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ABSTRACT

Globally, COVID-19 pandemic has negatively affected all sectors of economies. The crisis has drastically impacted food security. The Supply chains, food and nutrition security, as well as current and future production functions have been negatively impacted by a host of factors related to the COVID- 19 pandemic crisis. Hundreds of millions of people were already suffering from hunger and malnutrition before the virus hit. Unless immediate action is taken, we could see a global food emergency. The purpose of this paper was to contribute on understanding of the resultant impacts that COVID-19 has on food security in Rwanda. The paper focussed on a comprehensive literature review on past global pandemics lockdowns and the impact they had on food security on household livelihoods. Food security is a basic human need and basic requirement for survival in difficult times. In the longer term, the combined effects of COVID-19 itself, as well as corresponding mitigation measures and the emerging global recession could, without large-scale coordinated action, disrupt the functioning of food systems. Such disruption can result in consequences for health and nutrition of a severity and scale unseen for more than half a century. The onset of the COVID-19 crisis in Rwanda led to a total country lockdown on March 2020 that exponentially increased Rwanda's food security problems. Being a landlocked country, food supply chain distribution networks were severely constrained. The numerous negative impacts of the health crisis are having a compound effect on all facets of food security, including food production, safety and distribution. The lockdown, curfews, closures of markets, restrictions on border crossings and movement limitation measures (while necessary for public health and safety concerns), hamper the functioning of the agricultural sector, and Small to Medium Enterprise (SMEs) that make up the Rwanda supply chain backbone. These restrictions exacerbate food insecurity and nutritional deficits issues across the country affecting all sectors. Food prices have been showing an upward trend. In March 2020, the CPI increased by 4 percent compared to the previous month, 24 percent compared to the previous year, and 49 percent higher than five years ago. The prices of staple commodities such as beans, maize, and salt continue to surpass their respective 5-year averages. Although the overall Consumer Price Index is higher for the rural areas, the 5-year price data from National Institute of Statistics of Rwanda highlighted that the prices for all staple commodities were lower in rural areas. Rwanda has formulated a social protective plan for the delivery of free food to at least 20 000 households in the capital Kigali. This indicates that urban populations would be more impacted by the upward price changes, especially those in informal sector activities, which require them to be mobile in order to earn an income. The study concluded that COVID-19 crisis is undermining the ability of agri-food enterprises to ensure consistent supplies of food to markets from enforced closures, labour shortages due to illness, and a slowdown in operations caused by physical distancing and lockdowns. These circumstances are compromising enterprises' ability to continue

with business as usual, and in many cases, threatening the survival of some beyond the crisis, with implications for food security and increased long-term poverty and malnutrition.
During lockdown, 95% of participants indicated income decline and 88% reported being food insecure. Three quarters of participants cooked less frequently and half altered their diet. One quarter (27%) of households primarily using liquefied petroleum gas (LPG) for cooking before lockdown switched to kerosene (14%) or wood (13%). These results indicate that the livelihoods of urban Rwandan families were deleteriously affected by COVID-19 lockdown, with a likely rise in household air pollution from community-level increases in polluting fuel use. To safeguard public health, policies should prioritize enhancing clean fuel and food access among the urban poor. The paper suggested three key policy priorities: support vulnerable households to mitigate the impacts of income loss through cash transfer or improved credit access; interventions to improve agricultural inputs supply chains to ease the pandemic's impact on agricultural production; and support food insecure households through direct food distribution.

Keywords: *Covid-19, Lockdown, Food Security, Rwanda*

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INTRODUCTION

COVID-19 is a respiratory illness and there is no evidence that food itself is a vector of its transmission (ICMSF, 2020). However, the virus, and measures to contain its spread, have had profound implications for food security, nutrition and food systems. Global food prices rose close to 20% in the last year (January 2020-January 2021), consistent with broad movements of other commodity prices and US currency trends (World Bank, 2021). Despite a comfortable supply outlook, with food availability projected to be higher than last year's level for most major food grains, prices have been volatile due to a combination of downward revisions in maize and soybean supply outlook, export restrictions by two major grain exporters, and rising demand for feed grains from rebounding livestock production in East Asia, especially China. Given the status of global food supplies, export restrictions are unwarranted and could hurt food security in importing countries (Chitu, Eichengreen & Mehl, 2020).

COVID-19 pandemic has spread rapidly and extensively around the world since late 2019 has had profound implications for food security and nutrition (Klassen & Murphy, 2020). The unfolding crisis has affected food systems1 and threatened people's access to food via multiple dynamics. Countries have witnessed not only a major disruption to food supply chains in the wake of lockdowns triggered by the global health crisis, but also a major global economic slowdown (Laborde *et al.,* 2020). These crises have resulted in lower incomes and higher prices of some foods, putting food out of reach for many, and undermining the right to food and stalling efforts to meet Sustainable Development Goal (SDG) 2: "Zero hunger. (UNDP, 2015). The situation is fluid and dynamic, characterized by a high degree of uncertainty. According to the World Health Organization, the worst effects are yet to come (Ghebreyesus, 2020). Most health analysts predict that this virus will continue to circulate for a least one or two more years (Scudellari, 2020).

Food security and nutrition risks of these dynamics are serious. Already, before the outbreak of the pandemic, according to the latest State of Food Security and Nutrition report (FAO *et al.,* 2020), some two billion people faced food insecurity at the moderate or severe level. Since 2014, these numbers have been climbing, rising by 60 million over five years. The COVID-19 pandemic is undermining efforts to achieve SDG 2 (Sustainable Development Solutions Network, Leadership

Council, 2015b). The complex dynamics triggered by the lockdowns intended to contain the disease are creating conditions for a major disruption to food systems, giving rise to a dramatic increase in hunger. The most recent estimates indicate that between 83 and 132 million additional people (FAO et al., 2020)—including 38-80 million people in low-income countries that rely on food imports (Torero, 2020)—will experience food insecurity as a direct result of the pandemic. At least 25 countries, including Lebanon, Yemen and South Sudan, are at risk of significant food security deterioration because of the secondary socio-economic impacts of the pandemic (FAO & WFP, 2020). In Latin America, the number of people requiring food assistance has almost tripled in 2020 (UN, 2020a). Food productivity could also be affected in the future, especially if the virus is not contained and the lockdown measures continue.

More than 820 million people were already classified as food insecure. According to the Integrated Food Security Phase Classification (IPC) system that is used worldwide to establish objective measures of risks of food and nutrition failure and to prioritize resources and action, this number included 135 million people who are at or above crisis and emergency status (UN, 2020b).

World Food Programme estimates that an additional 130 million people could fall into this category by the end of the year (UNCTAD, 2020a). Near real-time household food security monitoring and model-based estimates suggest that deteriorating employment conditions and other factors may have pushed as many as 45 million people into acute food insecurity since February 2020, the majority of whom (33 million) reside in South and Southeast Asia, and most of the remainder in Sub-Saharan Africa.

The number of children under five years of age who are too short for their age, or stunted, now stands at 144 million, or more than one in five children worldwide. Currently 47 million children under five years of age fall within the wasting category, seriously underweight for their age. Both numbers are an improvement from the recent past, but such gains can be easily reversed. Stunting and wasting in early childhood both have life-long effects; children who suffer them cannot achieve their full physical or mental potential. Wasting increases the probability that children become poor and suffer ill-health throughout their lives, and that they and their children after them will die early (UNCTAD, 2020b).

There are already numerous indications that these numbers could grow rapidly without early interventions to save lives and restore livelihoods. The coronavirus is expected to slash the global economic output by $8.5 trillion over the next two years. Estimates suggest that the number of people who could be pushed into extreme poverty in 2020 may reach as high as about 49 million people, with around half of this increase occurring in Sub-Saharan African countries. Were this to happen, the number of people who are acutely food or nutrition insecure (Bracale & Vaccaro, 2020).

As countries continue to roll out sizable relief and stimulus packages, there is a high risk that they will not reach the most vulnerable. The focus should be on targeted measures that alleviate liquidity constraints on vulnerable firms and households (HLPE, 2020b). This is especially true for poor people in rural areas who may require specific tailoring of these packages to meet their unique liquidity needs. Finance institutions and agribusinesses that cater to the needs of small-scale producers and small businesses need to maintain liquidity through a range of financial tools. They need to be able to provide emergency loans on highly concessional terms, business continuity grants and loans, or moratorium or cancellation of loan repayments for their clients.

Before the COVID-19 pandemic, food insecurity in Africa was already high. There were 235 million undernourished people in sub-Saharan Africa in 2019, an increase of 15.6 percent compared to 2015. In addition, over 73 million people experienced severe acute food insecurity in the region in 2019 (out of 135 million globally). Also,

Sub-Saharan Africa is the only region in the world where the number of the extreme poor increased (from 276 million in 1990 to 413 million in 2015).

Only a few countries are on track to achieve the SDG 2 target of a 40 percent reduction in the number of stunted children by 2030. Although the prevalence of stunting in children under five is falling regionally, the number of stunted children is rising, reaching 58.8 million in 2018. Economic growth is necessary to reduce stunting, but alone itself, is not enough, and nutrition specific and nutrition-sensitive interventions are also needed (World Bank, 2019).

According to the latest Crop Prospects and Food Situation report of FAO (FAO, 2020), 34 out of the 44 countries currently needing external assistance for food are in Africa. Conflict driven crises continued to be the primary cause of severe food insecurity, while drought, floods and other shocks have also aggravated food insecurity conditions locally. The following countries currently require food assistance: Burkina Faso, Burundi, Cabo Verde, Cameroon, Central African Republic, Chad, Congo, Democratic Republic of Congo, Djibouti, Eritrea, Eswatini, Ethiopia, Guinea, Kenya, Lesotho, Liberia, Libya, Madagascar, Malawi, Mali, Mauritania, Mozambique, Namibia, Niger, Nigeria, Senegal, Sierra Leone, Somalia, South Sudan, Sudan, Uganda, United Republic of Tanzania, Zambia and Zimbabwe.

Acute food insecurity was widespread before the COVID pandemic. In West Africa, according to the March 2020 “Cadre Harmonise” analyses, the aggregate number of severely food insecure people (CH Phase 3: “Crisis” and above) was estimated at 11.4 million. If appropriate measures and responses are not implemented, this number is projected to increase to over 17 million people during the next lean season between June and August 2020, well above the 11.1 million food-insecure people that were estimated for the June to August 2019 period (UNESCO, 2015).

In Central Africa, the latest IPC analyses put the number of severely food insecure people in the subregion at about 16.5 million (excluding the Republic of the Congo, Gabon and Equatorial Guinea) in the first quarter of 2020. In Southern Africa, during the peak of the lean season between January and March 2020, the number of food-insecure people was estimated at 13.8 million, more than 20 percent above the figure in the corresponding period in 2019 (Altieri & Nicholls, 2020).

Similarly, in Eastern Africa, before the COVID-19 pandemic, food insecurity was already alarmingly high, with over 33 million food-insecure people (IPC Phase 3+), mainly located in Ethiopia, South Sudan and Sudan. The main reasons for this food insecurity include climatic shocks (drought and flooding), economic challenges and high food prices, the outbreak of livestock pest and diseases, conflict and insecurity, and population displacements. COVID-19 risks further escalating these figures, with huge rises in humanitarian needs and food insecurity because of both the pandemic itself and containment efforts. Slowdowns or reductions in the delivery of humanitarian assistance could be difficult in these contexts (Barrett, 2020). The pandemic will likely have repercussions on humanitarian operations on budgets (as resources may be reprogrammed to support COVID-19 efforts), and on logistics, as movement restrictions will hamper both staff and delivery. This will lead to rising humanitarian delivery costs. Costs of food assistance may also increase in case of any increases in the cost of cereals. This would increase the number of people requiring humanitarian assistance while posing an enormous challenge in terms of the ability of governments and organizations to address those needs. It is, therefore, crucial to rapidly mobilize and pre-empt COVID-19 impacts on food security in food crisis countries. FAO is thus pursuing this approach: maintain and secure existing critical humanitarian operations; and act to safeguard livelihoods and protect the food supply chain to mitigate the secondary effects of the pandemic. Ultimately the COVID-19 pandemic effect will

exacerbate existing food crises in Rwanda and drive worsening food security and nutritional outcomes.

Statement of the problem

The long-term effects of new coronavirus deaths, curtailment of movements, the disruption of food production and systems, and among other factors are not yet known. However, many lessons can be learned from past epidemics and natural disasters and management strategies that have been undertaken by Wuhan, China. The immediate effects have been witnessed in many areas where people scramble and kill one another during the distribution of humanitarian aid. Additionally, many food processing enterprises have been forced to shut down due to strict response strategies, and this can further escalate the food insecurity in the country if these firms cannot restart production soon

The COVID-19 pandemic is having a devastating impact on already fragile livelihoods and unstable economies in the Horn and East Africa. Some of these impacts may include reduced agricultural productivity, weak supply chains, increased cross border trade tensions, limited employment prospects and rising political and regulatory uncertainty. Before the COVID-19 pandemic hit, 33.1 million people in the eastern and central Africa region were severely food insecure (IPC phase 3 or worse) and required food assistance. Of these, 16.95 million are from four of the eight IGAD member countries (Ethiopia, Kenya, Somalia and South Sudan). In recent months, flooding and displacement have pushed thousands into food insecurity. In addition, a predicted second generation of desert locust infestation poses a large-scale threat to food security in the greater Horn of Africa. An already bleak food security picture will be compounded as the the COVID-19 pandemic could destroy livelihoods, disrupt supply chains, strain national budgets, and restrict trade. The UN is predicting that the number of severely insecure in the world could double in the next year.

The COVID-19 pandemic has affected all people in the food supply chain in Rwanda as well as the food security of the country. In Rwanda since the outbreak of COVID-19, it affected different people in the food chain, disrupting supply chain, and hampering trade. Farmers, livestock farmers, food transporters and small and medium agriculture entrepreneurs were all affected by the virus as far as food security is concerned.

On January 18, 2021, in response to the rise of COVID-19 cases, Kigali city began a 15-day lockdown with permitted businesses operating from 4 am to 6 pm. All movements outside of homes to access essential services require an approved permit from the police. On January 21, approximately 3,000 households in Kigali started receiving 3 kg of beans and 4 kg of maize flour or rice per person per week. There are concerns that some households will struggle to access adequate food and income during the lockdown, but the government is confident that rations will reach the most vulnerable households.

Since December 21, 2020, the re-introduction of stricter COVID-19 restrictions is limiting food and income-earning opportunities, particularly for poor urban households. Civil servant salaries have been reduced by a third for six months, with civil service offices limited to 15 percent occupancy. The current national restrictions are also impacting local and cross-border trade, especially among small-scale traders. Households reliant on fishing from Lake Kivu have also been restricted access to the lake. Nationwide, the reduction in labor and income-earning opportunities is impacting household purchasing power, but Minimal (IPC Phase 1) outcomes are expected to persist through January.

The ongoing beans and Irish potatoes harvest is increasing food availability across the country. In January, Irish potatoes prices are average, with a farm gate price of 220-230 RWF/kg and an urban consumer price of 300-350 RWF/kg. A kilogram of beans is being sold at 400-450 RWF compared to 900-1000 RWF during the October to December lean season. Along with the availability of bananas, sweet potatoes, and green maize, rural

areas are relying on their own production, which is driving Minimal (IPC Phase 1) outcomes. Rural household food security is expected to remain stable with the upcoming dry maize harvest in February.

Amidst the global fight against the coronavirus, Rwanda stands apart. Early and extensive measures—a strict nationwide lockdown from March 21 to May 4, pool testing, comprehensive contact tracing, and quarantining of cases—laid important groundwork for the country's broad-based response. The effects of slowed economic activity are far-reaching and consequential. Almost 80 percent of respondents say they have had to deplete savings to pay for food, healthcare, or other expenses since February 2020. 80 percent of employed individuals have earned less pay than they did in a typical week before the government closed schools, and more than 60 percent of employed individuals have spent fewer hours working compared to a typical week.

There is concern that the COVID-19 pandemic could turn into a hunger pandemic in the coming months. The COVID-19 pandemic will continue, and an increasing number of cases and deaths across the region is likely as the anticipated peak of the disease is expected to be towards the end of 2020. National government-implemented control measures are likely to vary across the region. The strict and widespread control measures are unsustainable in the long term. As control measures change, access to income among urban poor households will also fluctuate but overall, many will continue to face a notable decline in incomes. Rural households will likely engage in small scale farming and movement of livestock with some (but not large-scale) disrupted. The impact of the pandemic amidst other shocks will likely cause significant deterioration and erosion of livelihoods and productive assets, food security and nutrition of populations in this already fragile region. The closure of rural food and livestock markets will affect the incomes of rural livelihoods. At the same time, closures of restaurants and hotels will continue to reduce the demand for fresh produce, meat and fish, reducing incomes of farmers, livestock keepers and suppliers.

Dynamics of COVID-19 that threaten food security and nutrition

Supply chain disruptions

There have been major disruptions to food supply chains in the wake of lockdown measures, which have affected the availability, pricing, and quality of food (Barrett, 2020). The closure of restaurants and other food service facilities led to a sharp decline in demand for certain perishable foods, including dairy products, potatoes and fresh fruits, as well as specialty goods such as chocolate and some high value cuts of meat (Lewis, 2020). As the pandemic-related lockdowns took hold in many countries in March-May of 2020, there were widespread media reports of food items being dumped or ploughed back into the fields because of either collapsed demand or difficulties in getting these foods to markets (Yaffe-Bellany & Corkery, 2020). Farmers without adequate storage facilities, including cold storage, found themselves with food that they could not sell.

The movement of food through the channels of international trade was especially affected by lockdown measures. As borders closed and demand for certain food items dropped, food producers reliant on selling their crops via distant export markets were highly vulnerable, particularly those producers focused on perishable food and agricultural products, such as fresh fruits and vegetables or specialty crops, such as cocoa (Clapp & Moseley, 2020). In the early months of the outbreak of COVID-19, some food exporting countries also imposed export restrictions on key staple food items like rice and wheat, which led to some disruptions in the global movement of these staples as well as higher prices of these crops relative to others (Laborde et al., 2020). Certain countries, including those with high prevalence of food insecurity, are highly dependent on imported food and on commodity exports (FAO et al., 2019), which may make them particularly vulnerable to

these types of supply chain disruptions. Many of these export restrictions were lifted by August 2020, although the risk remains that such restrictions might be re-imposed, depending on the severity of any future spikes in the disease and the reimposition of lockdown measures.

Disruptions to food supply chains also resulted when food system workers experienced high rates of illness, leading to shutdowns and some food processing facilities such as meat packing, for example (CFS, 2020; Stewart et al., 2020). Labour-intensive food production has also been especially affected by COVID-19 among food system workers, including production systems that rely on migrant farmworkers (discussed in more depth below), who face barriers to travel and who often work in cramped conditions on farms and in food production facilities, some of which had to close temporarily to contain outbreaks (Haley et al., 2020).

Epidemics, pandemics and natural hazards and disasters such as communicable diseases, tsunamis, floods, droughts, landslides, earthquakes, and locust invasion inflict serious challenges on the economy (Watson et al., 2007). Specifically, epidemics impact negatively on the economy at different levels of society, from country to households to individuals (Kastelic et al., 2015; WBG, 2016, 2019). Epidemics result in less trade and transportation due to restrictions on the movement of people and goods within a country and between countries (Mwakalobo, 2007; Rohwerder, 2020). In 2014, Sierra Leone implemented a 3-days lockdown due to EVD (Kastelic et al., 2015). Limited trade and transportation have direct effects on the source of income of farming communities and food supply chains (Rohwerder, 2020). This is mainly because of restrictions on the movement of people from high-risk areas, quarantines and curfews thus affecting accessibility and availability of food especially if food is produced or sold in the areas regarded as high risk (Gatiso et al., 2018). According to the WBG (2016), 43 percent of Africa's population relies on cross border trade which is usually affected the most by imposed travel restrictions. The report further indicates that there was an economic loss of USD 2.8 billion during the EVD outbreak in Liberia, Sierra Leone, and Guinea in 2014- 2016.

Global economic recession and associated income losses

The COVID-19 pandemic triggered a global economic recession which has resulted in a dramatic loss of livelihoods and income on a global scale (World Bank, 2020a). The resulting drop in purchasing power among those who lost income has had a major impact on food security and nutrition, especially for those populations that were already vulnerable. Those in the informal economy are especially affected. In Latin America, for example, over 50 percent of employment is in the informal sector (FAO & CELAC, 2020). According to the International Labour Organization (ILO), more than the equivalent of 400 million full-time jobs have been lost in the second quarter of 2020 with a number of countries enforcing lockdown measures (ILO, 2020a). Developing countries in particular have been deeply affected, as they were already entering recession by late 2019 (UNCTAD, 2020a). Global growth is expected to fall dramatically in 2020, with various estimates showing a drop in the range of 5 to 8 percent for the year (IMF, 2020; OECD, 2020). Global remittances—a major source of finance in developing countries—are expected to drop by around 20 percent (World Bank, 2020a).

According to World Bank estimates, an additional 71 to 100 million people are likely to fall into extreme poverty as a direct consequence of the pandemic by the end of 2020 (World Bank, 2020a). The World Food Programme estimates that an additional 130 million people will face acute hunger as a result of the crisis, nearly doubling the 135 million people already facing acute hunger (Khorsandi, 2020). Already, a number of severe hunger hotspots have emerged. As the UN reports, some 45 million people have become acutely food insecure between February and June 2020, mainly located in Asia and Sub-Saharan Africa (UN, 2020b).

As food demand has contracted due to declining incomes, food producers' and food systems workers' livelihoods are further affected: food systems are estimated to lose 451 million jobs, or 35 percent of their formal employment (Torero, 2020). Similarly, the UN estimates that around one third of food system livelihoods are at risk due to the pandemic (UN, 2020b).

Widening societal inequities

The global economic slowdown triggered by the pandemic, as well as the spread of the disease itself, has exacerbated existing societal inequities in most countries (Ashford et al., 2020). These inequities are affecting rights as well as access to basic needs such as food, water, and health care, and access to jobs and livelihoods, all of which have implications for food security and nutrition. Food insecurity already disproportionately affects those people experiencing poverty and who face societal discrimination, and it is these very people who are at higher risk of contracting COVID-19 and who have less access to health care services (Klassen and Murphy, 2020). COVID-19 has also exacerbated inequities in access to safe sources of water and basic sanitation. According to the WHO, one in three people lack access to safe drinking water and basic handwashing facilities (WHO, 2020b). People without access to these services, which are vital for health and safe food preparation, are more likely to contract the disease, compounding existing inequities (Ekumah et al., 2020).

Gender inequities have also been exacerbated by the crisis, as women face additional burdens during COVID-19—as frontline health and food system workers, unpaid care work, community work, which has increased during lockdowns (McLaren et al., 2020; Power, 2020). Women are also at risk of an increase in domestic violence due to the recession and confinement at home when lockdown measures are in place (FAO, 2020b; WHO, 2020a). These inequities affect women and their prominent roles in food systems, including as primary actors ensuring household food security and nutrition, as well as being food producers, managers of farms, food traders, and wageworkers. According to FAO, the agricultural activities of rural women have been affected more than those of men (FAO, 2020b). This gender dimension is important because women, in their caregiving roles for the sick, children, and the elderly, are likely at greater risk of exposure to COVID-19, with knock-on implications for food production, processing and trade (Moseley, 2020).

Disruptions to social protection programmes

Social protection programmes have been disrupted by the pandemic, which in turn are affecting food security and nutrition. When the lockdowns began, most schools were closed, resulting in the loss of school meal programmes in both high- and low-income countries. The WFP estimates that 370 million children have lost access to school meals due to school closures in the wake of the pandemic (WFP, 2020a). In some countries, governments and the WFP are developing alternative means by which to reach school-aged children with food assistance, including take home rations, vouchers, and cash transfers (WFP, 2020b). While alternative school lunch arrangements (such as in Cameroon (WFP, 2020c) may close the gap in some instances, in other cases such options are not in place, adding to the financial burden of poor households struggling to feed their families (Moseley and Battersby, 2020).

The global economic recession that resulted from the pandemic and measures to contain it have also strained governments' capacities to provide social protection for those most affected by the crisis (FAO & WFP, 2020). In April, the G20 governments offered to freeze the debt service payments for 73 of the poorest countries, an initiative endorsed by the G7 governments, in order to free up funds to address the fallout from the pandemic. Fully implementing this initiative has been challenging, however, affecting the ability of the poorest countries to provide social protection for their populations through this crisis. According to the UN Commission for Africa (ECA), Africa needs $100 billion to finance its health and safety net response (Sallent, 2020). Most countries may have or will

need to borrow money to finance their response, but unfortunately several countries are constrained in how much they can borrow by already high debt to GDP ratios (Sallent, 2020).

Altered food environments

Food environments have been deeply altered by the pandemic. Lockdown measures and supply chain disruptions outlined above have changed the context and thus the way people engage and interact with the food system to acquire, prepare and consume food. The closure of restaurants and food stalls meant people who relied on foods prepared outside the home for their meals suddenly found themselves preparing food at home. But because of rigidities in supply chains, foods that previously were produced and packaged specifically for food service were not easily repackaged for retail sale and home use.

As the COVID-19 pandemic unfolded, many countries moved to shut down informal food markets, which governments saw as spaces for potential disease transmission, reflecting a 'formality' bias in public health and food policy (Battersby, 2020). Informal markets are extremely important as sources of food and livelihoods in developing countries (Young and Crush 2019). In South Africa, formal food retail outlets, which sell processed and packaged foods, were allowed to remain open while informal and open-air food markets, which typically sell more fresh fruits and vegetables, were shut down (even though open-air markets are actually safer in terms of person-to-person transmission (Moseley & Battersby, 2020)). This move was especially detrimental to poor people who are more reliant on such markets for food because they can buy produce and foodstuffs in smaller quantities. After lobbying from academics and civil society, these markets were eventually allowed to reopen.

Differentiated responses to these changes have emerged. A recent study suggests that poor households are likely to shift their spending away from fresh fruits and vegetables with high micronutrient content to less nutrient-rich staple foods as a direct result of the pandemic (Laborde, Martin & Vos, 2020). Other studies also showed a shift towards consumption of more processed foods (Bracale & Vaccaro, 2020). At the same time, in North America, there was a resurgence of interest in community supported agriculture (CSA) subscriptions, as people increasingly grew concerned about the safety of shopping in supermarkets and desired more direct access to fresh fruits and vegetables (Worstell, 2020), meat and fish products. CSA farms, however, were unable to meet all of this demand. There was also increased interest in home and community gardening as people sought to grow their own food to ensure their food security and nutrition (Lal, 2020). These changes to food environments had variable impacts on food diversity and nutrition.

Localized food price increases

Global cereal stocks are at near record levels and world food commodity prices overall fell in the initial months of the pandemic. However, the overall food price index trends mask wide variability in food commodity prices in the wake of the lockdowns. Initially, prices for meat, dairy, sugar and vegetable oil fell sharply, while prices for cereal grains remained steady. As the pandemic deepened, price trends have shifted, with meat prices rising, for example, as meatpacking workers experienced high rates of illness in some countries and meat-processing plants closed temporarily in order to halt transmission of the disease in worker communities (Waltenburg et al., 2020; EFFAT, 2020).

Further, there have been localized price changes affected by the dynamics of the pandemic, with some countries seeing localized food price increases, including countries that depend on food imports (Espitia et al., 2020). For example, Venezuela and Guyana saw food price increases of nearly 50 percent as of late July 2020, whereas Kenya saw food price rises of only 2.6 percent (FAO, 2020c). This uneven food price impact is the product of several complex factors, including export restrictions initially placed on some cereal crops

such as rice and wheat by several exporting countries, as noted above (Laborde *et al.,* 2020). In the case of rice, for example, prices increased in Thailand, Vietnam and the US by 32, 25 and 10 percent respectively, between February and mid-April 2020 (Katsoras, 2020). Currency depreciation in countries affected by the global recession also contributed to higher localized food prices for countries that rely on imported foods (UNCTAD, 2020a).

2021 Food Systems Summit: The future is now

The Food Systems Summit in 2021, and the preparatory process leading to it, offers governments and all stakeholders a critical opportunity for inclusive dialogues and for mobilizing multi-stakeholder action, both around the short-term socio-economic response and medium-term priorities to "build to transform."

Stakeholders should take advantage of the preparatory process as an important platform to forge an improved and accelerated approach to the complex task of transforming food systems. This can be a rallying call for re-committing to the 2030 Agenda in this area and accelerating progress towards the SDGs more broadly.

The current pandemic has highlighted our fragility, but also the interconnected nature of our world. It underscores the need to work together to address global challenges. Multi-stakeholder collaboration is needed at all levels, and there are many experiences and practical approaches to working together – even in a crisis where time is of the essence.

Food insecurity remains a major concern for numerous rural households in Sub-Saharan Africa who rely on agriculture as their main source of livelihood. The 1996 World Food Summit defines, food security as existing „when all people, at all times, have physical and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life," as in (Mutea et al., 2019). In the past two decades, epidemics and natural disasters have claimed millions of lives, adversely impacted dozens of people, and resulted in significant health, social, and economic consequences (UNESCO, 2007). The report further states that there were 404 disasters between June 2005 to May 2006 with nationwide consequences in 115 countries, including the death of 93,000 people and economic losses totalling 173 billion US dollars. Infectious diseases such as COVID-19, Ebola Virus Disease (EVD), Middle East Respiratory Syndrome (MERS) and Severe Acute Respiratory Syndrome (SARS), their associated mortalities, and desperate control and prevention measures, remain a significant threat throughout the world, thereby deteriorating the production capacity of the world food chains as well as food and nutrition security status of many households (Bloom et al., 2018). Since the first case of the COVID-19 was reported in Kenya, the pandemic continues to deepen pre-existing inequalities as well as exposing vulnerabilities in social, political, and economic systems which are in turn amplifying the impacts of the pandemic on food and nutritional security (Cytonn, 2020).

Following the outbreak of EVD in West Africa, the WHO developed guidelines on preparedness for countries to adapt to avert global epidemics (WHO, 2015). This involves the ability of countries to respond timely, detection of infections, containment, and treatment of cases (WHO, 2015). The report further states that effective, accessible, and efficient local health systems are essential for the prevention and control of infectious diseases. Adoption of these recommendations contributed to early detection of the Zika virus in 2016, the first EVD case in Uganda, and new EVD cases in the Democratic Republic of Congo (DRC) in 2018 (WBG, 2019). Key aspects of preparedness in the health sector include surveillance, laboratory capacities, and mobile health units and community involvement. These, coupled with political will, enabled Korea to contain a potential second MERS outbreak in 2018 and India was able to identify and contain the Nipah virus in 2018 (WBG, 2019; WEF, 2019).

The international community offers many such tools. The Food Systems Summit in 2021 will offer one avenue for action, but there are many other existing institutions serving as spaces within which actors can be mobilized and actions coordinated. Multi-stakeholder platforms that ensure effective representation and voices of all stakeholders can help mobilise rapid and innovative responses to impacts of the COVID-19 pandemic on the agriculture and food sectors.

As COVID-19 continues to advance, it is difficult to know the extent of the impact on food production and distribution systems. Looking at past infections as well as China's way of dealing with COVID-19, might guide policymakers and development partners in future policy formulation and programming. Also, many studies have been conducted to evaluate the impact of epidemics and natural disasters on food security. Most studies posited that many households are most likely to be hit due to negative impact of epidemics on crop production, incomes, movements and food chains which increases the problem of food and nutritional insecurity throughout the world (Kodish et al., 2019; Agrilinks, 2020). For instance, the 2013-2016 Ebola outbreaks in West Africa negatively disrupted the food system and markets, primarily in Sierra Leone, Guinea, and Liberia (Gatiso et al., 2018; FAO, 2015a). Research conducted by the Food and Agriculture Organization on the effect of the Ebola Virus Disease outbreak in West Africa revealed that the epidemic significantly impacted food security, where approximately half a million people were declared severely food insecure in the three worst-hit western African countries in 2014 (FAO, 2015a).

Regardless of the effects of COVID-19, several beneficial inventions have been improvised to support business operations. One of the most embraced innovations is online businesses between farmers and customers, especially in cities or aggregators. Social media has also been used in marketing activities. Home deliveries from agricultural shop outlets as well as fresh horticultural product supplies are among the ideal mechanisms that have been used during the pandemic and may aid in future business transactions. Beyond addressing the immediate concerns surrounding health and food emergencies, COVID-19 pandemic offers an opportunity for decisive collective action towards building resilient food systems (Shikomboleni, 2020). Thus, as various policy-makers in different countries engage on how to meet the food security demands of their nations considering disruptions caused by the COVID-19 pandemic; this is also the time to consider system-wide reconfigurations that can build greater resilience in local and national food systems.

Implications for the six dimensions of food security

The dynamics outlined above affect food security and nutrition in complex ways. The HLPE Global Narrative report highlights six dimensions of food security, proposing to add agency and sustainability as key dimensions alongside the four traditional "pillars" of food availability, access, stability and utilization (HLPE, 2020b). The COVID-19 pandemic is affecting, or has been affected by, each of these dimensions, illustrating the importance of each of these dimensions in interpreting the food security and nutrition implications of the crisis, including the proposed addition of agency and sustainability.

Availability:

While world grain stocks were relatively high at the start of the pandemic and remain strong, this global situation masks local variability and could shift over time. Grain production in high-income countries tends to be highly mechanized and requires little labour, making it less vulnerable to disease outbreaks among farm workers. In contrast, cereals production on smaller farms in lower income countries tends to be more labour intensive and female dominated. In contrast to grains, supply chains for horticulture, dairy and meatpacking are more vulnerable to the impacts of COVID-19 in higher income countries because of their more labour-intensive nature, susceptibility to food worker illnesses, and corporate concentration leading to larger farms and processing facilities where disease outbreaks may spread rapidly.

Disruptions in supply chains for agricultural inputs could also affect food production going forward.

Access:

More than any other dimension of food security, food access has arguably been the most affected by the COVID-19 crisis. The global economic recession triggered by lockdowns has had a very negative impact on people's ability to access food. As the crisis drags on, short-term coping strategies (e.g., savings, the selling of animals and assets) are reaching their limits or have been exhausted, and in developing countries have limited capacity to provide extensive social safety nets (Gerard et al., 2020). Poor households operate on tight budgets with little to no discretionary spending. This means that, in the absence of social safety nets, spending on food declined as incomes declined during the COVID-19 pandemic. These losses have affected low wageworkers, some farmers, and informal traders and hawkers. Food price rises, where they occurred, have directly affected households' ability to purchase enough food. Comorbidities have also deeply impacted some populations, particularly marginalized groups, making them more vulnerable to COVID-19, resulting in higher mortality and morbidity rates, with implications for labour, income and access to food for lower income groups (Moseley and Battersby, 2020).

Utilization:

Utilization and nutrition have been affected by the pandemic in important ways. Good nutrition is essential for supporting the human immune system and reducing the risk of infections. However, as people's ability to access food diminished in the crisis, this had a negative impact on their ability to afford a healthy diet (FAO et al., 2020). This impact is felt especially in low and middle-income countries, where people typically spend a higher proportion of their income on food compared to people in high-income countries, with the poorest households typically spending around 50-80 percent of their income on food (FAO, 2011). The shift in consumption toward more processed foods and fewer fruits and vegetables during the crisis, as noted above, also contributes to poor nutrition. These sorts of dietary shifts could have reinforcing impacts, as people who are experiencing malnutrition—in any form—are more vulnerable to contracting the disease and developing complications (Micha et al., 2020). Access to clean water and safe sanitation is essential for good hygiene as well as safe food preparation, both vital for ensuring good nutrition, but the pandemic widened inequities with respect to access to these vital services, thus affecting nutrition while at the same time increasing disease risk.

Stability:

The severe disruptions to food supply chains noted above are affecting the stability of global food supply and access (Bene, 2020). The export restrictions placed on staples like wheat and rice led to higher world prices for those crops, compared to prices for other foods, which generally fell (FAO, 2020c). Although most of the COVID-19 food export restrictions were temporary, the risk remains that countries may impose new export restrictions (Espitia et al., 2020). The upward pressure on food prices in some local contexts also affects food system stability, and ongoing economic uncertainty, which has contributed to these trends by affecting currency values and presents an ongoing risk to stability in global food markets. Uncertainty over the evolution of the pandemic and of restrictive measures also influences the ability and willingness of people and firms to invest in the agri-food sector (UNCTAD, 2020b).

Agency:

The most marginalized food system participants—including food producers and food system workers—have had little agency as the crisis has unfolded. As outlined above, food system producers and workers have been on the front lines and have suffered higher rates of disease and are affected by supply chain disruptions the most. The loss of jobs and livelihoods negatively affects agency, for example by weakening memberships of workers' unions, and the capacity of unions to defend the rights of workers that may have lost formal

contracts. Youth and women have been disproportionately affected by these impacts. Collective action and the ability to organize have been curtailed by physical distancing measures and lockdowns, as well as government emergency measures in some cases. The pandemic has also negatively affected women's economic and social empowerment, which limits their agency (FAO, 2020b).

Sustainability:

The pandemic is intertwined with the sustainability dimension of food security in complex ways. The expansion of industrial agriculture is associated with a rising prevalence of zoonoses—diseases that transmit from animals to humans—of which COVID-19 is a prime example (Everard et al., 2020). Fragile ecosystems, especially the degradation of wildlife habitats, are widely seen as a key driver of closer human-wild animal interaction that creates an increased opportunity for diseases to be transferred between them. Once the disease began to spread widely, the initial stages of lockdown measures, noted above, resulted in a dramatic increase in food waste due to restaurant closures and declining demand for certain types of foods (Sharma et al., 2020). The pandemic has also resulted in an increase in the use of single-use plastic food packaging and carrier bags, which are not easily recycled (Vanapalli et al., 2020). The pandemic also raises the risk that attention and funding will be diverted from climate change and environmental concerns such as biodiversity loss (Barbier and Burgess 2020), which can affect longer-term sustainability in the food system. The longer-term viability of food systems is also affected by the social and economic losses, the shift in production modalities and the loss of jobs and livelihoods that resulted from the pandemic.

Conceptual Framework

A number of overlapping and reinforcing dynamics have emerged that are affecting food systems and food security and nutrition thus far, including: disruptions to food supply chains; loss of income and livelihoods; a widening of inequality; disruptions to social protection programmes; altered food environments; and uneven food prices in localized contexts (see, e.g., Klassen and Murphy, 2020; Clapp and Moseley, 2020; Laborde et al., 2020). Moreover, given the high degree of uncertainty around the virus and its evolution, there may be future threats to food security and nutrition, including the potential for lower food productivity and production, depending on the severity and duration of the pandemic and measures to contain it. Below is a brief overview of these dynamics, which are also depicted in Figure 1. These effects have unfolded in different ways as the pandemic has unfolded over its initial, medium, and potential longer-term impacts, as summarized in Figure 1.

Impact of covid-19 on households

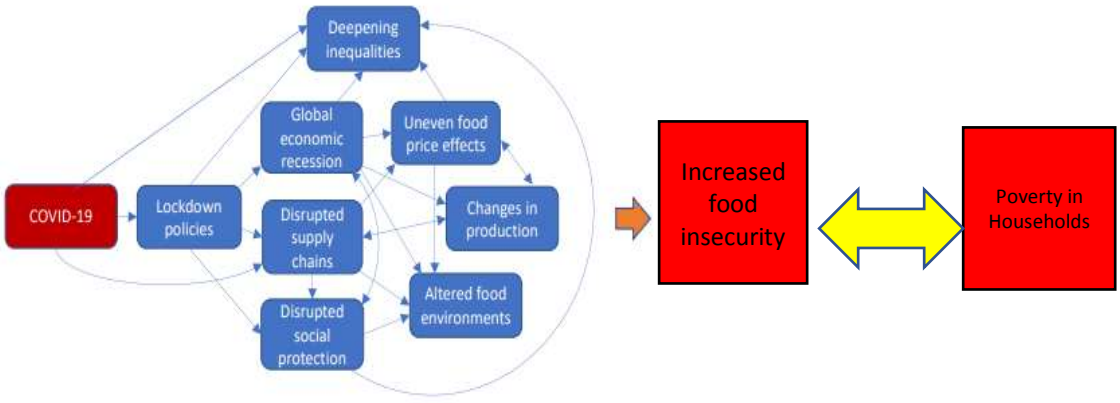

Figure 1: Dynamics of COVID-19 that threaten food security and nutrition

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Food security or vulnerability assessments, which provide a basic understanding of the determinants of food insecurity and vulnerability by location and population group. Vulnerability assessments differ from the more general food security assessments only in their greater emphasis on the risks that households face in their production, income and consumption activities, as well as the threat of rapid and acute declines in food security status. When conducted on a location-specific basis, vulnerability assessments often lead to one or a series of maps which characterize the regional dimensions of risk and coping capacity.

COVID-19 impact on food systems over time

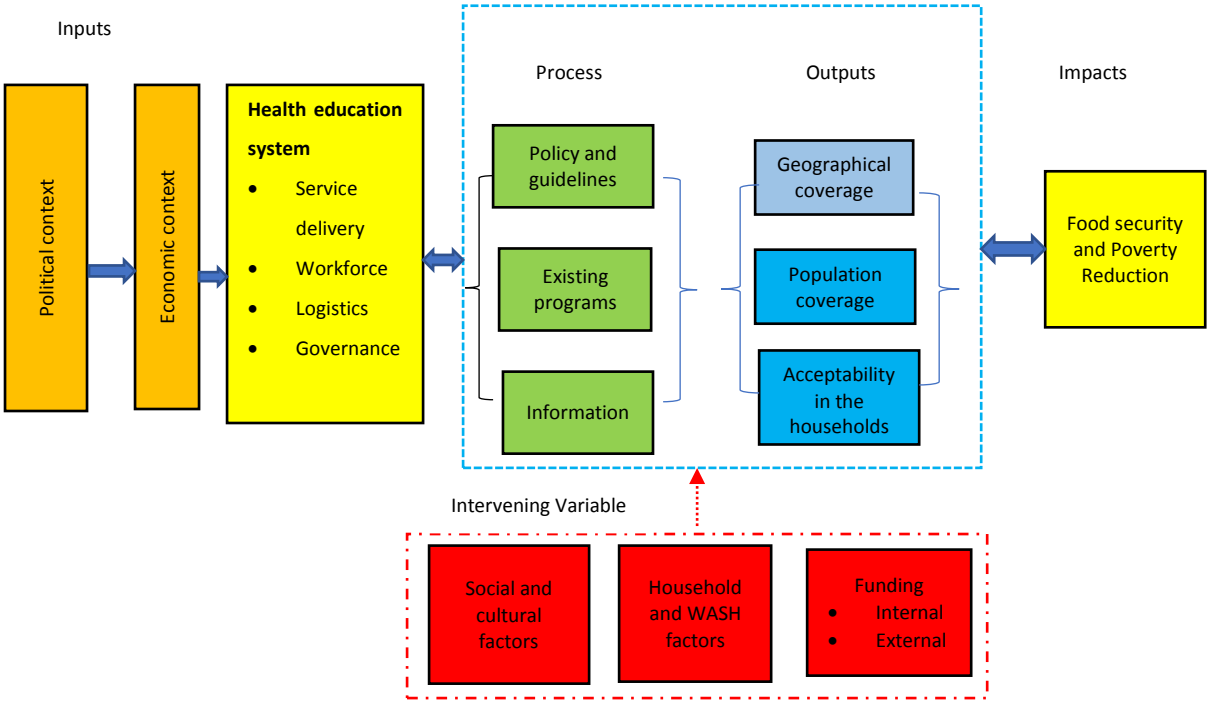

Figure 2: Conceptual Framework on impact of COVID-19 on food Security

The food security status of any household or individual is typically determined by the interaction among a broad range of agro-environmental, socio-economic, and biological factors. As with the concepts of health or social welfare, there is no single, direct measure of food security. However, the complexity of the food security problem can be simplified by focusing on three distinct, but interrelated, dimensions: aggregate food availability, household food access, and individual food utilization. Achieving food security requires addressing all three of these separate dimensions, ensuring that:

- The aggregate availability of physical supplies of food from domestic production, commercial imports, food aid, and national stocks is sufficient;
- Household livelihoods provide adequate access for all members of the household to those food supplies through home production, market purchases, or transfers from other sources; and
- The utilization of those food supplies is appropriate to meet the specific dietary and health needs of all individuals within a household.

Vulnerability is a forward-looking concept aimed at assessing community and household exposure and sensitivity to future shocks. Ultimately, the vulnerability of a household or community is determined by their ability to cope with their exposure to the risk posed by COVID-19. This ability is determined largely by household and community characteristics, most notably a household's or

community's asset base and the livelihood and food security strategies it pursues.

The framework shows that exposure to risk is determined by the frequency and severity of natural and man-made hazards, and their socio-economic and geographic scope. The determinants of coping capacity include household levels of natural, physical, economic, human, social, and political assets; levels of household production; levels of income and consumption, and, most important, the ability of households to diversify their income and consumption sources to mitigate the effects of any risks they face.

Constraints to that access, from either a short- or long-term perspective. In contrast, risk and vulnerability analysis, because it includes the element of risk that households face in their day-to-day decision-making and their capacity to respond effectively over time, views food access from a more dynamic, forward-looking perspective.

Impacts of covid 19 in relation to food security

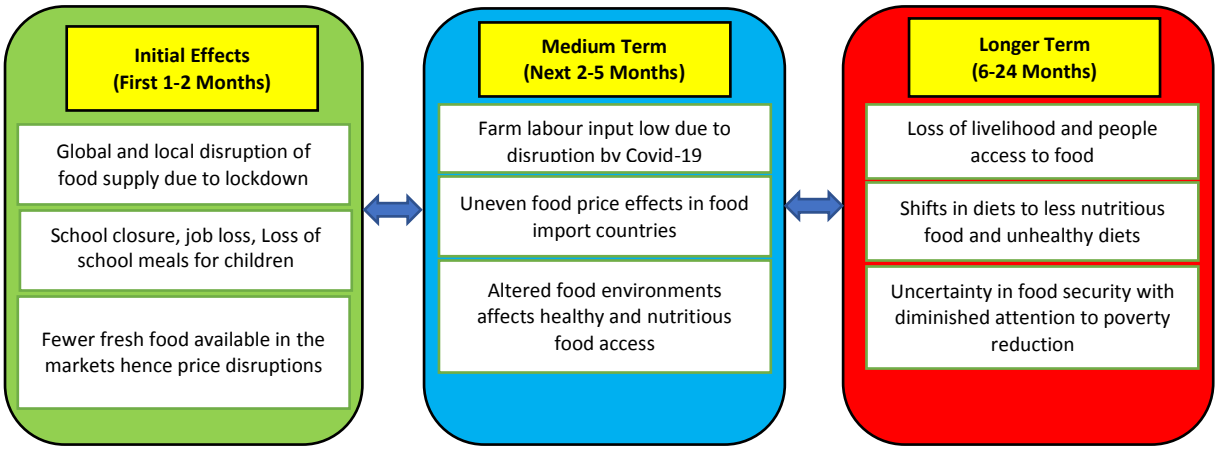

Figure 3: COVID-19 impact on food systems over time

As the COVID-19 pandemic unfolded, many countries moved to shut down informal food markets, which governments saw as spaces for potential disease transmission, reflecting a 'formality' bias in public health and food policy (Battersby, 2020). Informal markets are extremely important as sources of food and livelihoods in developing countries (Young and Crush 2019). In South Africa, formal food retail outlets, which sell processed and packaged foods, were allowed to remain open while informal and open-air food markets, which typically sell more fresh fruits and vegetables, were shut down (even though open air markets are actually safer in terms of person to person transmission (Moseley and Battersby, 2020)). This move was especially detrimental to poor people who are more reliant on such markets for food because they can buy produce and foodstuffs in smaller quantities. After lobbying from academics and civil society, these markets were eventually allowed to reopen.

Differentiated responses to these changes have emerged. A recent study suggests that poor households are likely to shift their spending away from fresh fruits and vegetables with high micronutrient content to less nutrient-rich staple foods as a direct result of the pandemic (Laborde, Martin and Vos, 2020). Other studies also showed a shift towards consumption of more processed foods (Bracale & Vaccaro, 2020). At the same time, in North America, there was a resurgence of interest in community supported agriculture (CSA) subscriptions, as people increasingly grew concerned about the safety of shopping in supermarkets and desired more direct access to fresh fruits and vegetables (Worstell, 2020), meat and fish products. CSA farms, however, were unable to meet all of this demand. There was also

increased interest in home and community gardening as people sought to grow their own food to ensure their food security and nutrition (Lal, 2020). These changes to food environments had variable impacts on food diversity and nutrition.

Threats to food security

The food system is bending under the intense pressure of the world population growth, increasing demand for food, in particular meat and meat products as well as milk and dairy products, scarcity water and land resources and the fight for arable land with the producers of bio-fuels, industry and urbanisation. Climate change, the vanishing of biodiversity of ecosystems and the diversity of agricultural cultivars, new plant and animal diseases, and increasing energy and food prices, the losses food and waste food, as well as speculation on the food market, will have a disadvantageous impact on global food security.

World population growth

In the last 50 years, i.e. in the years 1960-2010, the global population has increased from 3.0 to 6.8 bln people. On 11 October 2012 the world was inhabited by 7,000,976,253 people5 . According to demographic forecasts, in 2025 the Earth will be inhabited by 7.4 bln people, and in 2050 – 9.1 bln people.

The rapid growth of the world's population resulting mainly from the high birth rate in the developing countries, mostly African as well as in some countries of Asia and South America, means that feeding the population is one of the most important issues in the modern world. There are serious disproportions in the level of nutrition of the world's inhabitants resulting from the uneven distribution of food production (the largest areas of food demand are not the same as the largest areas of food production) and inadequate distribution of food, as well as improper political and institutional solutions. It should be emphasized that climate change causing droughts, floods and other disasters will have a disadvantageous impact on global food production ability (FAO, 2019).

Food prices

Global food crisis that began with the sudden increase in food prices all over the world at turn of 2007/ 2008 resulted in an increase in the costs of food product imports (especially in developing countries dependent on import), and had catastrophic effects on the household budgets. The increase in prices is being felt the most by the millions of the poorest people. It is estimated that global food prices can increase by 70-90% by the year 2030, and that's without calculating the impact of climate change, which could cause prices to double

METHODOLOGY

The COVID-19 pandemic is directly affecting food systems by impacting both food supply - as the capacity to produce and distribute food is affected - and demand - due to decreasing consumers' purchasing power. Smallholder farmers producing for export have lost access to global markets. As movement restrictions are imposed: agricultural input - such as seeds, fertilizers and insecticides - supply chains are impacted and access to farmlands limited. All at critical times in the season, reducing production, harvesting capacity, informal labourers' access to wages. On top of that, transport of goods to processing facilities and/or markets is impaired. Livestock supply chains are also exposed to risks: transhumance routes are already affected by movement restrictions and border closings.

Understanding who is suffering from hunger and malnourishment is essential to build momentum for action, to guide decision-making and to engage and empower the vulnerable as agents. To save lives in this and indeed in any future crisis requires robust tracking and monitoring. The need to invest in enhanced monitoring systems and predictive analysis has become apparent in the context of COVID-19. The data community needs to adapt and integrate its tools to provide timely, reliable measurement of the impact of COVID-19 on food security and to make the data easy to access, interpret and use by policymakers to enable them to make evidence-based decisions. This could be

further enhanced if the humanitarian and development community came together to better address the gaps in existing data collection systems, identify data and analysis standards where they don't exist as well as engage with countries where there is limited data or consistent divergences in their interpretation.

Econometric analysis

The study used econometric analysis. The six variables used in this paper are defined as follows:

- Food production index (FPdI) covers food crops that are considered edible and that contain nutrients. Coffee and tea are excluded because, although edible, they have no nutritive value.
- Real gross domestic product (RGDP) is a measure of total output for the Rwandan economy. This variable is expressed in Rwf million.
- Exchange rate (ER) and this variable was in Rwf/USD.
- Government expenditure on rural development (GovDevExp) in Rwf million.
- Food production index (FPI).
- Rwandan Population (MPop).

The choice of six macroeconomic variables is based on work by Aker and Lemtouni (1999). However, there are certain variables that has been substituted for example food security variable itself where food production index has been used replacing Guttman Scale of Food Security. Biodiesel production has been included as a determinant and it is known as one of the fundamental factors in Arshad (2009a & 2009b) and Arshad (2012). The use of RGDP is consistent with previous literature using income as one of the factors influence food security, (see Ahmed & Siddique, 1995, LeBlanc & McMurry, 1998, Arshad, 2009a & 2009b). World food prices as employed in Aker and Lemtouni (1999) are substituted with Rwanda food price index. The use of real exchange rate reflects the strength of the currency. Government expenditure in rural development shows a systemic factor as mentioned in Arshad (2009a & 2009b) and food price index reflects the inflation in food prices. Finally, Rwandan population reflects the population in a country.

Model Specification

The conceptual model for food security that was used in this study was based upon the framework by Thomson and Metz (1996). Within this framework, food security can be defined as a state in which supply and effective demand fulfill aggregate food requirement. Food availability is central to any model of food security and for a long time was the only indicator of food security for a fundamental reason. Food availability refers to the total food available for human consumption, supplied either by production, stocks, imports, or food aid. The empirical model outlined in this paper proposes food production index which will be used as proxy for food security since food production indicate food is available for the population which is produced by a country through domestic food production alone or beyond food domestic production or both. Lack of food supplies will cause hunger and food insecurity. Based upon the literature of food security and its components presented in the previous section, food security is a function of the following variables:

FPdI = f (GDP, ER, GovDevExp, FPI, MPop) ……(1)

where:

FPdI = Rwanda Food Production Index

GDP = Real Gross Domestic Product (Rwf million)

ER = Real Exchange Rate

GovDevExp = Government Expenditure on Rural Development (Rwf million)

FPI = Food Price Index

MPop = Rwanda Population (person)

The first six independent variables (BdPd, GDP, ER, GovDevExp, FPI and MPop) captured the domestic and global supply and demand mechanisms that affect the food economy, and

thus serve to explain food security at the country level. Among the important variables of this model are population determinants where it is more focused on local population. ER is included as a proxy for the availability of foreign exchange, which is needed to purchase food imports. The econometric model outlined above is suggested as a means to assess food security at the national level, and in particular to measure how certain domestic and international market forces affect it.

Thus, to investigate the response of food security to selected macroeconomic variable an unrestricted Vector Autoregressive (VAR) model is explored. The VAR model could provide a multivariate framework where changes in a particular variable (exchange) are related to the changes of its own lags and to changes in other variables and the lags of those variables.

RESULTS

This section presented the empirical results of the analysis which begins with the summary of the unit root test of the variable used for the empirical study in Table 1. Thus, both the Augmented Dickey Fuller (1979) and Phillips Perron (1988) tests are employed. The results shows that the variables expressed at level are non-stationary but when all the variables are first differenced there is evidence that all the variables are stationary. Since the variables n the model follow an I (1) process the next step is to test if there is a long run relationship exist among the variables.

Table 1: Unit Root Results

Variable	ADF		PP					
	Level		1st difference		Level		1st difference	
	No Trend	With Trend	No Trend	With Trend	No Trend	With Trend	No Trend	With Trend
LFPdI	-2.4351	-2.0636	-6.6760***	-7.3234***	-2.6133	-2.0636	-6.5911***	-7.3681***
LBdPd	2.0158	-1.7401	-1.8777	-2.0424	-1.7899	-0.5920	-2.9480*	-3.0463
LER	-1.7406	-1.6094	-5.9295***	-6.0407***	-1.7046	-1.6084	-5.9526***	-6.1640***
LFPI	-1.4908	-2.2591	-2.2065	-2.0216	-2.4575	-2.2005	-4.9224***	-5.0694***
LGDP	0.0254	-2.5762	-5.3705***	-5.3705***	0.3596	-2.5762	-5.3788***	-5.2872***
LGovDevExp	-2.2261	-2.5264	-2.4946	-2.0341	-2.4443	-3.2476*	-8.5224***	-7.7700***
LMPop	-1.3985	1.5879	0.9857	-0.2046	-3.5398	2.1250	-5.8890***	-6.9777***

Source: Compiled by authors from unit root test.

Note: *, **,*** represent significance at 10, 5 and 1 percent respectively.

The number of cointegrating relations from all seven variables, on the basis of trace statistics and the maximal eigenvalue statistics at 5 percent are summarized in Table 2. The result of the test statistics indicates that the hypothesis of no cointegration among the variables can be

rejected for Rwanda and the result reveal that at least five cointegrating vectors exist. Considering the existence of long-term equilibrium relationship among non- stationary variables in the system the analysis employs an unrestricted VAR. The optimal lag length is 1. In addition, since the variables are cointegrated the equations of the VAR also include the lagged values of the variables in levels to capture their long-run relationships.

Table 2: Cointegration Test Results

	Statistic		Statistic	Trace	Max-Eigen
	None	258.2965***	84.36019***	125.6154	46.23142
	At Most 1	173.9363***	60.37140***	95.75366	40.07757
	At Most 2	113.5649***	39.10362***	69.81889	33.87687
	At Most 3	74.46128***	34.95885***	47.85613	27.58434
	At Most 4	39.50243***	27.53697***	29.79707	21.13162
At Most 5	11.96547		7.231683	15.49471	14.26460
At Most 6	4.733783**		4.733783**	3.841466	3.841466

The output of the regression was given in Table 3 while the standard error and the t-statistics are in parentheses. With several lags of the same variables, each estimated coefficient might not be statistically significant due to multi- collinearity but collectively they may be significant on the basis of the F-test. The VAR result reveals the statistical and theoretical significance of the parameter estimate. Looking at the results individually, food price index (FPI) and population (MPop) were found to be statistically significant. Most of the other variables are found not to be significant. Nevertheless, the F-statistics of 1012.67 and 4115.88 are high enough and they imply the overall significance of the model. The lower value of the Akaike and Schwarz statistics suggest that the parameter estimate is significant statistically. The FPI exerts a positive impact on food security. This finding is following the *a priori* expectations. Mpop also shows a positive impact on food security. Both of these variables found to be significant. While the other variables follow the a priori expectations even though not significant.

Overall, the theoretical implications of these variables can further be evaluated from the variance decomposition result. In this study, we are interested with the importance of each variable shock in food security. This is addressed by computing the forecast error variance decomposition based on the VAR estimates. Variance decomposition allocates each variable's forecast error variance to the individual shocks, which is a measure of the quantitative effect that the shocks have on the variables. The variance decomposition suggests that shocks to the food security which is proxied by food production index increase as evidenced in Table 3 shows that own shocks constitute the predominant source of variation for all the variables in the model. The shocks in food security ranged between 100 percent in the first year declining in effects to about 85 percent in the second year, declining further to 74, 66, 58, 48, 40, 33, 28 and 24 percent respectively from year three to ten.

Table 3: Vector Auto Regressive estimates

	LFPdI	LBdPd	LER	LFPI	LGDP	LGovDevExp	LMPop
LFPdI (-1)	0.426931	-0.390678	-0.373703	0.501341	0.257707	-2.545688	0.050041
	(0.19145)	(2.25637)	(0.43875)	(0.32261)	(0.29406)	(1.42466)	(0.03780)
	[2.22995]	[-0.17314]	[-0.85175]	[1.55402]	[0.87637]	[-1.78688]	[1.32387]
LBdPd (-1)	-0.007212	1.100871	0.039454	0.041567	-0.007454	0.385295	0.003843
	(0.02145)	(0.25277)	(0.04915)	(0.03614)	(0.03294)	(0.15959)	(0.00423)
	[-0.33628]	[4.35531]	[0.80273]	[1.15017]	[-0.22629]	[2.41421]	[0.90753]
LER (1)	0.089718	0.258143	0.699340	-0.331358	-0.195896	-1.338030	0.023473
	(0.08880)	(1.04656)	(0.20350)	(0.14963)	(0.13639)	(0.66079)	(0.01753)
	[1.01033]	[0.24666]	[3.43654]	[-2.21446]	[-1.43626]	[-2.02490]	[1.33885]
LFPI(-1)	0.205109	-0.290808	0.149229	0.536911	-0.130302	-0.196216	-0.005610
	(0.07573)	(0.89255)	(0.17356)	(0.12761)	(0.11632)	(0.56355)	(0.01495)
	[2.70831]	[-0.32582]	[0.85984]	[4.20729]	[-1.12017]	[-0.34818]	[-0.37519]
LGDP(-1)	-0.128219	-0.542024	0.025364	-0.169809	0.675638	-0.533630	0.016814
	(0.09679)	(1.14070)	(0.22181)	(0.16309)	(0.14866)	(0.72023)	(0.01911)
	[-1.32473]	[-0.47517]	[0.11435]	[-1.04117]	[4.54476]	[-0.74091]	[0.87991]
LGovDevExp (-1)	0.019389	-0.511249	-0.103552	0.001451	-0.009065	-0.154358	0.000316
	(0.03508)	(0.41341)	(0.08039)	(0.05911)	(0.05388)	(0.26102)	(0.00693)
	[0.55275]	[-1.23666]	[-1.28817]	[0.02454]	[-0.16825]	[-0.59135]	[0.04561]
LMPop(-1)	1.268363	1.967397	0.325126	-0.078328	1.128953	5.455270	0.774483
	(0.58378)	(6.88016)	(1.33784)	(0.98370)	(0.89666)	(4.34408)	(0.11526)
	[2.17266]	[0.28595]	[0.24302]	[-0.07963]	[1.25906]	[1.25579]	[6.71958]
C	-9.704124	-7.139551	-1.886690	2.926529	-7.294239	-29.35451	1.815620
	(4.20107)	(49.5117)	(9.62746)	(7.07902)	(6.45265)	(31.2613)	(0.82943)
	[-2.30992]	[-0.14420]	[-0.19597]	[0.41341]	[-1.13043]	[-0.93900]	[2.18900]
R-squared	0.994074	0.971384	0.838091	0.959615	0.996626	0.680109	0.999168
Adj. R-squared	0.992346	0.963038	0.790868	0.947836	0.995642	0.586808	0.998925
Sum sq. resids	0.034118	4.738895	0.179178	0.096874	0.080489	1.889192	0.001330
S.E. equation	0.037704	0.444358	0.086405	0.063533	0.057911	0.280564	0.007444
F-statistic	575.1297	116.3856	17.74738	81.46776	1012.668	7.289376	4115.882
Log likelihood	64.09269	-14.84712	37.55573	47.39522	50.35986	-0.132644	116.0082
Akaike AIC	-3.505793	1.427945	-1.847233	-2.462201	-2.647491	0.508290	-6.750510
Schwarz SC	-3.139359	1.794379	-1.480799	-2.095768	-2.281057	0.874724	-6.384076
Mean dependent	4.221460	8.267834	1.101416	4.583924	12.35813	7.324655	9.960342
S.D. dependent	0.430950	2.311295	0.188941	0.278170	0.877200	0.436472	0.227031

Apart from its past values, biodiesel production, exchange rate, food price index, GDP, government development expenditure on rural development and population also accounted for variation in food security. Specifically, shock in biodiesel production did not contribute initially

to the shocks in food security in the first year but the contribution rose to 2.62 percent in the second year but decline marginally to 2.32 percent in the third year. Also, shocks in a exchange rate did not contribute initially to the shocks in food security in the first year but the contribution rose to 1.72 percent in the second year and increased to 4 percent in the third year. GDP shocks showed a mixed trend where in the second year it shows 2.91 percent of the shock and it increased till year six but and then decreased marginally till the 10th year. The government expenditure on the rural development showed a positive increase from year to year till year 10. Finally, population shocks contribute an increasing trend at first from year two to five but and then declined marginally till tenth year. As a conclusion it is very clear from Table 4 that biodiesel production, exchange rate and government expenditure on rural development variables will give the highest shock to food security in year ten. Whereas exchange rate and population in year five and finally GDP in year six.

Table 4: Variance decomposition analysis

Variance Decomposition of LFPdI							
	Period	LFPdI	LBdPd	LER	LFPI	LGDP	LGovDevExp	LMPop
1	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2	85.08907	2.619472	1.720207	6.016740	2.914270	0.010612	1.629633
3	74.23988	2.319169	2.822732	11.47288	5.425538	0.567430	3.152372
4	66.31892	3.121540	4.007353	14.14182	7.093766	1.355569	3.961025
5	57.63667	6.945510	5.851022	15.02367	7.977577	2.347262	4.218289
6	48.34943	13.00544	8.491619	14.63232	8.057546	3.438402	4.025245
7	39.78603	19.56963	11.63969	13.48016	7.517403	4.456877	3.550210
8	32.89794	25.28584	14.82764	12.06082	6.666249	5.281881	2.979632
9	27.85382	29.65421	17.70152	10.70295	5.762306	5.884528	2.440673
10	24.34744	32.76595	20.10836	9.550466	4.945198	6.294692	1.987891

In Rwanda, a survey by Business Professionals Network in April 2020 indicated that many small businesses had closed within one month of the lockdown – as many as 57.5 per cent of small- and medium-sized enterprises operating across different industries, leaving thousands of workers without income (BPN, 2020). Following the relaxation of measures in May, many small businesses reopened but are increasingly shifting to digital sales. The United Nations in Rwanda projected that loss of incomes because of lockdown/mobility restriction may lead to poor and marginalized groups remaining poor, and chronic poverty becoming more entrenched. In urban areas, 13.8% of households previously just above poverty line could slip into poverty, and 44.9% previously non-poor households could end up facing income insecurity.

In Burundi, Rwanda and Uganda, food prices increased by 8 to 10% between April 2019 and April 2020, following the start of the COVID-19 pandemic. This represents a significantly higher food inflation rate in the three countries than the average yearly food inflation of 4 to 5%.

CONCLUSIONS AND RECOMMENDATIONS

Since 2004 the growth of sub-Saharan Africa has accelerated mainly due to increased demand and favourable prices for its abundant mining products, creating expectations that Poverty and food

insecurity are most evident in urban and peri-urban areas; but many people residing in rural areas, particularly in remote locations, are especially at risk. The concept of "livelihood systems" is particularly appropriate to analyze the rapidly changing situations of poor households and to design policy interventions effectively targeting those households.

The study concludes that the pandemics largely impacts on food security and nutrition. Therefore, it is necessary to ensure sustainability of resources, strengthen infrastructure and food systems to avoid or minimize food crises in the future. Governments need to put measures geared towards promoting smallholder farming, which accounts for the highest percentage of production for developing countries, such as accelerating e-commerce platforms connecting farmers and consumers. Sustainable, resilient food systems need to be established to boost food safety and minimize transmission of pathogens. This will also reduce future food and health crises worldwide. One of the key ways in which the Rwandan economy can build resilience to mitigate and manage shocks is to create buffers with one vital safeguard being strategic food reserves. Food reserves are required as a buffer to support adjustment in times of drought and subsequent famines that put pressure on fiscal reserves, as well as for other crisis situations such as the current COVID-19 pandemic. The government should also decide whether to reconsider biotech seeds, which might provide greater resilience against climate and pest threats to improve the overall health of the system in the longer term.

The global COVID-19 pandemic, along with the implemented social distancing efforts intended to slow down its spread have brought economies and food systems into disruption at a global and local scale, with wide ranging ramifications in terms of food security. Food insecurity is likely to lead into serious consequences in terms of public health.

Rwanda shows the highest increase in the cost of a nutritious diet. COVID-19 related events abruptly reduced the supply of nutritious foods. This led to lower availability of these foods across the country and increases in their cost. Therefore, the cost of a nutritious diet increased by 12% in rural areas and by 15% in urban areas.

Additionally, emphasis should be placed on protecting supply chains from any form of disruptions in the short term. This is especially so with the current partial lockdown, there is also need for facilitated inter county and inter country border crossing through a coordinated approach of testing and social distancing measures to ensure free flow of staple food commodities.

The FPI exerts a positive impact on food security. This finding is following the *a priori* expectations. MPop also shows a positive impact on food security. This means the more population the more food insecure. Both of these variables found to be significant. While the other variables follow the a priori expectations even though not significant. The variance decomposition also shows that biodiesel production in Rwanda did not contribute initially to the shocks in food security in the first year but the continued to rise till year ten. The findings confirm that in the long run COVID-19 will have a negative impact on food security.

Social protection programs need to be enhanced in developing countries. This is important in maintaining livelihoods and reducing food and nutrition insecurity among households as well as complementing effectiveness of containment measures such as lockdowns and curfews that are meant to reduce social interactions in the community. Among them should include targeted emergency cash transfers and distribution of food items to the most vulnerable in society. Fiscal policy measures such as tax reliefs to avoid disruption of food supply chains; revision of budget for healthcare to enhance disaster preparedness; providing stimulus packages for SMEs and other businesses also reduce the economic impacts of pandemics.

Moreover, COVID-19 highlights that the concept of "One Health" covers more than just the emergence of an infectious disease, but also extends to food-related health outcomes. Ultimately, to prepare for future outbreaks or threats to food systems, one must to take into account the SDGs and "Planetary Health." By doing so, we should be able to mitigate the impact of larger societal and political risks such as vulnerability, livelihoods, etc., and their interactions with the natural environment.

The study recommended several lessons useful for our purpose can be drawn from these reflections:

- **Accelerate progress toward the Sustainable Development Goals and strengthen local and global food systems by supporting local production, rural small-scale producer communities and backyard gardens in low middle-income countries**. Small scale farmers in Africa produce 72% of livestock derived foods. Such support will promote families and communities to feed themselves with diverse food and supporting the nearby urban areas with regular supplies. This approach has been proposed for Africa, where a strategic focus is required to provide key grassroot players in the food system, such as the communities of producers, fishers, pastoralists, indigenous peoples and others, with all the support and facilities they need.
- **Engage with consumers as well as producers to improve food system resilience to shocks**. Food systems are considered to be an important driver of climate change, with emergent impacts on the prevalence and distribution of novel infectious zoonotic and animal diseases as well as other direct impacts on greenhouse gas emissions and biodiversity loss. Understanding and influencing patterns of household consumption may play a powerful role in addressing resultant environmental and social impacts, as well as acting as a driver of reduced economic activity.
- **Identify unintended consequences and trade-offs of cross-sectoral interventions and policies to "future-proof" food systems**. For example, rewilding policies which aim to repair damaged ecosystems and restore degraded landscapes may have indirect and unforeseen effects on human health and welfare including increases in traffic incidents and changes in disease dynamics (e.g., zoonosis). Rampant deforestation, uncontrolled expansion and intensification of agriculture, and damaging activities such as drilling, mining, and infrastructure development are examples of unsustainable exploitation of wild nature and natural resources that have been recognized as main drivers for the incubation and transmission of diseases. Developing well designed rewilding plans demands a thorough understanding of interacting ecosystem processes and the socioeconomic context in which rewilding takes place.
- **Adopt risk-based approaches to target future interventions and policies to mitigate future shocks in the global food system and improve food security**. Despite the difficulty in predicting the impact of COVID-19, it is possible to determine the likely sources of transmission and forecast impacts on the most vulnerable. Risk-based approaches should focus on prevention strategies that are compatible with the local social context and a safe re-opening of the domestic economy with emphasis on food security. Relatively simple policies to encourage measures like the use of masks and handwashing stations to be put in place among informal markets would allow them to stay open and minimize risks to consumers and workers. More integrated approaches should use disease modeling or risk assessment frameworks as tools to support the decision-making process.
- **Increase/develop relevant research capacity and expertise through interdisciplinary training and research funding for scientists and practitioners**. Shocks to food systems, such as COVID-19 extend beyond a single-sector

approach, demanding mobilization and integration of knowledge and skills across geographic, institutional and disciplinary boundaries. Sustainable food systems in the era of pandemics will require food production assistance and new tools, which include analyzing animal health and food safety through systematic approaches that will supply decision makers with significant added value.

- **Promote "One Health" and "Planetary Health" perspectives to cut across traditional domains to address the challenge posed by COVID-19**. The pandemic demonstrates our increasingly global, interdependent, and environmentally constrained societies. Broad integrated perspectives within the wider context of the SDGs are needed to properly address the impact of COVID-19, emerging infectious diseases and health threats on economics, international trade, politics, and inequality. In the future, our ability to prevent diseases and mitigate its impacts will depend on our competence to scale up action on the environment and avoid ruptures of ecological boundaries.

For the case of Rwanda, the study recommended that;

- Governments should scale up support for food processing, transport, and local food markets, and ensure trade corridors remain open to ensure the continuous functioning of the food supply chain and agri-food systems.
- Workers in the Food and Agriculture sector (agricultural production, food processing, distribution, retail and food service) are named as essential workers.
- Assessments to ascertain impact and contingency planning to support impacted livelihoods should continue.
- Support contextualised Agri-based initiatives that mitigate the impact of COVID-19 from disrupting food supply chains and associated livelihoods (e.g., disruption to farming operations, enable access to production inputs, critical emergency veterinary drugs as well as produce markets by farming households).

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