COVID-19, household resilience, and rural food systems: Evidence from southern and eastern Africa

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ABSTRACT

Resilience offers a useful lens for studying how human well-being and the systems on which it depends can absorb and recover from a range of shocks and stressors, including events such as the COVID-19 pandemic. Looking beyond the direct effects of observable shocks and individual or household resilience capacities to the meso-level mechanisms that shape impacts on communities, households, and individuals can both guide our understanding of COVID-19 impacts and help leverage findings from the pandemic context to better understand resilience to future food systems shocks. We develop a conceptual framework for the multiple paths through which observed, exogenous shocks interact with systemic, endogenous mechanisms to influence the resilience of household well-being and supporting food systems. We illustrate this framework with reference to the COVID-19 pandemic and policy responses as they unfolded in three rural study areas in Malawi, Madagascar, and Kenya. Consistent with this framework, we find multiple pathways through which the pandemic shock affected household food security and resilience. Our findings highlight that in some settings, at some points in the multi-stressor trajectory of a shock, the direct effects – in this case, infection with SARS-CoV-2 – may be grave for those who experience them but far less impactful in aggregate than the indirect impacts for society as a whole. Indirect impacts arise as behaviors, markets, and policies adjust to the shock, and they may affect entire populations. These adjustments are necessarily correlated and elicit varied household coping responses. We illustrate the degree to which, from the point of view of rural food systems and households, COVID-19 is less a new shock than a dramatic, recent manifestation of familiar stressors and uncertainties that burden poor rural populations in much of the low- and middle-income world.

1. Introduction

Few people living today have experienced anything like the COVID-19 pandemic. Mass global transmission of a highly infectious disease has caused well over 4.5 million confirmed deaths as of the time of writing and is still rising rapidly (Dong et al., 2020).[1] This toll far exceeds that of other recent international viral outbreaks that primarily impacted low- or middle-income countries (LMICs), such as severe acute respiratory syndrome (SARS) in 2003, Middle East respiratory syndrome (MERS) in 2013, and Ebola in 2014. Although over the period we study the vast majority of confirmed COVID-19 deaths have occurred in the high-income world, unlike in those previous outbreaks, the household-level well-being impacts in LMICs have been profound. The story of the food security impacts of the COVID-19 pandemic in rural areas of LMICs – on which we focus – is strikingly familiar. While the underlying disease and its trajectory are unique in the past century, many of the broader mechanisms through which the pandemic has impacted food systems in LMICs' rural areas are unfortunately far more frequently observed.

The challenges posed by recurrent crises over the past two decades – due to conflict, macroeconomic disruptions, natural disasters, pandemics, etc. and combinations of them – have rapidly transitioned how policymakers, development practitioners, and researchers frame discussions around longstanding development objectives and humanitarian concerns like food security. Response to shocks like the COVID-19 pandemic, and to the stresses caused by the growing frequency and severity of shocks, has become a defining feature of contemporary development and humanitarian policy. When facing a multi-stressor multi-shock environment (Béné et al., 2016), what can governments, non-governmental organizations (NGOs), donors, private firms, communities, households, and individuals do – independently and collectively – to

[1] We obtained statistics on the number of confirmed COVID-19 cases and deaths from the COVID-19 Data Repository by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University, which can be accessed at https://github.com/CSSEGISandData/COVID-19 or via the online tool at https://coronavirus.jhu.edu/map.html.

reduce exposure to and damage from catastrophic shocks and to accelerate recovery after shocks occur? This general line of inquiry increasingly falls under the amorphous label of 'resilience', often qualified as 'development resilience' (Barrett & Constas, 2014; Barrett et al., 2021b).

Parallel to the rise of resilience as an organizing theme of much development discourse, the food security community has increasingly embraced systems-based understandings of the complex web of relations that influence individual nutritional and food security status. The history of this trajectory is covered in detail within this volume, explicating the origins of food systems approaches (Fanzo & Graham, Chapter 3) and the nexus of food security, food systems, and resilience (Constas, Chapter 2), among other key dimensions. From pre-production phenomena like climate change and soil nutrient depletion (Vermeulen et al., 2012; Willet et al., 2019; Gashu et al., 2021), to post-harvest value chain intermediary behaviors (Gomez et al., 2013; Barrett et al., 2021a), and everything in between, a complex web of actors and actions mediate food security outcomes.

In this chapter, we emphasize four central ideas of the food systems framing of food security issues. First, interconnected ecosystems, institutions, and markets create multiple entry points for both shocks and interventions. Second, multiple iterations of endogenous responses by the many actors scattered throughout the system have feedbacks locally and further away. Third, the feedback between individual and household behaviors at the most micro level, meso-level collective and market behaviors, and macro-level policy responses underscores the need for multi-scalar analysis. Fourth, and integrating the prior points, shocks often have indirect impacts that far exceed their direct impacts in the aggregate, precisely because of the multiple mechanisms that link individuals to features of the social-ecological systems in which they reside and the endogenous, multi-scalar behavioral responses by many people and organizations.

Those four ideas have proved highly salient during the COVID-19 pandemic, which has underscored the deep interconnectedness of communities around the globe. Such 'telecoupling'—meaning the ties between distant communities' socioeconomic and

environmental interactions (Liu et al., 2007; Hull & Liu, 2018)—has manifest as policies in one nation have acutely impacted other places (e.g., far-reaching economic and epidemiological consequences of the Wuhan lockdown). The pandemic has also illuminated the vast response capacity a major shock can elicit from governments, firms and private individuals. The Coronavirus Government Response Tracker, a tool managed and regularly updated by Oxford researchers, reported almost 67,000 distinct policy responses by 183 different governments over the course of 2020 (Hale et al., 2021). These range from border or school closures, stay-at-home orders and other policies such as mask mandates or capacity limits intended to slow the spread of the disease, to public health interventions, to new social protection measures intended to support those who lost jobs or businesses. Indeed, a separate study identified that at least 3,333 different social protection measures were planned or implemented in 222 countries or territories as of mid-May 2021, most of them since January 1, 2021, as the depth and duration of the pandemic's impact necessitated additional response (Gentilini et al., 2021). Social protection coverage has been lowest and most variable in those countries with the highest poverty rates, however, and especially in harder-to-reach rural areas, like the sites we studied in Malawi, Madagascar, and Kenya.

Despite social protection measures, food security indicators have generally deteriorated globally during the pandemic, albeit with significant variation over time and across and within countries (FAO et al., 2021). Clean longitudinal comparisons are nonetheless difficult because among the few panel studies that track the same measures pre- and post-pandemic among the same households, virtually all had to switch survey methods, from in-person to telephone or online elicitation, and often to shorter survey instruments as a result, rarely with more than one post-pandemic observation (Adjognon et al., 2021; Ahmed et al., 2021; Amare et al., 2021; Egger et

al., 2021).[2] In the limited cases where large-scale, high-frequency data is consistently available, there is evidence of considerable fluctuations in the prevalence of food security over the course of the pandemic. In the US, for example, the share of adults who reported that their household sometimes or often did not have enough food to eat peaked at about 12% in July, subsided sharply as the daily infection and hospitalization rates ebbed, then returned to that peak again from late December through January as infection rates hit their highest levels to date.[3]

In this chapter we harness unusual, high-frequency household panel survey data from rural areas in three different countries – Malawi, Madagascar and Kenya – that afford an in depth look into the resilience of food security status over the course of the pandemic, and the mechanisms seemingly most strongly associated with those patterns. We emphasize the descriptive nature of the evidence we present. We do not assess the causal impacts of the pandemic – which are easily confounded by seasonality and other shocks, such as drought in southern Madagascar, a bumper maize harvest in southern Malawi (Upton et al., 2021), and flooding in Kenya – much less of various policy responses to the covariate shock. But, seen through a lens that expressly emphasizes the systemic interconnections among different policies and individual, collective and market behaviors, we show how a seemingly unique, catastrophic shock like the COVID-19 pandemic has played out in distressingly familiar ways that reinforce the need to improve our understanding of resilience to a wide variety of shocks that LMICs' rural populations routinely (and increasingly) suffer.

We begin by laying out a conceptual framework for analogous shocks and the ways in which COVID-19 has played out through familiar and inter-locking mechanisms. In Section 2, we then

[2] Aggarwal et al. (2021) is an important exception. They analyze household phone survey data collected from purposively selected locations in Liberia and Malawi starting before COVID began and continuing well into the pandemic period.

[3] US Census Bureau Household Pulse survey data available for April 23, 2020 - March 29, 2021, at https://www.census.gov/programs-surveys/household-pulse-survey/data.html.

provide background on our contexts, data, and COVID-19 related policies in these study areas. Section 3 lays out the results, first observed food security outcomes and then illustrating the impact mechanisms as put forward in the framework. Section 4 concludes with a brief summary and discussion.

1. Conceptual Framework

Resilience represents the capacity to "continue to develop in the face of change, incremental and abrupt, expected and surprising" (Folke, 2016) or, applied more specifically to the international development context, as the "capacity that ensures stressors and shocks do not have long-lasting adverse development consequences" (Constas et al., 2014, p.4). The COVID-19 pandemic was an indisputably major shock piled on top of a host of other stressors faced by rural communities in the low-income world. Yet the emerging empirical literature on the pandemic's impacts suggest that in many low-income, rural communities, the pandemic has perhaps impacted food security – and other manifestations of wellbeing – more through familiar, systemic pathways, for example by negatively impacting physical and financial access to food (see Béné et al., 2021 for a review), than by directly impacting households' health or causing excess mortality within those communities. We therefore look to resilience theory as well as the antecedent literature on rural development and resilience to other large, covariate shocks to develop a conceptual framework for understanding resilience in the context of the COVID-19 pandemic.

Following Barrett & Constas (2014), we view resilience as the sufficient probability of attaining and maintaining an acceptable level of wellbeing, here reflected in food security measured using several different indicators. Importantly, this implies that households that achieve stability but remain below a normative threshold are not considered resilient; a chronically hungry household is not resilient even if hunger levels are steady in the face of shocks. This outcome is enabled by diverse features of households and communities often termed "resilience capacities" (for reviews, see Ansah et al., 2019 and Barrett et al., 2021b). Per Barrett & Constas (2014, p. 14625), the concept of resilience adds value primarily in that "it compels a coherent, multidisciplinary,

and rigorous explanation of the interrelated dynamics of risk exposure, multiscalar human standards of living, and broader ecological processes". In developing our framework and empirical analysis, we conceptualize resilience specifically in terms of food security. Food security is a critical and universal aspect of wellbeing, and the four widely recognized axioms of food security – the availability, access, utilization of food, and its stability over time – share key properties with definitions of resilience (FAO, 1996; Upton et al., 2016).

Empirical studies of development resilience frequently focus on a specific shock or class of shocks (see Barrett et al., 2021b for a review). The most common shocks studied have been natural hazards, such as meteorological (extreme weather events) or climatological (droughts) phenomena (Barrett et al., 2021b). The next most common are economic shocks, such as global financial crises, and socio-political shocks, such as conflict. Studying resilience in reference to a specific class of shock has benefits for answering certain types of research questions, for example to inform policies designed to mitigate the direct effects of a particular type of shock to which a place or population is predisposed (Manyena, 2006). This can help us to understand the unique and (sometimes) severe direct effects of certain types of shocks that may emerge, for example when lives are lost and communities razed during a tropical cyclone, when civilians are killed or forced to flee civil conflict, or the morbidity and mortality from HIV/AIDS, Ebola, or COVID-19.

Our framework instead highlights meso-level mechanisms – e.g., local institutions and local and regional markets – as the intermediary pathways that shape the impact of macro-scale, covariate shocks on households. Framing around a specific event or class of shocks can be limiting if households and communities are often most affected by meso-level, systemic mechanisms, at least some of which can be linked to any number of causes. We therefore focus our framework and analysis on these common intermediary pathways to better identify broader lessons from the resilience literature, with relevance across multiple classes of large covariate shocks – including new and emerging threats, such as the COVID-19 pandemic. This also permits us to

interpret emerging findings related to the pandemic in a way that can inform future studies of resilience.

While in principle the pandemic is a shock to human health and the health system, beginning in March/April 2020 and for nearly all of the subsequent year, available evidence suggests that the disease itself has had only modest direct, adverse impacts on the communities we study. The main shocks arose rather from the economic impacts of global, national and local policy responses. This is consistent with emerging empirical literature on food security in the COVID-19 pandemic in many LMICs (see Béné et al., 2021). Yet the nature of 'global' or 'local' in the context of COVID-19 pandemic has also been at times obscured, with the telecoupling between geographically distant communities made visible as COVID-19 control measures and health shocks had far-reaching effects (Liu et al., 2021). The predominant mechanisms that have proved salient in the COVID-19 pandemic context, as evident in both the rapidly emerging research and our own data, are mobility restrictions, livelihood disruptions, and price shocks. For the purposes of investigating related literature, our conceptual framework lays out the predominant high-level shocks most typically associated with these mechanisms. In each case, a high-level shock is most likely to affect a given mechanism, but can also usually engender any and all of the others.

– Figure 1 –

Figure 1 lays out the basic conceptual model we employ. At the top (in capital letters) one finds a range of major, covariate shocks. Some may be distal to a rural community – like global financial shocks or an epidemic/pandemic experienced mainly in distant cities and countries – while others may be more proximate, like conflict or a natural hazards. A defining feature of a covariate shock is that exposure is correlated across many households. The scale of these shocks commonly induces policy responses at local, national, regional or even global level(s). Combined with the initial covariate shock itself, induced policy responses impact a range of individual, collective and market behavioral responses. These manifest in the meso-level mechanisms that govern livelihoods, food production, distribution and consumption, and the provision of public services,

including health care (indicated in red, with the dominant categories of mechanisms in boxes aligned with the shock(s) with which it is most commonly associated; and arrows below indicating where there are posited causal relationships). Together, those meso-level mechanisms impact the four pillars of food security (in blue): availability, access, utilization, and stability, resulting in observable changes in food security indicators. A pandemic like COVID-19 is simply a special case that has a more direct, visible effect on health but quickly propagates through other meso-level mechanisms, including employment, mobility, and price effects.

In what follows, we trace out the impacts of the COVID-19 pandemic in the three different low-income rural settings we study. We ask the question, what does pre-COVID-19 evidence under each of these shocks/stressors suggest about the resilience of households and food systems to the pandemic? We outline likely direct and indirect impact pathways in each area and glean insights by examining these using our data and current evidence in the broader literature.

2. The COVID-19 pandemic in rural Malawi, Madagascar, and Kenya

We tap high frequency survey and market monitoring data from three distinct study areas in Malawi, Madagascar, and Kenya (Table 1) to illustrate the application of our conceptual framework. These data include multiple food security indicators (Table 2). Within each country, COVID-19 policy measures varied considerably over space and time (Figure 2). In this section, we provide brief background on the context within each country, including a brief overview of dynamics of COVID-19 and related control measures, and on the data collection platforms on which we draw.

– Table 1 –

– Figure 2 –

– Table 2 –

2.1 Malawi

Rural Malawi is emblematic of the challenges inherent in building resilience. It includes diverse and dynamic socio-ecological systems, and is characterized by multiple shocks and stressors that trap households in food insecurity and poverty. The predominant livelihood in the study area is rainfed agriculture. Roughly 75% of households own land for agriculture, with home-grown crops, especially maize, accounting for the primary income source for 40%, and agricultural labor for another 40%. Rates of food insecurity in Malawi are typically high; recently as 70%, including "moderate" food insecurity, with 20-30% severely food insecure (Fisher & Lewin, 2013; Gourlay et al., 2021). High-frequency measures reveal that food insecurity is dynamic, with respect to both averages and *who* is food insecure. In the three southern districts we have studied over the past three years, 64% of households changed monthly food security status over time, with 56% classified as "crisis" *or worse* in over half of all periods.

In response to the increasing severity of weather-related shocks threatening food security, Catholic Relief Services (CRS) partnered with Cornell University researchers to develop the Measurement Indicators for Resilience Analysis (MIRA) platform, a system for high-frequency monitoring to understand resilience.[4] MIRA uses community-based agents to collect data from 2,250 households each month in three Districts of southern Malawi. Data are collected in a disaggregated manner (25/30 households per agent), on a Computer-Assisted Personal Interviews (CAPI) platform that can be readily updated to collect additional information as new issues arise, with frequent training updates and interactions with field supervisors, which can be done remotely (see sample information in Table 1). These design features permitted the addition of questions related to the COVID-19 pandemic without disrupting data collection methods or personnel. This contrasts with many household survey efforts that were forced to convert to

[4] See Upton & Knippenberg (2019) for a description of MIRA, and Knippenberg et al. (2019; 2020) for prior studies utilizing the Malawi data.

phone-based or online survey platforms at the start of the COVID-19 pandemic, with poorly understood impacts on attrition and response patterns.

The MIRA survey instrument includes detailed annual surveys, and rapid monthly updates following a recommended sentinel site survey design that intersperses thick, data-intensive rounds periodically among more frequent, thin, high-frequency rounds (Headey & Barrett, 2015). The annual survey includes information on livelihood activities, employment, assets, access to financial services, water and sanitation, access to services, and engagement in project activities. Monthly surveys collect food security indicators (Table 2), reports of shocks experienced, and whether or not assistance was received. The added COVID-19 module also reports on knowledge of the pandemic, related symptoms, areas of life affected, and market impacts. These data have already yielded new insights, for example into resilience measurement (Knippenberg et al., 2019), early warning (Knippenberg et al., 2020), and identification of the impacts of the Covid-19 pandemic and policy response (Upton et al., 2021).

2.1 Madagascar

The Great South of Madagascar is relatively unique within the island's patchwork of ecological systems in its susceptibility to damaging dry spells, drought, and water scarcity, and suffers high chronic food insecurity. The region is often rated highest risk by monitoring reports, with the highest rates in the country of households suffering crisis levels and worse[5]; and in our study sample nearly 100% of households changed monthly food security status over time, with 64% classified as "crisis" *or worse* in over half of all periods. As in Malawi, the predominant livelihood is rainfed agriculture; 95% of households in the study area report owning land, and 78% report

[5] See for example the (periodically updated) Integrated Food Insecurity Phase Classification reports; the report issued in December 2020 available on line at: https://reliefweb.int/sites/reliefweb.int/files/resources/IPC_Madagascar_AFI_AMN_2020Oct2021April_English_summary.pdf

crop agriculture as a primary livelihood. Given the coastal geography, relatively more rely also on livestock and fishing (13%), though fishing employs rudimentary technologies in open ocean, so presents its own challenges.

Following initial success with the MIRA approach in Malawi, and in light of the need to better understand resilience in this different context, CRS and Cornell rolled out a data collection platform in southern Madagascar very similar to that in Malawi starting in July 2018 (Table 1). 600 households were sampled among a census of those identified as among the most vulnerable by communities, guided by predesignated criteria (Upton & Knippenberg, 2019). The MIRA survey instrument from Malawi was adapted to southern Madagascar's shock environment and was expanded to track dietary diversity metrics at high frequency (Table 2). In April 2020, a module was added to include questions related to knowledge of COVID-19 and diverse impacts of the pandemic and policy response.

2.3 Kenya

Lake Victoria fisheries have undergone nearly a century of ecological and social change following the introduction of non-native Nile perch (Pringle, 2005), rapid commercialization of an export fishery (Abila et al., 2003), and high incidence of HIV within regional fishing communities (Seeley & Allison, 2005). Despite longstanding concerns of overharvest, today Lake Victoria's fisheries supply the largest lake harvest of fish in the world (FAO, 2016) amid ongoing vulnerabilities to a suite of contemporary ecological challenges, including climate and ecological change (Aura et al., 2020), and persistent rates of food insecurity within fishing regions (KNBS, 2018).

Prior to the COVID-19 pandemic, eight fishing communities in Kisumu and Homa Bay counties were selected for an in-person survey that aimed to examine perceptions of harmful algal blooms. Communities around Kisumu Bay were purposely selected based on exposure to high intensity of algal blooms as detected in satellite remote sensing data. We randomly selected 30

households within each community. All questionnaires were administered to the 'food manager' within each household, defined as the person mainly responsible for food preparation.

The survey was halted on March 21, 2020, after Kenya experienced its first case of COVID-19, and after we had completed data collection for three of the eight communities: Dunga, Lela and Kananga. Dunga is close to Kisumu, the third largest city in Kenya and the capital of Kisumu county, while Lela and Kananga are located near Homa Bay, the capital of Homa Bay county. Data collected included food security, dietary diversity, detailed data on fish consumption, and household demographics.

In June 2020, we began a follow-up phone survey with the 90 previously surveyed households to understand the changes in food security and food consumption patterns of households during the COVID-19 pandemic and the coping strategies adopted by households.[6] We collected information on household food security and household food consumption using the same questionnaires as the March 2020 survey. An additional module was administered to measure the perceived impact of COVID-19 and associated movement restrictions on food access, and also to explore coping strategies used by households during the pandemic.

2.4 COVID-19 and policy responses

We have tracked the implications of COVID-19 and the associated global and local policy responses in the study areas through both the surveys and remote key informant interviews, starting in April 2020 and continuing through (and beyond) the time of writing.

[6] We reached out to all 90 participants by phone and explained the follow-up study to them. Those who gave their verbal consent were re-enrolled into the study and interviewed by phone. Out of the 90 baseline participants, we re-enrolled and collected data on 88 (one participant could not be located and one participant had died prior to the follow-up study). Additional methodological details available in Fiorella et al. (2021).

Malawi: Our data and informants show that, through the end of 2020, the disease itself seems to have made very few people ill in southern Malawi; reports of experienced illness reflect a seasonal pattern (due to periods of cholera and malaria) that is nearly identical to the prior years surveyed. There have, however, been diverse impacts on mobility and markets that have had significant impacts on households' lives and livelihoods. The first and most dramatic change was the closure of international borders on April 17, 2020. Borders did not reopen until just over a year later, with traffic limited to essential goods and returning locals screened and quarantined on entry. The maize harvest in the area had been exceptionally good, meaning that maize was readily available internally. After the border closure, however, the prices of other, imported goods immediately rose, and there was concern that farmers would deplete maize stocks by bartering at very low prices for other goods. The national marketing board (ADMARC) stepped in to declare a sales price for maize in an attempt to curtail the bartering. But prices for other goods continued to be higher than usual. Internal movement was not restricted per se, but social distancing requirements and forced closure of certain types of businesses, predominantly in the service sector but also some small retail operations, led to reduced economic activity and job losses. Schools also closed – first from 23 March to 13 July 2020, and then again from 17 January to 22 February 2021 – with limitations on classroom capacity during periods of instruction and job losses for private school teachers and other support staff.

Madagascar: In Madagascar, as in Malawi, household reports offer no evidence of significant spread of the virus itself throughout 2020; survey reports of respiratory and other health problems are under 5% over the period, and track at or below levels reported since 2018. But global and national policy and behavioral responses have had considerable impacts, as we detail below. Inter-regional transit was briefly officially restricted in late June. Although official local restrictions were lifted relatively soon thereafter, the international borders remained closed for a much longer period, and local travel continued to be affected by quarantines, high fuel prices, and a state of uncertainty. Schools were closed for only brief periods, but the school calendar

was disrupted. Some households reported receiving aid, but we see no evidence that aid increased in our Madagascar (or Malawi) study area during the pandemic period.

Kenya: The Kenyan government responded to the COVID-19 pandemic with a number of policies to restrict movement among the population, and particularly within urban centers. Measures ranged from closing of schools to restrictions on maximum seating capacity in public transportation to a mandatory curfew, which was strictly enforced and remains in effect in May 2021 (Aluga, 2020).[7] Throughout the pandemic, Kenya's government has imposed more stringent policy responses than Madagascar or Malawi (Figure 2). By May 2020, the Kenyan government announced a substantial aid stimulus package to help its population to cope with the economic disruption stringent pandemic response measures had caused.

By early July, the Kenyan government changed course to reopen the country, despite the implications for COVID-19 risk and consequent waves of infections. The first wave of COVID-19 cases and deaths in Kenya peaked at the beginning of August 2020 (Dong et al., 2020). In October 2020, schools were abruptly permitted to reopen and movement restrictions were further eased; a second, larger wave of COVID-19 infections and deaths soon followed, peaking in mid-November 2020. The third, and largest, wave of COVID-19 infections peaked in March 2021.

3 Food Security outcomes and identified mechanisms

In this section we describe the net effect of these complex and varied policy, market, and individual responses on household-level food security indicators. We ask the question: have the households in our study areas been resilient to the health impacts, mobility restrictions, livelihood disruptions, and changes in food prices driven by the COVID-19 pandemic and other coincident shocks and institutional responses? We find that in none of our study settings do all

[7] Policies were put forward in a series of press releases and executive orders, described on the Kenya Ministry of Health website (available on line here: https://www.health.go.ke).

households achieve and maintain food security amid the pandemic; our study settings suffer from chronic food insecurity, which pre-dates the pandemic. This finding echoes concerns in the pre-COVID-19 resilience literature that poverty is both a driver and predictor of low levels of resilience in household food security (for a review of evidence, see Barrett et al., 2021b). The duration, magnitudes, and mechanisms through which the COVID-19 pandemic impacted resilience seem to vary among and within our study areas.

3.1 Food security outcomes

Assessing the true, strictly causal effects of the pandemic on food security - much less unpacking the precise causal mechanisms and estimating each's contribution to the net effect - is a daunting task because the meso-level mechanisms necessarily integrate other, contemporaneous shocks (e.g., from global commodity markets, local weather, etc.), which can mask or exaggerate the true pandemic effects in simple before-and-after comparisons (Upton et al., 2021). The richness of the data across the three sites enables reasonably informed discussion of the associations we observe and plausible (and implausible) mechanisms behind the observed net food security changes over the course of the pandemic crisis.

In Malawi, where we measure coping strategies indices – summarized in the Household Hunger Scale – food security status in 2020 was comparable to, or even slightly better than, prior years (Figure 3). That seemingly surprising outcome is almost surely due to a strong harvest that supported farm and farmworker incomes and kept staple food prices relatively low. Further in-depth analysis leaning on the full duration of the panel data and developing a counterfactual predictive model, however, finds evidence that food security was not as good as it should have been, and further that the pandemic-specific effects were regressive, affecting the worst off more severely (Upton et al., 2021). This finding is consistent qualitatively with the diverse likely impact mechanisms we identify (discussed below).

– Figure 3 –

In Madagascar, in contrast, household food security has deteriorated during the COVID-19 pandemic period – which coincided with a severe drought in southern Madagascar (Figure 4). Descriptively, coping strategies indices were not worse on average than in prior years, although local experts attribute this largely to households already being at the limit of what they could do to improve their situation, for example, having already reduced meal sizes and frequencies to a minimum. As regards dietary diversity, the situation clearly worsened relative to prior years, with many attributing this primarily to COVID-related market restrictions and price hikes. This is consistent with the broader, cross-national storyline one commonly hears (e.g., Egger et al., 2021). Due to the compound nature of the pandemic and the drought shock in Madagascar, and overlap in the meso-level mechanisms through which they impact food systems (discussed in the following sections), we are unable to parse their relative contribution to the deepening humanitarian crisis currently impacting this region.

– Figure 4 –

The situation has been less grave in our Kenya sites, even if food insecurity increased initially, as reflected in HFIAS measures (Figure 5) from March (pre-COVID-19) to June 2020 (during the COVID-19 lockdown), but returned roughly to pre-pandemic levels over the next several months. While maintenance of high levels of food insecurity does not constitute resilience, the relatively stability is noteworthy given that communities within the region experienced not only the COVID-19 pandemic but acute flooding amid rising lake levels, which also threatened food security. Food insecurity increases in these Lake Victoria coastal communities was in part a function of large upticks in worry, and in not being able to eat preferred foods. Market closures by government restrictions also affected households, with over half reporting in June 2020 that they had to go more places than usual to find food. Finally, food aid during this period was initially accessed by 17% of households in June 2020 and vacillated (range: 1-12% of households) from July 2020 to May 2021, and may also have provided a safety net.

Households activated coping strategies, including borrowing from friends and relatives, purchasing food on credit, and reducing portion sizes and meals in the early months of the pandemic. However, use of these coping strategies reduced and then plateaued around September 2020. Overall dietary diversity did not significantly change, although it was low at baseline, but diets shifted from nutrient-rich, perishables such as eggs and fresh fish to more shelf-stable products (e.g., beans).

In this setting, the easing of movement restrictions in mid-2020 and reopening of schools in October and November appear to have led to the second wave of COVID-19 cases. This increase in case rates, in turn, increased worry about COVID-19 infections. At the same time, these policy shifts appear to have stabilized rates of food insecurity and use of coping strategies by households in lakeside communities, with fewer households reporting reductions of work and incomes over the same period. In other words, easing of movement restrictions and reopening of markets – both far-reaching, meso-level impacts of the pandemic – allowed some households to get back to work, earn a fishing income, and participate in fish trading with consistent demand for fish within the region supporting this rebound. This policy shift highlights a key trade-off between meso-level and direct effects of shocks: increased exposure to health shocks occurred in conjunction with reduced livelihood disruptions.

– Figure 5 –

The general story is thus one of marked variation among and within sites in the evolution of food security over the course of the pandemic's first year. These mixed outcomes - with unchanged, or even slightly improved food security outcomes in southern Malawi, much worse ones in southern Madagascar, and initially worse and then largely unchanged outcomes in western Kenya - reflect the mixing of the pandemic shock, and its associated policy and market responses, with other shocks. The meso-level institutional and market mechanisms that mediate shocks' indirect impacts on household food security status necessarily vary. Where markets, governments and communities function relatively well – as in the Lake Victoria basin of western

Kenya – or where nature blesses farmers with good weather – as in southern Malawi – the likely net-negative impacts of the pandemic can be partly or fully offset, limiting the damage except to the relatively few who directly experience the shock through households morbidity or mortality. Conversely, where infrastructure is poor and a climate shock compounds the damages wrought by the pandemic, as in southern Madagascar, an already-bad situation gets made much worse. In each of these settings to date, the disease itself appears to have been less impactful than the indirect impacts of national and global policy responses to the pandemic. In this way, the COVID-19 pandemic shock's effects on food security in these rural African communities bears striking similarity to the broader profile of vulnerability and resilience to other shocks and underscores the central importance of the meso-level institutions that mediate the changes households and individuals experience (Barrett, 2005; Barrett & Swallow, 2006; Béné, 2020).

3.2 Meso-level mechanism 1: Health shocks

Many large covariate shocks have both direct and indirect impacts on human health. For example, the Ebola virus infected an estimated 28,000 people and killed over 11,000 during the 2014-2015 West Africa outbreak; but the cost in lives of the associated breakdown in healthcare access and utilization, although more difficult to measure, was likely orders of magnitude more deadly (see Elston et al., 2017 for a review). The emerging literature on COVID-19 indicates that – in addition to the morbidity and mortality associated with infections – health system disruptions, including decreases in childbirth interventions, treatment of (non-COVID) infectious diseases, as well as care for chronic conditions have likely resulted in large-scale increases in mortality (e.g., Roberton et al., 2020; Jain & Dupas, 2020).

Here, we assess how shocks to human health and health systems may have impacted food systems in our study areas during the COVID-19 pandemic. We consider both direct and indirect mechanisms. For example, increased morbidity and mortality resulting from infection *and/or*

disruptions in health systems may adversely affect household labor supply. This could result in income losses and reduced food access, as well as caregiving and nutrient absorption that compromise food utilization, leading to negative food security impacts of the pandemic. At a systems level, the strain on the healthcare system may divert societal resources away from more general social protection toward support for an overburdened health system, further compromising food access, availability and utilization.

Findings from our sites: While early in the pandemic there was no notable spread of the disease to our study areas, there was also a complete lack of testing. We therefore considered it prudent to track both reports of health incidents (asked as "shocks" in the questionnaires) and more specific questions regarding incidence in the households of symptoms attributable to COVID-19. Even under normal conditions, disease prevalence is relatively high and varies seasonally and spatially. So one wants to know whether the pandemic increased household reports of illness or death relative to non-pandemic periods. In both Malawi and Madagascar, high percentages of households reported health-related problems in prior years, in Malawi with typically high incidence (~15-20% of households) in February-April, often due to seasonal spikes in cholera or malaria. Reports of health shocks have been no higher than usual in 2020-21, and in fact declining over the early pandemic period. In Madagascar, a cholera outbreak in 2018-19 affected many households, for example, relative to which the experience of non-respiratory illnesses was comparatively very low in 2020-21 after the pandemic began. The trends we see are suggestive that there has been little direct incidence of COVID-19, while also highlighting that properly evaluating any eventual direct health impact could be confounded by the already high and heterogeneous burden of disease in typical years.

Particularly within the context of a pandemic, fear of contracting an illness may also play a substantial role in shaping households' behavior. Reports in Madagascar confirm that fear of contracting the illness in transit and in larger cities contributed to reduced rates of migration for work. Yet especially within communities with limited savings, disease control measures that limit

households' ability to work may also be an inter-related source of worry. In Kenya, worry about contracting COVID-19 was initially ubiquitous and fluctuated with periods of COVID-19 waves and high case counts (left panel of Figure 6). Initially (June to September 2020) nearly 80% of households reported some degree of worry about the impact of COVID-19 control measures. This share fell in October 2020 as movement restrictions were lifted and the country reopened (right panel of Figure 6). Fear and lack of trust, as well as movement restrictions and disrupted health service availability, may also disrupt access to routine care. While our data are not designed to capture this important class of indirect effects, it is likely that COVID-19 related health system disruptions affected, for example, prenatal and antenatal care and treatment for non-COVID infectious and chronic diseases, with potentially large health implications.

– Figure 6 –

3.3 Meso-level mechanism 2: Mobility restrictions

Natural disasters such as cyclones, earthquakes, floods and tsunamis can damage transport infrastructure, directly disrupting mobility among and within countries, often for extended periods (Hallegatte et al., 2019). Infectious human or animal diseases and some types of civil unrest can elicit government movement restrictions. Mobility restrictions imposed by government or nature are then complemented by voluntarily reduced mobility as fear and uncertainty induce caution among people who might otherwise travel (Gates et al., 2012; Elston et al., 2017). Mobility restrictions can impact food access directly, for example limiting access to markets, but also cross over into healthcare access, livelihood disruptions, food supply chain issues (and associated price shocks) and other disruptions to the longer-term accumulation of human capital (Béné et al., 2021). For example, Gates et al. (2012) estimate that 38 million school aged children (out of 230 million) in conflict-affected countries are not enrolled in school.

In the case of COVID-19 in LMICs, mobility restrictions would result directly from government policy responses to the pandemic, such as inter-regional travel restrictions and border closures.

This would disrupt migration for employment, causing income losses for both workers who typically migrate and for employers who typically rely on in-migrant workers. Transport restrictions can also disrupt food shipments, causing prices to rise or fall for products imported into and exported from the locale, respectively.

Less direct pathways for mobility restrictions could result from household behavioral change akin to what occurs in the case of conflict. Households could choose to limit their movement and/or change economic behaviors out of fear and uncertainty, both fear of infection due to the disease itself and a response to uncertainty around government policies and their enforcement.

Findings from our sites: International land borders were heavily restricted in Malawi, starting April 17, 2020, and without interruption until April of 2021. Malawian residents could return to the country, but with screening and observed quarantines. Only "essential" goods were allowed to pass, with some uncertainty around the specific details of what was considered essential. According to key informants, these restrictions affected goods and markets, as well as migrants' ability to travel (predominantly to higher-paying jobs in the Republic of South Africa).

– Figure 7 –

There were no official travel restrictions within and between regions in our study area in Malawi, but there were requirements for appropriate distancing in transit vehicles and mask requirements. The sanctions for violations were unevenly applied, and many people hesitated to circulate for fear of both the disease and of uncertainty in policies and crack-downs. Many of these more intangible impacts lessened starting around September, as concerns for the disease abated (only to pick up again by January, 2021). Figure 7 shows these reported impacts. Note there was little variation across months, almost no households reported no impacts, and 15-20% reported being unable to travel as needed. The more commonly reported impacts, however, are more relevant to employment and market access, issues we discuss below.

In Madagascar, the government did impose restrictions on travel between regions. These official restrictions were short-lived, however, lasting for only roughly two weeks, from late June 2020 through early July. However, household reports of inability to travel where needed *increased* throughout the period, even after official restrictions ceased. According to key informants, the de facto restrictions on travel were several-fold. First, policies such as inter-regional screening and quarantines, and uncertainty around these policies, delayed or discouraged even major commercial trucks (and all the more, individual travelers). Second, the towns themselves were economically depressed relative to typical years, making work less available. This reduced travel and further reinforced the unavailability of transit options. And, finally, people had the impression that towns were at much greater risk of infection with the disease, which further reduced transit demand and supply, even making it less available even to people who did wish to travel.

Figure 8 shows the areas of life affected by the pandemic in Madagascar over time. We see that reports of difficulty traveling where needed increased, peaking at fully 90% of all households in January 2021. Roughly 20% (depending on the period) report access to markets for sales being an issue, and perpetually 20% or fewer report no impacts. The remoteness and limited, rudimentary infrastructure of the Great South of Madagascar gave far greater prominence to mobility restrictions in this site, as compared to the more accessible ones in Kenya or Malawi.

– Figure 8 –

In Kenya, while the strictest initial enforcement of movement restrictions within major metro areas did not extend to our study site, school closures and national curfews affected all communities and fomented high levels of concern about contracting COVID-19. Curfews, in particular, had a disproportionate effect on fishers focused on the dagaa fishery. Dagaa are fished at nighttime, using lights to attract fish, and curfews forced fishers to either curtail activities or break the rules. A subset of participants reported that their regular activities were highly disrupted in the early months of the pandemic, and disruptions endured throughout the year. In

the months of June, July, and August 2020 more than 85% of fishers reported their fish catch was often or always reduced compared to the preceding year; a figure that fell to 56% in September 2020 as restrictions on movement began to ease and markets reopened. In June 2020, 75% of households reported they had reduced trips to get food; in May 2021 38% were still reporting reduced trips to access food.

3.4 Meso-level mechanism 3: Livelihood disruptions

Large covariate shocks may directly impact individuals' capacity to earn income, for example through the destruction of a productive asset or due to death or illness in the household (de Waal & Whiteside, 2003). But as these shocks propagate through the economy the indirect livelihood disruptions are often much more widespread, realized especially through general equilibrium effects in labor markets (Devereaux, 2007; Gates et al., 2012; Hallegatte et al., 2017; Kodish et al., 2019). In the context of COVID-19, initial concern frequently focused on income shocks to wage laborers as strict lockdowns took effect (e.g., Adjognon et al., 2021). However, emerging evidence indicates that the COVID-19 pandemic has also resulted in large-scale employment disruptions in rural areas of LMICs, with impacts falling disproportionately on the poorest subpopulations, who depend most heavily on wage earnings for income (Egger et al., 2021), although not all studies find such effects (Aggarwal et al., 2021).

Here, we explore the multiple pathways through which the COVID-19 pandemic may have resulted in employment disruptions and associated loss of income in our study areas. We posit that market-mediated occupations might be disrupted both by official policies as well as employers' behavioral responses to those policies. Employment disruptions may also be closely linked to mobility disruptions, for example as transport disruptions and border closures prevent migrant labor or disrupt agricultural markets. In turn, and similar to the case of mobility restrictions, less direct changes could result from households' choices due to fear and uncertainty; e.g., unwillingness to hire workers due to fear of infection, and/or not reopening a

business when one could due to fear that government policy would change again and shut it down, resulting in greater losses.

Findings from our sites: Initial reports from Malawi posited that the pandemic impacts would be much more important in urban areas, in large part due to reliance on market-mediated incomes such as services and wage labor (e.g. Furbush et al., 2021). Given the strong maize harvest in 2020, some were less concerned about the rural areas. Nearly 90% of the rural households in our sample, however, reported impacts of the pandemic on incomes (Figure 9). The source of this income loss is heterogeneous; for many, it was linked to closure of places of business, whereas for others it directly affected farming activities through labor availability and cost of inputs.

– Figure 9 –

In Madagascar, the pandemic and response coincided with unanticipated drought conditions in late 2019 (a long dry spell following initial rain), that nearly completely destroyed the anticipated March-April harvest. Agencies scrambled to recalibrate aid decisions and make food available, even as the pandemic unfolded and restrictions were put in place. The poor harvest had a clear and direct effect on households' food availability, as well as income for those selling post-harvest, that would have been at that stage unaffected by the pandemic. All the same, households all reported a combination of negative impacts of the pandemic and policy response on their income, in parallel with upward impacts on expenditures. Some of these were due to places of business closing, particularly early on; and some to unavailability of inputs, later and into the 2020 planting season. The greatest singular impact, however, that households linked to the pandemic (due to border closures and other availability shocks), was on prices of basic necessities.

In Kenya, initial movement restrictions receded in mid-2020 to allow for reopening of markets, greater movement, and reenergizing of the economy. While households in our study reported initially high levels of income reductions due to fear of COVID-19 (84%), these steadily declined

(Figure 10) with a brief, but relatively small, increase in November (36%) in response to the second wave of COVID-19 cases and deaths, during which time COVID-19 was believed to be spreading to a larger degree within rural areas. Notably, the third wave of infections to hit Kenya in 2021 saw these rates increase again to 25% in May 2021, but had an even more diminished impact. Through August 2020, over 85% of fishing households also reported reduced fish catch compared to the previous year. As markets reopened, however, fish catch improved starting in September 2020. Catch translated to improved incomes because demand for fish in Kenya's domestic markets remained strong, bolstered in part by declines in availability of imported tilapia from China. Underscoring this demand, fish farms within Kenya's young aquaculture sector even reported growth in 2020 (Benhamo, 2021).

– Figure 10 –

3.5 Meso-level mechanism 4: Price shocks

Sudden and sharp food price changes can be triggered by processes that are local to global in nature – including regional growing conditions, natural disasters, epidemics or pandemics, conflict, and other geopolitical events – with institutions playing an important mediating role (Headey & Fan, 2008; Dillon & Barrett, 2016). The poor are particularly vulnerable to food price shocks because they spend a large share of their income on food; most smallholder farmers and farm workers in eastern and southern Africa buy more food than they sell (Barrett, 2008). Consistent with previous global food price shocks and the importance of local policy and institutions in mediating their local effects, evidence of the COVID-19 pandemic's effects on food prices is heterogeneous; prices fell in some places, rose in others (Béné et al., 2021).[8]

[8] The strong recovery in global agricultural commodity prices since May 2020 seems to have little to do with the pandemic. Rather, it seems attributable more to depreciation in the US dollar, weather-related harvest shortfalls in several major export countries, relaxation in US-China trade tensions, economic recovery in China, not least of which

In rural areas of LMICs, we hypothesize that the nature of price shocks and their impacts on food security during the COVID-19 pandemic will vary according to local context. The direction and magnitude of price shocks will depend upon the extent to which transport was disrupted as well as the resilience of local markets to these disruptions. Unlike in urban areas that uniformly import food, the impacts of price shocks will depend on whether a community is a net exporter or importer of staple foods.

Findings from our sites: Our sites paint a study in contrasts among rural African food markets and underscore the need to unpack the meso-level mechanisms behind observed food price shocks (or lack thereof). While the harvest in Malawi was good and maize price followed fairly normal seasonal trends, the overland border closures led to increases in prices of other products of primary necessity, such as cooking oil, sugar, and soap. Roughly 20% of households reported that these goods increased in price, particularly May through June; and these price increases were correspondingly reported as a major source of the (real) income shock for roughly 20% of households. For this net food exporting region, transport disruptions during a good harvest year resulted in a drop in real, relative crop prices, hurting the incomes of many net seller farmers. The greater number of net buyers could not take advantage of maize prices during a favorable harvest because of rising prices of other, imported necessities.

By contrast, in southern Madagascar, transit restrictions combined with the poor harvest led to abnormally high food prices as the year wore on. These price increases affected all food items, but especially imported rice, the most commonly consumed food item (Figure 11). At the same time, and also due to the lower truck traffic, the prices fell for the livestock that many households in this arid-to-semi-arid region sell, pinching households' income on both sides as sales of small livestock are a common coping strategy when households need to purchase food. Prices began

from the African swine fever outbreak that decimated its hog population in 2019-20, leading to a collapse in global feed grains and oilseeds demand.

to normalize with the second harvest and greater transit opening in August - September, but then began to increase into October, earlier than in typical years (as is evident in the right-hand panel of the figure). While one cannot discern the cause of these increases, they were widely understood to be exacerbated by the transit disruption.

– Figure 11 –

4 Discussion and summary

Viewing COVID-19 through the lens of the mechanisms that mediate the impact of large, covariate shocks on individual households and communities highlights the degree to which the pandemic has been less a completely new shock than a variation on a recurring theme of structural deprivation in low-income, rural communities that face myriad shocks and stressors (Béné et al., 2016). We build on pre-pandemic resilience theory and evidence to outline a conceptual framework for examining the linkages between households in low-income, rural regions and local, regional and international food systems during the COVID-19 pandemic. We then apply that framework to empirical evidence from high-frequency monthly surveys of rural households in Malawi, Madagascar and Kenya. We see the COVID-19 pandemic less as a unique event than as the latest major covariate shock that lays bare systemic vulnerabilities that burden many rural populations situated within complex food systems in the low-income world. Rural households are exposed to food system shocks not only in their roles as food producers, but equally as food consumers or as workers within the broader agri-food value chain. Policy responses to shocks and the individual, collective, and market behavioural responses to both shocks and policy responses too often aggravate underlying structural problems that compromise food security among a large population not directly affected by the shock.

Our findings underscore how the direct impacts of even severe and large-scale covariate shocks can be overshadowed by the indirect impacts mediated by systemic mechanisms. This lesson is consistent with important lessons from the pre-COVID-19 resilience literature. The detrimental

development consequences of armed conflict on poverty, food security, and human health are well established (Gates et al., 2012). Although the impacts of the direct experience of violence (e.g., abduction, injury, or death of an immediate family member) are more severe at the individual level, the number of directly impacted people is far less than those whose behaviors are disrupted by conflict, also with adverse consequences, albeit of lower magnitude. The end result is that the aggregate impacts of violence on development indicators such as per capita expenditures or food security status come more through the indirect, systemic effects than due to direct experience of violence (Rockmore, 2017; 2020). Natural hazards and disease outbreaks have likewise been shown to impact food security and other aspects of well-being through multiple channels (Stoop et al., 2021; Hallegatte et al., 2017; Devereux, 2007; Adger et al., 2005a).

The framework and analysis in this chapter focus on how macro-level policies and meso-level mechanisms matter for the resilience of households' food security to a large covariate shock. In the case of the COVID-19 pandemic, our analysis illustrates how for many households these intermediate pathways have dominated their experience of the shock. We are far from the first to observe the multi-scalar nature of the mechanisms that reinforce vulnerability, poverty and food insecurity, a theme that emerges in several strands of literature including, for example, work on fractal poverty traps (Barrett & Swallow, 2006; Radosavljevic et al., 2021), system dynamics (e.g., Reyers et al., 2018), adaptation to climate change (e.g., Adger et al., 2005b) and food security resilience (Upton et al., 2016; Smith & Frankenberger, 2018; Vaitla et al., 2020). Yet much of the empirical development resilience literature to date focuses on the importance of individual or household level characteristics or 'capacities' for coping with adverse shocks and stressors (for a review, see Barrett et al., 2021b). This chapter highlights why this evidence base is insufficient. A household's ability to draw down savings, liquidate assets, or borrow to remain food secure during a price shock is desirable. But better yet, timely policies and well-functioning markets would ensure that such price shocks do not arise and provide a robust safety net for vulnerable households.

In developing timely policies in response to covariate shocks, governments are tasked with the formidable challenge of redressing and rebalancing exposure to myriad shocks in real time. Such efforts may involve complex trade-offs in not only navigating among different shock exposures (e.g., health shocks, livelihood shocks), but shaping who is exposed to which shocks (e.g., health shocks were initially most intense in urban areas). Unforeseen consequences, or, conversely, a bit of good luck also play a role. For example, nations with similar policies have faced or avoided, thus far, virus variants that alter the burden of covariate shocks. In the early phase of the pandemic, our data indicate health shocks have not been the predominant risk faced by poor, rural communities in Malawi, Madagascar, and Kenya. Yet this may change. For example, in mid-2021, Malagasy hospitals in the capital city of Antananarivo were overburdened and rural areas are reporting increasing rates of illness as virus variants spread rapidly.

Resilience is a forward-looking concept about the stochastic dynamics of well-being, applying only in the presence of shocks or stressors. Food security is one of the most basic manifestations of wellbeing and is absent or at risk for far too many households in the rural communities we study and many like them throughout the Global South. In the case of a major covariate shock like the COVID-19 pandemic, the food systems within which they operate suffer a range of shocks that affect them in their multiple roles as food consumers, producers, and workers. But because it has been less the disease itself that has impacted rural peoples than the impacts of policy, market, and behavioral responses to the disease – at least thus far – the pandemic period food security dynamics we observe reflect the broader issues facing vulnerable rural populations confronting multiple shocks and stressors.

Food availability shocks due directly to the disease have been negligible. Rather, to date, food availability – i.e., supply – disruptions arose mainly due to mobility restrictions and associated transport bottlenecks. Those supply shocks can lead to sharp and sudden relative price swings that impact food access, which has been more variable over the course of the pandemic. Downward price adjustments have hurt net sellers – e.g., of maize in Malawi or chickens in

southern Madagascar – while upward adjustments have made net buyers worse off – e.g., of most processed foods for these rural households – while relative price changes have induced consumers to substitute foods in their diets. Meanwhile, the same meso-level drivers that have disrupted the flow of food supplies have caused employment and income losses that have too often necessitated a rise in adverse household coping strategies. While social protection programs have scaled dramatically in these and other low- and lower-middle income countries over the course of the pandemic (Gentilini et al., 2021), to date there has been scant evidence of expanded food or livelihood assistance in the rural communities we study.

Ultimately, we see food insecurity indicators fluctuating significantly over time in these communities. Things haven't gotten uniformly worse. Indeed, in some places things seem to be somewhat better, at least temporarily, for example thanks to bumper maize harvests in southern Malawi or reduced fish imports that increased domestic demand in Kenya. This merely underscores how the pandemic shock is not the only – or even always the most salient – covariate shock impacting poor rural populations. The many different shocks and stressors they face all get mixed together in the complex food systems within which they operate. The meso-level mechanisms of those systems ultimately regulate food availability, access, utilization and stability for these rural households. Multiple adverse shocks hitting simultaneously – as in southern Madagascar – can cause mass hardship.

The upshot is that governments, NGOs, and donor agencies need to monitor both households and system-level indicators, watching for any of a wide range of shocks or new stressors that might disrupt the delicate equilibria that commonly regulate the food security status of these populations. Shoring up labor markets, transport systems, safety nets, and other meso-level mechanisms that intermediate between covariate shocks and households' food security status is crucial not just to pandemic response but to building household- and systems-level resilience more broadly in the varied systems of rural Africa. The issue is not so much resilience to a specific shock or stressor – pandemic, drought, floods, or something else – as it is resilience to the many

perils faced in everyday existence. And there are no one-size-fits-all solutions. Context matters enormously, as manifest in the markedly different experiences of the rural communities we study in Malawi, Madagascar, and Kenya. They may all be poor rural African communities facing the same global pandemic at the same time. But as we have shown, the different ways in which meso-level mechanisms have mediated the common, global disease and macroeconomic shock have manifest in different, time-varying food security profiles in these communities.

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Tables and Figures

Table 1: Data collection start dates, locations, and sample sizes

	Start Date	Region	District	Households Sampled
Malawi	September 2017	Southern	Blantyre Rural	750
			Chikwawa	750
			Nsanje	750
Madagascar	July 2018	Androy	Tsihombe	364
			Beloha	237
Kenya	March 2020	Western	Homa Bay and Kisumu Counties	90

Table 2: Food security indicators collected, by location

Indicator	Description	Citation	Collected monthly in...
Household Dietary Diversity Score (HDDS)	Sum across 11 food groups (unweighted, 24-heures)	Swindale & Bilinsky (2006), USAID/FANTA	Madagascar, Kenya
Food Consumption Score (FCS)	Sum of 8 food groups, weighted for quality and frequency (7 day)	Weisman et al. (2009), WFP/VAM	Madagascar
Household Hunger Scale (HHS)	Weighted sum of 3 extreme strategies, over last month (no food at all available in household, going to sleep without eating, and going a full day and night without eating)	Ballard et al. (2011), USAID/FANTA - III	Malawi, Madagascar
Reduced Coping Strategies Index (rCSI)	Weighted sum of 5 less severe strategies, over the last week (loan, reduction, less-preferred foods …)	Maxwell & Caldwell (2008), USAID	Malawi, Madagascar
Household Food Insecurity Access Scale (HFIAS)	Summed score or weighted categorization of food insecurity severity	Coates et al. 2007	Kenya

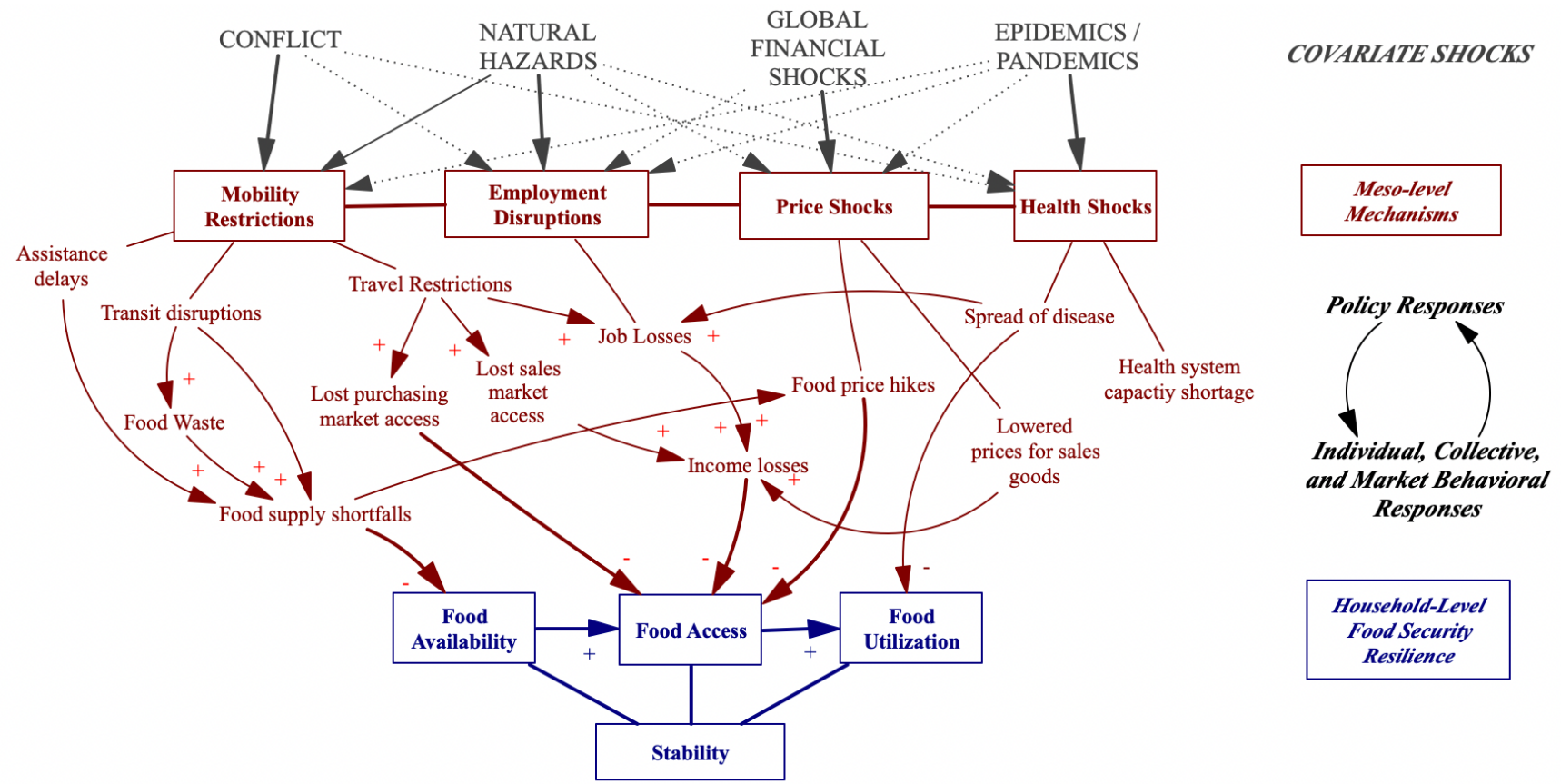

Figure 1: Conceptual Framework of covariate shocks, mechanisms, and food security resilience.

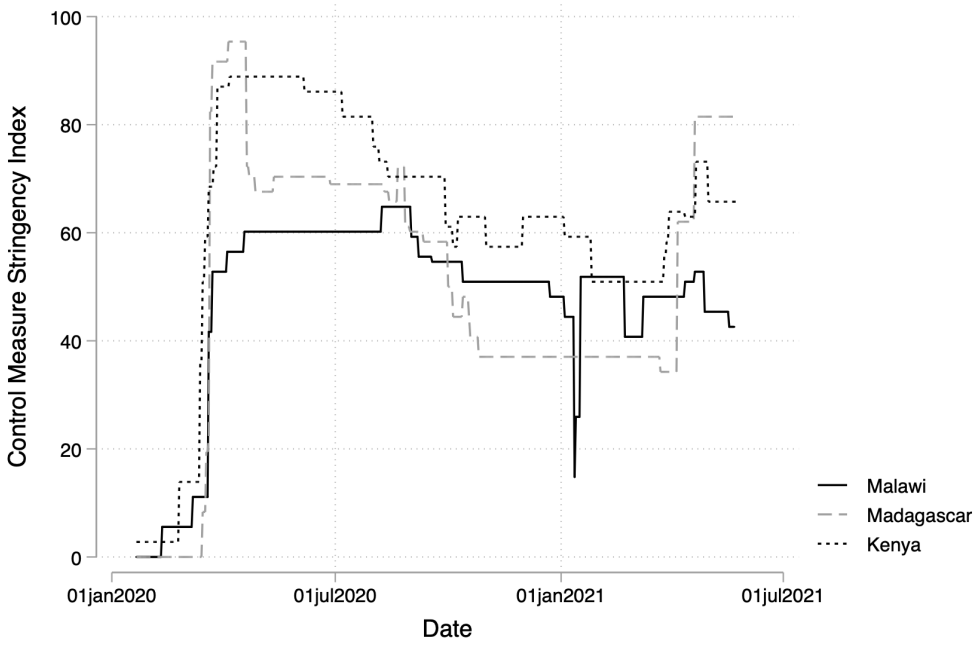

Figure 2: COVID-19 control measures' stringency varied over time in Malawi, Madagascar and Kenya, as shown by the Oxford COVID-19 Government Response Tracker (Hale et al. 2021).

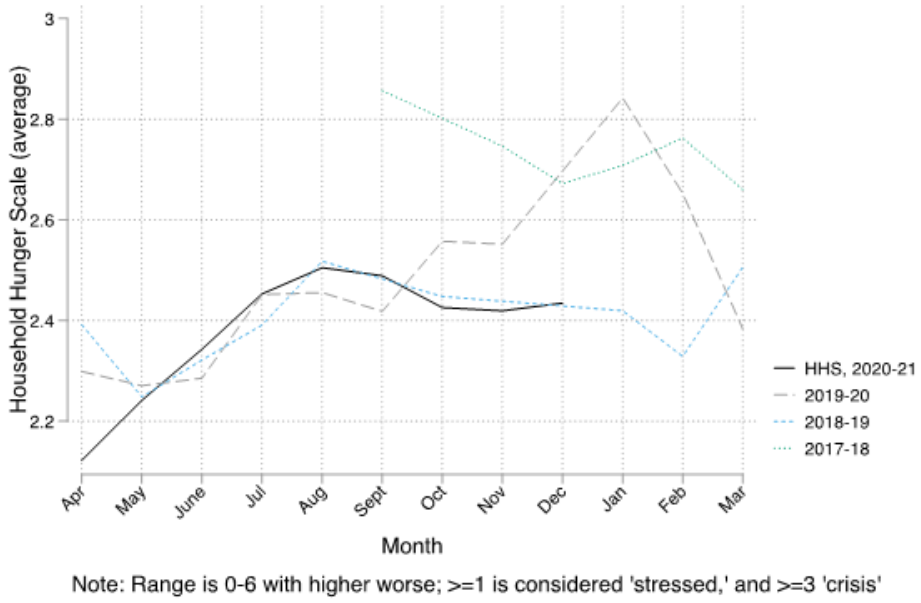

Figure 3: Mean Household Hunger Scale, over time, Malawi.

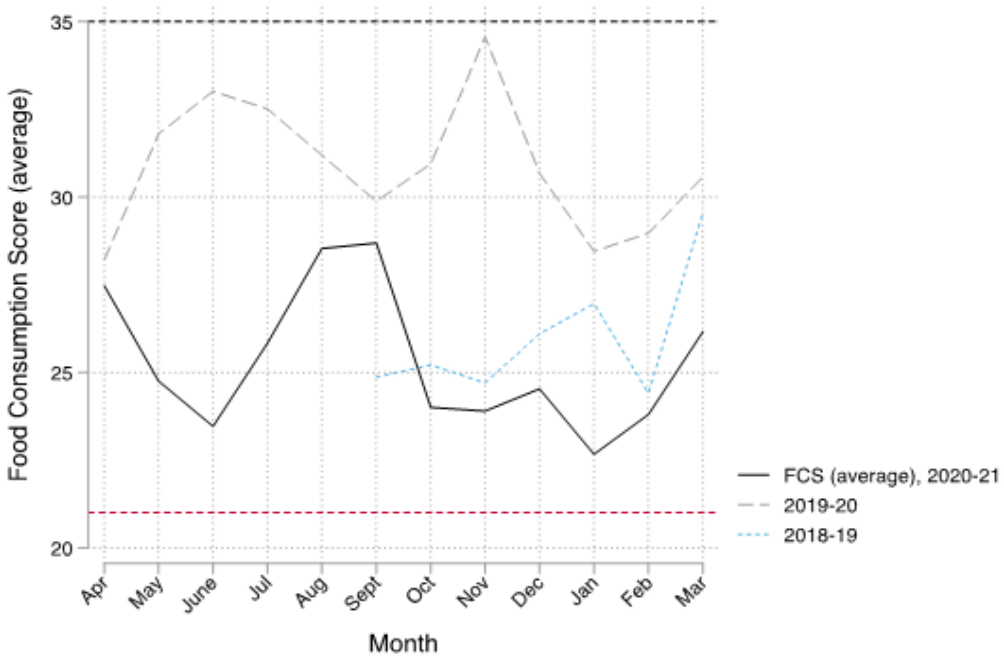

Figure 4: Mean Food Consumption Score, over time, Madagascar. Dashed horizontal lines represent standard thresholds for “Food Secure” (35) and “Borderline” (21). Years run April-March. A higher FCS is better.

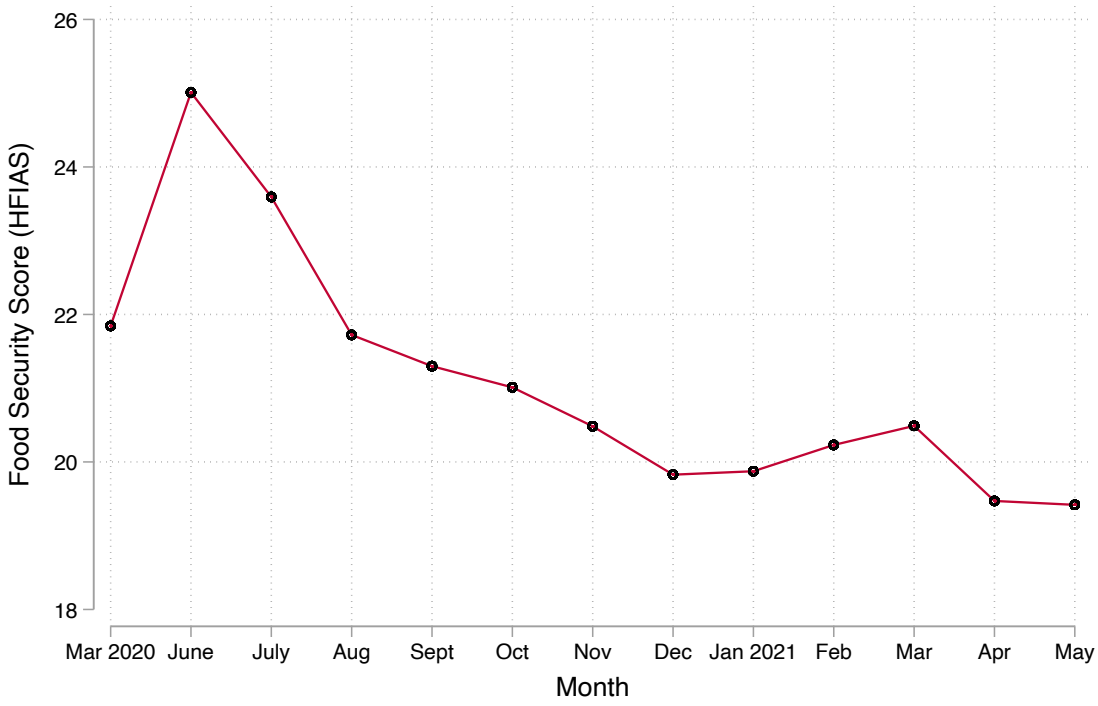

Figure 5: Food Security Score (HFIAS), Mar 2020 – Mar 2021, Kenya.

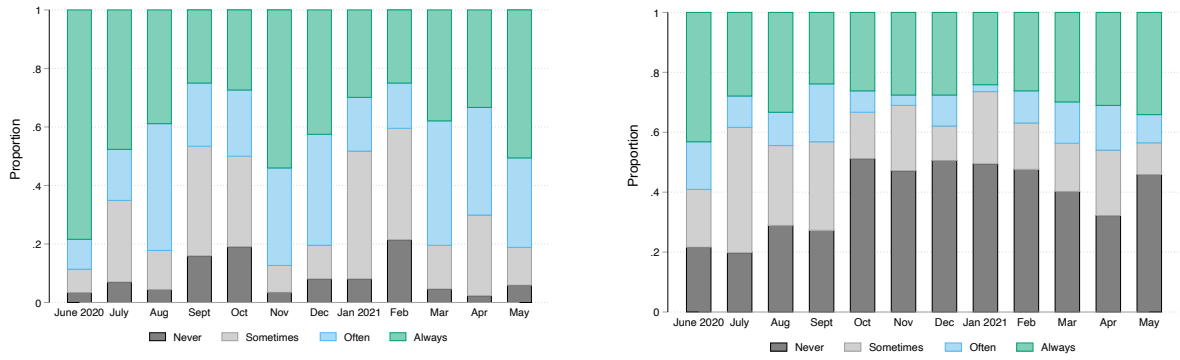

Figure 6: Reported worry about impacts of a) COVID-19 and b) COVID-19 control measures, Kenya, June 2020 – March 2021.

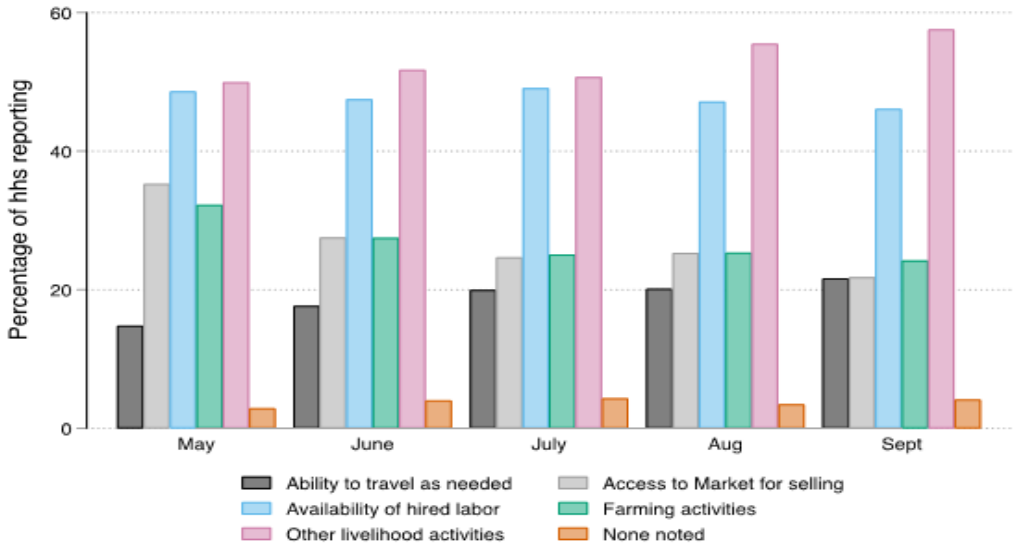

Figure 7: Reported impacts of the pandemic, May – Sept 2020, Malawi.

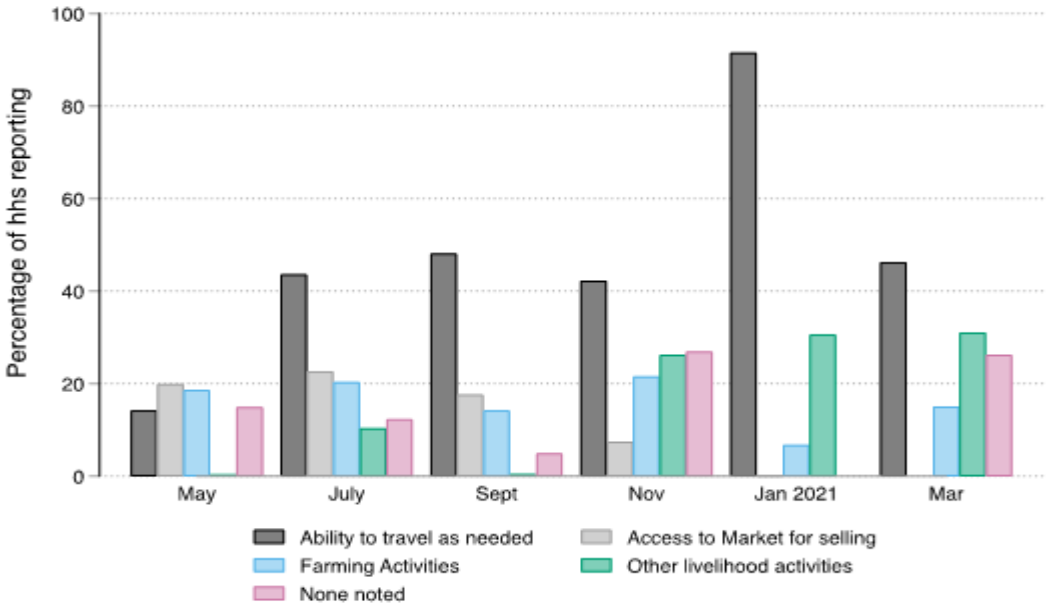

Figure 8: Reported impacts of the pandemic, April 2020 – March 2021, Madagascar.

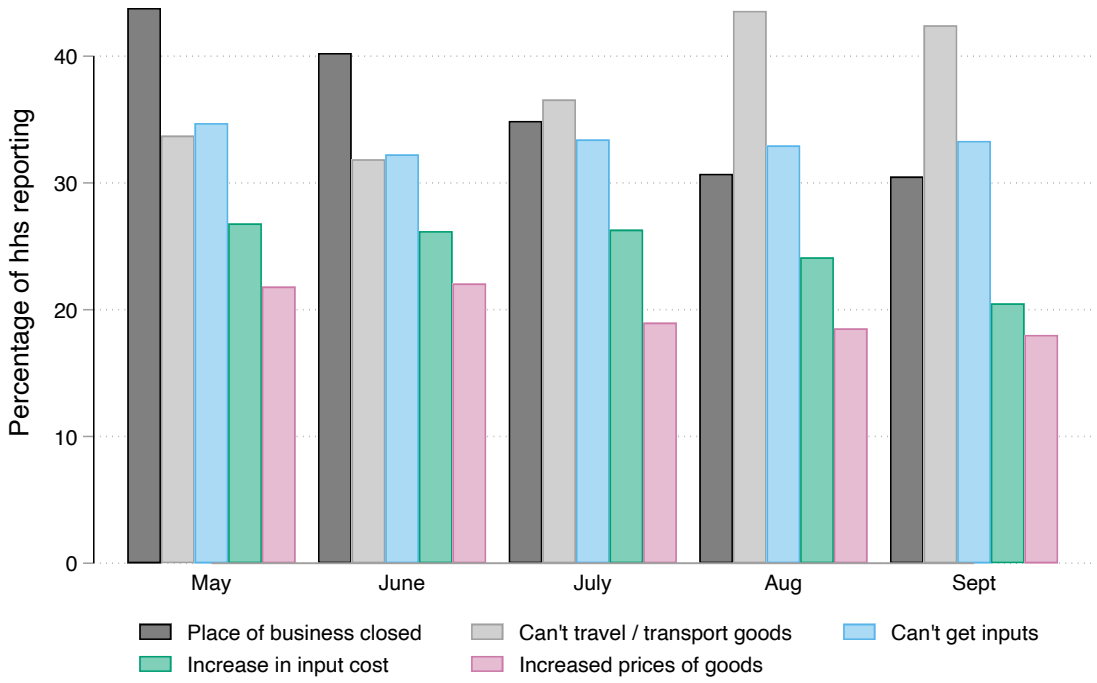

Figure 9: Reports of reasons for lost income among those reporting losses, May 2020 – Sept 2020, Malawi. 87-89% of all households reported lost income in every period, the vast majority (77%-80%) a male income earner.

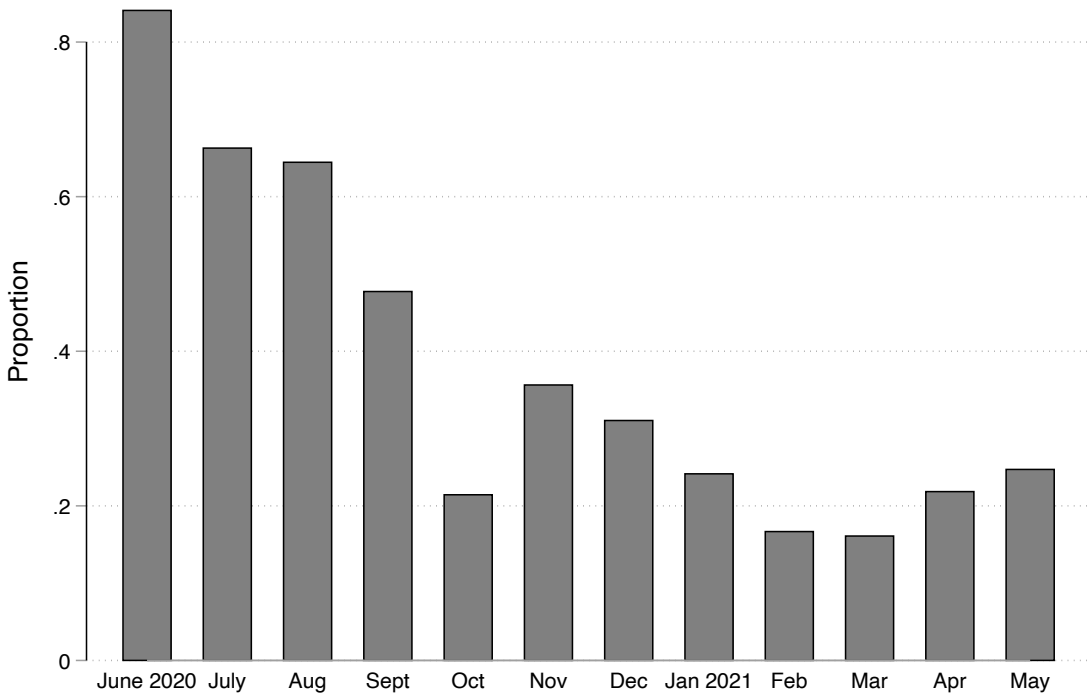

Figure 10: Household reports of working or earning less to avoid COVID-19 infection, Jun 2020 – Mar 2021, Kenya.

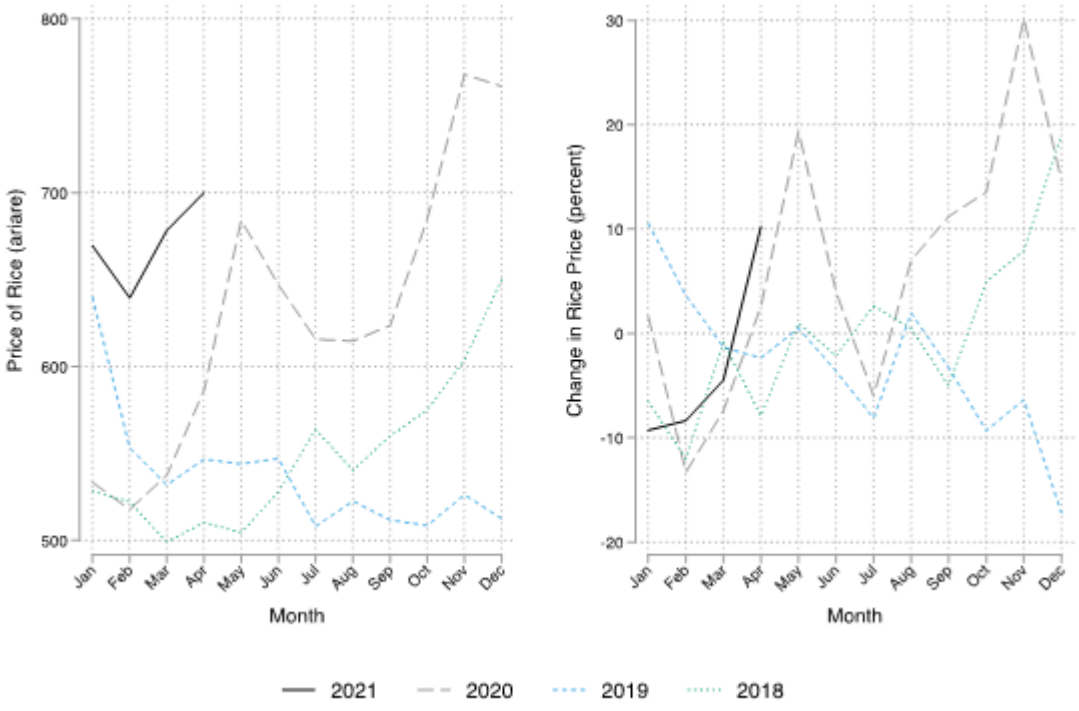

Figure 11: Month-to-month changes in imported rice price, comparing years, Madagascar.