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Smallholder farmer perceptions about the impact of COVID-19 on agriculture and livelihoods in Senegal

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\begin{abstract}
\textbf{CONTEXT:} The global COVID-19 pandemic has produced a variety of unanticipated shocks to farming and socioeconomic systems around the world. In case of Senegal, the country was already facing number of challenges at the inception of the pandemic, including high rates of poverty, prevalence of food insecurity, combined with other biophysical and socioeconomic challenges faced generally in Sub-Saharan Africa.

\textbf{OBJECTIVE:} To understand farmer perceptions of the potential impacts of COVID-19 on agricultural systems and social well-being of smallholder farmers in Senegal. Particular attention was given to potential vulnerabilities and resilience in the targeted farming systems.

\textbf{METHODS:} A survey was developed to better understand smallholder farmer perceptions regarding the anticipated impacts of COVID-19 on their agriculture practices and social well-being. The survey was administered (between June 5 and June 20) with smallholder farmers (\(n = 872\)) in 14 regions covering all agroecological zones. Variables of interest included perceptions of potential impact on farming systems, agricultural productivity, communities, economics, markets, labor, gendered division of labor, food security, and community well-being.

\textbf{RESULTS AND CONCLUSIONS:} Across the three farming systems examined (cropping, livestock, and horticulture) significant majorities expressed concerns related to access to inputs, ability to plant (cropping, horticulture), reduction of yields (cropping, horticulture), ability to feed livestock, ability to sell livestock, and the ability to hire labor (horticulture). The majority of respondents also expressed concern that COVID-19 would make it more difficult to get enough food on a regular basis for their household (82.5%); that the markets where they purchase food will either be closed or significantly disrupted (79.5%); that the price of food would increase (73.5%); and the market where they sell their produce/livestock will be either closed or significantly disrupted (73.2%).

\textbf{SIGNIFICANCE:} Anticipated impacts of COVID-19 on agriculture will be felt on both the biophysical aspects such as production and access to inputs and socioeconomic aspects such as access to labor, markets, or rapid shifts in demand. Results support the need to use farming systems approach to gather perceived and actual impacts of COVID-19 and warrants a more in-depth examination of agronomic and biophysical issues as well as the impact on the livelihoods and social well-being of families at community and household levels. Further examination will help identify the characteristics that strengthen smallholder farming systems resilience to adjust to anticipated and unanticipated shocks, such as COVID-19, to decrease the negative impacts and increase the rate of recovery.
\end{abstract}
1. Introduction

The rapid transmission of coronavirus disease 2019 (COVID-19) has presented a unique challenge of both minimizing morbidity directly due to COVID-19 while mitigating the negative impacts of necessary preventative measures. This tradeoff has been experienced both in developed and developing economies. While there has been significant progress in tracking the morbidity of COVID-19 globally, there has been limited progress quantifying the disruption of COVID-19 especially in sub-Saharan African countries and in more rural, informal sectors such as agriculture where real-time data is limited. Senegal was one of the first African countries to detect a COVID-19 case (March 2, 2020) and subsequently rapidly mobilized preventative measures such as closing large public gatherings, restaurants, schools, religious sites, aviation, foreign tourism, and imposed curfews, but did not impose a total lockdown (Le Nestour et al. 2020). COVID-19 cases and deaths have slowly risen, though slower than most countries, with reported confirmed cases of 14,014 and deaths at 291 as of September 8, 2020 (https://coronavirus.jhu.edu/map.html, n.d.). The disruption of such preventative measures on Senegalese food systems is less clear. Disruptions to agricultural markets and supply chains have been widely reported in Senegal with horticultural markets likely one of the hardest hits as they rely heavily on timely access and transportation to markets from rural and peri-urban settings and to demand from urban cities and towns. The timing of the imposed preventative measures also corresponded with much of the horticultural growing season, whereas Senegal had begun to lift restrictions prior to the start of the cereal production season around the end of July to early August 2020.

Agriculture accounts for nearly 15% of Senegal’s GDP (The World Bank, GDP (current US$), 2020; https://data.worldbank.org/indicator/NV.AGR.TOTL.ZS?locations=SN) with approximately 70% of the population dependent on agriculture for their food and livelihoods (https://www.worldpop.org/, n.d.). The adverse impact of COVID-19 in Senegal is further compounded by 11.3% of the population being food insecure (FAO, 2019), 17% prevalence of malnutrition (CLM 2018), climate change, soil degradation (Stewart et al. 2020), and high rates of rural poverty (Van den Broeck and Maertens 2017). Senegal’s farming system is predominantly agro-pastoral with most farmers participating in both livestock and grain production (Garrity et al., 2012). There is a gradient of livestock to grain production across the country with more pastoralist activity (i.e., primarily sheep, goats, cattle, and chickens) in the North (http://www.fao.org/livestock-systems/en/) and more food crops (i.e., primarily pearl millet and groundnut) in the South corresponding with a rainfall gradient from <300 mm to >1200 mm North to South (https://www.worldclim.org/, n.d.). Horticulture production is primarily located in peri-urban and rural settings near urban market demand and tourist destinations. Senegal is divided into 14 regions (Dakar, Diourbel, Fatick, Kafrnine, Kaolack, Kédougou, Kolda, Louga, Matam, Saint-Louis, Sédhiou, Tambacounda, Thies, and Ziguinchor) which are further subdivided into 45 departments (https://www.nationsonline.org/oneworld/map/senegal, n.d.).

These smallholder farming systems are also often less resilient to shocks and have fewer support structures in place to decrease the impact and increase the rate of recovery due to shocks (FAO, et al., 2019). Such shocks as COVID-19 will likely lead to disruptions on both the demand side due to loss of income from workers, reduction in tourism and restaurant activity, as well as the supply side due to production related issues such as disrupted supply, labor availability, and food losses and food wastage due to lack of storage facilities and a slow shift in transportation (Le Nestour et al. 2020). Additionally, the impacts of COVID-19 on agriculture will be felt on both the biophysical aspects such as production and access to inputs as well as socioeconomic aspects such as access to labor, markets, or rapid shifts in demand. Not all impacts due to COVID-19 can be assumed to be negative; for example, urban lockdowns have likely shifted labor to rural areas which may lead to increased agricultural activity and productivity (Le Nestour et al. 2020). Thus, there is tremendous need to use a farming systems approach to gather perceived impacts of COVID-19 on smallholder farmers across various components production, environmental, economic, social and human domains (Stewart et al. 2018). In addition, use of participatory approaches (Middendorf et al., 2020) to better understand the response and needs of researchers, policy makers, donors and smallholder farmers will be valuable information.

The objective of this study was to understand farmer perceptions of the potential impacts of COVID-19 on agricultural practices and social well-being of smallholder farmers in Senegal. A survey was developed to explore these perceptions as they relate to agricultural production, economic, and socioeconomic domains. The results captured the perceptions and highlight concerns about the resilience of farming systems, markets, labor, food security, and other issues.

2. Material and methods

2.1. Sample population and distribution

To address these questions, a multidisciplinary team developed a survey using Qualtrics® software. The survey design and implementation followed standard practices in the field (Dillman et al. 2014). The target audience for the survey was smallholder farmers from across Senegal’s 14 regions (Dakar, Diourbel, Fatick, Kafrnine, Kaolack, Kédougou, Kolda, Louga, Matam, Saint-Louis, Sédhiou, Tambacounda, Thies, and Ziguinchor). The sample frame was drawn in collaboration with Reseau des Organisations Paysannes et Pastorales (RESOPP), a farmer organization that maintains a database of approximately 24,000 farmers, and the Senegalese Institute of Agricultural Research (ISRA). The sample was stratified to ensure representation from across the diverse agroecological zones in Senegal. Each of the 14 regions has from three to four districts (Sow et al. 2016), as illustrated in Fig. 1.

The population considered in the survey included smallholder farmers (male and female) from across Senegal. The goal was to survey three districts per region, or 42 districts out of the total of 45 districts. In each district, 20 farmers were targeted, which produced an overall sample size of 885 farmers. In order to be included in the survey, the potential respondents needed to be at least 18 years of age, engaged in smallholder production, and head of household.

Once the sample was drawn, the survey was administered with the assistance of ISRA and local enumerators, who were familiar with local languages, agriculture, and cultural context. The database from which the sample was drawn included farmer names, region, and contact information. Respondent anonymity was maintained by ensuring that individual contact information was not linked to the resulting data. In the introductory instructions to the survey, participants were informed that participation was completely voluntary, that the information they shared would not be linked to them or any individual, and that the data would be reported in aggregate form only. It was also clarified that they had the option of withdrawing their participation at any time. These explanations were followed by the first question, which asked respondents specifically if they wished to participate in the survey, and an affirmative response was taken as their consent to continue.

The regions were divided up among the enumerators, who were supplied with the survey, translated into the local language, and the names and cellular numbers of the potential respondents. All enumerators were trained and given clear instructions on how to pose the question and document the response for uniformity. Once contact was made, respondent consent was ascertained, and the survey was administered via cellphone. As each respondent gave their answers to the questions, enumerators entered the data directly into the Qualtrics® survey system.

2.2. Survey design and timing

Overall, the content of the survey was designed to capture farmer
perceptions regarding their agronomic, livestock, and horticultural practices and biophysical conditions as well as social well-being concerns. The questions were relative to the main 2020 agricultural season. For most smallholder farmers, the main cropping season entails a planting season of June to July, and a harvest season of October to December (FAO/GIEWS, 2020). The survey also included demographic questions for disaggregation and analysis purposes. Variables of interest include the perceptions of potential impact of COVID-19 on farming systems and their practices, agricultural productivity, communities, economics, markets, labor, gendered division of labor, food security, and community well-being. A summary of the questionnaire structure in terms of design, questions, sections and possible responses is provided in Table 1. Of the total sample of 885 potential respondents, 872 agreed to participate in the survey, and 13 declined.

The survey was launched on June 5, 2020 and was closed on June 20, 2020. The first documented case of COVID-19 in Senegal was in March 2020 (Dia et al. 2020; Worldometer, 2020). During the survey period, the incidence of COVID-19 was increasing in Senegal (from 4155 to 5783 confirmed cases) though the average rate of daily increase was relatively low at 2.37% (https://covid19.who.int/region/afro/country/sn, n.d). In addition, the majority of the cases were clustered in the capital city of Dakar. Therefore, the respondents’ perceptions, concerns, and expected impacts from COVID-19 were based on a complex combination of access to information, media coverage, and other cultural spread of information in Senegalese society, as well as their own anticipated experiences potentially due to the pandemic.

Next we turn to the results and discussion section that describes the respondent demographics, farming systems, agronomic and biophysical conditions, agricultural adaptations, perceived impacts on their livelihoods and social well-being in regard to household and community challenges, and issues related to women and youth.

All the data collected from the survey was quantified (means, percentage and frequencies), standard deviation (SD) and analyzed using SPSS, a software package used for statistical analysis.

3. Results and discussion

3.1. Respondent demographics

Results from this survey represent a total of 872 respondents with 868 completing the demographic questions. Seventy-three percent of the respondents were male farmers ($n=637$) and 27% were female ($n=231$). The average age range of the farmers was between 45 and 54 years of age with the majority of respondents (86%) between the ages of 35 to 64. Household size ranged from 2 to “more than 20” family members per household, though the vast majority (86%) fell in the range of 6 to 20 members. Having said that, 11% of respondents reported a household size of “more than twenty.” The variation in household sizes depended on the village and compound. Seventy-eight percent of the respondents indicated having a strong relationship with a farmer organization, and 54% of these considered themselves to be active in that organization either most of the time (30%) or about half of the time (24%).

Near the top of the survey, all respondents were asked about the primary activity of their farm in order to characterize the farming system as primarily a cropping, livestock, or horticultural system, or whether it was a diversified system. As shown in Table 2, the large majority of respondents are engaged in farming systems that are primarily cropping (80%), followed by livestock (12.3%), and horticultural systems (3.6%). Those that characterized their farms as diversified made up 4.1%. Results from the diversified response were included in the other three categories (i.e., crops, livestock, and horticultural systems).

The following sections will provide a brief description of the farming systems from each category along with the perceived anticipated impacts from COVID-19. Subsequently, we discuss any anticipated mitigation strategies and then the perceived socio-economic and livelihood impacts related to the household and community, and potential issues related to women and youth.

3.2. Cropping systems

As noted above, 80% of respondents described their farms as
in these cropping systems would have direct implications for household level food security. Across the country the major crops grown are peanut, maize, pearl millet, rice, sorghum and cowpea (Leipert et al. 2020). Peanuts (i.e., groundnuts) play an important role in the rural economy as a cash crop and for other crops as well (Diagana et al. 2008).

Table 3 highlights some important findings regarding farmers’ anticipated impacts of COVID-19 on their cropping systems. The majority of respondents expressed concern that COVID-19 would reduce their access to crop inputs for the season (89.3%), reduce their ability to plant crops (78.9%), and reduce crop yields (79.6%). These percentages are the aggregation of the two response categories “somewhat agree” and “strongly agree.” In addition, slightly more than half of the respondents (51.6%) expressed a concern that COVID-19 would likely impact their ability to rent machinery. These response categories are on a 5-point scale, from 1 = “strongly disagree” to 5 = “strongly agree.” Based on this scale, the highest means for the responses are “reduce access to crop inputs” (4.36), “reduce ability to plant crops” (4.05), and “reduce crop yields” (3.98) (Table 3). These collective results suggest strong concerns about the upcoming planting and harvesting season due to COVID-19.

Following the questions above regarding farmers’ anticipated impacts of COVID-19 on their cropping systems, the survey asked respondents to estimate the extent of the expected impacts on crops. For those who anticipate a reduction in their ability to plant (cropped areas), 40.5% estimated that the reduction would be less than a quarter or none at all (aggregates the categories of “none” and “less than a quarter”), and 50.1% anticipate a reduction in their ability to plant crops by less than half or 26% to 50%. The remaining 9.5% anticipate more than half up to a 100% reduction in their ability to plant crops. Similarly, for those who anticipate a reduction in crop yields in the upcoming harvest season (Fig. 3), 41.6% estimated that the reduction would be less than a quarter or none at all (aggregates the categories of “none” and “less than a quarter”). And 50.3% anticipate a reduction in their anticipated yields by less than half or between 25% to 50%, which could have a major impact on food security. Therefore, as illustrated, a majority of farmers anticipate some impacts related to input access, area planted, and yields, and they appear to believe that these impacts will significantly affect their yields or ability to get their crops planted. Our crop simulation study to project potential impact of COVID-19 on major cereal crops in Senegal and Burkina Faso showed that changes in planting area and yields will impact total crop production, value and contribution to gross domestic product (Jha et al., 2021).

3.3. Livestock systems

As shown in Table 2, 12.3% of respondents described their farms as primarily livestock systems. The most common livestock raised among the respondents are cattle (67.1%) and goats/sheep (60.8%) (Table 4). The frequency of responses shown in Table 4 is greater than the number of respondents because they had the option of choosing multiple livestock as applicable, for example, if they raised both cattle and sheep or goats. Herd size (number of animals) ranged from very small (0–5) to very large (>501), though the majority (57.8%) fell in the range of 11 to 100 animals owned. Having said that, there were also 24 respondents (16.9%) in the 6 to 10 animals range, and 28 respondents (19.7%) in the 101 to 500 animals range.

Table 5 highlights findings regarding farmers’ anticipated impacts of COVID-19 on their livestock systems. Similar to the cropping system farmers, substantial majorities expressed concern that COVID-19 would reduce their access to inputs for livestock (85.9%), reduce their ability to feed livestock (78.8%), and reduce their ability to sell livestock (69.7%). These percentages are the aggregation of the two response categories “somewhat agree” and “strongly agree.” Less concern was express about the likely impact of on their ability to rent draft animals for farming operations. This finding could be due to the possibility that few farmers utilize these services, such as renting draft animals, in a typical year.
Based on the 5-point scale, (1 = “strongly disagree” to 5 = “strongly agree”) the highest means for the responses are “reduce access to inputs for livestock” (4.37), “reduce ability to feed livestock” (4.13), and “reduce ability to sell livestock” (3.97) (Table 5).

Fig. 2. Major crops grown among the survey respondents. 
Note: Respondents received this item if they indicated their farm was “primarily crops” or “diversified crops, vegetables, and livestock” (n = 734) and could select all applicable crop options. Responses in “Other” include: fonio (n = 7) and sesame (n = 3).

Table 3

Thinking about your perceptions of what might occur due to COVID-19, please indicate your agreement or disagreement with the following statements. COVID-19 will…

| Outcome                                                                 | Strongly Disagree | Somewhat Disagree | Neither Agree/Disagree | Somewhat Agree | Strongly Agree | Total | Mean (SD) |
|------------------------------------------------------------------------|-------------------|-------------------|------------------------|----------------|----------------|-------|-----------|
| Reduce my access to inputs (e.g., labor, seeds, fertilizers) in the upcoming season. | 2 (0.3%)          | 3 (0.4%)          | 73 (10.0%)             | 307 (42.0%)    | 346 (47.3%)    | 731   | 4.36 (0.70) |
| Reduce my ability to plant crops in the upcoming season.               | 4 (0.5%)          | 17 (2.3%)         | 133 (18.2%)            | 365 (50.9%)    | 212 (28.9%)    | 731   | 4.35 (0.78) |
| Reduce my ability to rent machinery for the upcoming planting season.  | 11 (1.5%)         | 110 (15.0%)       | 233 (31.9%)            | 236 (32.3%)    | 141 (19.3%)    | 731   | 3.53 (0.78) |
| Reduce my crop yields in the upcoming harvest season.                  | 4 (0.5%)          | 12 (1.6%)         | 133 (18.2%)            | 426 (58.3%)    | 156 (21.3%)    | 731   | 3.98 (0.72) |

Note: respondents received this item if they indicated their farm was “primarily crops” or “diversified crops, vegetables, and livestock.” Means are on a 5-point scale (1 = Strongly Disagree to 5 = Strongly Agree).

Fig. 3. Anticipated reduction in crop yields in the upcoming harvest season.
Note: Respondents received this item if they indicated their farm was “primarily crops” or “diversified crops, vegetables, and livestock” (n = 731).

Based on the 5-point scale, (1 = “strongly disagree” to 5 = “strongly agree”) the highest means for the responses are “reduce access to inputs for livestock” (4.37), “reduce ability to feed livestock” (4.13), and “reduce ability to sell livestock” (3.97) (Table 5).

3.4. Horticultural systems

As noted in Table 2, 3.6% of respondents described their farms as primarily horticultural systems. The most commonly grown crops among the respondents are shown in Fig. 4.
Table 4
Select the primary livestock that you raise. (Check all that apply.)

| Response option | Frequency | Percent |
|-----------------|-----------|---------|
| Cattle          | 96        | 67.1%   |
| Goats/Sheep     | 87        | 60.8%   |
| Donkeys         | 16        | 11.2%   |
| Horses          | 10        | 7.0%    |
| Other: Please list in the box below. | 4        | 2.8%    |

Note: respondents received this item if they indicated their farm was “primarily livestock” or “primarily livestock or diversified crops, vegetables, and livestock” in Table 1. Percentages are based on the number of survey respondents who selected “primarily livestock” or “primarily livestock or diversified crops, vegetables, and livestock” in Table 1 (n = 143). Other responses were: chicken (n = 3), and pig (n = 1).

Table 5
Thinking about your perceptions of what might occur due to COVID-19, please indicate your agreement or disagreement with the following statements. COVID-19 will...

| Outcome | Strongly Disagree | Somewhat Disagree | Neither Agree nor Agree | Somewhat Agree | Strongly Agree | Total | Mean (SD) |
|---------|-------------------|-------------------|-------------------------|----------------|---------------|-------|-----------|
| Reduce my access to inputs for my livestock (e.g., water, labor, feed, etc.) in the upcoming season. | – | 3 (2.1%) | 17 (12.0%) | 47 (33.1%) | 75 | 142 | 4.37 (0.78) |
| Reduce my ability to feed my livestock in the upcoming season. | 3 (2.1%) | 3 (2.1%) | 24 (16.9%) | 55 (38.7%) | 57 | 142 | 4.13 (0.91) |
| Reduce my ability to sell my livestock in the upcoming season. | – | 6 (4.2%) | 37 (26.1%) | 54 (38.0%) | 45 | 142 | 3.97 (0.87) |
| Reduce my ability to rent draft animals for farm operations. | 27 (19.0%) | 8 (5.6%) | 47 (33.1%) | 42 (29.6%) | 18 | 142 | 3.11 (1.27) |

Note: respondents received this item if they indicated their farm was “primarily livestock” or “primarily livestock or diversified crops, vegetables, and livestock” in Table 1 (n = 143). Means are on a 5-point scale (1 = Strongly Disagree to 5 = Strongly Agree).

Fig. 4. Main vegetables grown among the respondents of the survey (n = 67).

Note: respondents received this item if they indicated their farm was “primarily horticultural or vegetables” or “diversified crops, vegetables, and livestock” (n = 67) and could select all applicable vegetable options. Responses in “Other” were: eggplant (n = 7); carrots (n = 5); bissap (n = 1); cucumber (n = 1); peanut (n = 1); piment and others (n = 1). One respondent that selected “Other” did not describe the other type of vegetable.

Table 6
Thinking about your perceptions of what might occur due to COVID-19, please indicate your agreement or disagreement with the following statements. COVID-19 will...

| Outcome | Strongly Disagree | Somewhat Disagree | Neither Agree nor Agree | Somewhat Agree | Strongly Agree | Total | Mean (SD) |
|---------|-------------------|-------------------|-------------------------|----------------|---------------|-------|-----------|
| Reduce my access to inputs (e.g., seeds, fertilizers, water, etc.) in the upcoming season. | 1 (1.5%) | 3 (4.6%) | 5 (7.7%) | 21 (32.3%) | 35 | 65 | 4.22 (0.92) |
| Reduce my ability to plant vegetables in the upcoming season. | 1 (1.5%) | 3 (4.6%) | 13 (20.0%) | 23 (35.4%) | 25 | 65 | 4.05 (0.96) |
| Reduce my ability to hire labor for the upcoming planting season. | 1 (1.5%) | 2 (3.1%) | 15 (23.1%) | 21 (32.3%) | 26 | 65 | 4.06 (0.95) |
| Reduce my yields in the upcoming harvest season. | – | 2 (3.1%) | 7 (10.8%) | 37 (56.9%) | 19 | 65 | 4.12 (0.72) |

Note. Respondents received this item if they indicated their farm was “primarily horticultural or vegetables” or “diversified crops, vegetables, and livestock” in Table 1 (n = 67). Means are on a 5-point scale (1 = Strongly Disagree to 5 = Strongly Agree).
that the reduction would be less than half (aggregates the categories of “none”, “less than a quarter”, and “less than half”). For those who anticipate a reduction in vegetable yields in the upcoming harvest season, 96.9% estimated that the reduction would be less than half (aggregates the categories of “none”, “less than a quarter”, and “less than half”).

3.5. Adaptation and mitigation of COVID-19 impacts

As indicated in the survey design (Table 1), the remaining questions related to adaptation and mitigation of COVID-impacts, livelihoods and social well-being, and challenges related to women, youth, household and community. These questions were asked of all respondents regardless of their farming systems, (e.g., crops, livestock, or horticulture). Therefore, the following results represent the data from all 868 respondents. The sequence of questions began with understanding if farmers anticipated a need to make agricultural adaptations to mitigate the potential impacts of COVID-19. When asked in the survey “has COVID-19 impacted you directly”, 84.1% of the respondents indicated “yes”. The next set of questions was related to their potential plans. Thirty-one percent of respondents indicated that there was a “high to very high” likelihood that they would change their traditional agricultural practices to mitigate COVID-19 impacts. In regard to changing their crop calendar, 36.8% indicated that likelihood was “very low to low”, and 26.5% indicated the likelihood was “high to very high”, as illustrated in Table 7. More than half (53.8%) indicated that the likelihood of being able to hire labor for planting and harvesting for the upcoming cycle was “very low to low”.

Conversely, 60% of respondents indicated that the likelihood of managing their livestock differently was “very low to low”. When asked what contingency plans they were making (if any), 32% of the respondents indicated that they “had no plan” and 45% of the farmers indicated that they were going to diversify their crops, consider short variety cycles, and intensify their crops in the hopes of increasing production. Some farmers indicated the need to diversify activities (10%) including, “making an action plan for the gradual resumption of activities, sell animals, and approach banks to obtain funding.” Other responses to this question included financial concerns (8%), ability to obtain support from the government (2%), and the need to modify social mobility activities to protect against the virus (3%), all of which has the potential to impact farming activities and mitigation plans.

3.6. Livelihoods and social well-being

Table 8 highlights findings regarding farmers’ perceptions of what might occur due to COVID-19 related to their livelihoods and social well-being. The majority of the respondents expressed concern that COVID-19 would make it more difficult to get enough food on a regular basis for their household (82.5%); that the markets where they purchase food will either be closed or significantly disrupted (79.5%); that the price of food would increase (73.5%); and that the market where they sell their produce/livestock will be either closed or significantly disrupted (73.2%). These percentages are the aggregation of the two response categories “somewhat agree” and “strongly agree.” Based on the 5-point scale, the means for the responses are “getting enough food” (4.29), “market closure or disruptions (for purchases)” (4.06), “increase price of food” (4.04), and “ability to sell produce/livestock” (3.89), as indicated in Table 8.

In addition to access to food and markets, and potential rising costs, hiring labor is also a critical aspect in the farming systems. As clearly indicated in Fig. 5, farmers are concerned about the potential negative impacts from COVID-19 and are not very confident that they will have adequate access to labor throughout the coming agricultural cycle. On a scale of “not at all confident” to “very confident”, 47% of the respondents indicated that they were “not at all confident” to “only slightly confident” that they would have adequate access to off-farm labor, and 39.9% indicated that they were “somewhat confident” that they would have adequate access to labor.

An additional question, if the farmer depends on off-farm labor, was related to the ability to hire workers for the coming agricultural cycle from their community, the region, or from neighboring countries, which is very common for Senegal (e.g., Guinea-Bissau, Mali).

As shown in Figs 6, 79% of respondents were confident that they will be able to hire workers from their community, 42.5% from their region, and then their confidence drops to 7.7% from other regions and 1.8% from contiguous countries. The remaining 3.2% indicated having no confidence that they would be able to hire workers due issues related to COVID-19. These concerns are also highlighted in perceived challenges for communities, households, and youth, which is discussed later in this article.

3.7. Perceptions of impacts on women

Given the potential for disruptions and unanticipated impacts from COVID-19 at the community and household level, the researchers were also interested in exploring the farmers’ perceptions of what might be the impact on women and youth, specifically. This is because women play significant role in major agricultural activities (from planting to harvesting and processing) and non-agricultural activities (e.g. family care, nutrition and marketing). Similarly, youth engagement in agricultural activities is also increasing. Table 9 illustrates the perceived impacts of COVID-19 for women. Respondents (64.1%) indicated that they anticipate a significant increase in women’s labor in the household (e.g., meal preparation, water collection, childcare), and they anticipate a significant decrease in women’s labor in on-farm activities (56.9%), and a significant increase in off-farm activities (e.g., wage labor, market activities) represented by 59.3% of respondents. These percentages are the aggregation of the two response categories “somewhat agree” and “strongly agree.” Based on the 5-point scale, the means for the responses are “increase in women’s labor in the household” (M = 3.95), “decrease in women’s labor in on-farm activities” (M = 3.67), and “increase in off-farm activities” (M = 3.49).

To further understand the challenges, farmers were asked to identify what they considered the greatest challenges that COVID-19 will pose

![Table 7](image)

| Potential Plans | Very Low | Low | Medium | High | Very High | Total | Mean (SD) |
|-----------------|---------|-----|--------|------|-----------|-------|-----------|
| What is the likelihood that you will change traditional agricultural practices? | 105 (12.1%) | 179 (20.6%) | 313 (36.1%) | 190 (21.9%) | 81 (9.3%) | 868 | 2.96 (1.13) |
| What is the likelihood that you will change your crop calendar? | 56 (6.5%) | 263 (30.3%) | 319 (36.8%) | 205 (23.6%) | 25 (2.9%) | 868 | 2.86 (0.95) |
| What is the likelihood that you will be able to hire labor for planting and harvesting this upcoming agricultural cycle? | 111 (12.8%) | 356 (41.0%) | 269 (31.0%) | 110 (12.7%) | 22 (2.5%) | 868 | 2.51 (0.96) |
| What is the likelihood that you will manage your livestock differently? | 135 (15.6%) | 385 (44.4%) | 206 (23.7%) | 119 (13.7%) | 23 (2.6%) | 868 | 2.44 (1.00) |

Note. Means are on a 5-point scale (1 = Very Low to 5 = Very High).
for women in their household and/or community. Of the 868 responses, the top three challenges were related to: 1) food security and concerns of having access to food (27%); 2) social well-being and adapting to household needs due to the pandemic (24%); and 3) financial concerns (17.4%). Other topics that emerged were the need to diversify activities and to focus on health issues related to cleanliness and mobility.

3.8. Perceptions of impacts on youth

Respondents were also asked to reflect on their perceptions of what might occur for youth due to COVID-19, as illustrated in Table 10 and Fig. 7. When aggregating the response categories of “somewhat agree” and “strongly agree” in the 5-point scale, approximately 60% of

Table 8

| Statement | Strongly Disagree | Somewhat Disagree | Neither Agree nor Disagree | Somewhat Agree | Strongly Agree | Total | Mean (SD) |
|-----------|-------------------|-------------------|---------------------------|----------------|----------------|-------|-----------|
| Getting enough food on a regular basis for my household will become more difficult. | 4 (0.5%) | 7 (0.8%) | 141 (16.2%) | 295 (34.0%) | 421 (48.5%) | 868 | 4.29 (0.80) |
| The market where I purchase food for my household will be either closed or significantly disrupted. | 4 (0.5%) | 18 (2.1%) | 156 (18.0%) | 430 (49.5%) | 260 (30.0%) | 868 | 4.06 (0.78) |
| I anticipate a significant increase in the price of foods I purchase for my household. | 6 (0.7%) | 32 (3.7%) | 192 (22.1%) | 230 (26.1%) | 308 (35.5%) | 868 | 3.89 (0.89) |
| The market where I sell the produce/livestock from my farm will be either closed or significantly disrupted. | 5 (0.6%) | 38 (4.4%) | 190 (21.9%) | 446 (51.4%) | 189 (21.8%) | 868 | 3.89 (0.81) |

Note. Means are on a 5-point scale (1 = Strongly Disagree to 5 = Strongly Agree).
respondents indicated that they anticipate a significant increase in youth’s labor in on-farm activities (e.g., weeding, planting) and 70% of respondents anticipate a significant increase in off-farm activities (e.g., wage labor, market activities). Farmers were also asked to identify what they considered the greatest challenges that COVID-19 will pose for youth and the vast majority of the comments (75%) were related to jobs, (un)employment, and concerns of poverty. Other comments related to the need to keep youth engaged in economic activities, preferably in agriculture (8%). Other challenges were related to social well-being (5%), health concerns (4%), food security (3%), and fear of exile and/or idleness (2.5%). Interestingly, 5.5% of the responses indicated that they did not anticipate any challenges for the youth.

3.9. Access to social services, finances, and challenges

To augment our understanding of issues related to livelihoods and social well-being, the survey included questions related to access to social services and financial support. On a scale of “not at all confident” to “very confident”, 52% of the respondents indicated that they were “not at all confident” to “only slightly confident” that they would have access to other social services to help their household, and 51.8% of the respondents indicated their lack of confidence of having access to farm credit, subsidies and other financial supports. These results in Table 11 align with the comments from the challenges indicated by the farmers at the household and community level.

When asked “what are the greatest challenges that COVID-19 will pose for your household”, 55% of the 868 respondents indicated concerns related to food security, access to food, and potential famine. They also indicated concerns related to social well-being, access to services, and the precariousness of the situation (19%), as well as concerns with lack of jobs, employment, and potential poverty (16.5%). The remaining challenges were related to health, cleanliness, and following the COVID-19 preventative measures (8%). Similarly, when asked about challenges for the community, the main concerns were food security and fear of famine (44%), availability of jobs and fear of poverty (18.9%), and health (12.7%) and social well-being (11.8%) concerns. Other challenges that were mentioned were related to the need to change and/or reorganize their cultural and social systems to ‘strengthen solidarity between the different strata of society’ (4.7%), and the need to comply and respect the government’s response to the pandemic (2%).
women, specifically 64.1% anticipated a significant increase in women's labor in the household (e.g., meal preparation, water collection, childcare), and they anticipate a significant decrease in women's labor in on-farm activities (56.9%), and a significant increase in off-farm activities (e.g., wage labor, market activities) represented by 59.3% of respondents. In regard to impacts for youth, approximately 60% of respondents indicated that they anticipate a significant increase in youth's labor in on-farm activities (e.g., weeding, planting) and 70% of respondents anticipate a significant increase in off-farm activities (e.g., wage labor, market activities). And 75% of respondents were concerned about jobs, (un)employment, and concerns of poverty.

4. Summary of key findings

The objective of this study was to understand farmer perceptions of the potential impacts of COVID-19 on agricultural practices and social well-being of smallholder farmers in Senegal. In designing the survey, we were particularly interested identifying any potential vulnerabilities in Senegalese farming systems that might raise concerns about the resilience of these systems. A key point is that across the three farming systems (cropping, livestock, horticulture) significant majorities expressed concerns, especially related to access to inputs, ability to plant (cropping, horticulture), reduction of yields (cropping, horticulture), ability to feed livestock, ability to sell livestock, and the ability to hire labor (horticulture) (see Tables 3, 5, 6). These could point to important vulnerabilities in the farming systems but may also provide opportunities for specific interventions and capacity building efforts.

While a large majority of respondents say they have been impacted by COVID-19 (84.1%), few adaptive and mitigative activities are being put in place. Nonetheless, when asked about the likelihood that they would change traditional practices and/or change their cropping calendar, the largest response groups (about 36%) were in the “medium” category (Table 7). This may suggest an openness on the part of at least some farmers to mitigateative strategies, and therefore an opportunity for outreach and capacity building around best practices to mitigate the impacts of COVID-19.

The majority of respondents expressed concern that COVID-19 would make it more difficult to get enough food on a regular basis for their household (82.5%); that the markets where they purchase food will either be closed or significantly disrupted (79.5%); that the price of food would increase (73.5%); and the market where they sell their produce/subsidies, or other financial supports (30.3%) (Table 8). Indeed, 55% of the 868 respondents indicated concerns related to food security, access to food, and potential famine. Further, when asked about their likely access to social and other services, 52% of the respondents indicated that they were “not at all confident” to “only slightly confident” that they would have access to other social services to help their household, and 51.8% of the respondents indicated their lack of confidence of having access to farm credit, subsidies and other financial supports (Table 11).

Finally, respondents were also concerned about the impact for women, specifically 64.1% anticipated a significant increase in women’s labor in the household (e.g., meal preparation, water collection, childcare), and they anticipate a significant decrease in women’s labor in on-farm activities (56.9%), and a significant increase in off-farm activities (e.g., wage labor, market activities) represented by 59.3% of respondents. In regard to impacts for youth, approximately 60% of respondents indicated that they anticipate a significant increase in youth’s labor in on-farm activities (e.g., weeding, planting) and 70% of respondents anticipate a significant increase in off-farm activities (e.g., wage labor, market activities). And 75% of respondents were concerned about jobs, (un)employment, and concerns of poverty.

5. Conclusions

The survey results captured the perceptions, concerns, and anticipated impacts from COVID-19 and indicates a need to address these concerns to reduce the anticipated impacts from the pandemic. It is clear from the results that the anticipated impacts of COVID-19 on agriculture will be felt on both the biophysical aspects such as production and access to inputs as well as socioeconomic aspects such as access to labor, markets, or rapid shifts in demand. Across all farming systems (cropping, livestock, horticulture), there are significant concerns about access to inputs, the stability of markets (for both buying and selling), and access to labor. Identifying challenges related to the community, household, women and youth there was clear concerns related to food security (famine), social well-being, access to financial services, and the precariousness of the situation, as well as concerns with lack of jobs, (un)employment, and potential poverty.

The perceptions from this study are beneficial and warrant a more indepth examination of the actual impacts from COVID-19 on the farming systems related to the agronomic and biophysical issues as well as the impact on the livelihood and social well-being of the families as the community and household levels. This study supports the need to use a farming systems approach to gather perceived and actual impacts of COVID-19 on smallholder farmers across production, environmental, economic, social and human domains. It will also be important to examine the actual impacts related to the challenges faced by women and youth especially in regard to labor, income, and health. Based on this study, the researchers plan on conducting a follow up survey and potential in-depth interviews and/or focus groups to better understand actual impacts of COVID-19, with the hope to identify the characteristics that strengthen smallholder farming systems resilience to adjust to anticipated and unanticipated shocks, such as COVID-19, to decrease the negative impacts and increase the rate of recovery. In addition, there would be value in evaluating the catastrophic predictions made about the impact of COVID 19 in terms of mortality and morbidity particularly in developing poor countries, such as Senegal. Lastly, it is important to recognize the need to document the policies and approaches implemented by the Senegalese government in developing and monitoring structures for the improvement of smallholder resilience, but this was beyond the scope of this study.

Declaration of Competing Interest

The authors declare that they have no conflict of interest or no competing interest.

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Table 11

| Statement | Not at all | Only Slightly | Somewhat | Moderately | Very | Total | Mean (SD) |
|-----------|-----------|---------------|----------|------------|------|-------|-----------|
| How confident are you that you will have access to other social services to help your household? | 292 (33.6%) | 160 (18.4%) | 259 (29.8%) | 150 (17.3%) | 7 (0.8%) | 868 | 2.33 |
| How confident are you that you will have access to farm credit, subsidies, or other financial supports? | 263 (30.3%) | 187 (21.5%) | 224 (25.8%) | 185 (21.3%) | 9 (1.0%) | 868 | 2.41 |

Note. Means are on a 5-point scale (1 = Not at all Confident to 5 = Very Confident).
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