers, distributors, processors, and the final consumer. Arouna et al. (2020) attempted to assess COVID-19 on the rice sector in Ghana. Asante and Mills (2020) assessed the impact of COVID-19 at the marketplace, whereas Sers and Mughal (2020) broadly assessed COVID-19 on the rice value chain in West Africa. Obese et al. (2021) argued that COVID-19 negatively impacted the livestock sector through its manifestation in the demand and supply of food, animal breeding, input supply, and veterinary services. The agri-food and pandemic literature in this regard remains scarce, mixed, inconclusive, and limited given the novelty of the virus. The disruption caused by the virus has implications on the attainment of the Sustainable Development Goal (SDG) 2 – of achieving food security and sustainable agriculture. An attempt to understand Ghana's agri-food system's resilience to COVID-19 remains essential particularly from a production perspective. This paper, therefore, uses a Strength, Weaknesses, Opportunities, and Threats (SWOT) analysis intertwined with a resilience framework to assess Ghana's agri-food system resilience in the context of COVID-19 and SDG 2 within the period of lockdown and post lockdown (March 2020 – June 2020). We employed a qualitative method in primary data collection via focus group discussions, key informant interviews, and causal empiricism.

The study's findings showed that agricultural production remained fairly resilient to the disruption caused by COVID-19. Labor mobility was affected which led to delayed production. COVID-19 fairly affected Ghana's agri-food system but not to a level that resulted in substantial production deficits. Specifically, Ghana appeared self-
sufficient in the production of roots and tubers, but deficient in the production of cereals and poultry. Opportunities do exist in rice production. Fall Army Worm invasion however threatened cereal production.

The paper is structured as follows: Section 2 gives an overview of Ghana's agri-food system within the framework of its strength and weaknesses. Section 3 presents the conceptual and theoretical frameworks underpinning the study. Section 4 presents the methodological approach. Section 5 presents the results and findings of the study based on an analysis of strengths, weaknesses, opportunities, and threats (SWOT). Section 6 presents a conclusion and policy recommendations for consideration.

2. Ghana's agri-food system

2.1. Policy framework and governance

Ghana's agricultural policy frameworks have favored cash crop production at the expense of food crops in the past. Ghana's post-independence era sought to shift from cocoa production to other diversified cash, food, and industrial crops. A common feature observed during the 1960s, 70s, and early 80s was the direct influence of the International Monetary Fund (IMF) and the World Bank in policy formulation and implementation. Structural adjustment became imperative and focussed on export crop promotion. Hutchful (2002) indicated that the Medium-Term Agricultural Development Programme was advanced to promote the food sector. Commercial agriculture featured mostly in the mid-2000s through collaboration between Ghana and her donors. These policies were shaped by political, external, and social factors. Post-colonial policies focused primarily on agricultural inputs provision i.e., fertilizer subsidy programme, block farming, Agricultural Mechanization Service Centers (AMSEC), national buffer stock programme (Benin et al., 2013; Mockshell & Birner, 2015). Subsidies on agricultural inputs were essentially introduced on imported agro-inputs to encourage mechanized farming championed by the private sector. Julius (2019) explained that the block farming concept provided smallholder farmers with agricultural inputs and mechanized services.

Ghana had sector policies such as the Food and Agricultural Sector Development Policy Programme (FASDEP I & II), Ghana Shared Growth and Development Policy Agenda (GSGDA), Medium Term Agricultural Sector Investment Plan (2011–2015), Ghana Irrigation Policy, and Ghana Livestock Development Policy and Strategy and Extension Policy 2002. All these policies underscored commercial and modernized agriculture. The majority of these policies still disadvantaged the food crops sector. For example, leguminous crops such as cowpea have been described in the literature as an orphan crop because of the little attention received. The Planting for Food and Jobs (PFJ) programme started in 2017 to address this longstanding challenge by promoting food crops. The PFJ targets improvement in the productive base for some targeted crops (grains and legumes) and vegetables through subsidized inputs and technology transfer (Tanko et al., 2019). Pauw et al. (2018) indicated that the PFJ came with reforms in input supply systems which makes it distinct from just an input subsidy programme, and by further addressing bottlenecks in infrastructure, marketing, and information access. The ensuing section assesses Ghana's agri-food system within an analytical perspective of strengths and weaknesses.

Ghana's agri-food system within the framework of strength and weaknesses

Ghana's food system is dominated by many smallholder farmers who cultivate between 0–5 hectares, medium (5– 20 hectares), and few large-scale or commercial (>20 hectares) farmers (Houssou et al., 2016; Kwapong et al., 2021). Peasant production dominantly prevails alongside plantation schemes including tree crops such as cocoa, cashew, and oil palm (Gyapong, 2019). The peasant nature of agriculture renders the sector uncompetitive and non-lucrative. Particularly as most smallholder farmers do not keep farm records, hence face recall of past agricultural inputs, and out-put challenges (Ankrah, Boakye et al., 2021). Consequently, peasant farmers are unable to properly assess their farm enterprise profitability. Farmers are therefore unable to patronize the

services of private agricultural extension and hence, they rely heavily on public extension services from the Department of Agriculture which ironically appears ineffective (Anang & Asante, 2020). The public extension services are unable to meet the extension needs of farmers given the deficit in extension officers. Agricultural production is mainly rain-fed with limited irrigation schemes. This makes most smallholder farmers vulnerable to climate variability and change. Agricultural insurance access and subscription which can ameliorate the negative effects of climate change however remains low (14%) (Ankrah, Kwapong, Eghan et al., 2021).

Government is the main provider of irrigation schemes in Ghana coordinated by the Irrigation Development Authority (IDA). The IDA is however limited in scope and ineffective in the provision and upscaling of irrigation schemes. Ironically, Okyere et al. (2021) indicated that irrigation improved wellbeing. Typically, agricultural production takes place in remote villages and the produce are conveyed to urban centers to be sold after harvest. The production centers have poor road infrastructure and markets. The production system features men engaged in the labourious work at the farm with women involved in the less energy-sapping tasks. Women labor is however a considerable part of smallholder and family farming in West Africa (Fonjong & Gyapong, 2021). Despite women's phenomenal involvement in agriculture, they still face differential access to productive resources (Ankrah et al., 2020). Generally, farmers in Ghana produce enough roots and tubers but remain deficient in the production of cereals (rice, wheat, and maize), poultry, meat, fish, and vegetables. This renders Ghana highly import-dependent in making up for the deficits. The agri-food system is largely informal and dwells heavily on informal channels in production, processing, distribution, and marketing. The informal nature renders most farmers inclined to indigenous knowledge. Indeed, Ankrah, Kwapong, Boateng et al. (2021) showed that smallholder farmers used indigenous knowledge predictors in climate variability and change adaptation in Ghana. Ankrah and Freeman (2021) indicated the actors in the agricultural value chain do not act reflectively in addressing challenges and harnessing potentials.

Few high-ends supermarkets exist in the urban centers in the cities – Accra, Kumasi, Cape Coast, Takoradi, and Tamale. Against a backdrop of supply deficits in production, the government has so far implemented radical policies targeted at addressing the high import-dependency and commercial production to feed the rest of the world. First, there was the introduction of the fertilizer subsidy programme in 2008. The sole objective was to increase outputs through the increased use of inorganic fertilizers. More recently, policies such as the PFJ, Planting for Export and Rural Development (PERD), and Rearing for Food and Jobs (RFJ) have been implemented since 2017. The Ministry of Food and Agriculture (MoFA) argued that PFJ reduced maize imports. Additionally, the Ghana Commodity Exchange (GCX) provides a platform for the trading of listed agricultural commodities. The Ghana buffer stock system has been instituted to ensure the implementation of warehouse infrastructure in all districts in Ghana in a policy dubbed one-district, one-warehouse.

Generally, there is evidence to suggest appreciable levels of food insecurity in Ghana in the last five or so years. However, some regions are more affected than others. For instance, the Ghana Statistical Service (2021) reported that 47.7% of the population was estimated to be plagued by moderate or severe food insecurity. Approximately 10% was estimated to be severely food insecure in June 2020. In the same month and year, an estimated 38.7% of households in the Northern Region and Upper West Region (60.6%) were moderately or severely food insecure. From 2016 to 2017, an estimated 49.5% of the population was either moderately or severely food insecure with approximately 8% severely food insecure. The World Food Programme and the Ministry of Food and Agriculture's study that used a Food Consumption Score (FCS) indicated that 26% of households in Upper West, Upper East, Northern, North East, and Savannah regions experienced severe to mild food insecurity in both urban and rural areas (World Food Programme & Ministry of Food and Agriculture, 2012). Atuoye et al. (2017) indicated that in the Upper West Region, 16% of households were found to be moderate to severely food insecure. The authors further indicated the region constitutes the most deprived with a majority of the population being poor (nine out of ten

individuals) and live on less than $1.25 daily. In September 2020, the estimated moderate or severe food insecure households was 56.2% in Upper East Region. The estimated severe food insecure households were 5.8% in Northern Region and 11.6% in Ashanti Region. Urban areas generally experience less food insecurity relative to rural areas (Ghana Statistical Service, 2021).

The study situates Ghana's food insecurity in the context of the country's socioeconomic status given that this status highly correlates with food security. Evidence suggests regional variations in poverty incidence in Ghana. Typically, poverty in Ghana can be described to be primarily a rural phenomenon. The GSS (2018) report indicated that while six of the sixteen regions (Greater Accra Region, Western Region, Western North Region, Central Region, Eastern Region, and Ashanti Region) had lower rates of poverty incidence than the national average of 23.4%, the other 10 regions, recorded higher rates than the national average. The poverty incidence worsened in nine out of the sixteen regions – Western Region, Western North, Volta Region, Oti Region, Northern Region, North East, Savannah Region, Upper East Region, and Upper West Region. The Northern Region recorded the largest number of poor individuals. The Upper West Region has the highest (71%) poverty rate. The region however contributes less than 10% to national poverty due to its small population. The incidence rate, however, improved in the Ashanti Region, Bono Region, Bono East Region, Ahafo Region, Eastern Region, Greater Accra Region, and Central Region. The Greater Accra Region recorded the lowest poverty incidence. The region has had the lowest poverty headcount since 2005/2006. Ghana has an annual extreme poverty line of GH¢792.05 with an estimated 8.2% of the population living in extreme poverty (GSS, 2018).

Food crops

Table 1 presents an overview of cultivated area, output, and yields for selected food staples spanning the period between 2012 and 2020. This gives a good picture of the pre-COVID and COVID-19 periods. For brevity purposes, we discuss the area and yield change between 2019 and 2020. Of the total of eight staple crops presented, the cultivated area increased for 7, except for cocoyam which stayed the same. Similarly, despite COVID-19, productivity increased for all eight staple crops.

Livestock and poultry sub-sector

Table 2 presents an overview of the livestock and poultry production covering 2014 – forecasted figures in 2019. The table shows increases in cattle, sheep, goats, pigs, and poultry production. Pig production saw the highest (5.92%) increase and the lowest (0.36%) being cattle. Overall, the livestock production growth rates between 2018 and 2019 declined relative to growth obtained between 2017 and 2018 for sheep and cattle. On the other hand, poultry, pigs, and goats' population growth increased at an increasing rate between 2018 and 2019 when compared with 2017 and 2018.

3. Conceptual and theoretical frameworks

Tendall et al. (2015) defined food system resilience as the ability of a system and components within the system at different levels to provide at all times adequate and accessible food to individuals in the advent of unplanned disruption. This includes pandemics such as COVID-19 and climate change. Folke (2006) earlier defined resilience as the ability of a system to adapt and contain market and environmental disruptions without compromising the food supply chain. This study adopts these definitions as an underpinning concept. A principal challenge in the global south is the ability to design and institute an efficient food system that is resilient to crises. Buldyrev et al. (2010) underscored a high level of interdependence within a system, implying that failure or success in one system affects others. For instance, failure in manufacturing, input supply, production may disrupt the food supply. The global food systems may face failures in supply chains in the event of border

Table 1. Output, area cultivated, and yield (output per hectare) of selected food crops 2012–2020.

	2012	2013	2014	2015	2016	2017	2018	2019	2020
***AreaCultivated* (000 ha)**									
Cassava	869	875	889	917	879	926	977	1,102	1,061
Yam	426	422	428	430	427	493	478	500	505
Cocoyam	196	194	200	200	206	204	203	214	214
Plantain	337	340	356	363	358	363	387	409	429
Maize	1,442	1,024	1,022	881	865	970	1,021	1,150	1,190
Sorghum	231	226	227	228	201	224	228	226	228
Millet	172	161	162	162	137	157	142	148	140
Rice (Milled)	190	216	225	233	236	239	260	282	292
***Output* (000 t)**									
Cassava	14,547	15,990	16,524	17,213	17,798	19,138	20,842	22,750	24,369
Yam	6,639	7,075	7,119	7,296	7,440	8,253	7,850	8,754	8,946
Cocoyam	1,270	1,261	1,299	1,301	1,344	1,387	1,417	1,550	1,596
Plantain	3,557	3,675	3,828	3,952	4,000	4,279	4,632	4,479	5,812
Maize	1,950	1,765	1,769	1,692	1,721	1,986	2,298	2,912	3,071
Sorghum	280	257	259	263	230	278	316	347	356
Millet	179	155	155	157	159	165	182	230	236
Rice (Milled)	332	393	417	443	481	505	768	925	973
***Yields* (t ha^{-1})**									
Cassava	16.8	18.3	18.6	18.8	20.3	20.7	21.3	22.28	22.95
Yam	15.6	16.8	16.6	17	17.4	16.7	16.4	17.52	17.71
Cocoyam	6.5	6.5	6.5	6.5	6.5	6.8	7	7.24	7.47
Plantain	10.5	10.8	10.7	10.9	11.2	11.8	12	13.39	13.55
Maize	1.9	1.7	1.7	1.9	2	2	2.3	2.53	2.58
Sorghum	1.2	1.2	1.1	1.2	1.1	1.2	1.4	1.53	1.56
Millet	1	1	1	1	1.2	1.1	1.3	1.56	1.69
Rice (Milled)	1.7	1.8	1.9	1.9	2.9	2.1	3	3.28	3.34

Source: Statistics, Research and Information Directorate (SRID), Ministry of Food and Agriculture

Table 2. Livestock and poultry production, 2014–2019.

	Livestock and poultry population (000)									
	Cattle		Sheep		Goats		Pigs		Poultry	
Year	Qty.	Change (%)	Qty.	Change (%)	Qty.	Change (%)	Qty.	Change (%)	Qty.	Change (%)
2014	1,657	4.2	4,335	4.3	6,044	5.1	682	6.9	68,511	7.5
2015	1,734	4.6	4,522	4.3	6,352	5.1	730	7	71,594	4.5
2016	1,815	4.7	4,744	4.9	6,740	6.1	777	6.4	73,885	3.2
2017	1,901	4.7	4,978	4.9	7,151	6.1	816	5	75,363	2
2018	1,943	2.2	5,102	2.5	7,366	3	845	3.6	76,870	2
2019	1,950	0.36	5,200	1.92	7,700	4.53	895	5.92	79,500	3.42

Source: Statistics, Research and Information Directorate (SRID), Ministry of Food and Agriculture

closures, human mobility restrictions, import and export bans. Indeed, Atara et al. (2020) and Pisano (2012) highlighted the concept of resilience thinking for understanding social-ecological systems and their intersection at different scales over a period of time and geography.

Pisano (2012) indicated that resilience thinking essentially emphasizes how systems adjust to change and manage in the face of adversity. The concept is considered to have emanated from ecology as a measure of a system's ability to cope with disturbances and remain the same. Walker et al. (2004) indicated that ecological resilience refers to the ability of a system to withstand disturbance and revert to the original state. Alinovi et al. (2010) summarized that the concept of resilience in engineering and ecological resilience refers to the ability of a system to restore itself to its original function in the face of disturbance. Atara et al. (2020) indicated that ecological conceptualization of resilience is appropriate for understanding the food system. Pisano (2012) introduced the concept of social-ecological resilience as a useful way of assessing resilience through social systems such as households. This permits an assessment of household food (in)-security. The

author further classified resilience based on three characteristics. First, the amount of disruptions that a system can contain and remain intact, second, the extent to which the system can re-organize, and finally, the ability of the system to offer co-learning and adaptation. This study adopts the concept of social-ecological resilience as advocated by Pisano (2012) in understanding Ghana's agri-food system resilience to the COVID-19 pandemic. Specifically, this study assumes that a resilient system should be able to revert to its original state after a disturbance or a disruption caused by COVID-19. We need to note however that, reverting to an original status does not suggest an appropriate condition as this is relative to the pre-disturbance state which may or may not be appropriate. We seek to understand whether a pre-disturbance state has been worsened, maintained, or improved. Therefore, attention has been paid to present a picture of the pre-COVID-19 production status in Ghana (See Section 2).

Strength, weakness, opportunities and threats (SWOT)

SWOT analysis is a useful strategic planning tool for assessing internal capabilities (strengths and weaknesses) and externalities (threats and opportunities) that confront organizations (Cheng et al., 2021). Namin et al. (2019) viewed SWOT analysis as a qualitative framework for assessing factors that influence or hinder the performance of a system to deepen understanding and offer improvements. The analysis is typically based on a four-quadrant box that allows for a summary organized around strengths, weaknesses, opportunities, and threats. The strong and weak aspects are identified by assessing the factors in its environment whilst the environmental opportunities and threats are contingent on the elements outside the environment (Gürel & Tat, 2017). Strength defines an attribute that adds value to a system and offers a comparative advantage over others. Essentially, strength includes a positive and favorable feature (Gürel & Tat, 2017). This study defines strength in terms of the agri-food system's relative advantage.

Weakness at the organizational level refers to the instances where a system remains incapable or weaker in comparison to other systems and competitors. In this study, we conceptualize weakness to include components of the ineffective agri-food system that possess limitations in comparison to other components. The components' ineffectiveness, negatively affects the performance and weakens the agri-food system.

Opportunity refers to the ability to capitalize on a system to make positive gains in a competitive environment (Gürel & Tat, 2017). In this study, we conceptualize opportunity as the ability of the actors within the agri-food system to maximize potentials within the sector by capitalizing on its strength and potentials outside the Ghanaian agri-food system to overcome weaknesses and even neutralize external threats.

A threat is an element that renders challenging or impossible conditions that thwart the attainment of organizational goals. Threats may arise from changes in the present or future that challenges the current system and renders it uncompetitive (Ülgen & Mirze, 2010). They can constitute an impediment to the success of the organization, and cause unrecoverable damages. All environmental factors that saddle the effectiveness of the agri-food system constitute threats. COVID-19 has brought about a new world order that threatens Ghana's agri-food system.

Despite the comparative advantage in the use of SWOT analysis, traditional SWOT analysis has been criticized to lack greater depths, appear superficial, and descriptive (Hill & Westbrook, 1997). Additionally, Gürel and Tat (2017) argued that SWOT analysis is qualitative and subjective. Saydumarovna (2017), on the contrary, argued that SWOT analysis notwithstanding its shortcomings provides an effective, vivid, and useful structural description of a given situation. Cheng et al. (2021) argued that the simplicity of the processes involved in the performance of SWOT analysis makes it easily applicable.

Pickton and Wright (1998) proposed a combination of frameworks in enriching SWOT analysis. Vlados (2019) argued for dynamism by embedding evolutionary concepts to the internal and external environment analysis framework. Kim et al. (2016) argued for an integration of User Generated Content (UGC) which takes on board the customer preferences and views for products. This study adopts the views of Vlados (2019) and Kim et al. (2016) by incorporating the viewpoint of farmers, policy player actors, and actors of the agricultural value chain in assessing the agri-food system resilience particularly within the onset of COVID-19 when scarce literature existed. The study additionally incorporated the resilience framework embedded in a food system framing to fortify the rigor of SWOT as rightly proposed by Pickton and Wright (1998). This study was therefore a preliminary assessment envisaged to form a seminal work that further studies on the COVID-19 pandemic and agri-food systems literature can build on.

The food security framework in this study incorporates the two components of food security – availability, accessibility.

4. Methodological approach

4.1. Research design

The study relied on a qualitative research enquiry that dwelled on focus group discussions, key informant interviews, and casual empiricism. Rosumeck et al. (2020) argued that qualitative research allows interrogation of the 'why,' 'how' and 'processes' leading to a phenomenon. COVID-19 appears novel and understanding its effect requires an interrogation of how people adjusted, the processes leading to adjustments, consumer purchasing behavior, food distribution channels, food production, price hikes, reasons accounting for price hikes, and the understanding of Ghana's agricultural sector resilience. The objective was to understand happenings on the ground relative to Ghana's food resilience viz-a-viz COVID-19 and beyond from the perspective of the major stakeholders. Data collection took place over a period of five (5) weeks[1] relying on Key Informant Interviews (KIIs), Focus Group Discussions (FGDs), and casual empiricism through observations made to examine the strengths, weaknesses, opportunities, and threats within the Ghanaian agri-food system as COVID-19 continued to rage.

Data collection methods

Key Informant Interviews (KIIs)

A key informant interview guide was developed to seek responses on participants' views on the effects of COVID-19 on the agricultural sector. Therefore, participants were purposively selected with the assistance of employees of specific Departments of Agriculture (DoAs) under the respective local governments (Municipal/District Assemblies). Key informants constitute experts with knowledge on a particular issue under investigation. The study made use of KIIs because COVID-19 was novel, hence the need to talk to individuals with considerable knowledge concerning the subject area. The use of KIIs in such instances has been given credence by (Jennings, 2020; Yazdani et al., 2018). Key informant guides were designed and administered to respondents through phone calls. Eighty farmers and 48 market queens[2] across the 16 administrative regions of Ghana were interviewed to understand the production and marketing dynamics of foodstuffs within the context of COVID-19 (Table 3). The research team selected 16 Monitoring and Evaluation (M&E) staff and 32 Agricultural Extension

Table 3. Summary of qualitative interviews.

Interview Method	M&E/Extension Officers		Farmers		Market Queens		Total
Key Informant Interviews & Focus Group Discussions	Male	Female	Male	Female	Male	Female	176
	32	16	48	32	0	48	

Source: Fieldwork, 2020.

Agents (48 in total) from the Ministry of Food and Agriculture (MoFA)/Department of Agriculture (DoA). This was based on the concept of theme saturation. Therefore, theme saturation was attained at the point where no new themes emerged. This concept was what led to the total number of respondents engaged. Questions relating to production, input distribution, food availability, access, utilization, stability, and pricing were asked. Developed key informant guides were administered to respondents through phone calls and also limited physical interaction through strict observance of the COVID-19 protocols (handwashing, sanitization, use of nose masks, and social distancing).

Focus Group Discussions (FGDs)

Participants not exceeding 6 individuals were drawn from communities where interviews were conducted. A conscious effort was made to ensure fair gender representation on the composition of the FGDs. Here again, the study was guided by the concept of theme saturation in reaching the total number of FGDs conducted. Questions relating to food production, challenges associated with production, agricultural labor access, labor mobility, availability, access, utilization, stability, household consumption patterns, prices, and supply chain actors were discussed. A semi-structured FGD guide directed discussions. An effort was made to ensure equal/fair participation in the discussions, hence avoided a situation where few outspoken individuals over-shadow the discussions. The research team used other FGDs and KIIs to triangulate issues emanating in a process of confirming, discarding, and validating information obtained.

Casual Empiricism

Samii (2016) described casual empiricism as a method that focuses on causal identification via natural and experimental designs. This method was used to observe relevant key stakeholders' engagements with the COVID-19 on weekly basis to understand in real-time how COVID-19 affected individuals, institutions, and the production processes in the period between March 2020 – June 2020.

4.2. Data analysis

The study used a content analysis approach. Krippendorff (2018) described a content analysis as a data analysis method that allows for replicable and meaningful references considered valid to be made based on data within context. Content analysis continues to be used in contemporary times (Obane & Okajima, 2019) in understanding pertinent issues and the relevance that individuals or institutions assign them. Data that were recorded via phone calls were later transcribed. All transcribed data were analyzed with major and sub-themes identified and grouped. Statements supporting major and sub-themes were disaggregated into their relevant themes. Data analysis was done within the framework of SWOT. The SWOT analysis presents a useful way of having a holistic analysis of a system or phenomenon considering an analysis of the strengths, weaknesses, opportunities, and threats. SWOT received its application in the agricultural sector (Arun & Ghimire, 2018; Lupascu et al., 2020; Michailidis et al., 2015). Statements illustrative of production themes under the SWOT were quoted directly in the results and discussion section. The ensuing section presents the results and discussions.

5. Results and discussions – SWOT analyses of ghana's agri-food systems

Based on KIIs and FGDs conducted in March and April 2020, this section deals with the strengths, weaknesses, opportunities, and threats within Ghana's agri-food system as the COVID-19 effects permeated within the framework of resilience. We focus on local production within the remit of the pre-COVID-19 era, the effects, and the response.

5.1. Strengths

In this sub-section, Ghana's agri-food system is examined relative to its strength in the context of attaining SDG 2. This is assessed in terms of the COVID-19 effect on production and also the agri-food system's ability to return to the pre-COVID-19 state. In this regard, we examine three strengths that could be leveraged upon.

First, we infer from Table 1 that Ghana is strong in the production of roots and tubers specifically yam and cassava. Most roots and tubers were grown locally in quantities adequate to meet domestic demand before COVID-19. The country is self-sufficient in many of the roots and tubers and had significant stocks (growing on farmer fields – cassava, yam, cocoyam) and lasted the country throughout the year 2020. Poku et al. (2018) and Angelucci (2019) supported the claim that Ghana remained self-sufficient in the production of roots and tubers (cassava). Indeed the FAOSTAT (2017) indicated that Ghana is the sixth-largest producer of cassava and the third in Africa. COVID-19 however exerted an initial excess demand for processed *Gari*[3] which led to price hikes in Accra and Kumasi. The price hikes did not however affect the availability of the product. The products were available but a bit expensive during the imposition of the lockdown. The price of *Gari* for instance, tripled during the lockdown period. This situation did not degenerate beyond the lockdown period. Using Tendall et al. (2015) concept of resilience, we observed that roots and tubers were available in adequate quantities and were accessible to consumers. Generally, it can be concluded that Ghana remained resilient in the production of roots and tubers viz-a-viz the Tendall et al. (2015) and Pisano (2012) criteria on resilience. We note that production did not remain intact during the lockdown but was characterized by delayed production. Table 1 shows a reduction in area cultivated but this did not affect output and yield obtained in the year 2020. Second, the production system was able to re-organize itself given the fact that the lockdown imposition was short-lived and existed in the cities (Accra and Kumasi). In terms of system adaptation, the agricultural sector was exempted from the restrictions and specific exceptions were made for key production activities to be carried out. We, therefore, conclude that roots and tubers production remained fairly resilient during the lockdown and post lockdown period of COVID-19. Responses from KIIs suggested food stock availability in the typical production centers.

In the Northern Region, for instance, an M&E officer indicated that:

> Farmers had already grown and harvested enough yam. The lockdown did not affect farmers directly but it brought about limitations in transporting produce to the major cities which witnessed the lockdown (KII/Male/Northern Region/March, 2020).

This assertion was generally corroborated in all the other 15 administrative regions where farmer interviews were conducted. In the Oti Region, a farmer indicated that:

> Preparations were underway for us to start with our land preparatory activities to grow yams. Farming is our major occupation and we always go to the farm even though we heard that in Accra and Kumasi there was an imposition of a lockdown and COVID-19 cases kept on escalating" (KII/Female Farmer/Oti Region/April,2020).

Second, we observed that renewed efforts within the last couple of years to expand and formalize the buffer stock system provided a platform for managing food stocks (especially grains and legumes – maize, rice, millet, groundnuts) efficiently during the pre and post COVID-19 lockdown. Although the buffer stock system primarily supplies food to Senior High Schools (SHS) and other pre-secondary school feeding programmes, the closure of schools, led to a re-direction of efforts to serve local communities. In May 2020, the Ghana Education Service (GES) in collaboration with the National Food Buffer Stock Company (NAFCO)[4] aggregated unused food stocks from various secondary schools and delivered them to the Ghana Prisons Service to feed vulnerable inmates. In addition, the Ghana Commodities Exchange (GCE)[5] established in 2017 promoted the marketing of grains and cereals. Given Tendall et al. (2015) framework of

resilience, we conclude that the establishment of the Ghana Buffer stock system helped to manage grains availability and access in Ghanaian communities. Storage in the buffer stocks remained low but a conclusion cannot be drawn that it led to unavailability and food access challenges.

Third, the Planting for Food and Jobs (PFJ) programme consolidated gains in productivity improvement for cereals and legumes. Tanko et al. (2019) indicated that PFJ led to improvement in rice productivity and welfare outcomes of rice farmers in northern Ghana. Lambongang et al. (2019) showed that maize farmers enrolled on the PFJ made additional productivity gains of 4 bags for every acre of land cultivated in comparison to non-enrolled PFJ farmers. Indeed, discussions with various M&E officers were unanimous that the PFJ continued to consolidate Ghana's food security gains particularly in the grains (maize and rice) and legumes. This is a positive stride toward the achievement of SDG 2. Using Tendall et al. (2015) and Pisano (2012) frameworks of resilience and the SWOT analysis framework, we conclude that the PFJ contributed to strengthening Ghana's cereals production through the continuous production of grains that remained available and accessible during the pre & post lockdown periods. Shortages were not recorded but rather price hikes reported in Accra and Kumasi. Maize production was delayed but the value chain reorganized itself quickly within the limited period of lockdown and adjusted given the exemption for agricultural activities. The evidence did not suggest a reduction in production due to the uncertainty of COVID-19. We conclude a fair resilience even though the pre-COVID-19 situation does not show domestic self-sufficiency in cereals and grains.

An M&E officer in Ashanti Region indicated that:

> Since the inception of the PFJ programme there have been mixed reactions from the general public regarding its effectiveness in ensuring a steady supply of grains, I can say on authority that the PFJ has been very successful in ensuring a revamp in domestic production of maize. For once, the heavy imports of maize have come down drastically (KII/Male M&E Officer/Ashanti Region/April, 2020).

In an interview with a smallholder female farmer in the Savannah Region, she indicated that:

> The Planting for Food and Jobs helped me a lot because the government gave me inputs which I previously struggled to purchase, I only paid up to 50% which for me was a lot of money taken off my production cost. I witnessed a massive improvement in my maize outputs last year, I think the government should continue . . . . (KII/Female Farmer/Savannah Region/March, 2020).

Generally, across all regions where interviews were conducted it was found that farmers, extension, and M&E officers asserted that the PFJ consolidated and strengthened food security gains. Using the conceptual underpinning of what constitutes resilience by Tendall et al. (2015), we use two factors (the ability of a system and its components to provide adequate food at all times and its accessibility to individuals) and Pisano (2012) to examine resilience and found out that Ghana's roots, tuber, cereals, and legume sectors remained resilient even though delays were encountered in production and the sector was fraught with labor mobility challenges. Indeed, the initial lockdown imposition period witnessed a freeze in some cases, and in others, delay in production because farm labor migration to production centers was curtailed. Additionally, we use the SWOT framework, to extrapolate that Ghana remains strong in roots and tubers but is constrained in the legumes, cereals, and vegetable production. We observed that, during the lockdown, Greater Accra and Kumasi experienced price hikes in cereals which affected accessibility. In summary, Ghana's key strength lies in its self-sufficiency in roots and tubers, provisioning of buffer stock facilities, and PFJ in consolidating gains made in grains.

5.2. Weaknesses

A first inherent weakness includes a reliance on other countries for up to nearly 60%, 100%, and 75% of rice, wheat, and poultry products, respectively. Ragasa et al. (2020) indicated a high dependence on rice and wheat imports. Although local production can be ramped up for rice,

wheat cannot because of ecological constraints. There are inherent inefficiencies in the poultry subsector which makes it uncompetitive even though production increases yearly (Table 2). In an interview with a poultry farmer in Greater Accra, he indicated that:

> We always stressed the fact that poultry products imported from the USA and even China are relatively cheaper than what we produce locally because poultry production outside Ghana is highly subsidized (KII/Male/Poultry Farmer/Greater Accra/2020).

In another interview with a farmer in Bono Region, he indicated that

> We import virtually everything involved in the poultry production, right from the day-old chicks, veterinary medicines, and vaccines. Imports of poultry inputs had ramifications on our local currency (KII/Male/Poultry Farmer/Bono Region/2020).

Agbehadzi et al. (2019) bemoaned the high imports of day-old chicks in starting production. This raises grave concerns about the local capacity for producing day-old chicks. This consequently affects the quantum of locally produced birds (Table 2). This structural challenge in the poultry industry is exacerbated by the high cost of poultry feed and other poultry inputs. Thus, a unit output from a Ghanaian poultry farm costs higher to produce compared with imported products which are more price competitive. This has promoted high poultry imports (Banson et al., 2015; Kusi et al., 2015; Kwadzo et al., 2013; Sumberg et al., 2017). Using the concept of resilience, we observed that notwithstanding supply challenges, day-old chicks and poultry products continued to be available on the market in the year 2020. There were some initial contractions in supply during the lockdown period which meant a non-resilience (not available at all times and all levels) but this did not prolong in leading to supply deficits. We acknowledge that during the onset of the COVID-19 and the lockdown, the production was not the same as the pre-COVID -19 period, exposing Ghana's agri-food system vulnerability to pandemics. Poultry products remained available and accessible to the Ghanaian consumer but not without production challenges pointing to the need for farmers to be subsidized in their production to remain competitive.

Second, significant deficits in terms of warehousing space for mobbing up grain surpluses and storing for lean seasons continued to persist.[6] Manu et al. (2018) noted that warehousing for bagged maize improved in Ghana. Despite this improvement, there still appears to be a wide gap in warehouse provisioning. Government lacks the needed capital to make the required investments in storage and distribution infrastructure in the short to medium term. There seems to be little progress in improving the shelf life of perishable products like tomato and garden eggs – the processing infrastructure for these products has not expanded as expected. This supports the findings of (Anang et al., 2013; Robinson & Kolavalli, 2010) that observed Ghana's low processing capacity for tomatoes. Adopting the concept of resilience, we observed that, this weakness affected food availability and access during the pre and post-lockdown periods in Ghana (January – May), this weakness did not however affect Ghana's grain supply, availability, and access. The agri-food system did not respond with hastening the completion of the warehouses in progress, the state as of May, 2020 did not worsen than before but remained the same without an additional improvement.

Third, the lack of standardization and product grading limited the extent to which wholesalers could order supplies from production centers without being physically present. Most wholesalers however were compelled to order via phone without physical inspection. This process either built trust or revealed non-loyal producers. In March and April 2020 when movement restrictions were enforced, some aggregators could not trust producers to supply without physical farm gate inspection. This created some supply gaps during the lockdowns, particularly in the urban centers. Here again, because the lockdown was not prolonged and only imposed in the cities, using Tendall et al. (2015) and Pisano (2012) framework of resilience, we conclude that this weakness worsened the already existing weaknesses particularly during the pre and post-lockdown period. The system

adjusted to the changes, re-organized in a novel way to the existing system, and recorded disruption to regular production demands. This points to vulnerability in the agri-food system. This however did not escalate to food unavailability and access challenges.

A market woman interviewed at a yam market in Greater Accra Region indicated that:

> I was unable to get yams from the North due to the lockdown and I could not simply make arrangements for a vehicle to bring them. This was due to our typical practice of physically inspecting the products before purchase" (KII, Female/Greater Accra/2020).

In another interview with a market woman in the Bono East Region, she indicated that:

> I had a lot of food products at the market but due to the lockdown in Accra and Kumasi, the products just remained on the shelves. I normally aggregated the food products at the market and transported them to Accra and Kumasi (KII, Female/Bono East Region/2020).

In summary, Ghana is heavily dependent on rice, wheat, and poultry imports. The country recorded deficits in its warehouse spaces for storing grains and lacks standardization and product grading. These weaknesses, however, did not render Ghana non-resilient in terms of access to food and availability.

5.3. Opportunities

The main opportunity in all these challenging times (pre & post-lockdown) especially for the Ghanaian agri-food system is two folds; First, the potential for Ghana to meet her demand for rice locally or at least reduce its imports as much as possible exists. Nyarko and Kassai (2017) underscored Ghana's high rice import dependence. An M&E specialist in Central Region suggested that initial assessments of his region signaled that with the right infrastructure and investments, local production in that region alone could wean Ghana off imports completely or significantly reduce it.

In his opinion,

> the threats of COVID-19 opened a new door for dialogue and reconsideration of Ghana's rice production and processing. The good development here is that in the last two to three years, rice production in the region increased significantly. This could be partly attributed to the PFJ and some significant investments being made by the John Agyekum Kufour Foundation, a local NGO (KII, Male/Central Region/2020).

In other regions, more farmers registered with their district agricultural directorates to grow and process rice locally. Perhaps, COVID-19 challenge could pull the lever to raise Ghana's commitment to cultivate rice and feed itself. The areas to focus on as attempts are made to move things forward include the timely supply of good quality seeds; supporting farmers to access machinery and ultimately rolling out modern processing infrastructure within the context of efficiently managed markets. Cappelli and Cini (2020) argued that there exist shortages in food supplies and domestic productions in dealing with the global dimensions of COVID-19. Domestic production of wheat and flour has proven to be lifesavers in most European countries. Ghana and by extension most West African countries can mimic the European examples by exploring its competitive advantages in specific food items. Using Tendall et al. (2015) framework of resilience, we conclude that a component unit (inputs supply) within Ghana's rice sector could be well resourced to supply farmers with quality rice seeds to meet domestic demand. Considering the pre and post COVID-19 periods, the lockdown period restricted labor mobility but this did not adversely affect seed supply. We conclude that Ghana's food and livestock production suffered disruptions during the onset of COVID-19 and the lockdown bringing into question the vulnerability of the system, this however remained marginal and did not worsen the pre-COVID-19 status of the country's food system in terms of production. The system re-adjusted quickly to contain the effects of COVID-19.

Second, given the fact that Ghana has excess capacity in the production of roots and tubers like cassava as supported by Poku et al. (2018), this might be the time for Ghana to explore further the potential to produce cassava-based pastry products, biscuits, and bread. Current household

expenses on bread, wheat-based products, and biscuits are quite high. There is room for the development of cassava products using government purchasing power to create demand. Several secondary school children benefitted from one meal a day from the central government whilst in school. If our concern lies with switching the Ghanaian taste, the School Feeding Programme (SFP)[7] might be a good place to start with, for instance, cassava bread. This will reduce our dependence on wheat which is imported and replaced with our excess cassava output. Using Tendall et al. (2015) and Pisano (2012) framework of resilience, we conclude that Ghana's agri-food system has the needed capacity to produce adequate roots and tubers. Subsequently, there were no production shortfalls or unavailability of roots and tubers during the COVID-19 lockdown and post-lock down. In summary, Ghana has opportunities to revamp her domestic rice production as well as add value in terms of processing its roots and tubers.

5.4. Threats

Some of the existing threats include the Fall Army Worm (FAW) invasion and low investments in agriculture and specific threats emerging out of the COVID-19 outbreak.

First, the initial challenge of rapid devastation by FAW highlighted by (Banson et al., 2020; Nagoshi et al., 2018) had not disappeared completely. In the middle belt of Ghana, where planting begun in the first quarter, recorded threats from the FAW invasion. This posed an imminent threat to crops given the mobility restrictions during the lockdown period. This was further aggravated by the supply gaps created owing to the closure of borders and non-production of agricultural inputs in countries of origin. In addressing this challenge, the regional agricultural directorate in the Ashanti Region for instance, had to negotiate with regional authorities to obtain clearance for farmers to be allowed to spray their farms during the lockdown. In an interview with an M&E officer in Ashanti Region, he indicated that:

> As a directorate, we made a case for smallholder farmers to be exempted to undertake essential farming activities during the 3-week lockdown. We strongly believed that food crop production could not be compromised even in the period of the pandemic (KII, Male/Ashanti Region/2020).

It is commendable that this case was made by the M&E experts in Ashanti Region, because even with the departure of COVID-19, food remains essential to the survival of humankind, it could trigger another spell of hardship for the poor and militate against Ghana's target of SDG – 2. Assessing the disruptions caused by FAW within the framework of resilience by Tendall et al. (2015) and Pisano (2012), we conclude that, FAW invasions were not widespread and did not adversely affect production activities and produce in fields in causing food unavailability and access challenges (Please see Table 1). The system responded effectively through the deployment of Agricultural Extension Agents (AEAs) who were able to contain the few cases reported. Additionally, given the previous incidence of FAW, farmers had built capacity on control measures. Minimal disruptions occurred to production but the system remained intact. The system took about a month to re-organize itself into the pre-COVID state. Farmers still visited their farms and producing because most of the production centers did not have the imposition of lockdown but suffered the indirect consequences.

Second, we observed that low investments in agriculture hamper development in the sector and this was exacerbated by the COVID-19. Even though the government introduced COVID-19 alleviation funds, it targeted mainly formal sector organizations whereas smallholders' farmers remain largely informal (See section 2). Beneficiaries needed to be formally registered with Tax Identification Numbers (TIN) which by default excluded many smallholder farmers. Ironically, the COVID-19 period constituted one of the most critical periods where farmers needed financial support to boost their already existing low production. The government's attention has centered on allocating more financial resources to the health sector and this can potentially stifle investments in the agricultural sector. Already, capital investments in agriculture are low. Way below the 10% of Gross Domestic Product (GDP). The COVID-

19 attracted funds to the health sector. Thus further threatening the agricultural sector productivity gains. Literature (Benfica et al., 2019; Mason-D'Croz et al., 2019) however advocates for increased investment in the African agricultural sector. Using the framework of resilience Tendall et al. (2015) and Pisano (2012), we argue that even though agricultural investment remained low and, had negative repercussions for the sector, it did not substantially affect food production, availability, and access during and after the lockdown period. The system responded through the provision of social protection activities by providing free cooked meals for the vulnerable in the cities, most of whom were not farmers. The response was not on point in this regard. We envision a worsened financial situation for the smallholder farmer. The agri-food system in terms of the financial landscape remained non-resilient.

Third, emerging threats resulting from COVID-19 to the agri-food system in Ghana were numerous. We discuss six of these threats.

(i) A ban on social gatherings meant that extension activities to prepare farmers for the major season were curtailed in March and April 2020. This jeopardized some of the gains made so far in some administrative regions in terms of technology transfer and sustenance. An alternative to the physical meetings being envisaged is the use of the extension mobile vans. Limited extension mobile vans however presented a challenge. This suggests that they can only reach very few farmers before the season begins. Operational costs for these vans and the personnel to operate them were not been budgeted for 2020. Kwapong et al. (2020) suggested that peer-to-peer extension remains a viable alternative to explore to reach underserved farmers, and perhaps during pandemics such as COVID-19, this should be the way to go.

In the words of an M&E officer, he argued that:

> three months ago no one knew this viral disease could permeate to this extent and so there was absolutely no way we could plan for it. Ultimately, some regions fell on the local radio stations to carry their extension messages across to farmers (KII, Female/Savannah Region/2020).

No one envisaged a pandemic of this nature with the possibility of shutting down global economies and borders and to think that local governments would have budgeted for it is farfetched. Assessing the social gathering ban within the remit of resilience, we argue that, restrictions on social gatherings were short-lived and had exemptions on agricultural production. There were only indirect effects in the food basket areas in Ghana. Labour mobility was a major challenge encountered which led to delayed planting.

(i) There were further concerns that the Ministry of Food and Agriculture (MoFA) staff working in close partnership with communities including extension agents and market surveyors did not have access to Personal Protective Equipments' (PPEs) and sanitizers to facilitate their work. These workers were concerned with their safety hence the need to ensure that they did not contract the virus and transfer it to others. Although Ghana began the production of PPEs locally for distribution, the agricultural workers were not seen as frontline staff and were not immediately prioritized during the lockdown.

In an interview with an M&E officer in Ashanti Region, he indicated that:

> We were not given any PPEs to go about our official assignment, so any officer who engaged in extension activities did so at his or her own risk. Already there are lot of myths surrounding the COVID-19, so officials are unlikely to take personal risks (Male/M&E officer/Ashanti Region/2020).

In another interview in Western Region, an officer indicated that:

> The government only prioritized health workers as front liners but the work we as extension officers perform ensures food availability especially in this time and by extension, the government should think about widening the scope of workers classified as front liners to include agricultural extension agents. This is because our work remains vital in such a time which continues to be described as - not normal times (Male/Extensionist/ Western Region/2020).

Concerns were raised about PPEs and extension delivery, here again, farmers adapted a system of making calls via mobile phones and dwelling much on previous farming experience in producing what was needed. We conclude that within the resilience framework, notwithstanding PPEs challenges, food remained available and accessible to consumers, the neglect of provisioning of PPEs posed greater threats to the agricultural extension workers.

(i) It remained uncertain what might happen to fertilizer and agrochemical supplies because of Ghana's high import dependence. There was an initial concern of a freeze in fertilizer production in major countries of origin but here again, there were adequate domestic stocks that nullified this effect. Using the framework of resilience, we observed that agrochemical shops and wholesalers had adequate stocks which were evenly distributed. There were no shortages recorded for agrochemicals and fertilizers, and consequently no adverse effect on food availability and access.
(ii) Planting was delayed for about two weeks in some communities because of delayed rains exacerbated by the COVID-19. The lockdown did not have an impact on only the lockdown areas (cities) but also other areas – this is because people migrate from one region to the other during the planting season, but the lockdown curtailed this. For example, people who moved from Kwame Danso and adjoining communities to Ejura to offer labor services. Such laborers who out-migrate were unable to do so in significant numbers due to the lockdown. This marginally affected area under cultivation, production, and the potential output (See Table 1).

In an interview with a researcher with the Crops Research Institute, the officer indicated that:

Planting delayed for about two weeks. The lockdown did not have a major effect on the lockdown areas but also other areas – this was because people out-migrated from one region to the other during the planting season but the lockdown curtailed this. For example, people who moved from Kwame Danso and adjoining communities to Ejura to offer labour services ceased because of the lockdown. This affected production and the potential output that contributed to price hikes (Male Researcher/Ashanti Region/2020).

(i) Livestock production was affected. Some livestock producers who sold mainly to the school feeding programme were affected. The closure of schools curtailed demand and led to supply deficits in the short run. Indeed, Obese et al. (2021) indicated that COVID-19 affected livestock importation, inputs supply (feed), and disease control in Ghana. During the period of uncertainty, farmers could not correctly predict the future demand and could under-supply what the country needs in 2021. Haleem et al. (2020) rightly indicated that pandemics of this nature lead to disruptions in food production and supply chains, losses in both local and international businesses, and a decline in revenue. Using the framework of resilience, we observed that, livestock sector witnessed challenges but this did not linger for long and was marginal (See Table 2). This was because the lockdown was not nationwide and only lasted for 3 weeks. This notwithstanding, meat products were available and accessible during and after the period of lockdown (January – May).
(ii) Some seed producers missed the planting time, with few others not cultivating at all. Others reduced their total area under cultivation due to uncertainties about the future demand.

In summary, Ghana faced an emerging threat from recorded cases of FAW in parts of the country. The COVID-19 restrictions imposition hampered smooth agricultural extension delivery during the lockdown coupled with the generally low investment in agriculture.

Table 4. gives a summary of the main strengths, weaknesses, opportunities, and threats identified by the study. Taken together, one key weakness, which has potentially grave consequences if the global food chains falter, is Ghana's inability to meet its rice supplies with local production, despite existing evidence that land resources for rice cultivation are available in the country.

Table 4. SWOT analysis for Ghana's agri-food system resilience within the context of COVID-19.

Strengths (+)	Weaknesses (-)
1. Self-sufficient in food staples (Roots and Tubers).	1. High dependence on imports of rice, wheat, and poultry products.
2. Presence of buffer stock systems.	2. Deficit in warehouse space for storing grains.
3. PFJ consolidated gains in grains.	3. lack of standardization and product grading.
Opportunities (+)	**Threats (-)**
1. Potential for Ghana to meet her domestic rice demand.	1.Fall Army Worm invasion of food crops.
2. Potential to process excess roots and tubers produced.	2. Low investment in agriculture.
	3. COVID-19 restrictions hampered effective extension delivery.

Source: Fieldwork, 2020.

6.1. Conclusions and policy recommendations

The main findings from this article are four-fold. First, the Ghanaian agri-food system in terms of production suffered disruptions that led to delayed production and limited labor mobility in many production areas. Overall, this, however, remained marginal and did not suggest a significant effect on production. A key strength lied in the consolidation through direct government policies implemented since 2017 – notably the Planting for Food and Jobs. Second, despite this strength, the system relies heavily on rice, wheat, and poultry imports with underlining warehousing deficits and a lack of deliberate standardization of local produce. Third, there is significant evidence to suggest that Ghana can improve its local rice production to meet the demand and at the same time process excess roots and tuber produced. Finally, with low investments in the agri-food systems, the threat of fall armyworm invasion persisted whilst movement restrictions imposed by the COVID-19 pandemic hampered extension service delivery during the lockdown.

Relying on Tendall et al. (2015) and Pisano (2012) resilient frameworks, we conclude that Ghana's roots and tubers, grains, cereals, and livestock production suffered vulnerabilities in the face of COVID-19, however, the government exemption given to the agricultural sector helped to consolidate the sector's resilience. Overall, we conclude that Ghana's agri-food system in terms of production remained fairly resilient to COVID-19 disruption. A prolonged period and nationwide lockdown would have probably had a dire implication on the agri-food system. To forestall any disruptions in production in the future, we suggest that:

(i) Dedicated attention should be paid to Ghana's comparative advantage in the roots and tubers to position the country as a net exporter. This will require additional funding to the roots and tubers sub-sector coupled with its inclusion under the Planting for Food and Jobs (PFJ) to give it further attention.
(ii) Investment in warehouse infrastructure should be vigorously pursued through investment in Public-Private-Partnership (PPP) engagement under the National Buffer Stock System to adequately construct enough warehouses in all regions in Ghana in a much-advocated concept of food banks that can minimize the effects of pandemics by storing up food products that can last for several years.
(iii) In the broader sub-Saharan African (SSA) context, it will be useful for African countries to identify the crops and livestock that they depend heavily on imports and improve local production through dedicated efforts and investment to reverse the tide of import dependency. If the potential exists, like in Ghana's case with rice, targeted investments should be made to increase output. African countries that do not have the local capacity to produce those crops, can identify a substitute and ramp up production for the substitute to strengthen the resilience and food security preparedness to ameliorate effects of future pandemics and foster the attainment of the SDG-2.

Study limitations

We acknowledge that this study constituted a rapid assessment of Ghana's agri-food system during the initial onset of the COVID-19 i.e. March – June, 2020. This restricted analysis beyond this period. This informed our decision to use a SWOT analysis which has a major weakness of being qualitative and subjective. We minimized this weakness through the additional use of a resilience framework embedded with a food security framework considering two components (access and availability).

The study examined Ghana's agri-food system from a production perspective which appeared narrow but this permitted an in-depth analysis of the food system.

Notes

1. From the period of the partial lockdown to two weeks after the lift of the lockdown
2. Market queen is a term used to denote leaders of specific agricultural commodities in major markets in Ghana. Typically, the market governance system is such that individuals interested
3. Gari is a processed white-creamy granular flour obtained from cassava tuberto trade in the major markets need to do so through the market queens.
4. NAFCO currently has a storage capacity of 3500mt with the potential for expansion
5. Ghana Commodities Exchange is a set-up for regulating buyers and sellers in various agricultural commodities
6. Despite a drive to promote at least a warehouse per district, only 7 out of the 80 warehouses earmarked under the government's flagship programme of one-district one-warehouse had been delivered to the Ministry of Food and Agriculture in 2020
7. School Feeding Programme is a government social intervention programme that provides one free meal for school children in some selected public schools in Ghana

Disclosure statement

No potential conflict of interest was reported by the author(s).

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