Crop Remix? Farmer's Crop Choice in Response to Covid-19 Evidence from Burkina Faso

Crop Remix? Farmer's Crop Choice in Response to Covid-19

Evidence from Burkina Faso

by

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As members of the Master's Committee, we certify that we have read the thesis
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Abstract

Half a billion households around the world are smallholder agricultural households. These households are at a unique risk to unexpected shocks like the COVID-19 pandemic. This paper looks at how planting behavior changes from before the outbreak of the COVID-19 pandemic. We leverage household panel data from Burkina Faso where information on planting behavior was collected before the outbreak of the virus. Our main findings are that households who had the opportunity to change crops for the 2020 and 2021 growing seasons indeed changed crops. Additionally, households grew more cereal crops (especially maize) after the pandemic than before, while household use of agricultural inputs did not meaningfully change Further examination is needed to understand if the households resist changing crops due to effects from the pandemic or due to unrelated factors.

Introduction

There are around 500 million smallholder farming households across the globe. These households are largely subsistence farmers, who produce and consume all of their own food. These households also comprise a large proportion of the world's poor, living on less than $2 per day. The SARS-CoV-2 coronavirus (COVID-19) caused mass disruptions as governments across the world raced to mitigate the spread of the COVID-19 disease. Smallholder farming households reported concerns access to agricultural inputs, seeds, and their ability to harvest and sell crops shortly after the outbreak of the pandemic (Middendorf et al., 2021; de Boef et al., 2021). Food insecurity rose during the first year of the pandemic and rural households experienced more food insecurity later in the pandemic relative to urban households (Rudin-Rush et al., 2022; Adjognon, Bloem and Sanoh, 2021; Bloem and Farris, 2022; Ceballos, Kannan and Kramer, 2020). In order to cope with the persistent shock of the pandemic, small holder farming households employed a variety of strategies such as: livelihood diversification, decreasing consumption, liquidating assets, varying crop choice and diversity of crops cultivated (Salazar-Espinoza, Jones and Tarp, 2015; Michler and Josephson, 2017; Josephson, Kilic and Michler, 2021; Agamile, Dimova and Golan, 2021; Furbush, 2022; Jaacks et al., 2022). Smallholder farms receive much of their yearly income from their harvest. This makes crop choice and access to inputs a critical choice for a households' future well-being (CGAP, 2016). Deeper understanding of how households change their crop portfolio in the face of shocks can aid in ensuring local food and financial security for rural communities in low- and middle-income countries.

Using panel data collected by the World Bank in partnership with the government of Burkina Faso (Institut National de la Statistique de la Demographie , INSD; World Bank , WB), we derive each household's area allocated to the individual crops listed on their roster of cultivars. The main three crops, determined by planted area, are derived from the baseline data and compared to the main three crops reported to surveyors in the follow up rounds from October 2020 and July 2021. In addition to the crop rosters, household characteristics, plot characteristics, and agricultural input use are also recorded. In this paper, we investigate the common factors among Burkinabé farming households who change their top three crops between June 2020 and July 2021 (World Bank , WB). We pay specific attention to the crops and types of crops that households changed after the onset of the pandemic, and the agricultural inputs and practices are associated with a higher or lower number of changes.

Before the onset of the pandemic, around 25% of Burkinabè households reported growing fewer than three varieties of crops. Most households grew cereals, including sorghum, maize, millet, and rice; oilseeds, including seseame and groundnut, and pulses, including cowpea. Before the outbreak, the crop households reported cultivating most frequently was sorghum (the most frequent response was no crop[1]) as seen in Figure 6.1 . Other commonly reported crops are cowpea, groundnuts, sesame, and cotton. After the onset of the pandemic, there was a 17% decrease in the share of households reporting fewer than three varieties of crops. Additionally, households who reported one or fewer changes in October 2020 more often grew staples (cereal crops and cowpea) than the other categories of crops. The share of households reporting fewer than three crops before the pandemic also reported more changes in October 2020. 20% of households reported using improved varieties of seeds before the pandemic. Around 40% of households reported inter-cropping and almost 90% of households reported using fertilizer in the baseline survey. The mean number of changes in top three crops from October 2020 to July 2021 are significantly less than the mean number of changes in top three crops from before the pandemic to after. Women-headed households were more likely to change crops than men-headed households in every segment[2]. Households that inter-cropped at least one plot averaged fewer changes in their top three crops than households with only mono-cultured plots. Households reporting growing vegetables, fibre crops, and not reporting crops before the pandemic had higher average numbers of changes from the baseline data to October 2020, from baseline to July 2021. These results show that households did indeed change crops in the planting seasons after the onset of the pandemic relative to the planting season before the pandemic.

This paper contributes to the understanding of how households in low- and middle-income countries (LMIC) coped with the outbreak of COVID-19 and government efforts to control the spread of the virus. Evidence from Senegal indicate that the concerns of households during the acute phase of the pandemic response relates to disrupted access to desired inputs, and the ability to plant and harvest crops (Middendorf et al., 2021). This research is expanded upon in Jha et al. (2021) (this paper also looks at Burkina Faso), but the focus of these papers is on yields and only for cereal crops; household crop portfolio changes are not explored. Josephson, Kilic and Michler (2021) records reduced access to staples and medicines, lower rates of school attendance, loss of income, and increased food insecurity in the early months of the outbreak. The paper shows the trends across countries, but does not explore

[1]No crop is a classification that comes as a result of the derivation of the three main crop. This is expanded upon in the variables section

[2]i.e., from baseline to October 2020, baseline to July 2021, and October 2020 to July 2021

crop choices, results are from the early months of the pandemic and do not show differential effects between rural and urban sectors. Households in Uganda liquidated savings, and reduced consumption expenditures in response to the loss of income from the strict lock downs enforced by the government from March to May 2020 (Mahmud and Riley, 2021). These result are limited to how households utilized consumption smoothing coping mechanisms, and does not look at changes in household crop production as a coping mechanism. Aggarwal et al. (2020) shows decreasing income for vendors, but no changes in food security in the immediate aftermath[3] and insulated effects for rural households in Liberia and Malawi. Ceballos, Kannan and Kramer (2020) finds similar results in two different states in India, suggesting differences in how rural and urban households experienced the pandemic, results that were predicted in Reardon et al. (2020), echoed in Adjognon, Bloem and Sanoh (2021), Mahmud and Riley (2021), and Rudin-Rush et al. (2022). This suggests that rural households experienced disruptions differently to urban households. Results seen in Furbush (2022) do not show differences in livelihood diversification between urban and rural households, but disruptions were experienced differently. More evidence that coping mechanisms used by households in rural areas are different than more urban areas. Jaacks et al. (2022) examines how Indian farmers changed crops after the outbreak of the pandemic. This research is very similar to our paper; the LSMS-ISA and HFPS data allows to create a panel of households. We follow these households from the pre-outbreak growing season through the 2020 and 2021 growing season, in contrast to Jaacks et al. (2022), which is cross-sectional and uses a survey from the same states at different time points. Jaacks et al. (2022) finds similar results as our paper, where households growing cereals were less likely to change after the pandemic and input used did not change significantly from before the outbreak to the growing seasons after the outbreak. This paper expands on the previous research and gives evidence on the trends not only in the period immediately following the outbreak and government restrictions (2020 planting season), but also the changes that held in the 2021 planting season, a year after the outbreak.

This paper also contributes to the strain of research seeking to understand household crop choice and exogenous shocks. A common strategy to mitigate risk is to diversify the crops grown by households (Feder, Just and Zilberman, 1985; Rosenzweig, 1988; Michler and Josephson, 2017; Hashmiu, Agbenyega and Dawoe, 2022). Michler and Josephson (2017) report that households with higher crop diversity tend to be better off than households with lower diversity, and these households are better able to cope with shocks. This paper does not explore crop diversity because of the limitations in the data, but it does provide evidence that acute shocks can

[3]Before October 2020

spur households to change their planned . Hashmiu, Agbenyega and Dawoe (2022) suggests that market risks are a determinant factor in choosing between two different cash crops[4] and that diversification into food and cash crops can insulate households from future risk due to climate change. This paper. This findings are similar to Rivera-Padilla (2020) who develops a general equilibrium model to understand why, in Mexico, staple crops are grown when cash crops offer greater productivity for the same labor. Rivera-Padilla suggests that the high cost of international trade encourage households to grow staple crops and not cash crops[5]. Another factor in growing staple crops are subsistence requirements that cannot be filled by cash crops (Rivera-Padilla, 2020). Salazar-Espinoza, Jones and Tarp (2015) and Agamile, Dimova and Golan (2021) provide evidence that the women headed households are more likely to grow cash crops after a shock. In this analysis, a larger share women-headed households reported changing two or three crops, but the results are not statistically significant. In fact, women-headed households growing cash crops before the outbreak changed more crops on average than men-headed house. Josephson and Ricker-Gilbert (2020) provides evidence that taste and ease of processing can be determining factors in the planting decisions households make. This could explain some of the significant differences in the number of crop changes in women headed households compared to male headed households, a topic this paper will leave to future investigators.

Our results are not limited to simply understanding how the COVID-19 pandemic disrupted households as similar measures were taken in countries affected by the 2014 West Africa Ebola outbreakBeaubien (2014). This suggests that the market disruptions resulting from government efforts to reduce the spread of disease are not specific to the COVID-19 pandemic. Understanding which households are more sensitive to these disruptions can aid policy makers as they plan for future shocks. The timing of the HFPS modules can also assist in understanding the difference between acute changes in the face of the pandemic restrictions (seen in the 2020 planting season), and longer-term effects (seen in the 2021 planting season).

With this work, we seek to understand what factors made households more sensitive to the disruptions cause by the COVID-19 pandemic and the subsequent government responses. We investigate the changes in the planting season immediately after the pandemic declaration, and the planting season a year on. This is in contrast to Salazar-Espinoza, Jones and Tarp (2015), where the study focuses on the effect of a weather shock in a village and the changes a year or more after the shock. Our work expands on Jaacks et al. (2022) by using panel data, as opposed to cross-sectional

[4] cashews or cocoa

[5] An edict by the Burkinabè government banned international trade in cereal crops

data, and expanding from solely looking at main crops to top three reported crops. This paper is also related to Saenz and Thompson (2017) as we explore whether input use before a shock changes the crops grown during and after a long term shock. This paper and its contribution to the literature is unique in looking at how crop choices and input uses before a shock change the sensitivity of households to the disruptions of a shock, and in the magnitude of the shock being analyzed. While this research is limited to households in Burkina Faso that were able to respond to the HFPS, a greater understanding of how ex-ante planting decisions change acute planting decisions, and how households change their planting decisions in the face of persistent market disruption. These results are informative in two significant ways. First, it expands our knowledge of the characteristics of households are more sensitive to acute disruptions and characteristics that increase sensitivity to lasting disruptions. Secondly, the study adds to our understanding of the benefits and costs associated with policies that mitigate the spread of virulent diseases. In countries with high rates of poverty and limited access to inputs, measures to slow the spread of disease that adversely affect households ability to access inputs alter the benefit-cost analyses associated with restrictive policies.

The paper proceeds as follows: we first describe the data and context of this work, including characteristics of Burkina Faso before the onset of the pandemic, what the government response to the pandemic was, and the details of the surveys use for the analysis. We then present the empirical strategy use to evaluate what changes occurred after the pandemic. More specifically we describe the crops and crop categories grown by households who changed fewer crops on average after the outbreak. This is followed by the results, where we show that generally, households growing cereal crops and cash crops before the outbreak changed fewer crops after the outbreak. Additionally, input use was not associated with an increased number of changes in households' main three crops. Finally, we discuss the important takeaways and conclude our paper.

Context and Data

Our analysis focuses on household responses after the outbreak of COVID-19 and estimates the probability that households grow the same top three crops before the COVID-19 pandemic as they did during and after it. we also identify the crops and planting behavior before the pandemic and during the first planting season that are significantly associated with the likelihood that households change their crops after the start of the pandemic.

2.1 Crops and Country

Burkina Faso is a landlocked country in West Africa. The majority of the Burkinabè population live in rural areas, with nearly 90 percent of the population reliant on subsistence agriculture for their livelihoods. Of these people, the vast majority participate in rain-fed agricultural cultivation and do not engage in cash crop production (Beal et al., 2015; Institut National de la Statistique de la Demographie , INSD; World Bank , WB). The World Bank estimates that more than 40 percent of Burkinabè people live below the poverty line, with nearly 3.5 million people (20 percent of the country's population) suffering from food insecurity (McFarland and Woods, 2022). Burkina Faso ranks 184 out of 191 countries considering the human development index report of the United Nations (World Bank, 2023).

In addition to the challenges of poverty and food insecurity, Burkina Faso also faces significant difficulties with respect to climate change and political instability. The country is part of the Sahel region of Africa, climate change is expected to result in below decreased rainfall in the western area encompassing Burkina Faso (Monerie, Pohl and Gaetani, 2021). Rainfall in the 2020 planting season was below average, and increased aridity creates growing conditions more favorable to crops like millet and sorghum (Beal et al., 2015). Climate change is associated with increased weather shocks and lower incomes which could raise the risk of political instability (Ahmadou Aly Mbaye et al., 2022), despite the relatively lower occurrence of violent conflicts and demonstratiosn during the pandemic as evidenced by Bloem and Salemi (2021).

Further, Burkina Faso continues to cope with political instability. The country has long been subject to destabilizing terrorism and displacement in its northern region (Reuters, 2020). President Roch Marc Christian Kaborè, elected in 2015. The previous leader, President Blasie Compaorè had ruled since 1987 and stepped down after a failed attempt to amend the constitution allowing a third term (the constitu-

tion was amended in 2000 to limit candidates to two terms) (BBC, 2014). President Kaborè led Burkina Faso during the initial months of the outbreak. Elections were held in November of 2020, wherein President Kaborè ran for his constitutionally limited second term (Reuters, 2020; Freedom House, 2023). Participation in the 2020 election was limited by security risks and pandemic restrictions but opposition leaders accepted the result of the election (Freedom House, 2023). In January 2022, a coup led by Colonel Paul-Henri Sandaogo Damiba deposed President Kaborè because of security concerns related to the Islamist insurgency that has plagued the country (Reuters, 2022). In September of 2022, Captain Ibrahim Traore ousted the military government of Colonel Damiba and declared himself president in the following October (FPMA, 2022).

2.1.1 Agricultural Context

The economy of Burkina Faso relies heavily on agriculture, which employs about 80 percent of the workforce. Though cotton is an important export and a main cash crop, many individuals in the country are still reliant on subsistence agriculture to feed themselves and their families. While input use is increasing in the country, use of improved seed, inputs, etc. The instability resulting from the insurgency in the northern region has displaced almost 2 million people (World Bank, 2023). The afflicted regions generally are less productive and in some cases have been isolated economically by non-state military groups (FAO, 2023). The policies enacted to control the spread of COVID-19 coincided with lower than average rainfall. Higher than average imports were required to meet the demand for rice and wheat (FAO, 2023). Imports of fertilizers, pesticides, and seeds account for around 4% of total imports. Fertilizers mainly come from Nigeria and Mali; pesticides are mainly imported from China, and seeds are imported from France (Simoes and Hidalgo, 2011). In January 2021, exports of grains and grain products were restricted or banned in an effort to control rising prices of grain that result from the insurgency and limited agricultural production from afflicted regions FPMA (2022); FAO (2023).

The staple crops grown in the country include sorghum, millet, cowpea, maize, and rice. The main crops grown for export in the country are cotton, tree nuts, and food oil crops, including sesame seeds and groundnuts (Beal et al., 2015; Simoes and Hidalgo, 2011). The planting season for sorghum, millet, maize, groundnuts, and cowpea begins around April and ends before August. The harvest for most crops begins in the late Summer and early Autumn and is completed by early Winter. The exception is rice, which is planted in the Winter and harvested in the Spring before the main planting season (IPAD, 2022). From Figure 6.1 we can see that the largest shares of crops reported, are almost exactly the same as those reported in from USDA

and FAO resources (IPAD, 2022; FAO, 2023). The outbreak of COVID-19 occurred in the month before the growing season for most of the top ten crops grown (there are inconsistencies between the FAO and USDA planting calendar for rice). One exception is the growing season for cowpea, which can start later because of its heat tolerance, and can be harvested around two months after planting Sheahan (2012). The households were surveyed about their planting behaviors in October 2020, which coincides with the harvest season for most of the staples and cash crops with only rice as a potential exception. The survey round conducted in July 2021 which is near the end or after most of the sowing season for the major crops households grow.

2.2 COVID-19 Shock and Government Response

The government of Burkina Faso implented various restrictions to mitigate the spread of the novel virus throughout the country. Public events and gatherings in the country were restricted beginning in April 2020. These restrictions were lifted in October 2020, reinstated in December 2020, and lifted again (for the rest of the study period) in January 2021. Schools and workplaces were closed from April 2020 until June 2020. Travel restrictions were ordered from April 2020 to June 2020, after which point compliance was "recommended" until October 2020. Travel restrictions were reinstated for April and May of 2021[1] (Ritchie et al., 2020). In addition to these restrictions on movement and gatherings, an edict issued in January 2021 banned the export of maize, millet, and sorghum to keep food supplies in the country and limit rising prices (FPMA, 2022). This follows the lead of nearby and neighboring countries who also limited exports.

2.3 Survey and Sampling Design

To determine the change in the household reported top three crops, we combine data from the World Bank sponsored Living Standards Measurement Study - Integrated Surveys on Agriculture (LSMS-ISA) in partnership with Burkina Faso's Institut National de la Statistique de la Demographie's (INSD) Enquete Harmonisee sur le Conditions de Vie des Menages (EHCVM 2019) with the World Bank's high frequency phone survey (HFPS) data collected in partnership with the government statistical offices of Burkina Faso. The sample for the HFPS is drawn from households that had been interviewed during the most recent (2019) round of the national longitudinal household survey implemented by the respective national statistical office, with

[1] during the early planting season for main crops

assistance from the World Bank (Institut National de la Statistique de la Demographie , INSD). This pre-COVID-19 LSMS-ISA data are representative at the national, regional, and urban/rural levels and serve as a baseline for our post-COVID-19 analysis. The HFPS are not necessarily nationally representative because participation requires that each household have (1) at least one member who owned a phone, (2) cell network coverage, and (3) access to electricity. These requirements may lead to selection bias in the survey sample. As seen in Josephson, Kilic and Michler (2021) and Rudin-Rush et al. (2022), the use of sampling weights to re-balance the data can be use to be more representative of the countries being analyzed. In this paper less than 1% of the households responding in the baseline data failed to respond in waves 3 and 11.

While there are several countries that have both pre-pandemic and post-pandemic data that is useful, the wave surveying Burkina Faso's planting habits was taken during the harvest period following the declaration of the pandemic in October 2020. Thus, Burkina Faso is one of the few countries that has information about how the effects of the policy response to the pandemic acutely change planting habits, and how those same households change their planting habits in the agricultural season a year after the declaration of the pandemic. 1,018 households reported growing crops in the LSMS-ISA data. Of those households 976 responded to the HFPS in wave 3 (from October 2020), and 959 responded to the HFPS in wave 11 (from July 2021).

2.4 Variables

We are interested in whether households change one or more of their main three crops after the outbreak of the COVID-19 pandemic. In order to do this we must first derive what these crops were before the outbreak. This is done to ensure that our baseline results are comparable to the responses to cropping questions asked in wave 3 and wave 11 of the HFPS. We are also interested in some of the planting behaviors and household characteristics of households that change more crops or fewer crops.

The number of households reporting fewer than three main crops, around 25% of households pre-pandemic, is determined by a household reporting no crop in one or more entries of their top three reported crops. The share of households reporting no crop decreased by around 17 percent after the outbreak. The share of households reporting growing maize, around 11% pre-pandemic, increased by around 12%. In more general categories: the share of households growing staple crops increased by over 40%; the share of households growing cash crops increased by 7%; the share of households reporting no crop decreased by almost 50%; and the share of households

reporting other crops remained about the same in October 2020. In July 2021 results are largely similar, the share households growing cash crops is similar to pre-pandemic levels, and the share of households growing garden crops decresed by almost 8%.

In this study, the variables of interest are (1) the reported main three crop; (2) reported cropping behaviors like seed type, monocultured plots or inter-cropped plots, and (3) various inputs; and a derived variable that counts of reported changes in the top three crops in each households from pre- to post-outbreak HFPS waves. The baseline variables are derived from the agricultural survey modules in the LSMS-ISA. The post-outbreak responses ask households their three main crop and the plot area dedicated to the main crop. While the LSMS-ISA survey did not ask households to specify the main crop, households were asked about their entire roster of crops grown on their fields. In order to construct our variable of interest, we assume that when the HFPS asks for a household's main crop the intent of the question and the understanding of the household is that the main crops refer to the crops with the most land area dedicated to it. We further discuss the derivation of these variables and some intricacies of the questionnaires are elaborated upon in the following subsections.

The HFPS collects information about household's planting habits and behaviors in rounds 3, 6, and 11. This study focuses on rounds 3 and 11 as they have the most detailed information about the number of crops and allow us to best evaluate what changes were made by households during this time period. The baseline data from the LSMS-ISA reports the full crop roster grown by each household, the area of the plots owned by the household, and if the plot was inter-cropped the approximate share each crop took up of the plot. We then imputed the plot area information using the method from Josephson, Kilic and Michler (2021), multiply by the share of the plot inter-cropped, and then aggregate the areas by crop to derive the baseline main three crops. The HFPS data, post-outbreak, asks households what their main three crops are.

We also record household characteristics and cropping behavior, like the gender of the household head, pre-outbreak use of pesticides and fertilizer, whether the seeds were local or improved varieties. In the HFPS data, households are asked in round 3 whether the "coronavirus" change planting behavior and in what ways did it change planting behavior. In round 11 the survey asks households if what problems they experienced during the planting season, such as their ability to access seeds, fertilizer, pesticides, other inputs, labor, and whether sick family members impeded the households ability to grow crops.

The LSMS-ISA survey module with the data that is the closest match to the questions in the HFPS is the post-planting module. The questions used to derive

the main crops include those related to crop roster, field size, inter-cropping, and the portion of the field reported as inter-cropped. Households are asked to report the area of the plots within the cultivated land parcels. For some households, surveyors took GPS measurements of parcels and fields. Missing values for both self-reported plot area and GPS measurements were imputed using predictive mean matching in a similar method to Kilic, Yacoubou Djima and Carletto (2017). When the area of the field is determined, the next step is to assess whether the field is inter-cropped. Households report the portion of the field dedicated to each crop in the inter-cropped field. The area of each field dedicated to each crop is then aggregated with the other crop areas by field to get the area planted of each of the crops on the household roster. The three crops with the most area are defined as the household's baseline main three crops. Some households report growing only one or two crops in the baseline data. This response (or lack of response) is coded as no crop. It is possible that there are many households with one plot engaging in mono-culture, but it seems unlikely as households growing no crop changed 1.8 crops on average from before the outbreak to after the outbreak. We assume it indicates a conscious decision to grow fewer crops, or fallow plots. This assumption means that we consider it a crop change if a household reports no crop in the baseline data, and reports a different crop in the HFPS data.

To construct our outcome variables, we use the the main crop responses to make an indicator variable that takes the value of one if one of the crops reported change. We look at four different ways the reported crops could change. The first is whether any of the crops change in the post-outbreak data. We then look at how crops change from before the pandemic to the crops reported in round 3 of the data, how they change from the baseline to round 11 of the data, and finally how reported crops change from round 3 to round 11 of the data. These time periods show how households change not just from pre- to post-outbreak, but also how households continued adapting as the outbreak wore on. Examining the mean number of changes a household who reported each crop or crop category gives evidence to how the types of crops that households grown before a shock could increase or decrease household's sensitivity to the shock. Households could find that crops grown just for home consumption, garden crops like okra or other vegetable, are less useful during times of shock. It could also be that households ate or sold the reserves of their harvest in anticipation of hardships resulting from the government response to the pandemic. To replenish the reserves, households may have to change their planned crop rotation and grow crops that can be stored, sold, and consumed.

Empirical Strategy

As we are interested in whether the mean number of changes post-outbreak in top three crops differ between households who grow specific crops or categories of crops pre-outbreak, and our variables of interest are all categorical or binary indicators, one-way and two-way factor ANOVA is a method that fits well with our data. Our variable of interest, the number of different crops grown post-outbreak, is bounded below and above by zero and three. The following equations are use to address the truncated variables and its categorical or binary predictors. The one-way ANOVA regression equation is:

$$Y_{i,t} = \alpha + \tau \times CROP_{i,k,t-n} + \epsilon_{ik,t} \tag{3.0.1}$$

where $Y_{i,t}$ is the number of changes made from the previous time period by the ith household who grew crop k in period $t - n$, where n takes the value of 1 when looking at the time period immediately preceding time period t (i.e. when looking at the changes from the baseline to round 3, or from round 3 to round 11) and 2 if it is from the baseline and t is round 11. α is the constant term that indicates mean number of changes made by households from the baseline to round 3 or round 11; or from round 3 to round 11, who reported growing no crop at least once in the pre-outbreak data or in round 3[1]. τ_{it} is the deviation from the mean α for each level of the crop classification system with no crop as the base level. ϵ is the error term.

To address interactions between input use, gender of household head, and inter-cropping we use two-way ANOVA which looks at the difference in means between households who indicated using the input, are women-headed, or inter-crop their fields. The two-way factor ANOVA regression equation is:

$$Y_{i,t} = \alpha + \tau \times CROP_{ik,t-n} + \delta(CROP_{ik,t-n} \times X_{i,baseline}) + \epsilon_{ik,t}. \tag{3.0.2}$$

The coefficients represented in the two-way factor ANOVA are the same as the one-way factor ANOVA. The δ term is the deviation from mean number of changes made by a household growing crop k in the time period $t-n$. $X_{i,baseline}$ takes a value of 1 if the ith household affirmatively reported one of the following factors: being a women-headed household, inter-cropping at least one field, using improved seeds, using pesticides, or using fertilizers. Errors are clustered at the household level.

[1] Column 3 in the regression tables

Results and Discussion

Here we will discuss the results of the One-Way ANOVA from the most general classification system (i.e., no crop, staple crops, cash crops, garden crops, and other crops), to the FAO classification system (i.e., cereals, fruits and vegetables, food oil crops, legumes, other crops, and garden crops), to the top ten listed crops. After discussing the results from the one-way ANOVA, we will discuss results from the two-way ANOVA again from the most general classification to the most specific.

4.1 One-Way ANOVA Results

We conduct the one-way ANOVA for each crop classification system, the results below will be reported from most to least general. The base factor level[1] is households who report growing "no crop" at least once.

4.1.1 Large Crop Groupings

The mean number of changes for reported crops before the outbreak to October 2020 is 1.8, as seen in Column 1 of Table 6.1. The mean number of changes made by households from pre-outbreak to July 2021 is also 1.8 seen in Column 2 Table 6.1. The mean number of changes from October 2020 to July 2021 made by households who reported growing no crop in the pre-outbreak survey is 1.2, as seen in Column 3 of Table 6.1. The mean number of changes made by households between October 2020 and July 2021, who reported growing no crop in October 2020 is also around 1.2, as presented in Column 4 of Table 6.1.

Households growing staple crops and cash crops change fewer crops between the baseline survey and October 2020 than those reporting no crop, in their top three crops in the baseline survey. These results are bolstered by Figure 6.2 which shows the changes in the share of households from before the outbreak to October 2020 by each crop grouping. Here we see a large decrease in the share of households reporting growing no crops, and increases in households reporting growing staples and cash crops. Changes in the other categories (garden crops and other) are smaller and reflect the lack of significance in those same groupings, as presented in Table 6.1.

The results which examine the household crop changes from pre-outbreak to July 2021 are slightly different. As seen in Column 2 of Table 6.1, the average number

[1] This remains the same for all analyses

of changes for households growing staple crops is almost identical as the changes in October 2020. The primary difference in this period is that cash crops are not significantly different from those reporting growing no crops. Households reporting growing garden crops change more crops, on average, in this time period than those reporting no crop. This is demonstrated in Figure 6.3, which shows the diminished, but still positive, increasing share of households growing cash crops and a decrease in the share of households reporting garden crops. We suspect that this may be due to the timing of the government restrictions: households did not have as much time to change their planned crops for the growing season in 2020 as they did for the growing season in 2021. Households who initially reported no crop in their top three crops before the pandemic may have an easier time growing additional crop than households with more crops as a higher ratio of planting plots could be in use. Since, garden crops are more perishable than the staple crops, households may be encouraged to grow crops that are more stable, if they assume they will have to use some of their reserved harvest or will not be able to sell their harvest.

We further see that household crop changes from October 2020 to July 2021, presented in in Table 6.1, show similar average changes to those who change from pre-outbreak to July 2021. Households growing staples change fewer crops, on average, and households growing garden crops change more crops, on average. The results for garden crops are more significant, which adds further evidence that households growing garden crops change when they had the opportunity to do so.

Finally, from October 2020 to July 2021, households average number of changes was not significantly different for any crop category reported. This could be evidence that households that had the opportunity to change their cropping decisions for the 2020 growing season were not as sensitive to the restrictions as households that did not. These results are seen in Table 6.1 and further evinced in Figure 6.4, where one can see that there is a larger share of households growing staple crops and decreases in the shares of households growing all other crop groupings.

4.1.2 FAO Groupings

The results from Table 6.2 show a wider variety of crops, but they are similar to the results from Table 6.1. From Figure 6.5, there are increases in households reporting cereal crops and food oil crops. Table 6.2 shows that households growing food oil crops, legumes, and cereals change fewer crops than those who reported growing no crop. As presented in Column 2 of Table 6.2, it is clear that households growing garden vegetables change more crops, and households growing cotton, legumes, and cereals change fewer crops for the 2021 growing season. For the 2021 growing season, the share of households growing cereal crops, and food oil crops both increased, while

the share of households growing other categories of crops fell. The pattern seen in the larger crop groupings holds as seen in Figure 6.6, with more cereal crops, and food oil crops being reported.[2] The number of changes between the 2020 and the 2021 growing season, were higher for households who grew vegetables and food oil crops before the outbreak. The changes were lower for households who grew cotton and cereals before the outbreak. As with the larger categories there are no significant differences in the number of changes made by households who grew any of the crop categories. Looking to Figure 6.7, households only reported growing more cereal in this time period. The shares of households reporting other crops all decreased.

4.1.3 Top Ten Crops

Sorting the crops into the top ten most reported gives a more detailed look into the crop choice of households who change more or fewer crops. The top ten crops grown before the outbreak are: no crop, sorghum, cowpea, maize, millet, groundnuts, sesame, cotton, rice, and okra. Crops outside of the top ten are recorded in the other crops category. From the pre-outbreak growing season to the 2020 growing season, Figure 6.8 reports that more households reported growing (1) maize, (2) rice, (3) sorghum, (4) millet, (5) groundnut, and (6) sesame. These crops make up cereals and staples, as well as food oil crops. Indeed, from Table 6.3, the results from the ANOVA show that households growing cereals, and oil crops change fewer crops on average than those growing other crops. A divergence from Figure 6.8, fewer households reported growing cowpea and groundnuts, but households growing cowpea and groundnuts change fewer crops than those reporting no crops.

The mean number of household crop changes from the pre-outbreak growing season to the 2021 growing season was lower for households growing maize, sorghum, millet, cowpea, and cotton. Households growing okra and reported more changes in the 2021 growing season. This can be seen in Table 6.3. The same pattern seen in the 2020 growing season appears again in the 2021 growing season. households growing cowpea change fewer crops. Figure 6.9 shows that fewer households grew cowpea in the 2021 growing season. It may be that the households that grew cowpea before the outbreak change their crop to grow more cereals. If they were to only change cowpea, then this could account for the low number of changes, the decrease in the share of households reporting cowpea, and the increase in cereal crops.

The mean number of changes between the 2020 growing season and the 2021 growing season is lower for households growing maize, sorghum, millet, and cotton, before the outbreak. It is higher for households who grew sesame, groundnuts, and

[2]Food oil crops are included in the cash crop category as they are an agricultural export (Simoes and Hidalgo, 2011).

crops outside of the ten most commonly reported crops pre-outbreak. These results can be seen in Table 6.3. Considering Figure 6.10 it is evident that the share of households growing growing maize, sorghum, millet, and okra (though to a smaller degree) increased between the 2020 and the 2021 growing season. As with the previous findings, the crops grown in the 2020 planting season did not have a significantly different number of changes.

The main takeaway is that households growing cereal crops change fewer crops from pre-outbreak to post-outbreak. Households growing vegetables, food oil crops, and less common crops reported more changes in the number of crops they grew. The primary caveat is that we only know changes within the three crops that households reported. As seen with cowpea and other crops and crop categories, the share of households growing these crops decreased in the post-outbreak period, but the average number of changes was fewer than those who did not report one or more crops in their top three crop roster. It cannot be ruled out that these households did grow that crop, and it was not reported because of the limitation of the survey questions.

4.2 Two-Way ANOVA Results

In this section we present the results which focus on the differences that appear when looking at the interaction of crop and various pre-outbreak cropping choices and household traits, like gender of the head of household, whether the household intercrops, the use of improved seeds, and the use of fertilizer or pesticides. Considering first Figure 6.11, we see that the share of women headed households reporting two and three changes from pre-outbreak to the 2020 growing season is higher than share of households headed by men. For the 2021 growing season, we see that a larger share of women-headed households reported two changes than the share of men-headed households. From Figure 6.12 we see that there is little difference in the distributions of changes between households who only relied on monocultured plots, and the households that had at least one plot inter-cropped. In Figure 6.13 more households that use local seeds change two crops from before the outbreak to the 2021 growing season, while households that use improved seeds before the outbreak were more likely to change three crops. For fertilizer use, in Figure 6.14, we see that a slightly larger share households who did not use fertilizer change one crop, while a slightly larger share of households that did use fertilizer change two crops for the 2020 growing season. In the 2021 growing season, the share of households who change one crop and did not use fertilizer is slightly larger than the share of households who use fertilizer and change one crop. In Figure 6.15, we can see there

appear to be very few differences between both the pesticide users and the different harvest seasons.

Considering Table 6.4, we see that the average number of changes in women-headed households is not significantly different than men-headed households. However, women-headed households who grew staple crops before the outbreak change more crops in the 2020 and the 2021 growing season than the other households. Additionally, women-headed households who grew garden crops before the outbreak change more crops on average between the 2020 and the 2021 growing seasons. This result combined with the one-way ANOVA table 6.1, could suggest results similar to those in Agamile, Dimova and Golan (2021) where women-controlled plots grew cash crops after a shock. Table 6.5 gives evidence to the contrary as women-headed households change more crops on average, and those growing cotton and staples change more crops on average men-headed households growing those same crops. It does appear that in general for the households growing the same crops before the outbreak, women-headed households change more crops on average than men-headed households.

In Table 6.7, 6.8, and 6.9, the households that inter-cropped their fields change fewer crops in the 2020 growing season on average than those who did not.The households that inter-cropped and grew staples or cash crops change fewer crops on average than those who did not inter-crop. Households that inter-cropped pre-outbreak change more crops from the 2020 to the 2021 growing season than those that did not. However, in Tables 6.8 and 6.9 inter-cropping households growing cereals and food oil crops, groundnuts and millet, before the outbreak change fewer crops than other households from the 2020 to the 2021 growing seasons.

From Tables 6.10, 6.11, 6.12, seed type did not significantly increase or decrease the number of crops households change on average for any of the time periods. Those using improved varieties of seeds and growing crops categorized as other change more crops on average than those who did not from the pre-outbreak growing season to the 2020 growing season. Households using improved seeds and growing cereals change fewer crops on average than households growing other crops and using improved seeds. Households growing other crops and using local seeds change fewer crops than those who reported no crop. From Table 6.12, we know that households using improved seeds and growing rice change fewer crops on average than those who reported no crop. When controlling for improved varieties, households growing vegetables and food oil crops during the 2020 growing season change more crops on average than those who did not. Households growing cotton in the 2020 growing season change fewer crops on average between the 2020 growing season and the 2021 growing season than those reporting no crop. This results could indicate that households who grow

cotton, potentially for the export market may be less sensitive to the disruptions associated with the pandemic.

In Tables 6.13,6.14, and 6.15, we see that using pesticides does not significantly change the number of crops grown in any of the time periods. Thosethat use pesticides change fewer crops on average when they grew other crops before the outbreak for both the 2020 and the 2021 growing season. Garden crops and cash crops growers who also use pesticides change fewer crops on average than those reporting no crops between the 2020 and the 2021 growing season. Groundnut planters before the outbreak change more crops on average between the 2020 and the 2021 growing seasons than those that did not. Considering that cotton and oil seed crops are categorized as cash crops in the larger grouping system, it does not appear that there are consistent trends across the types of crops. This may be due to groundnut being a common crop that is food, a commodity, and a crop that improves soil health. In terms of cotton, there may be contracts that must be fulfilled, regardless of the pandemic, or households that grow cotton and use pesticides did not feel the pressure to change crops. As cotton is a major export, households may find it more worthwhile to eschew staples and crops for home consumption to increase household earnings. This response may also be due to the Economic Community of Western African States lowering barriers to trade for certain goods. Rivera-Padilla (2020) provides evidence that households grow export oriented crops when trade barriers are low. Households that use fertilizer before the outbreak change more crops on average than households who did not, but considering the widespread use of fertilizer it may reflect the country trend rather than a trend of these specific input users.

For all sets of results, households averaged more changes from pre-outbreak growing seasons to post-outbreak growing seasons than they did between the 2020 and 2021 growing seasons. Households that use pesticides and grew cotton appear to change fewer crops on average, but these trends are not consistent across the different inputs and should be taken with caution. This shows that in the middle of the pandemic there may not be the chance to change crops as drastically as there were before the outbreak. Additionally, it could show that households response to the shock was undertaken as the restrictions were put in place by the government. Another result of interest is the reticence for change from the households that grew cotton and use pesticides. This could be due to the households being relatively better off than households growing staple and garden crops. It could also be the case that these households have higher risk tolerance, as the income from these crops is could drastically improve a household's living situation. A last takeway from this study is that households who grew fewer than three varieties of crops before were much more likely to grow more crops after the outbreak. This indicates that the risk of poor

soil quality for future harvests is not as much of a worry as having crops available in what to these households could be indefinite restrictions.

Conclusion

The objective for this research was to examine whether the types of crops or interactions between crops and inputs made before the outbreak of the pandemic had any association with the number of changes in the top three reported crops during the pandemic. The majority of evidence shows that households growing staples, especially cereal crops, tended to change fewer crops from the pre-outbreak growing season to the post outbreak growing seasons. This question is important, especially in Burkina Faso, as the country had seen rising prices in grains before the pandemic due to low rainfall during the growing season that resulted in an export ban in January 2021 (FPMA, 2022).

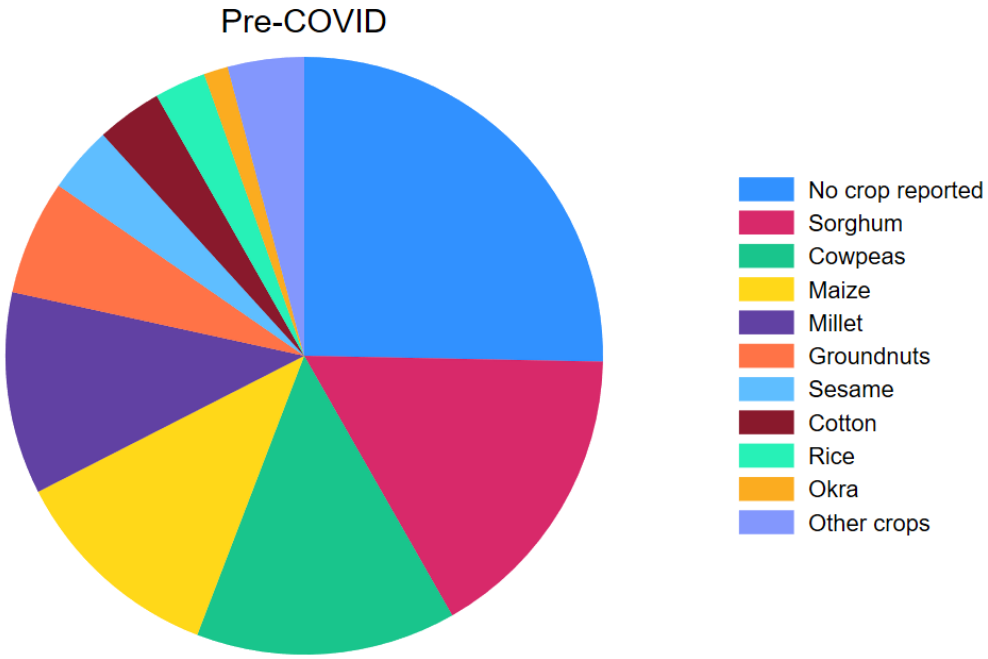
Similar to Furbush (2022), our findings are mixed. Our major conclusion is that households change more crops on average between the pre-outbreak and post-outbreak growing seasons than they did between the 2020 and the 2021 growing seasons.While the planting season had started with the onset of the pandemic, households who reported growing fewer crops in the baseline data changed more crops. Unused fields could quickly be used to grow more crops (to the detriment of soil health) which could explain why these households reported more changes than households growing more crops. Lack of access to inputs, or markets could account for the few changes that occur between the 2020 and the 2021 growing season. Our second major conclusion is that households growing cereal crops and staple crops before the outbreak generally change fewer crops between the pre- and post-outbreak growing seasons than those who grew other crops, such as cowpea and garden crops. After the outbreak maize was the most commonly reported crop compared to sorghum the most common crop before the outbreak. Government restrictions on grain exports in January 2021, and a trend of increasing grain prices may have made this crop appealing as a food crop and an income generating crop. Finally, households growing cotton that also used pesticides changed fewer crops during the pandemic. Cotton being the major export may offer a higher return, or it could be grown by households that are already better off than other households. Households who grow crops for export would also have fewer choices and may have based their planting decisions on the ability to export crops. This is another possible reason why cotton growers changed crop less frequently between the 2020 and 2021 planting season.

This paper is important because it focuses on a little studied coping mechanism in an understudied setting in response to a major world event. Understanding the way small-holder farm households adjust to large disruptions can aid policy makers

in designing programs to address those most vulnerable to these shocks. This paper also expands our understanding of the lasting effects of the COVID-19 pandemic. Greater understanding of the unique changes the pandemic had, will better allow researchers to evaluate the benefits and costs of different types of government response to potential future disease outbreaks. Finally, as climate change and other world events like the war in Ukraine disrupt the international trade of crops, domestic food production takes on a greater importance. The knowledge that households under sustained supply disruptions grow more staple crops can bolster community food security and resilience to future disruptions.

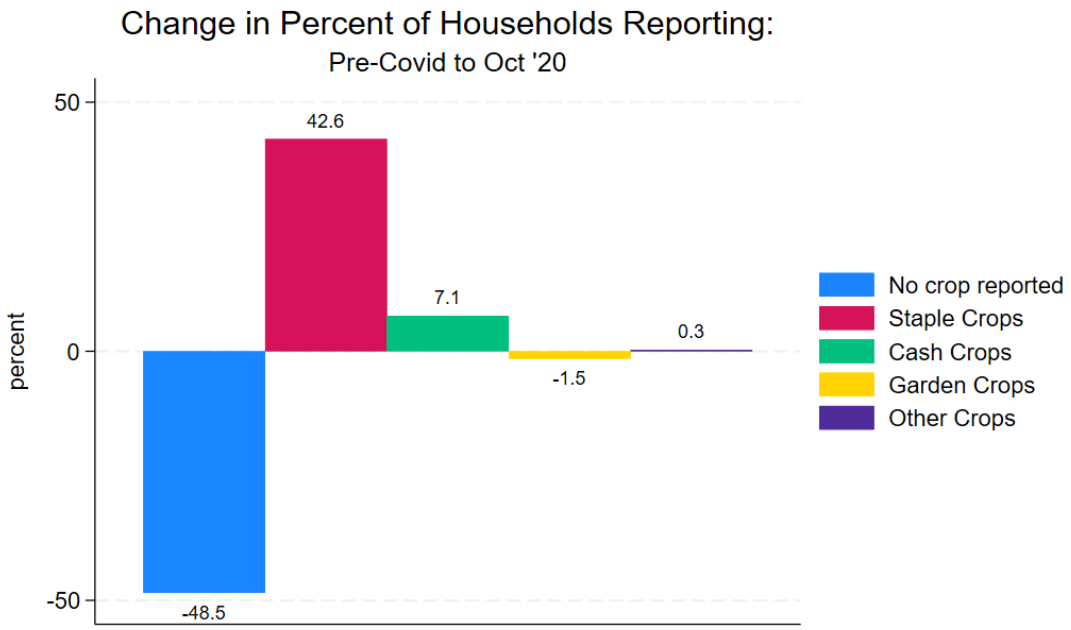
Figures and Tables

Figure 6.1: Top Ten Crops Reported By Households Pre-Outbreak



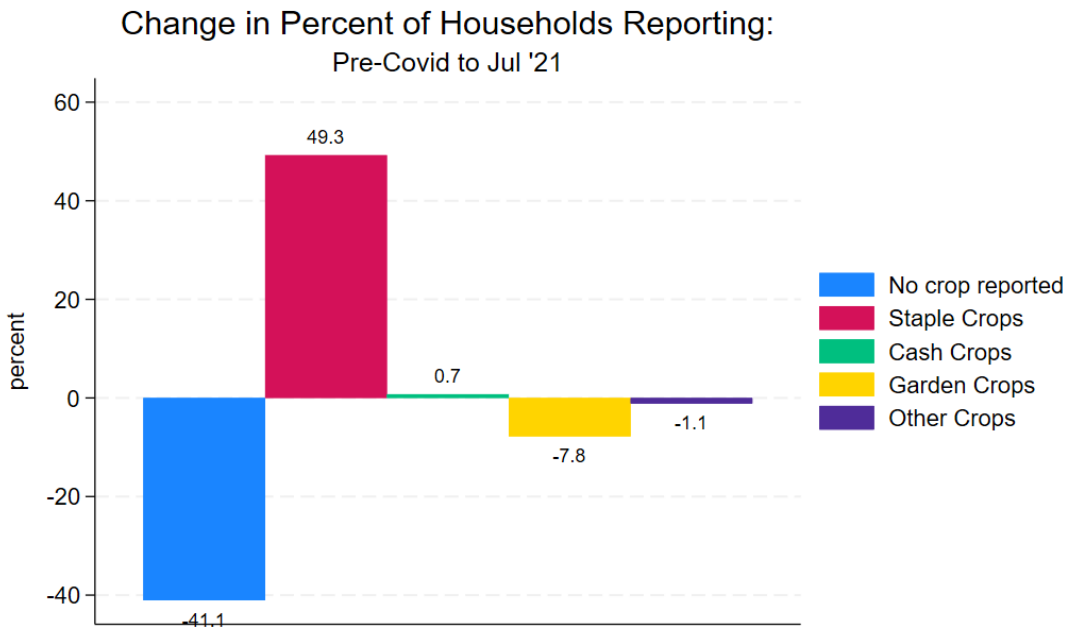
Note: The figure presents the share of households reporting the aggregated crop categories from before the outbreak of COVID. Staple crops include Maize, Millet, Sorghum, Rice, and cowpea. Cash crops include Cotton, groundnuts, and sesame. Garden crops include vegetables like tomatoes, okra, and many others. Other crops refer to crops that few households reported growing, like starchy tubers.

Figure 6.2: Change in Share of Households



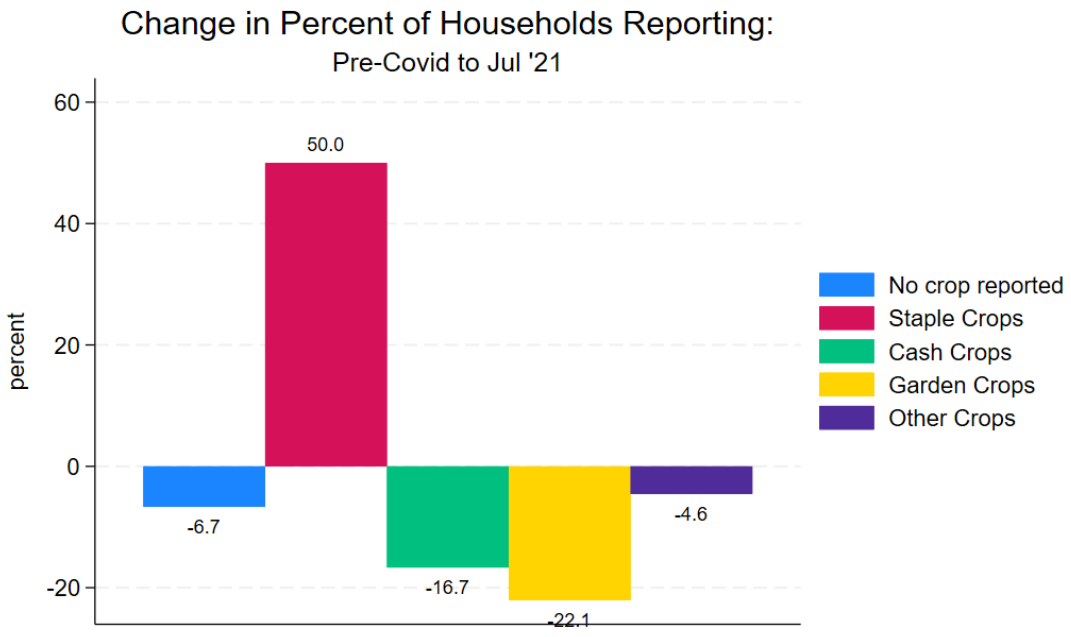
Note: The figure presents the change in the share of households reporting the aggregated crop categories from before the outbreak of COVID to the 2020 growing season. Staple crops include Maize, Millet, Sorghum, Rice, and cowpea. Cash crops include Cotton, groundnuts, and sesame. Garden crops include vegetables like tomatoes, okra, and many others. Other crops refer to crops that few households reported growing, like starchy tubers.

Figure 6.3: Change in Share of Households



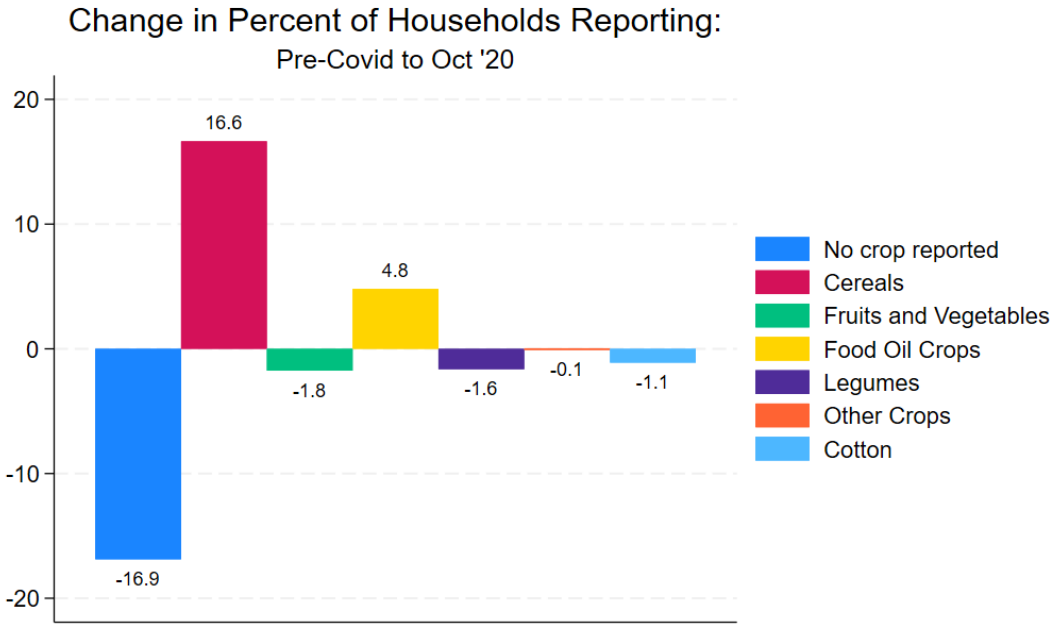
Note: The figure presents the change in the share of households reporting the aggregated crop categories from before the outbreak of COVID to the 2020 growing season. Staple crops include Maize, Millet, Sorghum, Rice, and cowpea. Cash crops include Cotton, groundnuts, and sesame. Garden crops include vegetables like tomatoes, okra, and many others. Other crops refer to crops that few households reported growing, like starchy tubers.

Figure 6.4: Change in Share of Households



Note: The figure presents the change in the share of households reporting the aggregated crop categories from before the outbreak of COVID to the 2020 growing season. Staple crops include Maize, Millet, Sorghum, Rice, and cowpea. Cash crops include Cotton, groundnuts, and sesame. Garden crops include vegetables like tomatoes, okra, and many others. Other crops refer to crops that few households reported growing, like starchy tubers.

Figure 6.5: Change in Share of Households



Note: The figure presents the change in the share of households reporting the aggregated crop categories by an adapted version of their FAO code from before the outbreak of COVID to the 2020 growing season. Cereals include Maize, Millet, Sorghum, and Rice. Legumes include cowpea, bambara beans, and other legumes but not groundnuts. Food oil crops include sesame and groundnuts. Other crops refer to crops that few households reported growing, like starchy tubers.

Figure 6.6: Change in Share of Households

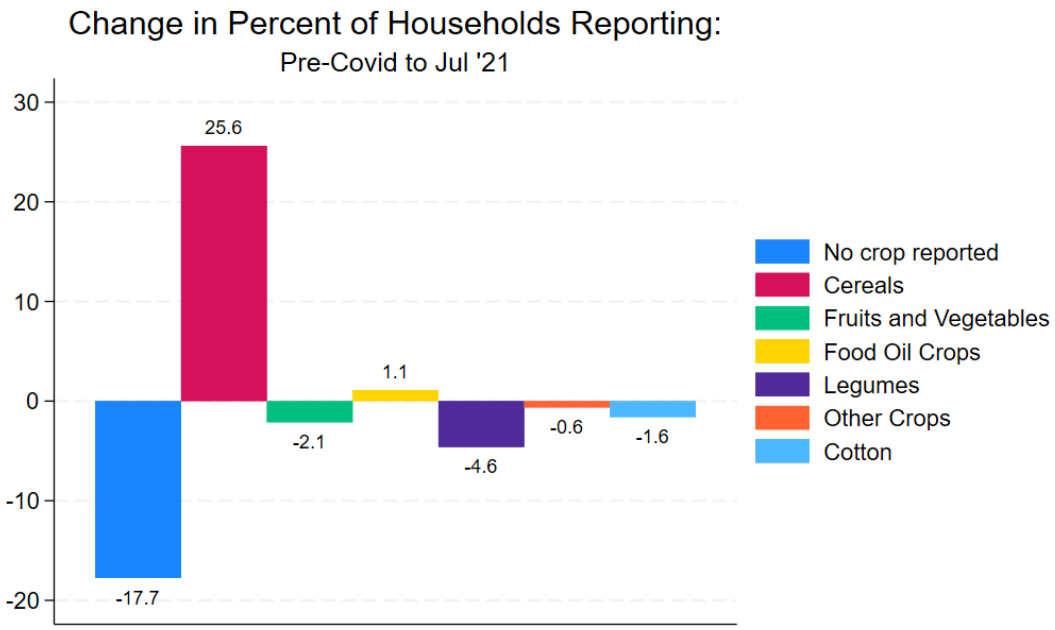
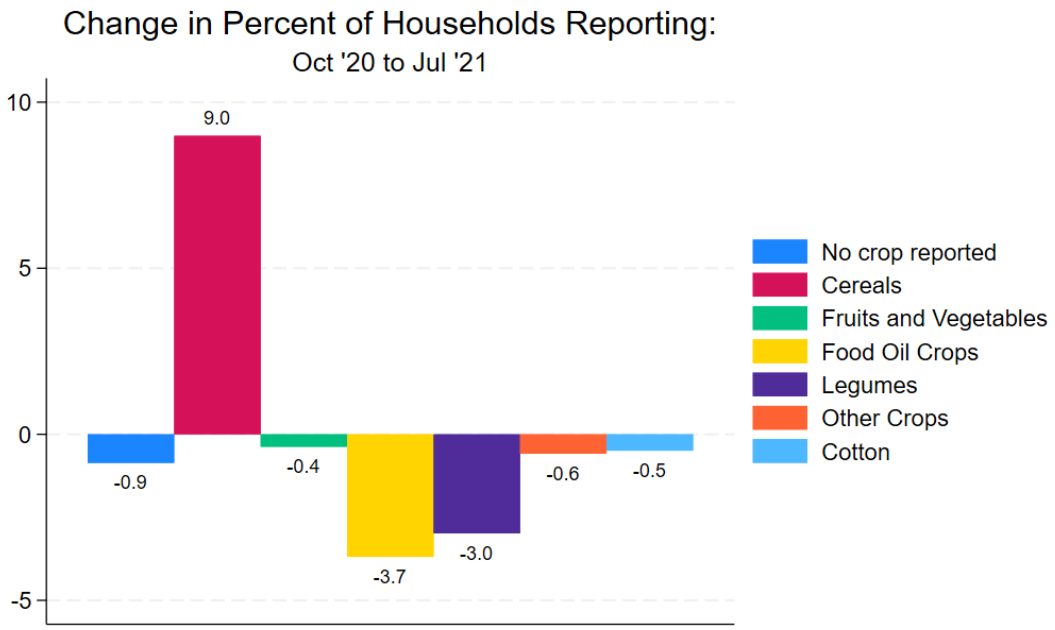
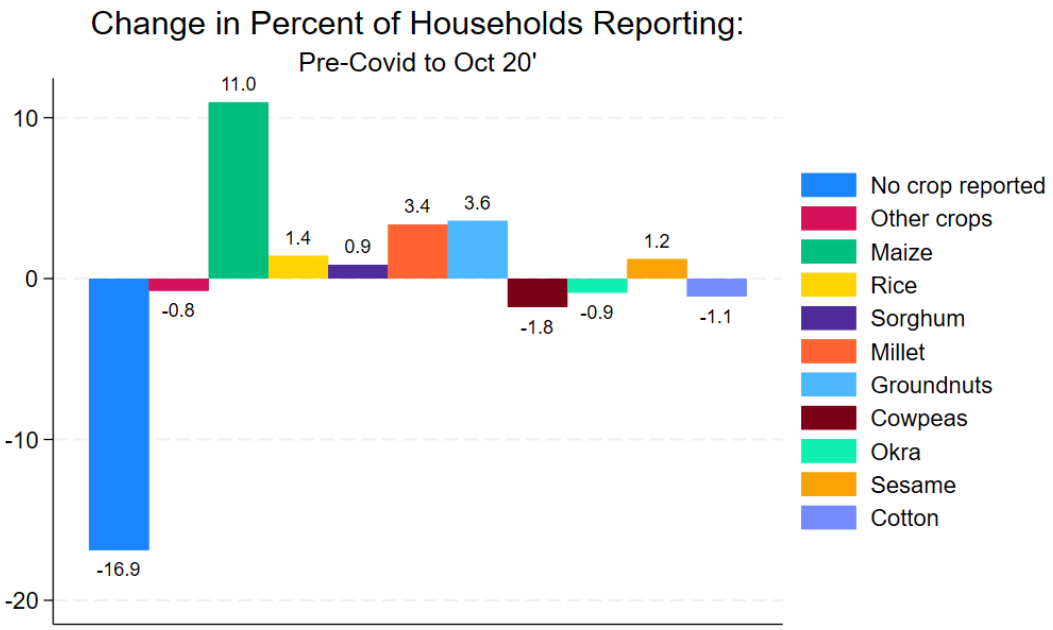


Figure 6.7: Change in Share of Households



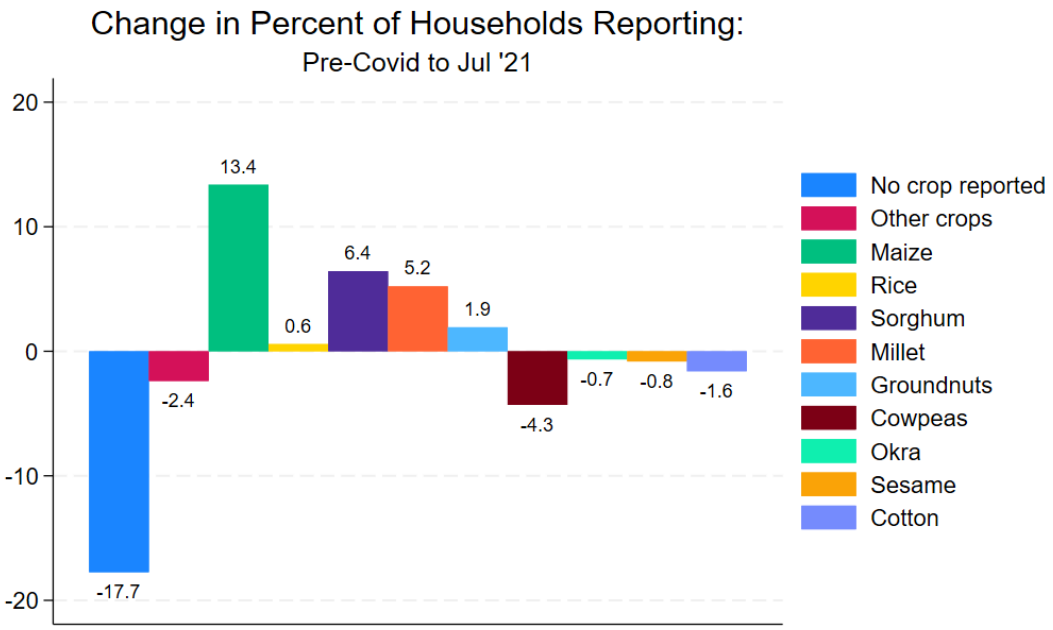
Note: The figure presents the change in the share of households reporting the aggregated crop categories by an adapted version of their FAO code from before the outbreak of COVID to the 2020 growing season. Cereals include Maize, Millet, Sorghum, and Rice. Legumes include cowpea, bambara beans, and other legumes but not groundnuts. Food oil crops include sesame and groundnuts. Other crops refer to crops that few households reported growing, like starchy tubers.

Figure 6.8: Change in Share of Households



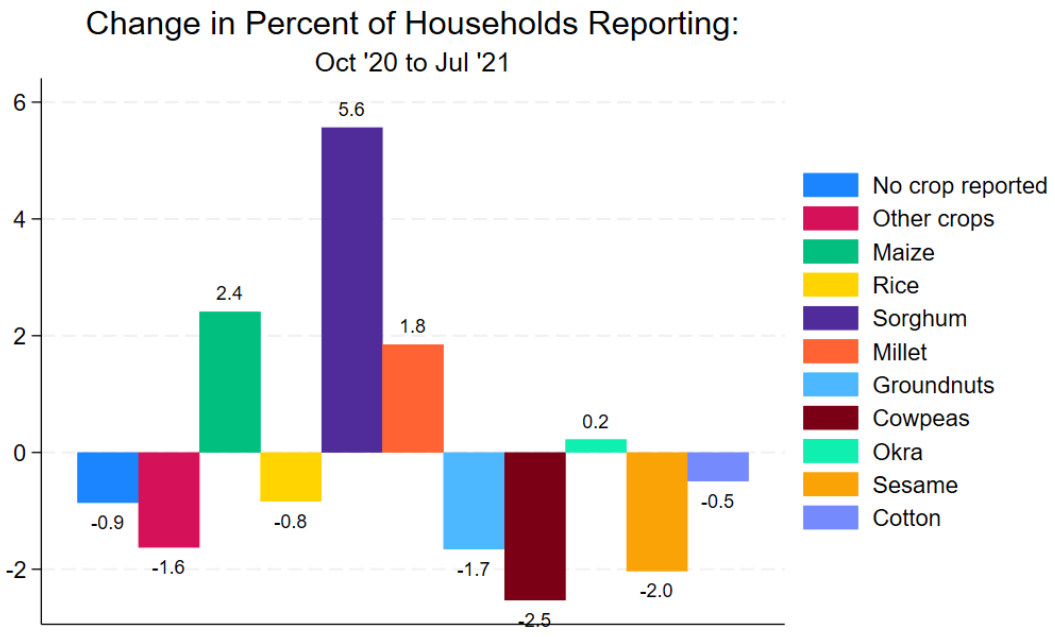
Note: The figure presents the change in the share of households reporting the aggregated crop categories by an adapted version of their FAO code from before the outbreak of COVID to the 2020 growing season. Cereals include Maize, Millet, Sorghum, and Rice. Legumes include cowpea, bambara beans, and other legumes but not groundnuts. Food oil crops include sesame and groundnuts. Other crops refer to crops that few households reported growing, like starchy tubers.

Figure 6.9: Change in Share of Households



Note: The figure presents the change in the share of households reporting the top ten most common crops grown in by those surveyed for the LSMS-ISA wave before the COVID-19 Outbreak. All crops outside of the top ten are classified as other.

Figure 6.10: Change in Share of Households



Note: The figure presents the change in the share of households reporting the top ten most common crops grown in by those surveyed for the LSMS-ISA wave before the COVID-19 Outbreak. All crops outside of the top ten are classified as other.

Figure 6.11: Share of Households Changing Number of Crops by Gender

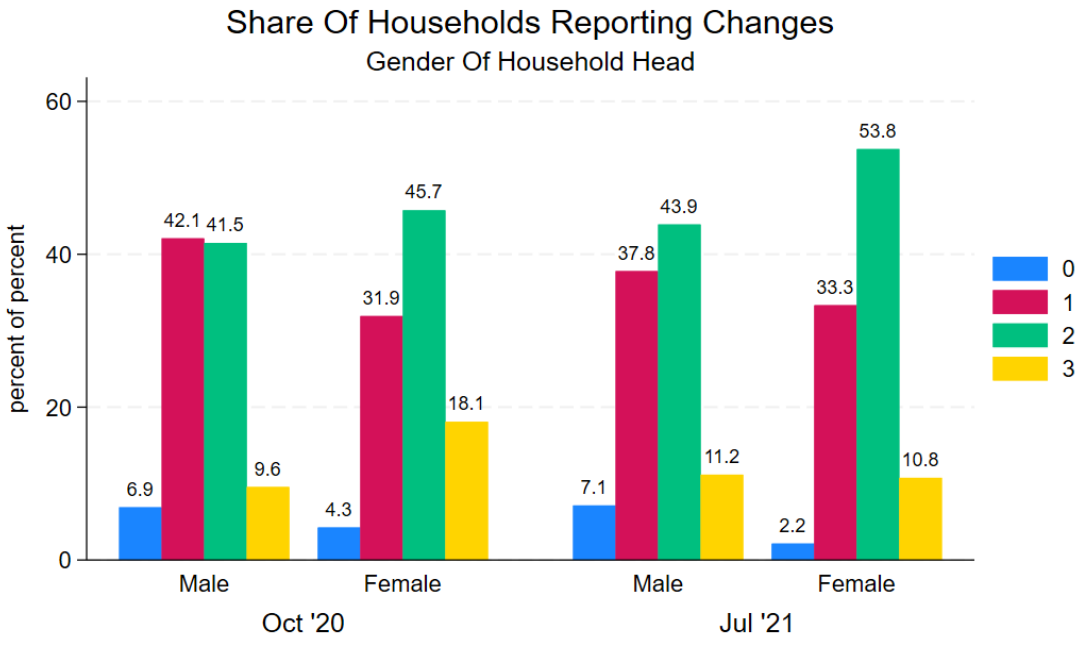


Figure 6.12: Share of Households Changing Number of Crops by Stand Type

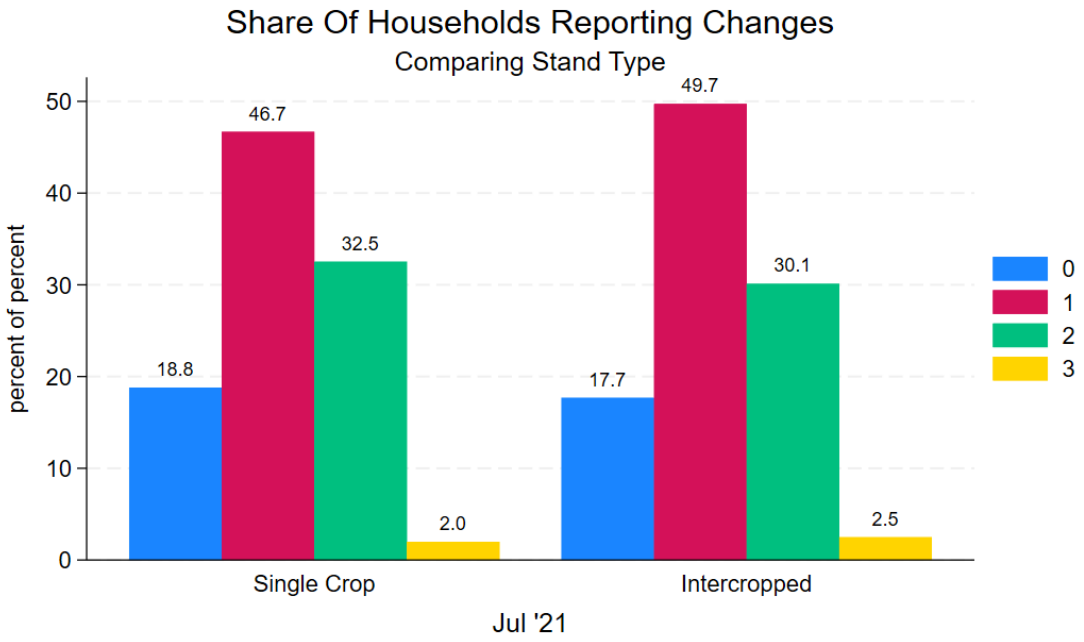


Figure 6.13: Share of Households Changing Number of Crops by Seed type

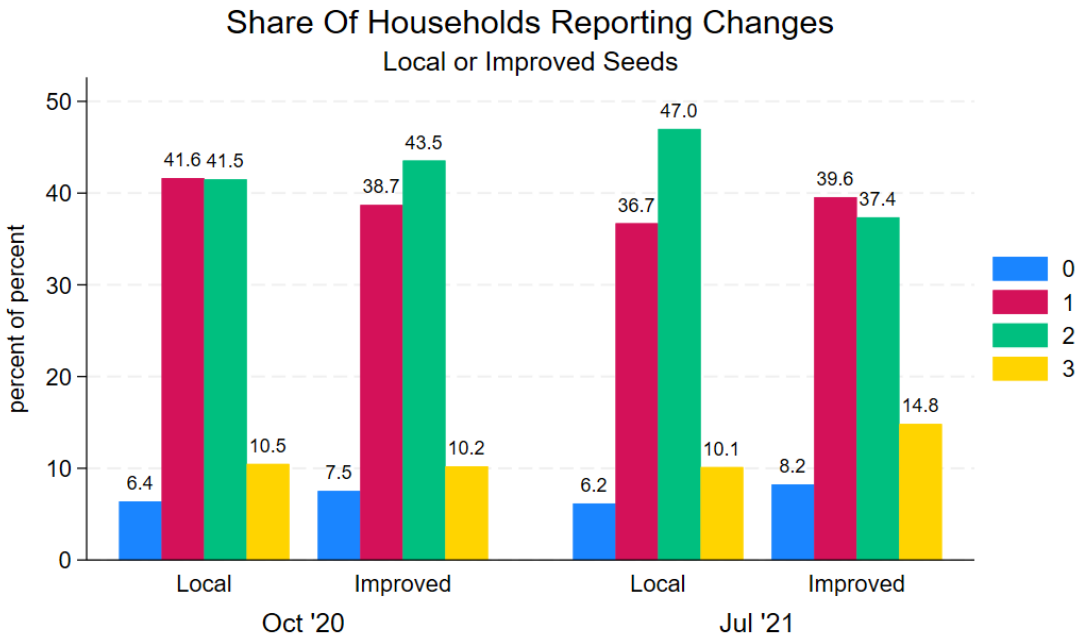


Figure 6.14: Share of Households Changing Number of Crops by Fertilizer Use

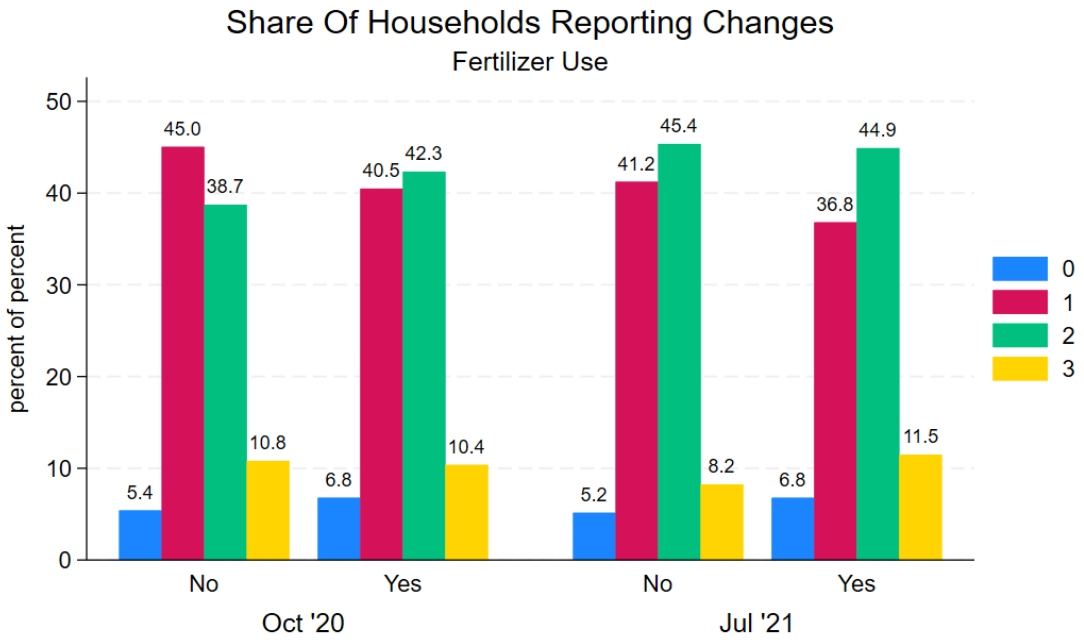


Figure 6.15: Share of Households Changing Number of Crops by Pesticide Use

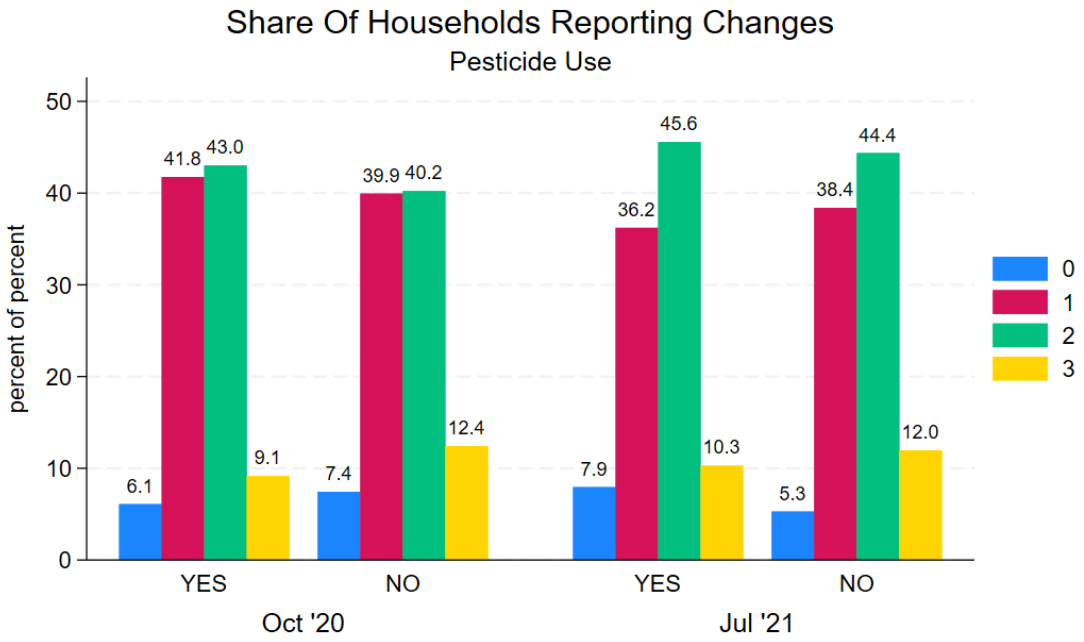


Table 6.1: General Category Crop Changes

	Pre-Outbreak to Oct '20 (1)	Pre-Outbreak to Jul '21 (2)	Oct '20 to Jul '21 (3)	Oct '20 to Jul '21 (4)
No Crops Reported	0.000	0.000		0.000
	(.)	(.)		(.)
Staple Crops	-0.314***	-0.334***	-0.118*	-0.044
	(0.036)	(0.038)	(0.069)	(0.037)
Cash Crops	-0.155***	-0.085	0.057	-0.085
	(0.053)	(0.056)	(0.079)	(0.056)
Garden Crops	-0.004	0.101	0.320***	-0.007
	(0.064)	(0.064)	(0.089)	(0.063)
Other Crops	-0.201	-0.005	0.173	0.095
	(0.17)	(0.18)	(0.16)	(0.13)
Constant	1.757***	1.797***	1.227***	1.209***
	(0.037)	(0.038)	(0.069)	(0.039)
Observations	2763	2589	2442	2442

NOTE: The values reported in this table represent deviations from the mean number of changes households made from before the Outbreak to the 2020 growing season for columns 1 and 2. For column 3 they represent the deviation from the mean number of changes between the 2020 growing season and the 2021 growing seasons for households who reported no crop at least once in the LSMS-ISA data. The values in column 4 represent the deviation from the mean number of top three crop changes households made from the 2020 growing season to the 2021 growing season by households who reported no crop as one of their top 3 crops at least once in the Oct '20 survey round. Standard errors in parentheses

*$p < 0.10$, *$p < 0.05$, *$p < 0.01$

Table 6.2: FAO Classification Crop Changes

	Pre-Outbreak to Oct '20 (1)	Pre-Outbreak to Jul '21 (2)	Oct '20 to Jul '21 (3)	Oct '20 to Jul '21 (4)
Cereals	-0.324***	-0.371***	-0.139**	-0.048
	(0.036)	(0.039)	(0.068)	(0.037)
Vegetables and melons	0.107	0.192**	0.506***	0.046
	(0.093)	(0.091)	(0.17)	(0.093)
Oilseed crops and oleaginous fruits	-0.187***	-0.033	0.163**	-0.066
	(0.055)	(0.056)	(0.076)	(0.058)
Leguminous crops	-0.248***	-0.205***	0.028	-0.036
	(0.045)	(0.046)	(0.077)	(0.048)
Other crops	-0.168	-0.004	0.157	0.183
	(0.15)	(0.17)	(0.16)	(0.12)
Temporary fibre crops	-0.110	-0.144*	-0.259**	-0.126*
	(0.078)	(0.083)	(0.11)	(0.073)
Constant	1.757***	1.797***	1.227***	1.209***
	(0.037)	(0.038)	(0.069)	(0.039)
Observations	2763	2589	2442	2442

NOTE: The values reported in this table represent deviations from the mean number of changes households made from before the Outbreak to the 2020 growing season for columns 1 and 2. For column 3 they represent the deviation from the mean number of changes between the 2020 growing season and the 2021 growing seaons for households who reported "No Crop" at least once in the LSMS-ISA data. The values in column 4 represent the deviation from the mean number of top three crop changes households made from the 2020 growing season to the 2021 growing season by households who reported "No crop" as one of their top 3 crops at least once in the Oct '20 survey round. Standard errors in parentheses

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$

Table 6.3: Top Ten Crop Changes

	Pre-Outbreak to Oct '20 (1)	Pre-Outbreak to Jul '21 (2)	Oct '20 to Jul '21 (3)	Oct '20 to Jul '21 (4)
0	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)
Other crops	0.099	0.127	0.435***	0.056
	(0.089)	(0.085)	(0.12)	(0.084)
Maize	-0.431***	-0.446***	-0.136**	-0.007
	(0.046)	(0.046)	(0.066)	(0.048)
Rice	-0.322***	-0.117	0.027	-0.062
	(0.093)	(0.100)	(0.098)	(0.091)
Sorghum	-0.299***	-0.405***	-0.185**	-0.077*
	(0.043)	(0.046)	(0.075)	(0.045)
Millet	-0.248***	-0.304***	-0.141*	-0.045
	(0.048)	(0.052)	(0.076)	(0.049)
Groundnuts	-0.182***	-0.049	0.143*	-0.060
	(0.062)	(0.065)	(0.081)	(0.069)
Cowpeas	-0.281***	-0.224***	-0.009	-0.033
	(0.045)	(0.046)	(0.077)	(0.048)
Okra	0.067	0.272**	0.328*	0.076
	(0.11)	(0.13)	(0.18)	(0.15)
Sesame	-0.197**	-0.005	0.203**	-0.076
	(0.083)	(0.081)	(0.090)	(0.081)
Cotton	-0.110	-0.144*	-0.259**	-0.126*
	(0.078)	(0.083)	(0.11)	(0.073)
Constant	1.757***	1.797***	1.227***	1.209***
	(0.037)	(0.038)	(0.069)	(0.039)
Observations	2763	2589	2442	2442

NOTE: The values reported in this table represent deviations from the mean number of changes households made from before the Outbreak to the 2020 growing season for columns 1 and 2. For column 3 they represent the deviation from the mean number of changes between the 2020 growing season and the 2021 growing seaons for households who reported "No Crop" at least once in the LSMS-ISA data. The values in column 4 represent the deviation from the mean number of top three crop changes households made from the 2020 growing season to the 2021 growing season by households who reported no crop as one of their top 3 crops at least once in the Oct '20 survey round. Standard errors in parentheses

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$

Table 6.4: General Crops Interaction With Household Head Gender

	Pre-Outbreak to Oct '20 (1)	Pre-Outbreak to Jul '21 (2)	Oct '20 to Jul '21 (3)	Oct '20 to Jul '21 (4)
Staple Crops	-0.340***	-0.356***	-0.073*	-0.136*
	(0.039)	(0.042)	(0.042)	(0.076)
Cash Crops	-0.142**	-0.093	-0.095	0.051
	(0.056)	(0.060)	(0.060)	(0.089)
Garden Crops	-0.003	0.098	-0.054	0.290***
	(0.069)	(0.071)	(0.069)	(0.095)
Other Crops	-0.195	-0.006	0.093	0.175
	(0.17)	(0.18)	(0.13)	(0.16)
Female	0.040	-0.004	-0.014	0.012
	(0.10)	(0.091)	(0.10)	(0.18)
Staple Crops × Female	0.252**	0.193**	0.246***	0.183
	(0.099)	(0.085)	(0.083)	(0.18)
Cash Crops × Female	-0.127	0.099	0.107	0.039
	(0.19)	(0.15)	(0.16)	(0.18)
Garden Crops × Female	0.004	0.025	0.401**	0.306
	(0.17)	(0.15)	(0.17)	(0.29)
Constant	1.750***	1.798***	1.212***	1.225***
	(0.040)	(0.043)	(0.043)	(0.077)
Observations	2763	2589	2442	2442

NOTE: The values reported in this table represent deviations from the mean number of changes households made from before the Outbreak to the 2020 growing season for column 1 and to the 2021 growing season for column 2. For column 3 they represent the deviation from the mean number of changes between the 2020 growing season and the 2021 growing seasons for households who reported no crop at least once in the LSMS-ISA data. The values in column 4 represent the deviation from the mean number of top three crop changes households made from the 2020 growing season to the 2021 growing season by households who reported "No crop" as one of their top 3 crops at least once in the Oct '20 survey round. The interaction terms represent the deviations from the mean number of changes for households reporting the crop and are women-headed. Standard errors in parentheses

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$

Table 6.5: FAO Crops Interaction With Household Head Gender

	Pre-Outbreak to Oct '20 (1)	Pre-Outbreak to Jul '21 (2)	Oct '20 to Jul '21 (3)	Oct '20 to Jul '21 (4)
Cereals	-0.348***	-0.394***	-0.073*	-0.157**
	(0.039)	(0.043)	(0.041)	(0.076)
Vegetables and melons	0.114	0.215**	-0.020	0.397**
	(0.11)	(0.10)	(0.10)	(0.17)
Oilseed crops and oleaginous fruits	-0.165***	-0.037	-0.075	0.173**
	(0.059)	(0.061)	(0.063)	(0.086)
Leguminous crops	-0.286***	-0.221***	-0.078	0.014
	(0.049)	(0.052)	(0.054)	(0.085)
Other crops	-0.144	-0.012	0.159	0.160
	(0.15)	(0.17)	(0.12)	(0.16)
Temporary fibre crops	-0.117	-0.158*	-0.127*	-0.258**
	(0.079)	(0.084)	(0.075)	(0.11)
Female	0.040	-0.004	-0.014	0.012
	(0.10)	(0.091)	(0.10)	(0.18)
Cereals × Female	0.243**	0.214**	0.233***	0.189
	(0.100)	(0.089)	(0.083)	(0.18)
Vegetables and melons × Female	-0.047	-0.152	0.437**	0.617
	(0.19)	(0.21)	(0.21)	(0.40)
Oilseed crops and oleaginous fruits × Female	-0.197	0.043	0.086	-0.059
	(0.17)	(0.14)	(0.16)	(0.18)
Leguminous crops × Female	0.292**	0.112	0.309***	0.127
	(0.12)	(0.11)	(0.11)	(0.20)
Other crops × Female	-0.646***	0.218	0.643***	0.021
	(0.18)	(0.19)	(0.15)	(0.20)
Temporary fibre crops × Female	1.326***	1.364***	-0.070	
	(0.12)	(0.12)	(0.12)	
Constant	1.750***	1.798***	1.212***	1.225***
	(0.040)	(0.043)	(0.043)	(0.077)
Observations	2763	2589	2442	2442

NOTE: The values reported in this table represent deviations from the mean number of changes households made from before the Outbreak to the 2020 growing season for column 1 and to the 2021 growing season for column 2. For column 3 they represent the deviation from the mean number of changes between the 2020 growing season and the 2021 growing seasons for households who reported no crop at least once in the LSMS-ISA data. The values in column 4 represent the deviation from the mean number of top three crop changes households made from the 2020 growing season to the 2021 growing season by households who reported "No crop" as one of their top 3 crops at least once in the Oct '20 survey round. The interaction terms represent the deviations from the mean number of changes for households reporting the crop and are women-headed. Standard errors in parentheses

*$p < 0.10$, *$p < 0.05$, *$p < 0.01$

Table 6.6: Top Ten Crops Interaction With Household Head Gender

	Pre-Outbreak to Oct '20 (1)	Pre-Outbreak to Jul '21 (2)	Oct '20 to Jul '21 (3)	Oct '20 to Jul '21 (4)
Other crops	0.083	0.140	0.011	0.383***
	(0.095)	(0.092)	(0.087)	(0.12)
Maize	-0.433***	-0.470***	-0.017	-0.159**
	(0.048)	(0.050)	(0.052)	(0.073)
Rice	-0.360***	-0.153	-0.108	-0.025
	(0.10)	(0.11)	(0.100)	(0.11)
Sorghum	-0.317***	-0.420***	-0.113**	-0.202**
	(0.046)	(0.051)	(0.050)	(0.082)
Millet	-0.299***	-0.325***	-0.068	-0.142*
	(0.051)	(0.057)	(0.055)	(0.084)
Groundnuts	-0.158**	-0.048	-0.072	0.154*
	(0.066)	(0.072)	(0.075)	(0.093)
Cowpeas	-0.315***	-0.240***	-0.071	-0.024
	(0.049)	(0.052)	(0.053)	(0.085)
Okra	0.090	0.302*	-0.062	0.204
	(0.13)	(0.16)	(0.18)	(0.20)
Sesame	-0.176**	-0.020	-0.081	0.205**
	(0.086)	(0.086)	(0.086)	(0.097)
Cotton	-0.117	-0.158*	-0.127*	-0.258**
	(0.079)	(0.084)	(0.075)	(0.11)
Female	0.040	-0.004	-0.014	0.012
	(0.10)	(0.092)	(0.10)	(0.18)
Other crops × Female	0.238	-0.156	0.542*	0.491
	(0.22)	(0.18)	(0.30)	(0.40)
Maize × Female	0.049	0.292**	0.111	0.217
	(0.17)	(0.12)	(0.14)	(0.17)
Rice × Female	0.236	0.259	0.310	0.351
	(0.21)	(0.25)	(0.23)	(0.23)
Sorghum × Female	0.200	0.150	0.344***	0.190
	(0.13)	(0.12)	(0.12)	(0.20)
Millet × Female	0.406***	0.170	0.175	0.031
	(0.14)	(0.13)	(0.12)	(0.21)
Groundnuts × Female	-0.178	-0.009	0.096	-0.051
	(0.19)	(0.16)	(0.18)	(0.19)
Cowpeas × Female	0.270**	0.113	0.277**	0.140
	(0.13)	(0.11)	(0.11)	(0.20)
Okra × Female	-0.102	-0.096	0.489*	0.560**
	(0.26)	(0.28)	(0.27)	(0.26)
Sesame × Female	-0.281	0.226	0.050	-0.013
	(0.33)	(0.26)	(0.30)	(0.31)
Cotton × Female	1.326***	1.364***	-0.070	0.021
	(0.12)	(0.12)	(0.12)	(0.20)
Constant	1.750***	1.798***	1.212***	1.225***
	(0.040)	(0.043)	(0.043)	(0.077)
Observations	2763	2589	2442	2442

NOTE: The values reported in this table represent deviations from the mean number of changes households made from before the Outbreak to the 2020 growing season for column 1 and to the 2021 growing season for column 2. For column 3 they represent the deviation from the mean number of changes between the 2020 growing season and the 2021 growing seasons for households who reported no crop at least once in the LSMS-ISA data. The values in column 4 represent the deviation from the mean number of top three crop changes households made from the 2020 growing season to the 2021 growing season by households who reported "No crop" as one of their top 3 crops at least once in the Oct '20 survey round. The interaction terms represent the deviations from the mean number of changes for households reporting the crop and are women-headed. The columns are the same as listed above. Standard errors in parentheses

$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

Table 6.7: General Crops Interaction With Stand Type

	Pre-Outbreak to Oct '20 (1)	Pre-Outbreak to Jul '21 (2)	Oct '20 to Jul '21 (3)	Oct '20 to Jul '21 (4)
Staple Crops	-0.320***	-0.300***	0.011	-0.063
	(0.041)	(0.047)	(0.044)	(0.083)
Cash Crops	-0.196***	-0.122*	-0.005	-0.016
	(0.066)	(0.067)	(0.067)	(0.098)
Garden Crops	-0.010	0.148*	-0.013	0.330***
	(0.079)	(0.079)	(0.078)	(0.11)
Other Crops	-0.271	-0.154	0.062	0.194
	(0.21)	(0.22)	(0.16)	(0.20)
Intercropped	-0.147*	-0.087	0.133*	0.120
	(0.076)	(0.075)	(0.075)	(0.14)
Staple Crops × Intercropped	0.088	-0.020	-0.166**	-0.167
	(0.071)	(0.073)	(0.071)	(0.14)
Cash Crops × Intercropped	0.155	0.127	-0.264**	0.139
	(0.11)	(0.12)	(0.12)	(0.16)
Garden Crops × Intercropped	0.061	-0.097	-0.022	-0.070
	(0.13)	(0.13)	(0.13)	(0.18)
Other Crops × Intercropped	0.290	0.587	0.132	-0.081
	(0.29)	(0.36)	(0.26)	(0.34)
Constant	1.795***	1.821***	1.173***	1.194***
	(0.045)	(0.048)	(0.049)	(0.085)
Observations	2763	2589	2442	2442

NOTE: The values reported in this table represent deviations from the mean number of changes households made from before the Outbreak to the 2020 growing season for column 1 and to the 2021 growing season for column 2. For column 3 they represent the deviation from the mean number of changes between the 2020 growing season and the 2021 growing seasons for households who reported no crop at least once in the LSMS-ISA data. The values in column 4 represent the deviation from the mean number of top three crop changes households made from the 2020 growing season to the 2021 growing season by households who reported "No crop" as one of their top 3 crops at least once in the Oct '20 survey round. The interaction terms represent the deviations from the mean number of changes for households reporting the crop and who inter-cropped at least one field.

*$p < 0.10$, *$p < 0.05$, *$p < 0.01$

Table 6.8: FAO Crops Interaction With Stand Type

	Pre-Outbreak to Oct '20 (1)	Pre-Outbreak to Jul '21 (2)	Oct '20 to Jul '21 (3)	Oct '20 to Jul '21 (4)
Cereals	-0.332***	-0.342***	0.007	-0.084
	(0.041)	(0.048)	(0.043)	(0.083)
Vegetables and melons	0.110	0.268**	-0.028	0.487**
	(0.11)	(0.11)	(0.11)	(0.23)
Oilseed crops and oleaginous fruits	-0.214***	-0.037	0.044	0.144
	(0.073)	(0.069)	(0.072)	(0.095)
Leguminous crops	-0.197***	-0.023	0.023	0.091
	(0.075)	(0.079)	(0.084)	(0.099)
Other crops	-0.276	-0.139	0.160	0.194
	(0.17)	(0.20)	(0.14)	(0.20)
Temporary fibre crops	-0.150*	-0.169*	-0.102	-0.250**
	(0.086)	(0.091)	(0.081)	(0.13)
Intercropped	-0.147*	-0.087	0.133*	0.120
	(0.076)	(0.075)	(0.076)	(0.14)
Cereals × Intercropped	0.083	-0.025	-0.170**	-0.168
	(0.074)	(0.077)	(0.074)	(0.14)
Vegetables and melons × Intercropped	0.024	-0.179	0.174	-0.020
	(0.20)	(0.19)	(0.19)	(0.33)
Oilseed crops and oleaginous fruits × Intercropped	0.121	0.042	-0.303**	-0.004
	(0.11)	(0.11)	(0.12)	(0.15)
Leguminous crops × Intercropped	0.023	-0.195**	-0.164*	-0.177
	(0.096)	(0.095)	(0.099)	(0.15)
Other crops × Intercropped	0.486	0.548*	0.105	-0.134
	(0.30)	(0.32)	(0.24)	(0.32)
Temporary fibre crops × Intercropped	0.169	0.102	-0.037	0.046
	(0.21)	(0.24)	(0.19)	(0.20)
Constant	1.795***	1.821***	1.173***	1.194***
	(0.045)	(0.048)	(0.049)	(0.085)
Observations	2763	2589	2442	2442

NOTE: The values reported in this table represent deviations from the mean number of changes households made from before the Outbreak to the 2020 growing season for column 1 and to the 2021 growing season for column 2. For column 3 they represent the deviation from the mean number of changes between the 2020 growing season and the 2021 growing seasons for households who reported no crop at least once in the LSMS-ISA data. The values in column 4 represent the deviation from the mean number of top three crop changes households made from the 2020 growing season to the 2021 growing season by households who reported "No crop" as one of their top 3 crops at least once in the Oct '20 survey round. The interaction terms represent the deviations from the mean number of changes for households reporting the crop and who inter-cropped at least one field. Standard errors in parentheses

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$

Table 6.9: Top Ten Crops Interaction With Stand Type

	Pre-Outbreak to Oct '20 (1)	Pre-Outbreak to Jul '21 (2)	Oct '20 to Jul '21 (3)	Oct '20 to Jul '21 (4)
Other crops	0.039	0.116	-0.009	0.401**
	(0.12)	(0.11)	(0.098)	(0.17)
Maize	-0.513***	-0.480***	0.017	-0.098
	(0.052)	(0.054)	(0.054)	(0.078)
Rice	-0.382***	-0.143	-0.084	0.019
	(0.11)	(0.11)	(0.10)	(0.12)
Sorghum	-0.212***	-0.366***	-0.035	-0.128
	(0.058)	(0.066)	(0.062)	(0.096)
Millet	-0.153**	-0.137*	0.095	-0.052
	(0.065)	(0.075)	(0.072)	(0.10)
Groundnuts	-0.238***	-0.074	0.092	0.089
	(0.084)	(0.085)	(0.087)	(0.10)
Cowpeas	-0.247***	-0.055	0.033	0.061
	(0.077)	(0.081)	(0.087)	(0.099)
Okra	0.013	0.370**	0.077	0.606***
	(0.10)	(0.15)	(0.18)	(0.20)
Sesame	-0.174	0.015	-0.028	0.236**
	(0.11)	(0.098)	(0.10)	(0.11)
Cotton	-0.150*	-0.169*	-0.102	-0.250**
	(0.086)	(0.091)	(0.081)	(0.13)
Intercropped	-0.147*	-0.087	0.133*	0.120
	(0.076)	(0.075)	(0.076)	(0.14)
Other crops × Intercropped	0.211	0.055	0.136	0.016
	(0.17)	(0.17)	(0.18)	(0.24)
Maize × Intercropped	0.297***	0.124	-0.093	-0.134
	(0.11)	(0.100)	(0.11)	(0.14)
Rice × Intercropped	0.273	0.101	0.195	0.021
	(0.21)	(0.24)	(0.18)	(0.21)
Sorghum × Intercropped	-0.068	-0.019	-0.141	-0.165
	(0.087)	(0.091)	(0.089)	(0.15)
Millet × Intercropped	-0.077	-0.233**	-0.305***	-0.219
	(0.094)	(0.10)	(0.098)	(0.15)
Groundnuts × Intercropped	0.188	0.090	-0.384***	0.061
	(0.13)	(0.13)	(0.14)	(0.16)
Cowpeas × Intercropped	0.048	-0.175*	-0.174*	-0.191
	(0.097)	(0.097)	(0.10)	(0.16)
Okra × Intercropped	0.214	-0.353	-0.008	-0.670**
	(0.35)	(0.28)	(0.31)	(0.31)
Sesame × Intercropped	0.003	-0.035	-0.164	-0.122
	(0.17)	(0.17)	(0.17)	(0.18)
Cotton × Intercropped	0.169	0.102	-0.037	0.046
	(0.21)	(0.24)	(0.19)	(0.20)
Constant	1.795***	1.821***	1.173***	1.194***
	(0.045)	(0.048)	(0.049)	(0.086)
Observations	2763	2589	2442	2442

NOTE: The values reported in this table represent deviations from the mean number of changes households made from before the Outbreak to the 2020 growing season for column 1 and to the 2021 growing season for column 2. For column 3 they represent the deviation from the mean number of changes between the 2020 growing season and the 2021 growing seasons for households who reported no crop at least once in the LSMS-ISA data. The values in column 4 represent the deviation from the mean number of top three crop changes households made from the 2020 growing season to the 2021 growing season by households who reported "No crop" as one of their top 3 crops at least once in the Oct '20 survey round. The interaction terms represent the deviations from the mean number of changes for households reporting the crop and who inter-cropped at least one field. Standard errors in parentheses

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$

Table 6.10: General Crops Interaction With Seed Type

	Pre-Outbreak to Oct '20 (1)	Pre-Outbreak to Jul '21 (2)	Oct '20 to Jul '21 (3)	Oct '20 to Jul '21 (4)
Staple Crops	-0.285***	-0.302***	-0.030	-0.101
	(0.038)	(0.040)	(0.040)	(0.075)
Cash Crops	-0.192***	-0.099	-0.059	0.108
	(0.064)	(0.065)	(0.071)	(0.087)
Garden Crops	0.044	0.139**	0.008	0.401***
	(0.077)	(0.068)	(0.074)	(0.10)
Other Crops	-0.410**	-0.080	-0.030	0.285
	(0.17)	(0.20)	(0.13)	(0.18)
Improved	0.084	0.067	0.018	0.071
	(0.10)	(0.11)	(0.10)	(0.18)
Staple Crops × Improved	-0.165	-0.182	-0.078	-0.090
	(0.10)	(0.11)	(0.11)	(0.18)
Cash Crops × Improved	0.059	0.002	-0.081	-0.227
	(0.12)	(0.13)	(0.12)	(0.20)
Garden Crops × Improved	-0.205	-0.158	-0.061	-0.314
	(0.14)	(0.17)	(0.15)	(0.20)
Other Crops × Improved	0.916***	0.227	0.472	-0.571
	(0.35)	(0.43)	(0.32)	(0.37)
Constant	1.743***	1.786***	1.206***	1.215***
	(0.040)	(0.041)	(0.043)	(0.076)
Observations	2763	2589	2442	2442

NOTE:The values reported in this table represent deviations from the mean number of changes households made from before the Outbreak to the 2020 growing season for column 1 and to the 2021 growing season for column 2. For column 3 they represent the deviation from the mean number of changes between the 2020 growing season and the 2021 growing seasons for households who reported no crop at least once in the LSMS-ISA data. The values in column 4 represent the deviation from the mean number of top three crop changes households made from the 2020 growing season to the 2021 growing season by households who reported "No crop" as one of their top 3 crops at least once in the Oct '20 survey round. The interaction terms represent the deviations from the mean number of changes for households reporting the crop and using improved seed varieties. The columns are the same as listed above. Standard errors in parentheses

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$

Table 6.11: FAO Crops Interaction With Seed Type

	Pre-Outbreak to Oct '20 (1)	Pre-Outbreak to Jul '21 (2)	Oct '20 to Jul '21 (3)	Oct '20 to Jul '21 (4)
Cereals	-0.297***	-0.334***	-0.028	-0.118
	(0.038)	(0.041)	(0.040)	(0.076)
Vegetables and melons	0.130	0.214**	0.012	0.550***
	(0.11)	(0.099)	(0.11)	(0.20)
Oilseed crops and oleaginous fruits	-0.174***	-0.039	-0.041	0.207**
	(0.061)	(0.058)	(0.065)	(0.085)
Leguminous crops	-0.227***	-0.191***	-0.028	0.018
	(0.048)	(0.049)	(0.050)	(0.084)
Other crops	-0.343**	-0.136	0.044	0.285
	(0.16)	(0.18)	(0.13)	(0.18)
Temporary fibre crops	-0.176	-0.200	-0.135	-0.277*
	(0.14)	(0.14)	(0.14)	(0.14)
Improved	0.084	0.067	0.018	0.071
	(0.10)	(0.11)	(0.10)	(0.18)
Cereals × Improved	-0.156	-0.198*	-0.098	-0.110
	(0.10)	(0.12)	(0.11)	(0.18)
Vegetables and melons × Improved	-0.124	-0.110	0.127	-0.199
	(0.21)	(0.23)	(0.21)	(0.34)
Oilseed crops and oleaginous fruits × Improved	-0.085	0.010	-0.114	-0.217
	(0.14)	(0.16)	(0.15)	(0.19)
Leguminous crops × Improved	-0.135	-0.086	-0.051	0.069
	(0.14)	(0.14)	(0.15)	(0.20)
Other crops × Improved	0.627**	0.394	0.482*	-0.571*
	(0.29)	(0.36)	(0.26)	(0.34)
Temporary fibre crops × Improved	0.030	0.028	-0.001	-0.008
	(0.17)	(0.18)	(0.17)	(0.24)
Constant	1.743***	1.786***	1.206***	1.215***
	(0.040)	(0.041)	(0.043)	(0.076)
Observations	2763	2589	2442	2442

NOTE: The values reported in this table represent deviations from the mean number of changes households made from before the Outbreak to the 2020 growing season for column 1 and to the 2021 growing season for column 2. For column 3 they represent the deviation from the mean number of changes between the 2020 growing season and the 2021 growing seasons for households who reported no crop at least once in the LSMS-ISA data. The values in column 4 represent the deviation from the mean number of top three crop changes households made from the 2020 growing season to the 2021 growing season by households who reported "No crop" as one of their top 3 crops at least once in the Oct '20 survey round. The interaction terms represent the deviations from the mean number of changes for households reporting the crop and using improved seed varieties. The columns are the same as listed above. Standard errors in parentheses

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$

Table 6.12: Top Ten Crops Interaction With Seed Type

	Pre-Outbreak to Oct '20 (1)	Pre-Outbreak to Jul '21 (2)	Oct '20 to Jul '21 (3)	Oct '20 to Jul '21 (4)
Other crops	0.057	0.112	0.009	0.520***
	(0.11)	(0.097)	(0.100)	(0.14)
Maize	-0.393***	-0.388***	0.020	-0.112
	(0.053)	(0.050)	(0.055)	(0.074)
Rice	-0.280**	0.037	0.065	0.114
	(0.11)	(0.12)	(0.10)	(0.11)
Sorghum	-0.269***	-0.375***	-0.066	-0.163**
	(0.046)	(0.049)	(0.049)	(0.082)
Millet	-0.254***	-0.306***	-0.037	-0.138*
	(0.050)	(0.054)	(0.052)	(0.083)
Groundnuts	-0.196***	-0.078	-0.042	0.173*
	(0.066)	(0.069)	(0.075)	(0.088)
Cowpeas	-0.253***	-0.212***	-0.033	-0.020
	(0.048)	(0.049)	(0.051)	(0.085)
Okra	0.075	0.283**	0.079	0.214
	(0.12)	(0.13)	(0.15)	(0.20)
Sesame	-0.125	0.045	-0.037	0.292***
	(0.11)	(0.083)	(0.099)	(0.10)
Cotton	-0.176	-0.200	-0.135	-0.277*
	(0.14)	(0.14)	(0.14)	(0.14)
Improved	0.084	0.067	0.018	0.071
	(0.10)	(0.11)	(0.11)	(0.18)
Other crops × Improved	0.088	0.007	0.130	-0.384
	(0.18)	(0.19)	(0.18)	(0.27)
Maize × Improved	-0.176	-0.232*	-0.103	-0.118
	(0.11)	(0.12)	(0.12)	(0.17)
Rice × Improved	-0.184	-0.557**	-0.439**	-0.333
	(0.21)	(0.22)	(0.20)	(0.24)
Sorghum × Improved	-0.172	-0.170	-0.055	-0.123
	(0.12)	(0.14)	(0.13)	(0.20)
Millet × Improved	0.093	0.046	-0.058	-0.015
	(0.16)	(0.18)	(0.16)	(0.20)
Groundnuts × Improved	0.099	0.187	-0.105	-0.166
	(0.18)	(0.19)	(0.18)	(0.22)
Cowpeas × Improved	-0.185	-0.078	0.001	0.074
	(0.14)	(0.14)	(0.15)	(0.21)
Okra × Improved	0.098			0.500*
	(0.15)			(0.26)
Sesame × Improved	-0.264	-0.188	-0.123	-0.320
	(0.18)	(0.21)	(0.18)	(0.21)
Cotton × Improved	0.030	0.028	-0.001	-0.008
	(0.17)	(0.18)	(0.17)	(0.24)
Constant	1.743***	1.786***	1.206***	1.215***
	(0.040)	(0.041)	(0.043)	(0.076)
Observations	2763	2589	2442	2442

NOTE: The values reported in this table represent deviations from the mean number of changes households made from before the Outbreak to the 2020 growing season for column 1 and to the 2021 growing season for column 2. For column 3 they represent the deviation from the mean number of changes between the 2020 growing season and the 2021 growing seasons for households who reported no crop at least once in the LSMS-ISA data. The values in column 4 represent the deviation from the mean number of top three crop changes households made from the 2020 growing season to the 2021 growing season by households who reported "No crop" as one of their top 3 crops at least once in the Oct '20 survey round. The interaction terms represent the deviations from the mean number of changes for households reporting the crop and using improved seed varieties. The columns are the same as listed above. Standard errors in parentheses

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$

Table 6.13: General Crops Interaction With Pesticide Use

	Pre-Outbreak to Oct '20 (1)	Pre-Outbreak to Jul '21 (2)	Oct '20 to Jul '21 (3)	Oct '20 to Jul '21 (4)
Staple Crops	-0.307***	-0.307***	-0.081*	-0.120
	(0.045)	(0.045)	(0.047)	(0.11)
Cash Crops	-0.220***	-0.018	-0.153*	0.175
	(0.074)	(0.079)	(0.093)	(0.12)
Garden Crops	0.068	0.169*	-0.040	0.508***
	(0.087)	(0.091)	(0.10)	(0.14)
Other Crops	0.498**	0.892***	0.086	0.273
	(0.22)	(0.27)	(0.28)	(0.56)
Yes	-0.020	0.028	-0.085	0.013
	(0.078)	(0.081)	(0.080)	(0.14)
Staple Crops × Yes	0.012	-0.046	0.082	-0.001
	(0.073)	(0.080)	(0.078)	(0.14)
Cash Crops × Yes	0.138	-0.119	0.141	-0.265*
	(0.11)	(0.11)	(0.12)	(0.16)
Garden Crops × Yes	-0.117	-0.121	0.087	-0.359**
	(0.13)	(0.13)	(0.13)	(0.18)
Other Crops × Yes	-0.850***	-1.095***	0.067	-0.113
	(0.29)	(0.34)	(0.31)	(0.59)
Constant	1.752***	1.775***	1.247***	1.227***
	(0.046)	(0.046)	(0.050)	(0.11)
Observations	2733	2562	2418	2418

NOTE: The values reported in this table represent deviations from the mean number of changes households made from before the Outbreak to the 2020 growing season for column 1 and to the 2021 growing season for column 2. For column 3 they represent the deviation from the mean number of changes between the 2020 growing season and the 2021 growing seasons for households who reported no crop at least once in the LSMS-ISA data. The values in column 4 represent the deviation from the mean number of top three crop changes households made from the 2020 growing season to the 2021 growing season by households who reported "No crop" as one of their top 3 crops at least once in the Oct '20 survey round. The interaction terms represent the deviations from the mean number of changes for households reporting the crop and using pesticides. The columns are the same as listed above. Standard errors in parentheses

*$p < 0.10$, *$p < 0.05$, *$p \leq 0.01$

Table 6.14: FAO Crops Interaction With Pesticide Use

	Pre-Outbreak to Oct '20 (1)	Pre-Outbreak to Jul '21 (2)	Oct '20 to Jul '21 (3)	Oct '20 to Jul '21 (4)
Cereals	-0.323***	-0.344***	-0.087*	-0.141
	(0.044)	(0.046)	(0.047)	(0.11)
Vegetables and melons	0.085	0.203	0.039	0.737***
	(0.12)	(0.14)	(0.14)	(0.22)
Oilseed crops and oleaginous fruits	-0.166**	0.014	-0.174**	0.201*
	(0.071)	(0.074)	(0.084)	(0.12)
Leguminous crops	-0.244***	-0.201***	-0.070	0.013
	(0.053)	(0.053)	(0.057)	(0.11)
Other crops	0.123	0.425	0.353	0.273
	(0.21)	(0.33)	(0.22)	(0.56)
Temporary fibre crops	-0.752***	-0.108	0.420	0.217
	(0.046)	(0.28)	(0.28)	(0.25)
Yes	-0.020	0.028	-0.085	0.013
	(0.078)	(0.081)	(0.080)	(0.14)
Cereals × Yes	0.026	-0.044	0.089	-0.003
	(0.074)	(0.082)	(0.077)	(0.14)
Vegetables and melons × Yes	0.049	-0.029	0.055	-0.665**
	(0.19)	(0.18)	(0.19)	(0.30)
Oilseed crops and oleaginous fruits × Yes	-0.015	-0.100	0.237**	-0.093
	(0.11)	(0.11)	(0.12)	(0.16)
Leguminous crops × Yes	0.023	0.057	0.058	0.043
	(0.10)	(0.11)	(0.11)	(0.16)
Other crops × Yes	-0.397	-0.576	-0.151	-0.133
	(0.28)	(0.38)	(0.26)	(0.59)
Temporary fibre crops × Yes	0.686***	-0.042	-0.517*	-0.569**
	(0.097)	(0.29)	(0.29)	(0.28)
Constant	1.752***	1.775***	1.247***	1.227***
	(0.046)	(0.046)	(0.050)	(0.11)
Observations	2733	2562	2418	2418

NOTE: The values reported in this table represent deviations from the mean number of changes households made from before the Outbreak to the 2020 growing season for column 1 and to the 2021 growing season for column 2. For column 3 they represent the deviation from the mean number of changes between the 2020 growing season and the 2021 growing seasons for households who reported no crop at least once in the LSMS-ISA data. The values in column 4 represent the deviation from the mean number of top three crop changes households made from the 2020 growing season to the 2021 growing season by households who reported "No crop" as one of their top 3 crops at least once in the Oct '20 survey round. The interaction terms represent the deviations from the mean number of changes for households reporting the crop and using pesticides. The columns are the same as listed above. Standard errors in parentheses

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$

Table 6.15: Top Ten Crops Interaction With Pesticide Use

	Pre-Outbreak to Oct '20 (1)	Pre-Outbreak to Jul '21 (2)	Oct '20 to Jul '21 (3)	Oct '20 to Jul '21 (4)
Other crops	0.298**	0.198	-0.005	0.746***
	(0.12)	(0.14)	(0.17)	(0.19)
Maize	-0.356***	-0.412***	-0.016	-0.150
	(0.065)	(0.065)	(0.080)	(0.11)
Rice	-0.290**	0.051	0.014	0.186
	(0.14)	(0.19)	(0.14)	(0.15)
Sorghum	-0.353***	-0.376***	-0.113**	-0.165
	(0.052)	(0.053)	(0.056)	(0.11)
Millet	-0.273***	-0.308***	-0.101*	-0.164
	(0.053)	(0.056)	(0.055)	(0.11)
Groundnuts	-0.206***	-0.015	-0.172*	0.173
	(0.075)	(0.081)	(0.094)	(0.12)
Cowpeas	-0.270***	-0.220***	-0.068	-0.026
	(0.053)	(0.053)	(0.057)	(0.11)
Okra	-0.048	0.312**	0.117	0.344
	(0.12)	(0.16)	(0.16)	(0.22)
Sesame	-0.049	0.104	-0.180	0.297**
	(0.13)	(0.12)	(0.15)	(0.14)
Cotton	-0.752***	-0.108	0.420	0.217
	(0.046)	(0.28)	(0.28)	(0.25)
Yes	-0.020	0.028	-0.085	0.013
	(0.078)	(0.081)	(0.081)	(0.14)
Other crops × Yes	-0.310*	-0.138	0.144	-0.592**
	(0.17)	(0.18)	(0.20)	(0.23)
Maize × Yes	-0.091	-0.046	0.038	0.021
	(0.093)	(0.095)	(0.10)	(0.14)
Rice × Yes	-0.022	-0.242	-0.087	-0.293
	(0.19)	(0.23)	(0.18)	(0.20)
Sorghum × Yes	0.192**	-0.052	0.078	-0.084
	(0.094)	(0.10)	(0.097)	(0.16)
Millet × Yes	0.201	0.113	0.205	0.086
	(0.13)	(0.14)	(0.13)	(0.16)
Groundnuts × Yes	0.098	-0.100	0.293**	-0.096
	(0.13)	(0.14)	(0.14)	(0.16)
Cowpeas × Yes	-0.013	0.054	0.064	0.051
	(0.10)	(0.11)	(0.11)	(0.16)
Okra × Yes	0.602***	-0.115	-0.279	-0.085
	(0.22)	(0.29)	(0.38)	(0.42)
Sesame × Yes	-0.207	-0.161	0.185	-0.152
	(0.17)	(0.16)	(0.18)	(0.18)
Cotton × Yes	0.686***	-0.042	-0.517*	-0.569**
	(0.097)	(0.29)	(0.29)	(0.28)
Constant	1.752***	1.775***	1.247***	1.227***
	(0.046)	(0.046)	(0.050)	(0.11)
Observations	2733	2562	2418	2418

NOTE: The values reported in this table represent deviations from the mean number of changes households made from before the Outbreak to the 2020 growing season for column 1 and to the 2021 growing season for column 2. For column 3 they represent the deviation from the mean number of changes between the 2020 growing season and the 2021 growing seasons for households who reported no crop at least once in the LSMS-ISA data. The values in column 4 represent the deviation from the mean number of top three crop changes households made from the 2020 growing season to the 2021 growing season by households who reported "No crop" as one of their top 3 crops at least once in the Oct '20 survey round. The interaction terms represent the deviations from the mean number of changes for households reporting the crop and using pesticides. The columns are the same as listed above. Standard errors in parentheses

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$

Table 6.16: General Crops Interaction With Fertilizer Use

	Pre-Outbreak to Oct '20 (1)	Pre-Outbreak to Jul '21 (2)	Oct '20 to Jul '21 (3)	Oct '20 to Jul '21 (4)
Staple Crops	-0.245**	-0.160*	0.037	0.038
	(0.097)	(0.097)	(0.096)	(0.23)
Cash Crops	-0.032	0.199	0.200	0.191
	(0.19)	(0.19)	(0.18)	(0.24)
Garden Crops	-0.199	0.303**	0.072	0.155
	(0.19)	(0.15)	(0.21)	(0.31)
Other Crops	-0.699***	-0.613***	-0.086	1.941***
	(0.100)	(0.088)	(0.096)	(0.23)
Yes	0.053	0.197**	0.146	0.193
	(0.11)	(0.098)	(0.10)	(0.24)
Staple Crops × Yes	-0.067	-0.187*	-0.098	-0.176
	(0.10)	(0.10)	(0.10)	(0.24)
Cash Crops × Yes	-0.122	-0.315	-0.313*	-0.156
	(0.20)	(0.20)	(0.19)	(0.26)
Garden Crops × Yes	0.222	-0.224	-0.090	0.172
	(0.20)	(0.17)	(0.22)	(0.32)
Other Crops × Yes	0.489**	0.576***	0.187	-1.845***
	(0.20)	(0.21)	(0.17)	(0.28)
Constant	1.699***	1.613***	1.086***	1.059***
	(0.100)	(0.088)	(0.096)	(0.23)
Observations	2733	2562	2418	2418

NOTE: The values reported in this table represent deviations from the mean number of changes households made from before the Outbreak to the 2020 growing season for column 1 and to the 2021 growing season for column 2. For column 3 they represent the deviation from the mean number of changes between the 2020 growing season and the 2021 growing seasons for households who reported no crop at least once in the LSMS-ISA data. The values in column 4 represent the deviation from the mean number of top three crop changes households made from the 2020 growing season to the 2021 growing season by households who reported "No crop" as one of their top 3 crops at least once in the Oct '20 survey round. The interaction terms represent the deviations from the mean number of changes for households reporting the crop and using fertilizer. The columns are the same as listed above. Standard errors in parentheses

*$p < 0.10$, *$p < 0.05$, *$p \leq 0.01$

Table 6.17: FAO Crops Interaction With Fertilizer Use

	Pre-Outbreak to Oct '20 (1)	Pre-Outbreak to Jul '21 (2)	Oct '20 to Jul '21 (3)	Oct '20 to Jul '21 (4)
Cereals	-0.210**	-0.197*	0.037	0.005
	(0.097)	(0.10)	(0.100)	(0.23)
Vegetables and melons	0.190	0.687***	0.164	0.608*
	(0.21)	(0.22)	(0.36)	(0.36)
Oilseed crops and oleaginous fruits	-0.251	0.101	0.123	0.136
	(0.18)	(0.14)	(0.16)	(0.25)
Leguminous crops	-0.312***	-0.058	0.034	0.149
	(0.12)	(0.11)	(0.11)	(0.24)
Other crops	-0.199	-0.613***	-0.086	1.941***
	(0.36)	(0.088)	(0.096)	(0.23)
Temporary fibre crops	-0.105	-0.157*	-0.148**	-0.059
	(0.079)	(0.084)	(0.074)	(0.23)
Yes	0.053	0.197**	0.146	0.193
	(0.11)	(0.098)	(0.10)	(0.24)
Cereals × Yes	-0.119	-0.188*	-0.102	-0.164
	(0.10)	(0.11)	(0.11)	(0.25)
Vegetables and melons × Yes	-0.095	-0.560**	-0.123	-0.128
	(0.23)	(0.24)	(0.38)	(0.40)
Oilseed crops and oleaginous fruits × Yes	0.083	-0.152	-0.213	0.028
	(0.19)	(0.15)	(0.17)	(0.26)
Leguminous crops × Yes	0.091	-0.154	-0.087	-0.134
	(0.13)	(0.12)	(0.12)	(0.25)
Other crops × Yes	0.014	0.581***	0.277*	-1.859***
	(0.40)	(0.19)	(0.16)	(0.28)
Temporary fibre crops × Yes				-0.225
				(0.26)
Constant	1.699***	1.613***	1.086***	1.059***
	(0.100)	(0.088)	(0.096)	(0.23)
Observations	2733	2562	2418	2418

NOTE: The values reported in this table represent deviations from the mean number of changes households made from before the Outbreak to the 2020 growing season for column 1 and to the 2021 growing season for column 2. For column 3 they represent the deviation from the mean number of changes between the 2020 growing season and the 2021 growing seasons for households who reported no crop at least once in the LSMS-ISA data. The values in column 4 represent the deviation from the mean number of top three crop changes households made from the 2020 growing season to the 2021 growing season by households who reported "No crop" as one of their top 3 crops at least once in the Oct '20 survey round. The interaction terms represent the deviations from the mean number of changes for households reporting the crop and using fertilizer. The columns are the same as listed above. Standard errors in parentheses

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$

Table 6.18: Top Ten Crops Interaction With Fertilizer Use

	Pre-Outbreak to Oct '20 (1)	Pre-Outbreak to Jul '21 (2)	Oct '20 to Jul '21 (3)	Oct '20 to Jul '21 (4)
Other crops	-0.032	0.512**	-0.286	0.775**
	(0.23)	(0.23)	(0.41)	(.36)
Maize	-0.254	-0.347**	-0.229	0.036
	(0.17)	(0.16)	(0.20)	(0.24)
Rice	0.101	0.387	0.414*	0.108
	(0.24)	(0.27)	(0.25)	(0.29)
Sorghum	-0.326***	-0.267**	0.057	0.008
	(0.12)	(0.11)	(0.11)	(0.24)
Millet	-0.116	-0.182	0.031	-0.059
	(0.13)	(0.12)	(0.12)	(0.25)
Groundnuts	-0.032	0.199	0.200	0.200
	(0.19)	(0.19)	(0.18)	(0.24)
Cowpeas	-0.322***	-0.075	0.037	0.137
	(0.12)	(0.11)	(0.11)	(0.24)
Okra	0.301	0.587*	0.514**	0.304*
	(0.25)	(0.34)	(0.24)	(0.18)
Sesame	-0.608**	-0.030	0.014	-0.059
	(0.26)	(0.16)	(0.27)	(0.36)
Cotton	-0.105	-0.157*	-0.148**	-0.059
	(0.079)	(0.084)	(0.074)	(0.23)
No	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)
Yes	0.053	0.197**	0.146	0.193
	(0.11)	(0.098)	(0.11)	(0.24)
Other crops × Yes	0.133	-0.438*	0.362	-0.373
	(0.25)	(0.24)	(0.41)	(0.39)
Maize × Yes	-0.174	-0.107	0.217	-0.193
	(0.18)	(0.17)	(0.21)	(0.25)
Rice × Yes	-0.474*	-0.562*	-0.546**	-0.099
	(0.26)	(0.29)	(0.27)	(0.31)
Sorghum × Yes	0.038	-0.145	-0.159	-0.220
	(0.13)	(0.12)	(0.12)	(0.25)
Millet × Yes	-0.144	-0.129	-0.087	-0.095
	(0.14)	(0.13)	(0.14)	(0.27)
Groundnuts × Yes	-0.155	-0.286	-0.288	-0.068
	(0.20)	(0.20)	(0.19)	(0.26)
Cowpeas × Yes	0.064	-0.157	-0.086	-0.165
	(0.13)	(0.12)	(0.13)	(0.25)
Okra × Yes	-0.267	-0.356	-0.529*	0.283
	(0.28)	(0.37)	(0.29)	(0.37)
Sesame × Yes	0.474*	0.041	-0.108	-0.225
	(0.27)	(0.18)	(0.28)	(0.26)
Constant	1.699***	1.613***	1.086***	1.059***
	(0.100)	(0.088)	(0.096)	(0.23)
Observations	2733	2562	2418	2418

NOTE: The values reported in this table represent deviations from the mean number of changes households made from before the Outbreak to the 2020 growing season for column 1 and to the 2021 growing season for column 2. For column 3 they represent the deviation from the mean number of changes between the 2020 growing season and the 2021 growing seasons for households who reported no crop at least once in the LSMS-ISA data. The values in column 4 represent the deviation from the mean number of top three crop changes households made from the 2020 growing season to the 2021 growing season by households who reported "No crop" as one of their top 3 crops at least once in the Oct '20 survey round. The interaction terms represent the deviations from the mean number of changes for households reporting the crop and using fertilizer. The columns are the same as listed above. Standard errors in parentheses

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$

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