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Effects of COVID-19 Pandemic on Agricultural Food Production among Smallholder Farmers in Northern Drakensberg Areas of Bergville, South Africa

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Abstract: COVID-19 pandemic has greatly affected social and economic activities in the agriculture systems. The extent of pandemic disruptions on agriculture food production systems is lamentably scanty in rural areas. A survey was carried out in the Northern Drakensberg areas of Bergville, and it assessed the impact of COVID-19 on agricultural food production in smallholder farming systems comprising crop-livestock systems. A survey was conducted using structured questionnaires that measured the impact of COVID-19 within farming operations and average crop yield trends pre-COVID-19 and during COVID-19. Most farmers (77.1 to 92.4%) reported having limitations in accessing agricultural inputs of seeds, fertilizers, herbicides, fungicides, and insecticides during the COVID-19 pandemic. Results indicated a continuous decrease in yields of maize, dry beans, and soybeans across two years of cropping seasons during the COVID-19 pandemic. The study demonstrated that COVID-19 lockdowns accompanied by movement restrictions negatively impacted food production of staple crops (maize, dry beans, soybeans) despite suitable rains received during COVID-19 production periods. COVID-19 policies and legislations sensitive to the plight of poor rural communities are necessary as these communities are more reliant on local agricultural food production for their livelihoods and income. Strong co-operations must be established among input suppliers, smallholder farmers associations, extension services, and local retailers to assist smallholders to obtain inputs at local retailers even during COVID-19 lockdown restrictions.

Keywords: agricultural food production; COVID-19 pandemic; smallholder farmers; food value chain; lockdown restrictions

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1. Introduction

It is paramount to establish the resilience of smallholder farmers amid disaster and other shocks such as the COVID-19 pandemic to sustain staple food production, a pillar of food security. Smallholder farmers are those farmers who manage farming land that ranges from less than one hectare to 10 hectares in size [1,2]. They are engaged in various forms of farming activities, of which among these are monocropping, mixed cropping, and mixed farming involving various types of livestock. Crop-livestock farming systems have many benefits, such as sustaining food production, economic growth, soil health, feed for livestock, and reducing contamination of the environment. Smallholder farmers deliver food and nutrition security and other socio-economic and environmental outcomes for the farm-household at local, regional, and global levels [3]. Furthermore, smallholder farmers are crucial to ending hunger and undernutrition worldwide [4]. They are key to global food security and nutrition as they produce about 80% of the food in sub-Saharan Africa (SSA) and Asia [5]. However, smallholder farmers are vulnerable to shocks, which are adverse natural events such as climate change, including health-related shocks, as these affect

production systems and consequently reduce smallholder farmers' productive capacity. According to Elder [6], smallholder farmers are key actors in global food production systems but are often less likely to have the resources, opportunities, and voice needed to manage risk and maintain their livelihoods when exposed to shocks. Recent studies have shown that health-related shocks such as the COVID-19 pandemic create production challenges across the world, including low access to seeds, farm inputs, hired labor, and agricultural finance [7]. Restrictions to limit the spread of the COVID-19 pandemic produced a severe supply-side shock in rural areas of sub-Saharan Africa, including through frictions in agricultural markets [8]. The COVID-19 global impact has vastly destabilized the economies and non-economic activities of various sectors as well as the food production value chains. It has been realized that COVID-19 has an impact on the whole process of the food value chain from field to the consumer [9].

In South Africa, level 5 hard lockdown restrictions were announced on 23 March 2020, to be effected on 26 March 2020 to curb the spread of the COVID-19 pandemic. The lockdown included a prohibition on movement, except for one family member at a time who was allowed to go shopping for essential goods, which were considered as food and cleaning items [10]. This shopping could only take place locally, and public transport was also limited to a few hours a day to allow essential service providers to travel to work. Any travel outside of one's immediate area required permits for essential service [11]. The limitations imposed by the South African government decelerated activities of viable and industrial segments, resulting in diverse categories of income-earning citizens losing their jobs or being underpaid. Small and large businesses, including the agricultural sector, were unable to function. This further impacted the delivery of services as expected, posing an immense danger to the affordability of goods and services within the food supply chain. The Department of Agriculture, Land Reform, and Rural Development declared the agricultural sector as an essential service. The Disaster Management Act 2020 Regulation Gazette No. 11062) [12] was amended to ensure that farmers continued to contribute toward food security. Farmers who lived on their land were able to farm; however, those who had to travel a distance were more challenged. Moreover, challenges of obtaining permits from the police were encountered, which then impacted the accessibility of inputs and sales of produce. Furthermore, this negatively impacted informal traders who obtained produce from farmers and sell to local markets. Farmers who eventually managed to obtain travel permits encountered the challenge of having inputs sold out and therefore out of stock. The extension, as well as advisory services and local offices of the Department of Agriculture, were mostly unavailable, and offices closed [13]. In addition, due to lack of affordability, farmers could not fully observe the protocols on COVID-19 regulations recommended by the World Health Organization (WHO) in the workplace that deal with temperature tests, maintaining social distancing, adhering to wearing face masks, provision of handwashing facilities and regular disinfection of surfaces and objects. All these negatively impacted workforce hygiene and food production [14].

The COVID-19 impact is a health and human crisis threatening the pillars of food and nutrition security of millions of people around the world. The price index for global food production indicates that cereal crops increased, resulting in high food inflation impacting the retail sector across the globe [15]. The surging cost of food impacted access and affordability in households that were already experiencing high levels of food insecurity. This poses a threat in addressing malnutrition as per the Sustainable Development Goals SDGs (Goal 2/3) policy recommendations [16] which also exacerbates the impact of malnutrition at an individual and household level. It is highlighted that during COVID-19, the South African food price inflation showed increased levels ranging from 3.4% in 2019 to 4.6% in 2020, with an estimated value of 5.4% in 2021 [17]. In 2020 it was estimated that between 720 and 811 million people were facing hunger globally, with Africa showing that 1 in 5 people experiencing hunger [18]. Unless immediate action is taken, a global food emergency could be encountered if this global crisis is not effectively addressed [19]. Most of the food worldwide is produced by smallholder farmers, and it is therefore paramount that

immediate interventions are taken to provide support to smallholder farmers to augment COVID-19 food production shocks.

Furthermore, smallholder farmers play a key role within the food supply chain, with many contributing to poverty alleviation, as observed in some countries in Africa and Asia [20]. There is an urgent need for assistance and synergistic support for smallholder farmers through various collaborations from institutions and organizations [21]. This will enable them to contribute meaningfully within globalizing food system threatened by the pandemic. The implication of COVID-19 in sub-Saharan Africa has exacerbated food insecurity due to regulations such as border restrictions, limiting food trade and distribution for farmers who are already faced with other challenges such as climate change, water insecurity, and land degradation [22]. The devastating climate change, including desert locusts and the COVID-19 pandemic, are threatening food security and are a double burden faced by smallholder farmers in some African regions. The direct and indirect impacts of COVID-19 in Africa included but were not limited to illness and deaths of food systems workers, interruption of food supply chains, unemployment, depreciation of currency value, and disruption of social protection programs [23]. This negatively impacted smallholder farmers' livelihoods and Africa's food security. The COVID-19 pandemic effect exacerbates existing food crises in different African countries, especially in East African regions, and drives worsening food security and nutritional outcomes. Furthermore, there is concern that the COVID-19 pandemic could turn into a hunger pandemic in Africa [24]. It is recommended that Africa's medium- and long-term strategies for improving food security should include improving and diversifying its agricultural productivity and production of key food commodities. In addition, African countries, at the regional level, must preserve open and efficient social protection programs and cross-border supply and distribution networks for agricultural inputs [23]. Similarly, smallholder farmers in Asia face double the challenges of climate change and the COVID-19 pandemic. The COVID-19 pandemic has deepened the existing challenges faced by smallholder farmers in accessing key resources essential for the conducive operation of agribusiness. In some countries in Asia, such as Myanmar, COVID-19 impacts on the agri-food system were less evident and often more indirect compared to other sectors such as tourism. This resulted in the rural sector being allocated only a very small share of the government's initial fiscal response to mitigate the economic impacts of COVID-19 [25]. However, studies by the authors of [26] conducted in 25 countries in Asia revealed that there was limited to moderate effect of COVID-19 on medium-term food availability, access, and use in some Asian countries. This was attributed to local production, including backyard gardens, livestock, poultry, and rice-field fisheries, which played a key role in stabilizing food availability and access and especially nutritional security during the pandemic [26]. The COVID-19 crisis shows that small-scale farmers in some African regions, particularly Southern Africa, are not yet prepared for supplementing local communities as farmers have little transformative capacity and agency to establish localized food systems that provide sufficient food for communities. The situation in some Asian countries such as in Indonesia demonstrates that well-organized, small-scale farmer groups are part of the informal economy and are highly acknowledged actors within localized food systems and that these informal local food systems are able to perform with resilience to shocks when larger food supply chains are severely disrupted or break down [27]. Across the regions of Africa and Asian countries, the literature shows that smallholder farmers face the double burden of COVID-19 and climate change that threatens their livelihoods and food security. In addition, the literature shows that the COVID-19 pandemic caused major disruptions in agricultural food production and the food supply chain. Therefore, cooperation between the two continents through established structures is necessary to learn from each other and respond adequately and appropriately to strengthen and sustain food security.

The crop-livestock production system is key toward sustainable food security in South Africa. The production of cereals such as maize, wheat, barley, etc., is essential since they are consumed by most households as staple food [28]. The lack of such staples can have

a vast negative implication within consumption patterns and dietary intake for many households of farmers and the community at large, which might potentially affect food security. Therefore, the investigation of the implications of the COVID-19 pandemic on crop-livestock-producing farmers is of paramount importance in the region. The extent of the pandemic disruptions on agricultural food production systems is lamentably scanty in smallholder farming systems. The study aims to assess the impact of COVID-19 on agricultural food production activities of rural farming systems in three community wards under Bergville local municipality in Northern Drakensberg, South Africa. This took into cognisance crop-livestock production during a three-year cycle prior to COVID-19, which is 2016/2017 to 2018/2019, and during the COVID-19 pandemic, which is 2019/2020 to 2020/2021) and recommended intervention measures to address concerns from the assessment. It was hypothesized that the COVID-19 pandemic with associated lockdown regulations and movement restrictions would negatively impact agricultural food production.

This paper is structured as follows: Section 1 highlights the role of smallholder farms in global food security and challenges they encounter in terms of acquiring resources to manage risks and maintain livelihood when exposed to shocks such as natural- and health-related shocks. It also draws from literature the common devastating effect of the COVID-19 pandemic on agricultural food production among smallholder farmers in Africa and Asia. This section also highlights the importance of the research study using the recent literature to fill the gap in the scientific literature. The other remaining parts of the paper are structured as follows: Section 2 presents the methodology for data collection and its analysis. Section 3 presents the findings of the study, and Section 4 provides interpretation and implications of the findings, while Section 5 reports on conclusions and Section 6 presents recommendations, limitations of research, and the proposed future research.

2. Materials and Methods

2.1. Study Area

The research study was conducted among smallholder farmers within Amangwane, Amaswazi, and Amazizi wards at Bergville in the foothills of the Drakensberg mountains in KwaZulu Natal, South Africa, which are strategic areas for food security of the province. The study area is located at 28°44′ S, 29°22′ E within uThukela Catchment Region at Bergville. The mean annual rainfall range is 712–895 mm, and the mean annual temperature is 17.1 °C (Figure 1). However, temperatures vary substantially from summer to winter [29].

This study area is characterized by the crop-livestock farming system, which is the major contributor to the livelihoods of the many smallholder farmers in this region of Kwa-Zulu Natal. In South Africa, Drakensberg foothills are known as the main hub of crop (maize and legumes)-livestock (cattle) production system. Within the study area, the Department of Agriculture and Rural Development, through Extension and Advisory services units, provides support services for farmers. These services include agricultural inputs and machinery (for training purposes) and advisory services. The farmers are capacitated through the extension advisory support of the Bergville local extension office. Smallholder farmers and commercial farmers' cooperatives form an essential link within agri-food value chains, particularly for cereals and grain legumes. To collect data that will gather knowledge on challenges associated with production, management, and economic activities in the agriculture sector, key variables that could be interrupted by the incidence of COVID-19 were conceptualized as in Figure 2. The figure displays enclosed centralized study areas with projected variables.

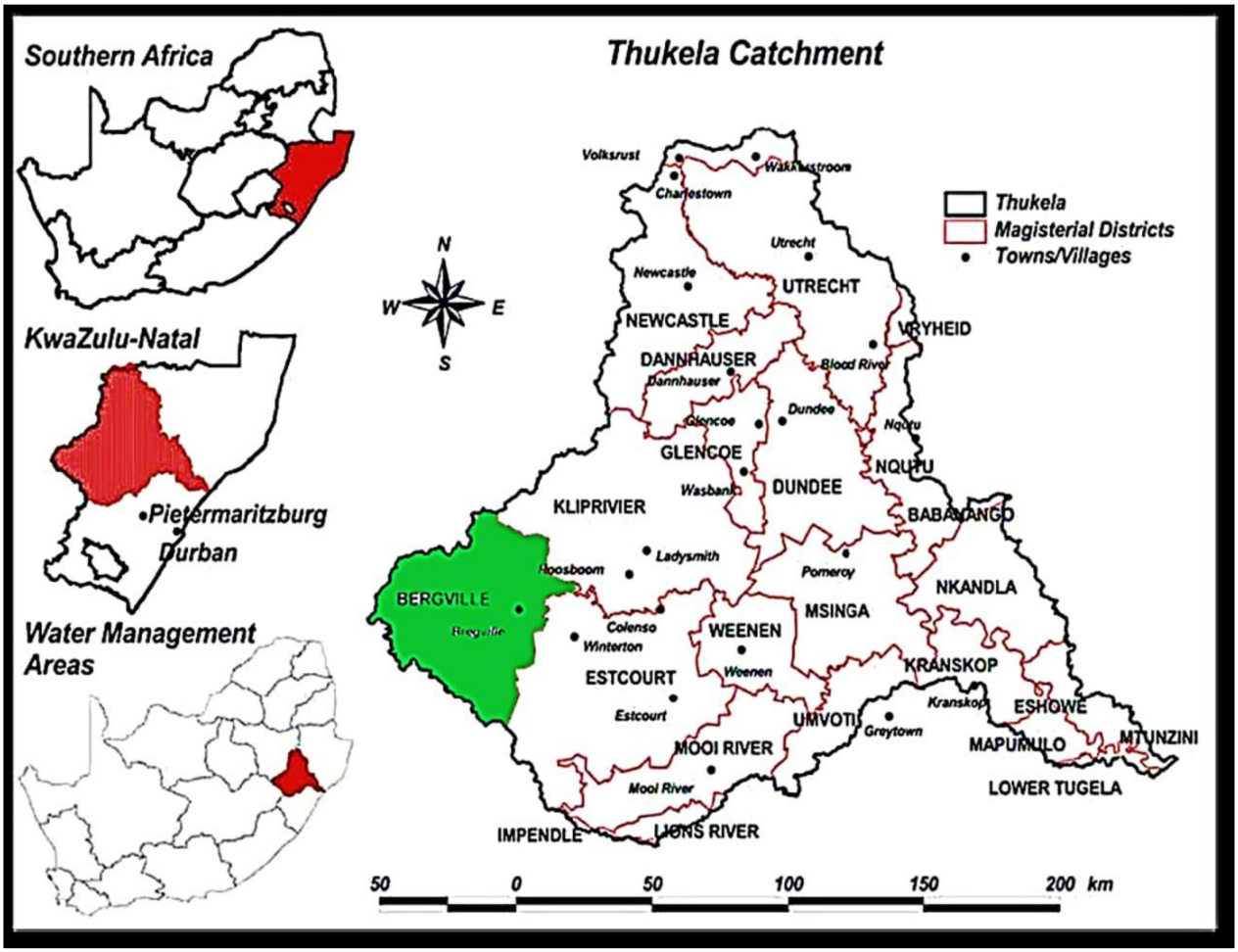

Figure 1. Map showing the Bergville area within uThukela Catchment Region in KwaZulu Natal Province, South Africa.

The study was quantitative in nature and smallholder farmer centered, aiming to investigate the impact of COVID-19 through structured individual farmer interviews and to conduct a situational analysis during the implementation of lockdown restrictions. All guidelines were followed according to the SA COVID-19 regulations and Human Science Research Council for the participation of farmers. Ethical clearance was granted (NScI/03/2021), and the recruitment of smallholder farmers (n = 70) was purposive since these are farmers who are actively engaged in agricultural food production activities per ward. These smallholder farmers play a crucial role in the sustainable food security of the region. Furthermore, these farmers regularly receive agricultural extension services in the district and therefore were requested to participate in the study through collaboration with the Bergville local agricultural district office. A developed questionnaire measured both qualitative and quantitative data on the impact of COVID-19 within farming operations. These included determining average yield trends prior to COVID-19 cycle (PC-1-3) (PC—Prior to COVID-19 cycle starting from 2016/2017 to 2018/2019) to the period during COVID-19 (DC-1 and DC-2) (DC—During COVID cycle starting from 2020 to 2021) cycle of the pandemic. The first three (PC-1-3) cycles comprised production prior to COVID-19, which involved 2017 to 2019 harvests, and the second two cycles involved 2020 to 2021 harvests. In this study area, the crop growing season commences from October to March of the following year. Furthermore, trends in crop yields and climate in terms of rainfall were determined for each growing season, prior to COVID-19 and during the COVID-19 pandemic. Climate trends (rainfall) were calculated by summing up monthly rainfall from local weather stations for each crop growing season to determine if there is any relationship

between the total rainfall and crop yields during the crop growing season. Such information is critical and useful to establish whether the trend in crop yields is due to climate (rainfall) or COVID-19 impact or both.

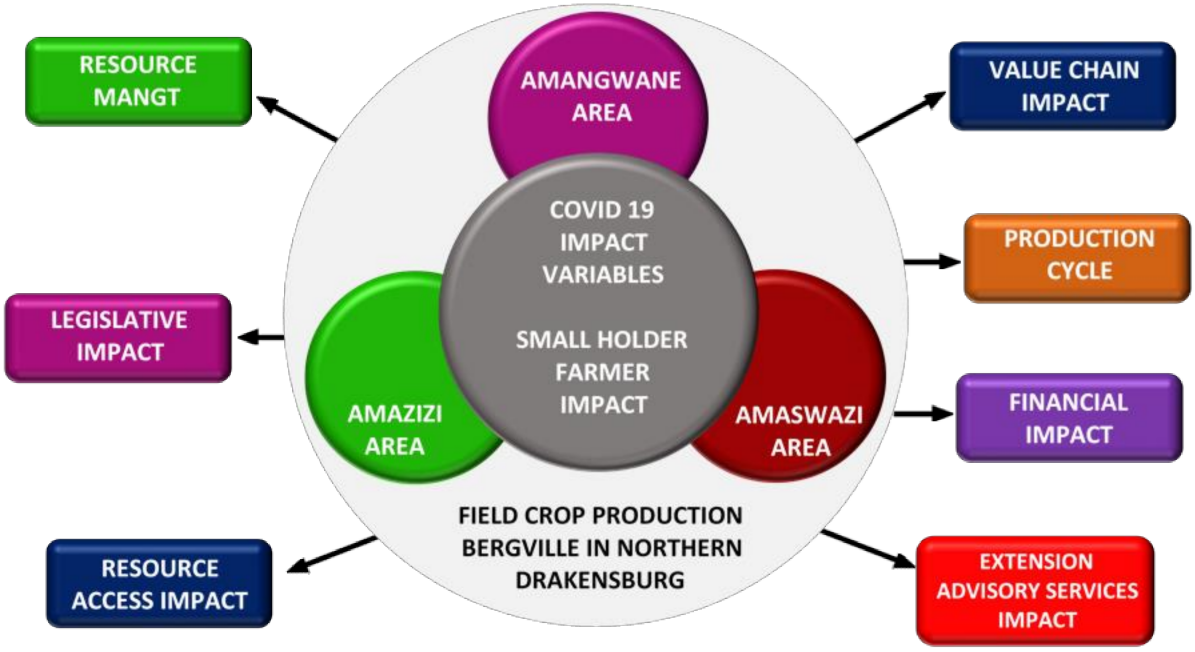

Figure 2. Variables highlighting direct impacts on farming operation during COVID-19.

2.2. Data Collection

Data collection commenced after the recruitment of farmers was conducted through monthly meetings. These official meetings were held after easing of lockdown level five, which had tighter movement restrictions for farmers and provision of extension services. The total sample size (*n*-70) comprised both men and women farmers practicing crop-livestock farming with a mean age of 43.6 (±19.6) years.

Structured interviews were conducted by trained field workers. There were two phases of data collection. Phase 1 entailed the assessment of crop yields prior to the COVID-19 pandemic. Phase 2 measured crop production outputs during the COVID-19 pandemic. This was necessary to assess if there are any differences between these intervals as local production by these small-scale farmers is key in the sustainability of the value chain.

2.3. Statistical Analysis

The data were analyzed using IBM Statistical Package for the Social Sciences computer software program (SPSS) for Windows Version 25.0 to determine the key variables impacting farmer production. The descriptive statistics were used to produce frequency tables. Analysis of variance (ANOVA) was used to determine the mean, standard error (SE), and level of significance for crop yields.

3. Results

3.1. Demographics of Respondents

The survey revealed that male farmers were the majority (n = 70%) as opposed to female counterparts (n = 30%) with higher age categories ranging from 39 to 59 years at 42.9%, followed by the older category range (60–70 years) at 34.3%. During the first diagnosis of COVID-19 in South Africa, the latter age groups were found to be associated with comorbidities increasing higher levels of contraction of the pandemic leading to high levels of stress [30]. Therefore, there is a possibility that this group of farmers could have been increasingly prone to increased anxiety and depression due to impact on the health

status while also encountering other farming challenges, which will be further reported in other sections.

3.2. General Challenges Experienced during Lockdown Restrictions and Regulations

A series of various challenges encountered by farmers during COVID-19 lockdown restrictions are indicated in Table 1. Farmers reported having limited access to services that are required for farming operations. These were due to movement restrictions that were exacerbated by a lack of permits to access the city and nearby towns. The movement restrictions were part of COVID-19 legislation gazetted during 2020 in South Africa.

Most farmers in the study area are practicing crop-livestock farming systems. These farmers indicated major challenges related to animal health services, which resulted in livestock deaths, while crop producers encountered postharvest losses due to poor access to customers associated with stringent movement restrictions. The implications of this included disruptions within the food value chain, food losses, and prices. Similar findings were reported in a study conducted in India on how hard lockdown restrictions negatively impacted food value chains leading to increased food prices and food losses [31].

The value chain operations were impacted negatively as farmers encountered limited access to food production inputs and services, which negatively affected their income. According to the FAO report that was observing the trends of the pandemic, all key players within the food system have shown to be adversely impacted by COVID-19 [32]. This negatively influenced the sequential flow of goods and services to meet expected harvest, processing, storage, transportation, distribution, marketing, and selling of goods. The movement of goods and services within farming operations is vital for the food security pillars (access, availability, sustainability, and use) within the food system. Therefore, it is important that in addressing food insecurity during the era of COVID-19, local food systems must adopt interventions that will mitigate gaps.

Other challenges that emerged during the lockdown were related to the community dynamics attributed to theft of crops and livestock as many people were not at work, including children not attending schools. The increase in the theft was worsened by damaged to fencing, which was reported earlier. This theft was attributed to food insecurity and was part of "coping strategies" for the community as they faced hunger and were unable to gain income during the lockdown. However, this negatively affected farmers' livelihoods.

A double burden challenge (COVID-19 and the impact of climate change observed through flooding) was perceived to be a related phenomenon by farmers. This was due to the highest rainfall of 311.2 mm obtained in March 2021, which resulted in flooding in most parts of Bergville areas (Figure 3). This led to soil erosion and the washing away of fences in crop fields, making nearby community members and livestock have easy access to crop fields. This resulted in the theft and damaging of crops by people and livestock, respectively, leading to loss of income. These negative impacts on food production require farmers to build agricultural businesses and adoption of strategies that are resilient to climate change in order to improve farming systems for long-term benefits [33].

These findings highlighted how the recovery plan for farmers from COVID-19 was aggravated by the impact of climate change. Farmers had to regroup by exploring coping strategies such as borrowing funds from each other to further ensure that farming operations were running, and what was even more urgent was trying to cope with their own household food security.

Table 1. Farmer challenges encountered during lockdown regulations enforcements (n = 70).

CHALLENGE STATUS	
SA COVID-19 Regulations and Lockdown Implications	**Farmer Responses**
Investigative Questions	• "Livestock is our primary source of income for taking our children to school, providing income and we use it for traditional ceremonies. We have felt neglected by government to support us during the maintenance of vaccinating schedules and ensuring animal health."
What are major challenges that you encountered during the implementation of COVID-19 regulations (level 5) in your area?	• "It was difficult to access these essential services for our businesses as permits were not accessible. We could not go to the city or nearby towns to buy inputs for crops and livestock, sell our produce. Accessing extension advisory services was also a challenge and all these challenges resulted in impacting the health of our animals and poor harvest of crops."
	• "Accessing veterinary services was a major concern and threatened the wellbeing of livestock. We watched our livestock get sick and some eventually dying without any access to these services due to restrictions of movement."
	• "The impact of level 5 strict regulations not only restricted our movement to access services, but it also caused us not to have access to our customers which resulted in profit and post-harvest losses particularly."
How different were levels 3–1 to level 4–5 in terms of impacting your farming operations?	• "Level 3 to level 1 (eased restrictions) to a limited extent allowed us to move and access transport to purchase inputs, equipment, extension services, veterinary services, customers, auctions and even our agricultural cooperatives were able to meet. Even though there was this movement, it was already too late the damage was far too high. Crops had stunted, loss of our crops and livestock was greatly felt."
	• "The return of staff to work was good. However, the workload for staff present was high and this impacted on staff morale as sometimes people they often worked with, were no longer on the same rotation list or even were retrenched. This has negative implication on the working environment." • "At this stage we had already lost so much even profits, so the payment of staff was a challenge."
Implications on the value chains	• "Lack of accessing seeds resulted in us not able to plant our crops during the planting season and manage our crops this set us back even more since the production cycle was entirely affected."
How were your value chains for both crop and animal production impacted?	• "The prices of animal feeds became expensive, lack of sufficient staff due to fear still associated with COVID-19, family responsibility and staff rotations as well as the limited budget resulted in lack of rotational grazing and head counting of livestock." • "In most cases the price of our livestock dropped as the demand for them in market was lowered, some cattle we sold them next to nothing."
	• "The ratio of livestock to each staff member was not balanced and negatively impacted operations leading to high levels of pressure and stress, this impacted the management of our livestock."
	• "In cases where we obtained a harvest, other key players within the value chain that provided us with the services such as hiring of tractors, harvesters, transporters, processors and customers came with higher costs which we could no longer afford, this impacted the pricing and positioning our produce."
	• "Distribution of harvested produce to processors and other farmers was impacted resulting in piles of stock lacking storage in our facilities since processors become too restrictive on the quality of our produce."
	• "Price of crops produced dropped significantly as there was much competition after level 5 and our clients pushing us to sell tons of produce at a much lower price which resulted at a loss. We could not even negotiate the way we used to with our customers, preference was given to commercial farmers."
	• "The rate of the cattle price dropped highly during the very few auctions that were arranged in the later part of the year (2020). We usually had regular auctions in a year but during 2020 we had only two. This was another loss on profit margins since auctions are an important source of income. Livestock could not even meet auction standards what was worse is that this limitation added on top of the financial constraints we had already experienced."
Community dynamics and climate change implications	• "We experienced theft of our livestock and the crops from particularly local community members who were homebound due to regulations. The incidents of theft have impacted our profits both from mixed farming operations."

Table 1. *Cont.*

	CHALLENGE STATUS
How did community dynamics and weather patterns influence farming operations?	• "Reports of stollen livestock have been reported to law enforcement agencies and we are still waiting since there has been no response. No one is willing to compensate us from this crime, we have lost hope in terms of managing this crime in the area. We also had to sell our valuables to ensure survival and recover from the losses."
	• "During this COVID-19 season 2020, we experienced excessive rainfall which damaged our crops, properties and soils were left eroded which is a major challenge. The damage of our fencing during floods allowed the community members to invade inside our fields resulting in increased theft since even now our fencing around riverbanks and farming areas are still not repaired."
	• "We faced a double challenge for both the impact of climate change and COVID-19 simultaneously, we even assumed that climate change seen in such flooding was a result of the COVID-19 virus in the air. This COVID-19 pandemic has destroyed our farming operations, we have suffered." • Farmers indicated the presence of unknown weeds that they could not treat, and high level of mice invading the eroded soils.
	• "We often had to borrow from each other as well since we faced financial constraints from our business operations whilst also address our own household security situation as we were also starving. Our land remained bare because this pandemic took away the ability to cultivate in our land, feed our families and our communities."

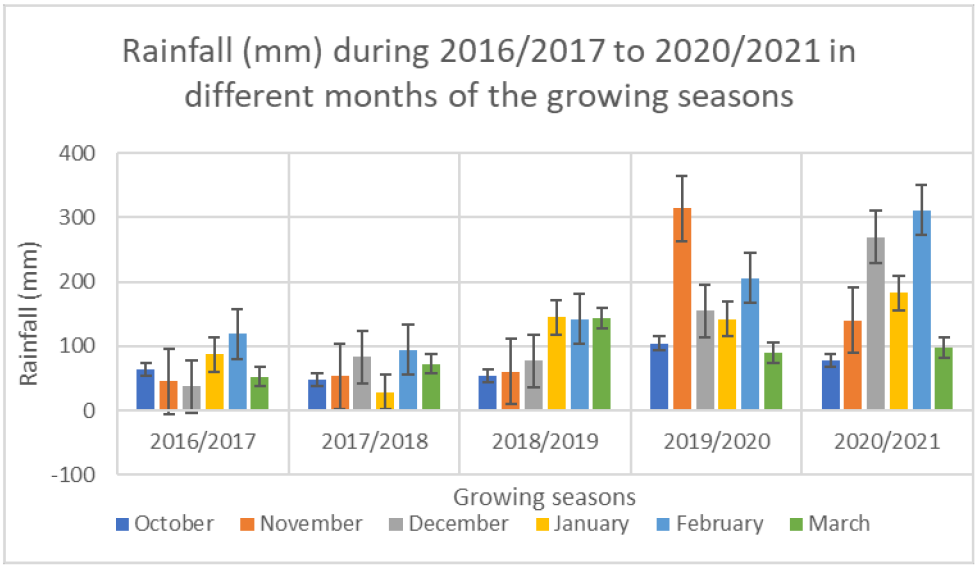

Figure 3. Rainfall (mm) patterns in different months during 2016/2017 to 2020/2021 of the growing seasons. Source: Weather and Climate [34].

To mitigate the challenges of COVID-19, the Department of Agriculture, Land Reform and Rural Development (DALRD) requested data on the profile of smallholder farmers, which included size, typology of farmers, farm location, infrastructure, and support services [35]. These data were necessary as part of the national intervention that was urgent in providing direct support. In this study, some farmers (n = 48.6%) were not registered and could not benefit from intervention programs. These unregistered farmers should be encouraged and supported to register so that they will be included in the government database.

3.3. Impact of COVID-19 on Access to Resources and Management

COVID-19 pandemic has had weighty repercussions on food security dimensions and business within the study area. The calamity has imperiled communities' access to food as local farmers who supply them with various foods struggled to obtain sufficient produce and market access. These resulted in hunger, undermining the well-being, worth, and dignity of people. An overview of limited access to essential agricultural services and inputs is presented in Figure 4.

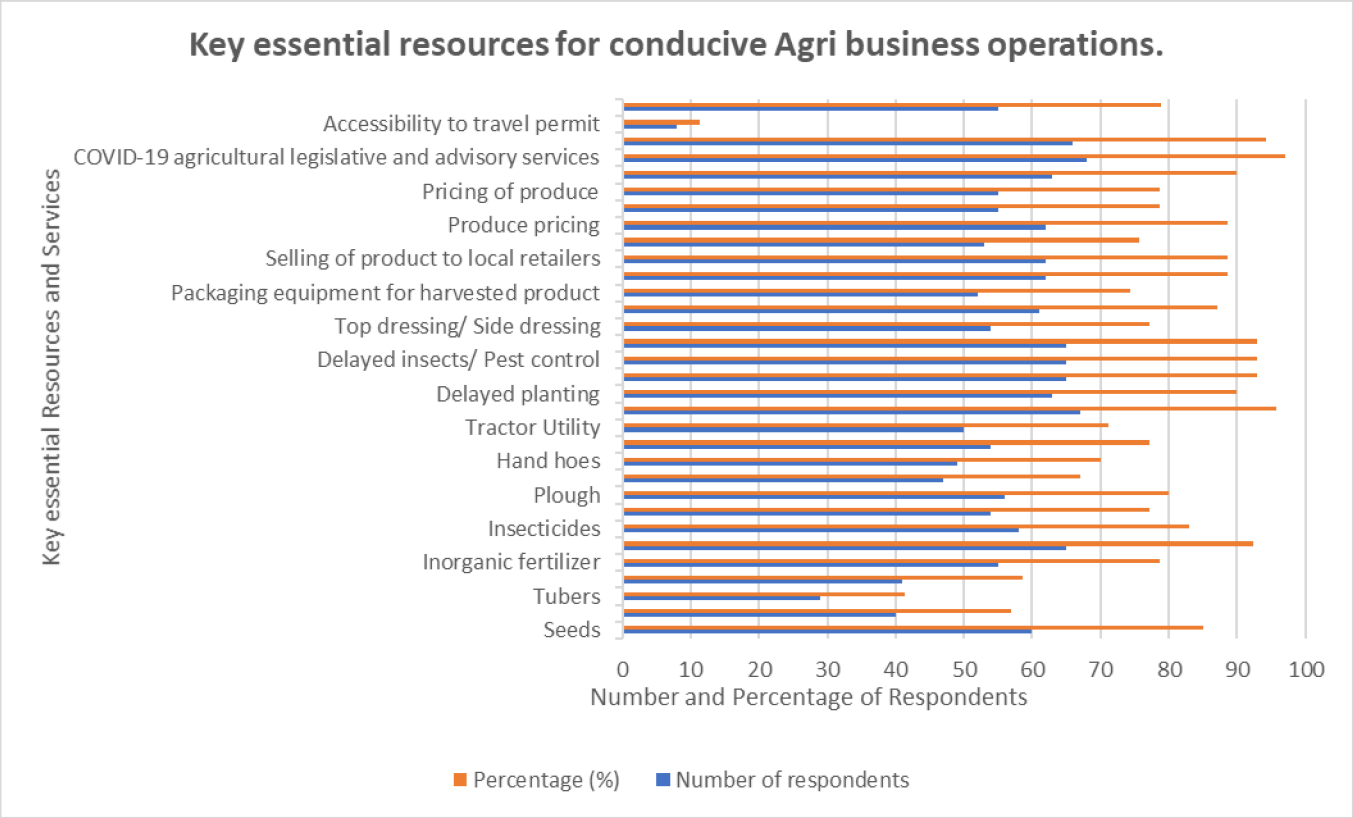

Figure 4. Key essential resources for conducive agribusiness operations.

Most farmers (88.6%) reported that COVID-19 impacted negatively on their farming activities. There were 85.7% and 57.0% farmers who could not buy seeds and seedlings, respectively. More than 58.6% of the farmers could not have access to organic fertilizers, while 77.1%–80.0% could not have access to tillage equipment. Furthermore, over 90.0% of farmers encountered delays in plowing, planting, weeding, insects/pests, and diseases control, which led to 87.0% of farmers indicating delays in harvesting. The study revealed that 68%–80% had a problem with packaging equipment for harvested products, transportation of harvested products, storage processing, and packaging. Farmers (75.0%–88.6%) could not sell to local retailers and promote their produce. The failure of farmers to carry out activities was the inability to secure permits required for movement from one area to another.

The pricing of produce by the market placed high levels of pressure, with over 78.6% of farmers indicating that they had no control over pricing and could not negotiate the price to meet their projects projections. Subsequently, the processors who were the main buyers of cereals and grain legumes restricted the quantities they can supply due to unfavorable market conditions, which was linked to COVID-19. A total of 90.0% of farmers could not have access to financial resources and extension advisory services, and these negatively impact food production.

It is evident that when smallholder farmer encounters devastating consequences related to their resources, it will have a dire effect on achieving Sustainable Development Goal (SDG) 1, "No poverty", SDG 2: "Zero hunger and SDG 3 "Good Health and Well-Being". South Africa has a high unemployment rate of 32.5% depicted during 2020, which increases the poverty line among vulnerable communities [36]. As many people lost their jobs and incomes during COVID-19, poverty could have led to greater levels of hunger in this study area. It was apparent that there was hunger within farmer households as farmers could not produce sufficient food for the community, leading to household food insecurity.

Loss of income, livelihoods, and escalating food prices in communities broaden the inequality gap [37,38], leading to malnutrition, compromised health status, and overall well-being. Figure 5 indicated that farmers' human capacity was overall negatively impacted (78.6%) due to absenteeism (75.7%), staff shortage (61.4%), staff retrenchments (52.9%), family labor constraints (51.4%), and staff morale (74.3%). Staff health was a concern that can be attributed to absenteeism, staff shortage, staff morale, and even death, although the study did not investigate if this was related to COVID-19.

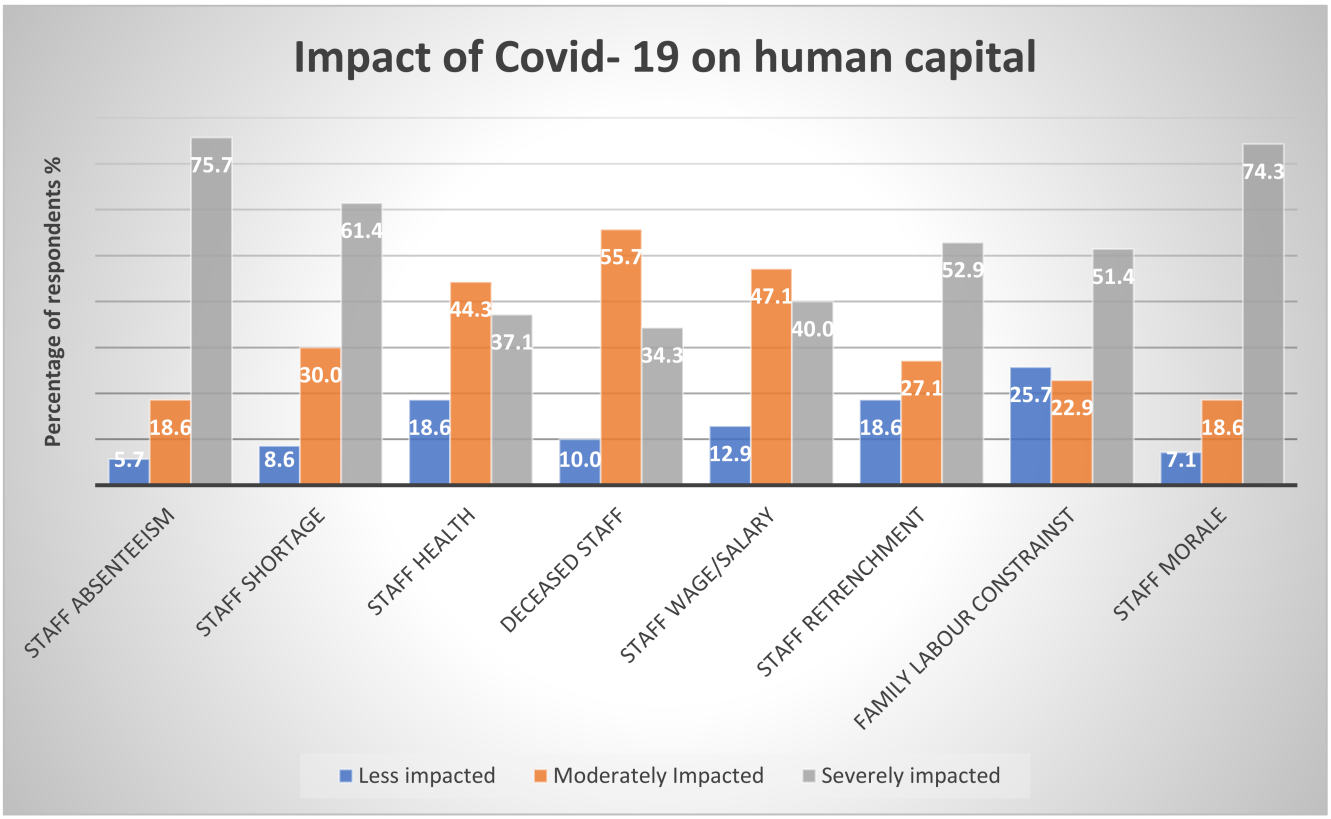

Figure 5. Degrees of impact for human capital.

3.4. Patterns of the Agricultural Food Production at Pre-COVID-19 and during COVID-19 Periods

Agricultural production is largely dependent on three key factors, such as seasonal climate, inputs supply, and human capital, with farmers playing a vital role in managing the production system. In this study, the yield production of specific agricultural commodities (maize, dry beans, and soybeans) was compared to evaluate the impact of the COVID-19 pandemic. To ascertain the pattern of crop yields during COVID-19, yields were divided into five production cycles across five growing seasons, which are 2016/2017, 2017/2018, 2018/2019, 2019/2020, and 2020/2021. The first three seasons are for yield production prior to COVID-19, and the last two are for yields during COVID-19.

The results indicated a continuous decrease in crop yields of maize, dry beans, and soybeans across two years (2019/2020 to 2020/2021) of cropping season during the COVID-19 pandemic. The survey of this study revealed that an average maize grain yield of

2.2 t ha^{-1} was recorded over a 3-year production period prior to COVID-19 (PC) compared to 1.4 t ha^{-1} maize grain yield recorded over a 2-year production period during COVID-19 (DC) pandemic and the yields differed significantly (p = 0.002). Similar patterns of yields reductions were observed in dry beans and soybeans, where 9% and 7% yield reductions were recorded, respectively. However, the yield reductions were not significant for both dry bean (p = 0.829) and soybean (p = 0.732) (Table 2).

Table 2. Average yields trends of maize, dry beans, and soybeans during pre-COVID and COVID periods.

Crop	Yield (t ha^{-1}) Pre-COVID-19 2017–2019 (Means ± SE)	Yield (t ha^{-1}) during COVID-19 2020–2021 (Means ± SE)	%Yield Reduction	p-Value
Maize	2.2 ± 0.17	1.4 ± 0.25	36	0.002
Dry beans	1.1 ± 0.13	1.0 ± 0.17	9	0.829
Soybeans	0.95 ± 0.13	0.88 ± 0.16	7	0.732

It is worth noting that the crop yields reductions observed in the study during COVID-19 production periods occurred during the growing seasons when the study area received suitable rains. The suitable rains recorded over a two-year production period during COVID-19 is a clear attestation that yield declines in crop yields were not mainly attributable to climatic conditions but to other factors such as COVID-19 lockdown restrictions.

The study area received a total rainfall of 621.12 mm during the 2018/2019 growing season, which was the highest rainfall amount of the three growing seasons prior to COVID-19 and had a positive relationship with maize yield as manifested with the highest maize grain yield of 2.5 t ha^{-1} during that growing season. Similar trends were observed in both dry bean and soybean, where higher yields were recorded compared to the 2017/2018 season. In contrast to this, were the lowest grain maize, dry bean, and soybean yields of 1.1 t ha^{-1}, 0.92 t ha^{-1}, 0.68 t ha^{-1}, respectively, recorded in the 2020/2021 growing season during COVID-19 despite the highest rainfall of 1078.00 mm received during this production period (Figures 6–8).

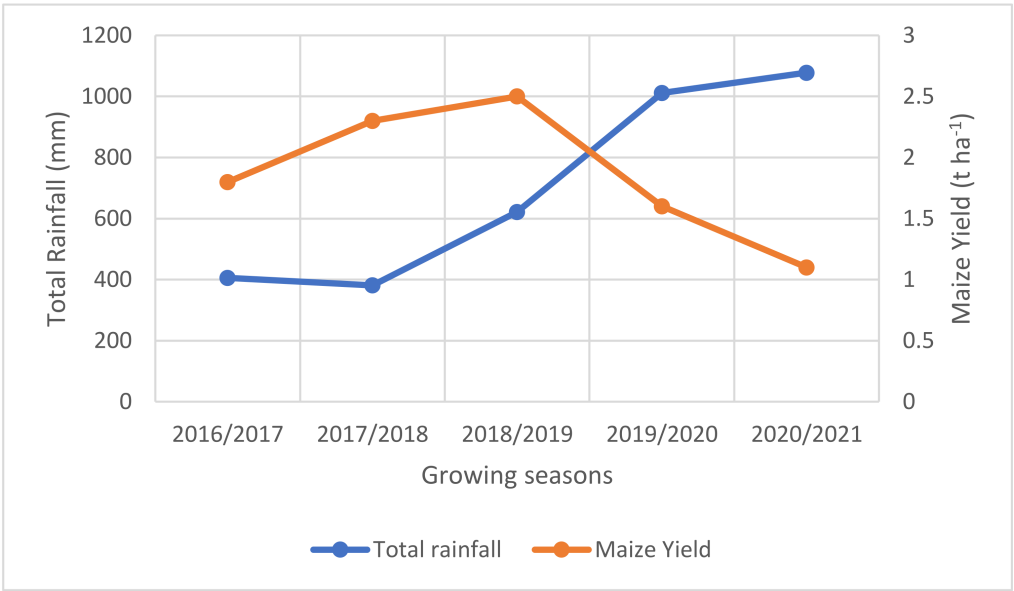

Figure 6. Relationships between total rainfall and maize yields during 2016/2017 to 2020/2021 growing seasons. Blue: total rainfall. Source: Weather and Climate [34]; Yellow: maize yield. Source: own data gathered from survey during the study.

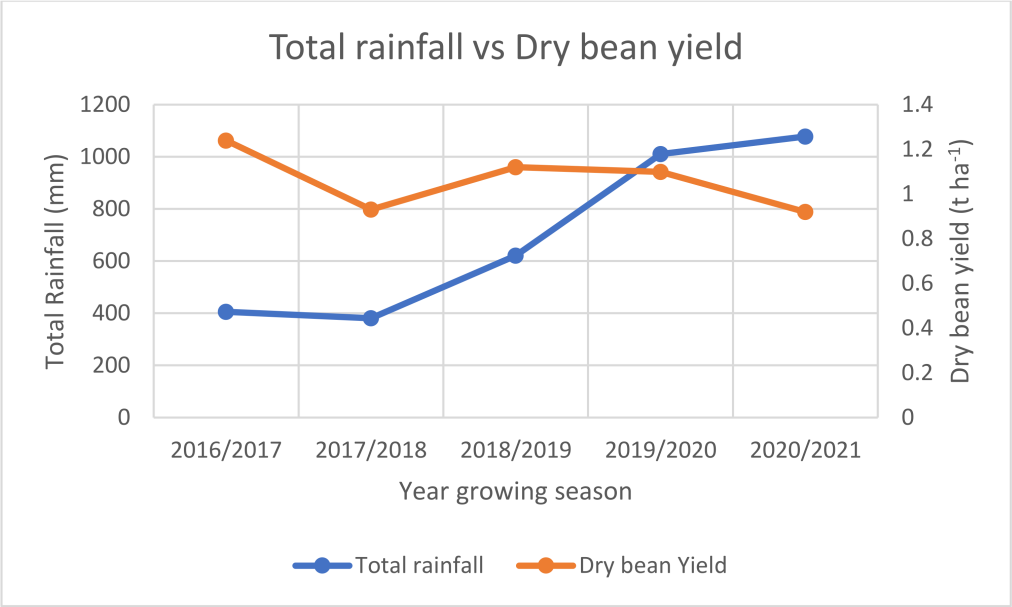

Figure 7. Relationships between total rainfall and dry bean yields during 2016/2017 to 2020/2021 growing seasons. Blue: total rainfall. Source: Weather and Climate [34]; Yellow: dry bean yield. Source: own data gathered from survey during the study.

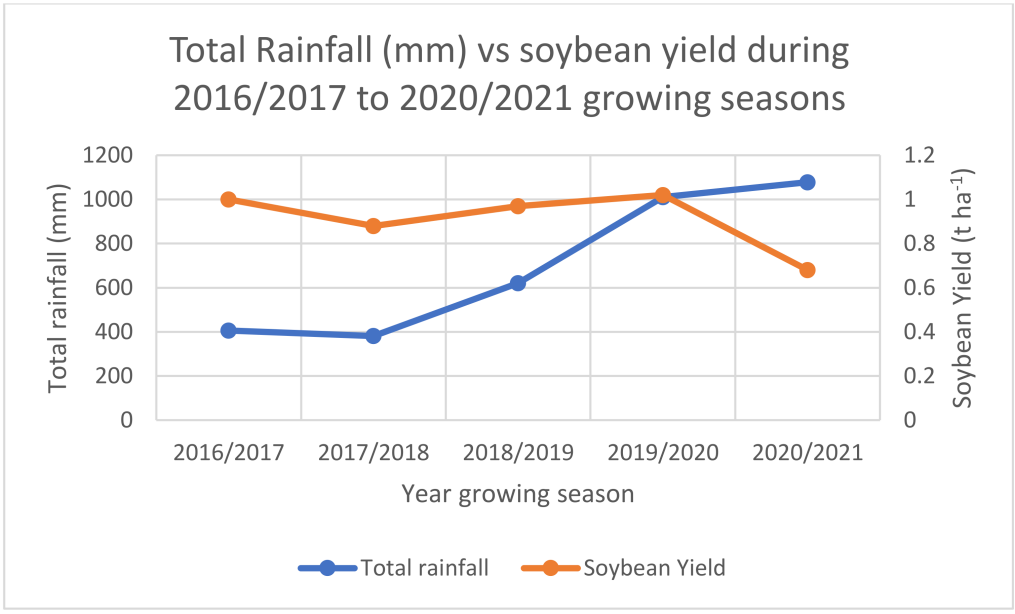

Figure 8. Relationships between total rainfall and soybean yields during 2016/2017 to 2020/2021 growing seasons. Blue: Total rainfall. Source: Weather and Climate [34]; Yellow: soybean yield. Source: own data gathered from survey during the study.

4. Discussion

The study revealed that male farmers were the majority (n = 70%) as opposed to female counterparts (n = 30%). The lower percentage of women can be attributed to the inequalities endured by women within sub-Saharan Africa as they encounter challenges associated with access to land, land rights, access to agricultural inputs, credit facilities, and extension services [39]. Access to extension support services by women farmers is crucial in promoting and sustaining livelihoods, agricultural food production, and food security in smallholder farming systems.

Farmers reported having difficulty in accessing and managing their resources because of increased prices reduced income, which resulted in affecting overall gains leading to them not coping with the new normal of running a business during the COVID-19 pandemic. In addition, farmers could not have access to financial resources and extension advisory services, and these negatively impact food production. The results corroborate the findings of the study conducted in Zimbabwe, which reported that lack of extension services due to COVID-19 negatively impacted agricultural production and food supply [40]. Access to food is an essential indicator of how well a society allocates its wealth, revealing the condition of a political liability, economic restructuring, and the people's degree of dedication to sustain the right to food [41]. The suitable health and well-being of human resources within the value chain are vital in sustaining farming operations and improving a vibrant local food system. The implications of these challenges are associated with a negative impact on agricultural productivity.

The results indicated a continuous decrease in crop yields of maize, dry beans, and soybeans across two years (2019/2020 to 2020/2021) of cropping season during the COVID-19 pandemic. The notable yields decline indicates the negative impact that COVID-19 lockdown mitigation measures, such as movement restrictions, had on agricultural food production on small-scale farmers, which resulted in a non-relationship between suitable rains and crop yield. The COVID-19 restrictions imposed in March 2020 to curb the spread of the pandemic in the country coincided with the crop reproductive stage, which is the critical growth stage of the plant. These stringent restrictions disrupted the execution of key agricultural activities such as insects and disease control. Furthermore, the disruptions might have exposed plants to insect attacks and disease infection and consequently yield reductions. Any attack by insects and diseases during the reproductive stage result in enormous yield reductions. Further to this, the planting periods for maize and grain legumes in 2020, which usually commence in October to November, coincided with existing COVID-19 lockdown restrictions. These lockdown-mitigating measures such as movement restrictions disrupted access to inputs such as seeds, fertilizers, herbicides, insecticides, fungicides, which are essential during pre- and post-planting periods. In addition, the stringent lockdown restrictions that were re-introduced in December 2020 to curb the COVID-19 second wave further exacerbated the situation as it coincided with critical crop growth stages such as vegetative and flowering stages. These restrictions negatively affected agronomic activities due to their further disruptions of inputs supply, weeds, insects, and diseases control. Such disruptions during critical crop growth stages might have resulted in huge yield reductions, as evidenced during 2020/2021 harvests (Figures 6–8). These sharp crop yield declines revealed the production shocks that the smallholder farmers were subjected to by the COVID-19 pandemic in the study area.

Furthermore, the reported crop yields decline might be attributed to the agricultural inputs limitations and agricultural activities constraints experienced by the farmers in the study area. This was shown by 77.1% to 92.4% of the farmers reported having limitations in accessing agricultural inputs of seeds, inorganic fertilizers, herbicides, fungicides, and insecticides during the COVID-19 pandemic. In addition, 67.1% to 80.0% of the farmers indicated a lack of access to farming equipment. There are strong links between agricultural inputs such as fertilizer, water and seeds, and crop yields [42], and this confirms that limitations to agricultural inputs reported by farmers in the study area might have resulted in crop yield reductions. In addition, the lack of access to farming equipment reported by 67.1% to 80% of farmers might be the other key driving factor to low crop yields during the COVID-19 pandemic. Studies by Manyevere et al. [43] have shown that limited access to farming equipment and extension services are some of the major contributing factors to crop productivity decline. Furthermore, the grain legume yield reductions during 2020/2021 might also be associated with high rainfall received in February. Grain legumes such as dry beans and soybeans do not tolerate prolonged periods of rainfall such as those in February but require only moderate amounts of rainfall [7].

The reduction in crop yields that constitute staple foods such as cereal maize and grain legumes (dry beans) observed in the study may have profound implications and is a threat to food security of the local area as these staple crops supply a major part of energy and nutrients for humans. Maize staple is increasingly in demand not only in the study area but globally as noted by Grote et al. [44] that its demand will double between 2010 and 2050 in the developing world.

The decrease in staple crop yields of maize and dry beans observed in the study area due to COVID-19 is of concern as it exacerbates already existing food insecurity experienced in poor communities of South Africa and particularly those of the KwaZulu Natal Province. According to the study by Integrated Food Security Phase Classification (IPC) 2021 [45], 16% of the population in South Africa faced high levels of acute food insecurity. The study further reported that KwaZulu Natal Province was classified to be in a crisis of food insecurity (IPC Phase 3), with 15% of the population already in this category during December 2020. Furthermore, this study projected that KwaZulu Natal Province will have a 20% population (the highest in South Africa) facing acute food insecurity by March 2021, which is an increase of 5% in less than three months.

Furthermore, it is important to note that reduction in yields of maize and dry bean staple food crops might lead to the rise in an increased hunger in the study area, compromising the immune system of the people and rendering them to the vulnerability of chronic diseases such as cardiovascular (CVD), type 2 diabetes, obesity, etc. It is well known that healthy foods such as maize and dry beans are the first line of defense against diseases. Studies by Siyuan et al. [46] have shown that regular consumption of whole grains of maize (corn) lowers the risk of developing chronic diseases such as CVD, obesity, type 2 diabetes and improves digestive health. People with such comorbidities have a weak immune system and are consequently infected easily by COVID-19. The study by Honardoost, et al. [47] on the association between the presence of comorbidities and COVID-19 concluded that the presence of comorbidities is associated with COVID-19 infections with the strongest association observed for cerebrovascular disease, followed by CVD, chronic lung disease, cancer, diabetes, and hypertension. The reduced food production in the study area is a clear negative consequence of lockdowns accompanied by movement restrictions for curbing and mitigating the spread of COVID-19 infections. These, unintentionally, might have the potential of subjecting communities to hunger, compromised immune system, developing chronic diseases, and eventually increase in COVID-19 infections. In addition, it is evident from the study that COVID-19 lockdowns associated with movement restrictions have disrupted food production in the local area. This disruption has the potential to severely exacerbate already existing food insecurity and poverty in these rural farming systems. According to the High-Level Panel of Experts (HLPE) [48], such a COVID-19 health crisis put food out of reach for many people, thus undermining the right to food and stalling effort to meet the Sustainable Development Goal (SDG) 2 "Zero Hunger". This shows that COVID-19 policies and legislations that are sensitive to the plight of poor rural communities are essential and necessary as these communities are more reliant on local agricultural food production for their livelihoods and income.

5. Conclusions

The lockdown imposed in the country due to COVID-19 had adverse consequences on smallholder farmers and the economy. The study examined the impact of the COVID -19 pandemic on agricultural food production, focusing on Bergville local municipality in Northern Drakensberg using qualitative and quantitative in-depth questionnaires with selected farmers. The study demonstrated that COVID-19 lockdowns associated with movement restrictions have disrupted food production in the local area. This disruption has the potential to severely exacerbate already existing food insecurity and poverty in these rural farming systems. The analyses of the responses obtained indicated that COVID-19 with its accompanying lockdowns and execution of new health protocols resulted in disruptions of operational agricultural activities and services such as procurement of inputs,

distribution, and sales of produce. The study demonstrated that COVID-19 lockdowns accompanied by movement restrictions negatively impacted food production of staple crops (maize, dry beans, soybeans) despite suitable rains received during COVID-19 production periods. Such food production reductions have profound implications for the food security of the local area as these staple crops supply a major part of energy and nutrients for humans.

6. Recommendations and Study Limitations

It is crucial that agricultural policies establish measures and interventions that will ensure the sustainability of agricultural systems. Furthermore, COVID-19 policies and legislations that are sensitive to the plight of poor rural communities are necessary as these communities are more reliant on local agricultural food production for their livelihoods and income. In addition, strong co-operations must be established among input suppliers, smallholder farmers associations, extension services, and local retailers. This cooperation will assist smallholders to obtain inputs at a local retailer even during COVID-19 lockdown restrictions because it is in these retailer shops where they normally purchase household goods, and there is no need for travel permits.

Gender equity and agricultural empowerment are future interventions that should be considered in empowering communities in this study area. These interventions should include training on resource management, expanding the market base, and establishing a strong agri-business. The structured farmers support programs that are regularly conducted should be inclusive of other relevant stakeholders within the agri-foods value chain, such as harvesters, storage facilities suppliers, processors, and retailers. Modern production technology can be introduced to these farmers to further assist them in improving their production output during the COVID-19 pandemic. The impact of COVID-19 among the farmers for selling fresh produce indicated the need for farmers to build their own communal storage facilities as this can assist them to keep the produce in an acceptable state to avoid postharvest losses. The study demonstrated a lack of youth involvement as most farmers were older. Therefore, further involvement of youth in agricultural initiatives would be beneficial in revitalizing the local economy and promoting agricultural sustainability. The limitations of the study are as follows: The survey was not conducted in other sub-wards in Bergville due to the limitation in financial resources. At the commencement of data collection in April 2021, farmers had not harvested some of their crop produce, so researchers had to go back to collect information on yields for the season, and these were not obtained at the same time. The respondents were from diverse areas, and researchers always relied on the coordinator to get them together, which sometimes caused some delays. The other limitation is that the survey concentrated mainly on crop enterprises compared to livestock enterprises.

Future research is necessary to quantify the loss of income by the smallholder farmers due to the COVID-19 pandemic in the study area. In addition, future research is a need that will focus on the impacts of support programs provided by the government to mitigate the challenges of the COVID-19 pandemic on smallholder farmers.

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