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Research paper

Food security, poverty and household resilience to COVID-19 in Burkina Faso: Evidence from urban small traders’ households

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ABSTRACT

Analoges of the effects of the COVID-19 pandemic on food security of urban households and their resilience are increasingly receiving scholarly interest. In Burkina Faso, urban households whose primary activity is trade were the most immediately impacted by COVID-19 due to the closure of markets. The objective of this research was to analyze the effect of income loss due to COVID-19 on food security and poverty among urban small traders’ households by considering their resilience capacity. A survey was performed on 503 households of small traders operating in 5 markets in Ouagadougou. Objective and subjective indicators of food security were calculated, as well as several indices of resilience capacity. A simple logit model and ordered logit model were used for the socioeconomic analysis. Three main results emerge. First, COVID-19 has increased the likelihood of households being food insecure due to their lower food consumption scores. Second, estimates show that COVID-19 has reduced households’ incomes by increasing their likelihood of entering poverty. Finally, at all levels of analysis, households with adaptive capacity were able to adjust to the shock, but social security was not a mitigating factor. Implications in terms of economic policies are discussed.

1. Introduction

In its 1996 Declaration, the World Food Summit defines food security as “when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life”. Access to safe and nutritious food is recognized as a human right (Eide, 2007). Food insecurity such as malnutrition of thousands of children, pregnant and lactating women, and the elderly weakens their immune systems and exposes them to various health risks (FSIN, 2020). In Burkina Faso, food insecurity in its diverse forms remains a public health challenge (Becquey et al., 2012; Melgar-Quinonez et al., 2006; Nikiema et al., 2021; Ruel et al., 2010; Savy et al., 2006). The number of people suffering from severe food insecurity increased by 28% in 2019 (FSIN, 2020); 82% of children under the age of 5 and 49.6% of women aged 15 to 49 in the country are anemic, and only 24.6% of children aged 6 to 23 months meet the minimum requirements for dietary diversity.

Yet, knowledge of the impacts of shocks, especially of major shocks like that of the COVID-19 pandemic, on food security of urban households is currently needed. As early as the 1980s, the analysis of the issue of food security shifted from a focus on national and international macro systems to a focus on micro systems and especially individuals and households from the analyses of Sen (1999). Food security is then being analyzed in relation to the characteristics of households and individuals and specifically their capacity and, more generally, their resilience (Diagana et al., 1999; Savadogo & Kazianga, 1999; Singare et al., 1999). However, the shocks parameters have always remained the same. Particularly since the 2000s, the analysis has started to focus on urban contexts. For example, noting the absence of a national mechanism for capturing urban forms of food insecurity, several authors have focused on the issue for the purposes of informing public action (Becquey & Martin-Prevel, 2010; Becquey et al. 2012). Similar to his predecessors, Becquey (2010) developed his analysis within the framework of traditional shocks.

These contributions have made it possible to orient research towards the city within the framework of already known types of crises, particularly within the framework of traditional crises. But, the COVID-19 pandemic has come to reinforce the urgency that has already faced the countries of the Sahel region and Burkina Faso in particular the need to improve mechanisms for the prevention, monitoring and

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management of food crises. Becquey (2010) noted that there was at time no national system that seeks to capture urban forms of food insecurity. COVID-19, a global respiratory disease that first appeared in December 2019 in the city of Wuhan, China, created a new type of crisis. The objective of this work is to analyze the effect of income loss due to COVID-19 on food security and poverty among urban households of small traders, considering their resilience capacity. Most previous studies on the effects of COVID-19 on food security have focused on rural environments (Waiibel et al., 2020; Mahmud & Riley, 2021; Janssens et al., 2021) or on the broader macroeconomic national level (Zidouemba et al., 2020). It is, however, necessary to consider urban environments, as most of the populations of African cities, such as that of Ouagadougou, were more affected by the pandemic than rural populations (African Arguments, 2020). Households of small traders should be the most affected due to markets lockdown.

The literature on the effects of COVID-19 on food security used data collected online (Auerbach & Thach, 2020; Kansiime et al., 2020; Mahmud & Riley, 2021) with the risk of not reaching vulnerable households through online systems. In addition, in the context of COVID-19, studies have less focused on resilience capacity of households, which international organizations are increasingly calling to consider in the analysis of food security (D’Errico & Di Giuseppe, 2018). This study addresses these limitations by examining the most affected vulnerable population of urban areas, small traders, through face-to-face. The analysis takes into account the resilience capacity of households and their adaptive strategies.

The remainder of the article is organized as follows. Section 2 presents a brief review of the literature on informal sector, food security and covid-19 pandemic impacts. Section 3 describes the methodology and descriptive analysis of the data collected. Section 4 presents econometric results and discussion. Section 5 gives conclusions and discusses the policy implications of the study.

2. Literature review

The literature review covers topics such as informal sector, food security and covid-19 pandemic impact.

2.1. Informal sector in developing countries

Most of small traders operate in informal sector (Van Dijk, 1980). The topic of informal sector has been a scholarly interest since the end of the 1970s. It continues to some interest in current debates on economic development in low-income countries. Akuoko et al. (2021) discuss the concept of informality in the light of the COVID-19 pandemic in Ghana. According to the authors, the neo-liberal approach to informality on the continent which has long considered it as an abnormality rather meant that the informal sector’s contribution to development was largely neglected. Yet, in reality, many African countries such as Ghana show a different socioeconomic setup where informality takes the center stage, to the extent that the effects of the pandemic in Africa is expected to look like no other continent. In conceptualizing the concept of informality, the authors observed that “the theorization of the informal sector has gone from being labeled as ‘hidden’, ‘black’ and ‘second’ to being recognized as a permanent and important aspect of urban lives globally” (Akuoko et al., 2021). However, the neo-liberal approach to informality has a transitional abnormal phenomena to be absorbed by the formal sector resulted in governments focusing on the illegality of informal sector rather than its capacity for development. Since the evidence has challenged such view, the authors call for approaching the informal sector as a relevant factor for understanding other social processes such as resilience to shocks, and pandemics in particular. Benjamin et al. (2012) suggest understanding the causes and consequences of informality are crucial given that the informal sector plays a dominant role in West African economies, particularly with regard to employment. Meagher (1997) studied the link between crisis, informalization and the urban informal sector in Sub-Saharan. Analysing the size of the informal economy in Sub-Saharan Africa, Xaba et al. (2001) showed that with 78 per cent is non-Agricultural employment, 61 per cent in urban employment and 93 per cent employed in new jobs. Whereas in 1990, 21 per cent of SSA’s 227 million labor force was working in the informal economy, by 1998 it was estimated to comprise 40–60 per cent of urban employment. During this period, while there was a decline or stagnation in the growth of formal employment, there was an increase in informal sector activities in the region. In some instances the informal economy plays a far more significant role in the country’s economy than the formal economy, as reflected in the number of economically active people working in the informal economy. Hussmanns (2004) noted the informal economy plays an important role for employment creation, income generation and poverty reduction in many countries, especially developing and transition countries. The IMF (2021) notes that informal workers may be more vulnerable to negative shocks such as the COVID-19 pandemic, as they are likely to face greater income losses without the benefit of social protection. In their paper, Bennett and Rablen (2012) observed that urban labor markets in developing economies exhibit considerable diversity, typically including significant segments of both voluntary and involuntary self-employment, as well as formal and informal wage employment. Onyebuke and Geyer (2011) through a thorough review focusing on Nigeria show how relevant it is to relate various processes in Africa with the informal economic realities of the continent. Meagher and Yunusa (1996); Yusuff and Sherifat (2011) engaged in discussion of the concept because of its centrality in socio-economic analysis.

2.2. Food security and resilience analysis

From a theoretical point of view, three main approaches to analyzing the effects of COVID-19 on food security are available (Devereux et al., 2020). The first is the capabilities approach developed by Sen (1981), which identifies four legal sources of food security at the individual or household level. These sources include production, personal labor, trade and the right to transfer. The second approach is that of the FAO (2009) relating to the four pillars of food security, namely, availability, access, use, and stability. The third method is the food system approach, which takes into account the environment (populations, infrastructures, institutions, etc.) and activities involved in the production, distribution and preparation of food. Thus, the first approach highlights the importance of informal transfers and social capital to the analysis of food security. The latter two approaches cover both the demand and supply aspects of food.

Increasingly, household-level food security analyses take into account resilience capacity. Of ecological (Holling, 1973), technological (Tierney & Bruneau, 2007) and psychological (Lee et al., 2013) origin, the concept of food security has been extended to development economics in studies on poverty. Poverty is then viewed not in simple statistical terms but based on its dynamic and stochastic nature (Carter & Barrett, 2006). In some vulnerability studies that focus on the effects of climate change shocks, the concept of resilience tends to be equated with the “capacity to cope (adaptive capacity)” alone (Bhattacharjee & Behera, 2018). It is through empirical studies measuring resilience at the household level that researchers have come to adopt a broader measure. Based on these empirical studies, the concept of resilience is defined as “the capacity which ensures that stressors and negatives hooks do not adversely affect long-term development” (Constas et al, 2014).

This broad and dynamic definition has received its most systematic operationalization in the work of Smith and Frankenberger (2018). The authors conceptualize the capacity for resilience along three dimensions. The first dimension is absorptive capacity, which describes the “ability to minimize exposure to shocks and stresses (ex-ante) when possible and to recover quickly when exposed (ex-post)”. Relevant indicators include social capital bonds, asset ownership, cash savings, access to an informal safety net, the availability of disaster preparedness.
measures and the mitigation of the effects of disasters. The second dimension is adaptive capacity, which “involves making proactive and informed choices about alternative livelihood strategies based on changing conditions” (Smith & Frankenberger, 2018). Adaptive capacities include building bridges between social capital, aspirations and confidence to adapt, the diversity of livelihoods, human capital, and exposure to information. The third dimension is transformative capacity, which “refers to enabling conditions that promote more sustainable resilience.” Indicators of transformative capacity include building bridges between social capital, the nexus between social capital, access to markets, access to services, women’s empowerment and governance.

2.3. COVID-19 impacts

Empirical studies have looked at the impact of COVID-19 on several dimensions including food security and poverty. Lusk (2020) studied food insecurity in Canada following the COVID-19 pandemic. The author showed that the fear of running out of food leads people to accumulate stocks by buying more than normal. In addition to a lack of access to food due to increasing demand, the author describes other causes such as the closure of shops due to workers’ illnesses or social distancing measures. For Hobs (2020), resilience to the pandemic originates from the consumption of local products or online supply systems because one can anticipate food shortages due to panic payments and reduced supplies.

Kerr (2020) observed that the resilience of the international food system can alleviate food insecurity by reducing panic purchasing and shifting demand. According to Deaton and Deaton (2020), households will experience income shocks from COVID-19, which in turn will lead to an increase in the prevalence of household food insecurity. Food supply chain resilience depends on a government’s ability to facilitate capital flows and international trade and maintain transportation, which will help ensure long-term food availability. Using the Canadian Community Health Survey (CCHS), the authors analyze this process in Canada by showing that COVID-19 has created unprecedented “income shocks” resulting in a long-term reduction in the circulation of capital, international trade, and transport. Along the same lines, the resulting drop in income will have an impact on household spending.

Analyses of the effects of COVID-19 have also focused on poverty. In this sense, the measurement of these effects has concerned both supply and demand. In the case of the economic impact of COVID-19, as shown by Suryahadi et al. (2020), there are two underlying assumptions. First, production capacity is reduced due to the infection of workers. Second, the need to restrict activity for disease suppression results in reduced production, international trade and tourism. Then, the supply shock leads to a demand shock. The overall result is an economic recession pushing millions of people into poverty. Based on this assumption, Suryahadi et al. (2020) showed in reference to Indonesia that with the slightest impact of COVID-19 on growth, the poverty rate should increase from 9.2% to 9.7% in September 2019 and that by the end of 2020, this rate should increase to 17.9%.

Several other studies have analyzed the effects of COVID-19 across employment. Largue (2020) analyzes the issue of work in relation to the coronavirus in Canada, as work is used not only for production but also as a source of household income. The COVID-19 pandemic prompted Canada and several other countries to impose an economic shutdown to prevent a deadly public health crisis from becoming much deadlier, resulting in job loss for many workers. Rising unemployment, restaurant and school closures, and social distancing have triggered reductions in demand for some products and foods and increased demand for others, leading to shifts in demand for inputs, including labor, as a source of income for food demand, among other commodities.

Dev (2020) anticipates a household food crisis in India as a result of the COVID-19 pandemic due to the country’s large population, the country’s dependence on informal work, and closures and extremely disruptive social distancing measures. In the context of the pandemic, Klassen and Murphy (2020) showed that many workers of farms, warehouses, restaurants, grocery stores, meat packers and delivery services have experienced precariousness, insufficient pay and suppressed bargaining power; the benefits offered by employers have been temporary or dependent on attendance; and government and employer policies have limited access to living wages, social protections and labor democracy. Migrant food workers have limited access to basic employment standards, while others do not have access to work due to closed borders and businesses; indirectly, income from remittances has reduced, affecting many households in countries of origin.

In some developing countries, the effects of COVID-19 on urban food security have been analyzed. For example, Das et al. (2020) identify the determinants of food insecurity and of coping strategies used in urban and rural households of Bangladesh during the month-long COVID-19 lockdown period for a total of 212 participants, including 106 urban and 106 rural households. The authors found that approximately 90% of the households were suffering from different levels of food insecurity. Severe levels of food insecurity were more common in urban (42%) than rural (15%) households. In a similar line, Crush and Si (2020) analyzed the link between Covid-19 and food security among the urban poor in the global south (developing countries), while Egger et al. (2021) investigated household strategies in the face of insufficiencies of government support in Africa including Burkina Faso, Asia, Latin American countries, in relation to the covid-19 pandemic. Wadsani and Prasad (2020) were concerned with the same topic among Indian slum households.

For Africa, the literature focuses on institutional notes. The FAO (2020), in its Regional Response Plan 2020–2021 for Burkina Faso, Mali and Niger, integrates the COVID-19 pandemic into a plan initially developed to respond to humanitarian needs in general in these countries. The plan anticipates a food crisis following pandemic and government response measures. The studies published on the COVID-19 pandemic are similar in that they are all speculative or forward-looking with little knowledge of the actual characteristics of households. Very few studies on the issue have focused on Africa. While a few studies have been conducted in Nigeria (Andam et al., 2020; Amare et al., 2020), Burkina Faso (Zidouemba et al., 2020; Zidouemba et al., 2020), Uganda (Trotter & Mugisha, 2020), Zimbabwe (Makoni and Tichaawa, 2021) and Ghana (Durizzo et al., 2021), there is still a need for further empirical studies on large samples of households, particularly those vulnerable of informal sector.

3. Methodology and data analysis

3.1. Socio-econometric specification

3.1.1. Resilience and food security equation

The COVID-19 pandemic, with the quarantine measures it has triggered and resulting cessation of economic activities of most households in urban areas, has had important implications in terms of food security. The literature generally assumes that in the face of shocks, households exploit their resilience capacity. Several shocks have been discussed, including climatic shocks (Smith & Frankenberger, 2018), economic shocks, family events, and war (Brück et al., 2019). Thus, in reference to the shock associated with the COVID-19 pandemic, it is relevant to take consider the resilience capacity of affected households.

Several ways to measure the resilience capacity of households have been developed. D’Errico and Di Giuseppe (2018) and D’Errico and Pietrelli (2017) consider adaptive capacity, assets and access to basic social services. Following the FAO methodology, in addition to these pillars, social security, which has been essential in some countries in the face of the Covid-19 pandemic (Bassier et al., 2020; Córdoba et al., 2020; Dapilah et al., 2020) is also considered. It is the latter that is used in the context of this work. This analytical framework shows that in the event of a shock, households will activate a number of management strategies to maintain well-being. Thus, resilience measures cross the essential pillars: adaptive capacity, assets and access to basic services.
and social security. Adaptive capacity considers the savings of household, the number of years of study of the head of household and the existence of an asset generating an annuity. Assets include ownership of a maintained house (with walls, a roof, and a floor), a telephone, a computer, a television, a radio, a motorcycle, land, animals (poultry or livestock), etc. Access to basic services concerns access to healthcare, education, water, hygienic requirements (toilets) and electricity. Social security takes into account formal (state and credit institutions, etc.) and informal transfers (relatives, friends, etc.). The FAO conceptual model guides us in two ways. The first is that three pillars must be taken into account in measuring resilience capacity. The second concerns the empirical models in which the dependent variables measuring well-being change must be taken in difference (i.e. with and without the shock).

Thus, adaptive capacity, basic social assets and services and social security are the three main pillars used to analyze a household shock). Being change must be taken in difference empirical models in which the dependent variables measuring well-being capacity was calculated using a simple average of the three parameters to be estimated and \( \theta \) is an idiosyncratic error term.

### 3.1.2. Adaptive strategies

In addition, the analysis of food status during the COVID-19 pandemic makes use of the coping strategy index. This index is recommended for analyzing food security in times of crisis such as the COVID-19 pandemic (Knippenberg et al., 2019). Strategies that vulnerable households can use in the event of a shock include (i) purchasing food on credit, (ii) engaging in secondary activities for additional income, (iii) consuming less preferred foods, (iv) reducing the number or size of meals, (v) seeking support from a relative or friend, and (vi) sending children to beg. The survey uses the following question for each household: Has the household resorted to one or more of these strategies due to COVID-19? If so, for how many days (during a week) did the household use them? Formally, the coping strategy index (CSI) is calculated as follows:

\[
CSI = \sum_{d} w_{d} \text{days}_{d} \tag{2}
\]

CSI is the coping strategy index, days denotes the number of days a household has committed to strategy \( d \), and \( w \) is the weight of each strategy with reference to the weights proposed by Maxwell et al. (2008) and Knippenberg et al. (2019). A high CSI indicates high levels of food insecurity and therefore low levels of well-being. A maximum score of 70 indicates high food insecurity due to a shock (Knippenberg et al., 2019). This analysis allows households to be grouped according to their level of food insecurity.

Resilient households are those maintaining an acceptable level of well-being despite the shock of the COVID-19 pandemic. Here, well-being is measured by the coping strategy index (CSI). According to Knippenberg et al. (2019), the threshold of CSI is \( j < 10 \). Thus, a household with a coping strategy index of less than or equal to 10 despite the shock is considered resilient. Many studies highlighted socio-demographic characteristics such as age, household size, gender and income to shape the resilience capacities of urban households. In the context of resilience to food insecurity in Uganda, educated households are more resilient than low educated households while female headed households are less resilient compared to male headed households (D’Errico & Di Giuseppe, 2018). Also, social security can help in terms of the provision of loans, gifts, emotional support and early warnings, which are important for enhancing resilience (Aldrich & Meyer, 2014).

To estimate the probability of a household being resilient, i.e., below the food insecurity threshold following the COVID-19 shock, the following equation is estimated:

\[
P_h(CSI < j) = w_0 + \beta RCI_h + \xi \text{incomedloss}_h + \rho X_h + \epsilon_h \tag{3}
\]

Where is \( P_h \) the probability of a household being resilient. \( X_h \) represents socio-demographics characteristics of household \( h \) (cf Table A3). \( RCI \) is the household resilience capacity index based on social security, adaptive capacity, assets and access to basics services. \( \text{incomedloss} \) is income loss due to COVID-19. \( \beta, \xi, w_0 \) and \( \rho \) are parameters to be estimated, and \( \epsilon_h \) is an idiosyncratic error term.

### 3.1.2.1. Poverty equation

The effect of COVID-19 on household poverty can stem from several mechanisms. Through the combination of supply and demand shocks, COVID-19 can cause a decline in economic activities, leading to lower growth. These macroeconomic shocks lead to a decrease in average expenditure per capita at the household level (Suryahadi et al., 2020). Beyond the macroeconomic effect, another effect on poverty would result from the cessation of economic activities.
of directly affected households, such as small traders’ households. Although poverty is a multidimensional phenomenon, the analysis here is limited to the monetary dimension. Generally, monetary poverty is observed when total annual household income is below the poverty line.

The analysis model is formalized as follows:

$$P_n = \gamma + \beta RCI_n + \zeta \text{incomeloss}_n + \delta \text{incomeloss}_n + \rho X_n + \epsilon_n$$  \hspace{1cm} (4)

Where $P_n$ represents a dummy variable that takes a value of 1 if the household is poor and zero otherwise. A household is considered poor if the total income per adult in the household is below the absolute monetary poverty threshold, which is 153,530 CFA francs per adult per year at the current price in Ouagadougou (INSD, 2014). $RCI$ is an index reflecting a household’s resilience capacity, incomeloss is income loss due to COVID-19 and $X$ is a vector of variables representing household characteristics (household size and household income) and household head characteristics (Age, gender, educational level). Female-headed households were more likely to be poor than male-headed households. Also, an increase in age of the household head may reflect increased work experience, which is associated with increased income and asset ownership, both of which enhance household welfare (Lekobane & Seleka, 2017). Evidences suggest that increasing household size (Sekhampu, 2013) and household head with lower levels of education experience higher poverty levels (Cheema & Sial, 2012). However, resilience capacity of household could play a key role in coping with COVID-19.

As in the previous cases, to determine if resilience capacity mitigates the effect of COVID-19 on a household’s probability of being poor, an interaction variable is taken into account as follows:

$$P_n = \gamma + \beta RCI_n + \zeta \text{incomeloss}_n + \delta \text{incomeloss}_n + \rho X_n + \epsilon_n$$  \hspace{1cm} (5)

### 3.2. Estimation strategy

As a first step, as an estimation strategy, we use a logit model that estimates the probability of a household becoming food insecure as a result of the COVID-19 pandemic. Therefore, the dependent variable is a binary variable that takes a value of 1 if the variation of the food security indicator (food consumption score, food diversity score and food expenditure) is negative and zero otherwise. The same model is used to estimate a household’s probability of being resilient to COVID-19 by considering the coping strategy index.

Moreover, considering the categorization of food security status, an ordered logit model is used. Two categorizable food security indicators are used, namely, the food consumption score and food diversity score.

For the food consumption score, the formulated ordered logit is as follows:

$$Y^* = \delta X + \epsilon$$  \hspace{1cm} (6)

with $Y^*$ being a latent variable defined as follows:

$$Y = 0 \text{ if } Y^* \leq \gamma_1; \gamma_1 < \gamma_2 \text{ if } Y^* \leq \gamma_2 \text{ and } \gamma_2 < 2 \text{ if } Y^* = 2$$

$Y^*$ is a categorical variable where $0 = \text{severe food insecurity}$, $1 = \text{moderate food insecurity}$ and $2 = \text{food security}$.

For the dietary diversity score, $Y^*$ is also a categorical variable where $0 = \text{low dietary diversity}$, $1 = \text{moderate dietary diversity}$ and $2 = \text{high dietary diversity}$.

Under the ordered logit model, the outcome variable is household food status with the assumption that it is ordered from lowest to highest but that the distance between adjacent levels is known (Sharauanga et al., 2016).

Finally, we identified a subsample of households whose food security status has deteriorated as a result of the COVID-19 pandemic. Thus, food security indicators for COVID-19 (food consumption score, dietary diversity score, household per capita food expenditure and coping strategy index) were used as outcome variables. The ordinary least squares method was used. Additionally, the method developed by White (1980) was used to ensure the robustness of the estimators to heteroskedasticity. Descriptions of the explanatory variables used and multicollinearity test are given in the appendix in Table A3 and Table A4, respectively.

### 3.3. Data and respondents characteristics

#### 3.3.1. Data

Burkina Faso diagnosed its first case of COVID-19 on March 10, 2020, but the country had already had its Preparedness and Response Plan in place since March 03, 2020. After the confirmation of the first case and the spread of the virus, response measures accelerated. The Council of Ministers of March 03 adopted a ban on national and international events until April 30, 2020. Eleven days later, the council closed all educational establishments until March 31; on March 16, self-containment was required on return from abroad. In turn, religious organizations suspended their mass gatherings and prayers.

On March 20, a curfew from 7 p.m. to 5 a.m. was introduced; air, land and rail borders were closed; restrictive measures for places open to the public were introduced; social distancing measures were established; and quarantine measures were established in cities recording at least 1 case of COVID-19 and large markets in Ouagadougou were closed. All of these measures, particularly the closing of markets, could have consequences in terms of food security and poverty among urban households.

The city of Ouagadougou has 85 markets and yaars. Among these markets and yaars, 40 have been closed by the state from March 26, 2020 to April 29, 2020. The data used come from a survey of 503 small

### Table 1

Descriptive statistics.

| Variables                                      | Obs | Mean  | Std. Dev. | Min  | Max  |
|------------------------------------------------|-----|-------|-----------|------|------|
| Age of household head (1 = man) %              | 500 | 41.37 | 11.86     | 18   | 81   |
| Gender of household head (1 = Educated) %      | 502 | 72.7  | 44.58     | 0    | 100  |
| Household size                                 | 502 | 7.38  | 3.93      | 2    | 22   |
| Education of household head (1 = Educated) %   | 498 | 33.93 | 47.39     | 0    | 100  |
| Literacy of household head (%)                 | 498 | 12.05 | 32.58     | 0    | 100  |
| FCS (without COVID-19)                         | 503 | 54.2  | 18.60     | 8    | 132  |
| FCS (with COVID-19)                            | 501 | 47.35 | 17.70     | 6    | 132  |
| Household dietary diversity score (Without COVID-19) | 503 | 5.64 | 1.88 | 12 |
| Household dietary diversity score (With COVID-19) | 502 | 5.08 | 1.63 | 12 |
| Monthly Food expenditure (without COVID-19)     | 502 | 69413.5 | 57394.57 | 6200 | 626900 |
| Monthly Food expenditure (with COVID-19)        | 501 | 55160.57 | 46319.73 | 4000 | 323300 |
| Household non Food expenditure (annual)         | 492 | 312318.8 | 923614.2 | 6900 | 1.80e+07 |
| Log Household income per capita (annual)        | 501 | 12.95 | 0.90 | 7.43 | 17.11 |
| Adaptive capacity index                        | 503 | 79.08 | 22.13 | 0 | 99.96 |
| Assets and access to basic services index       | 503 | 77.51 | 14.02 | 0 | 99.96 |
| Social security index                          | 502 | 28.65 | 12.22 | 0 | 99.92 |
| Household resilience capacity index             | 503 | 48.64 | 12.59 | 0 | 92.75 |
| Coping strategy index (CSI)                     | 440 | 19.43 | 13.66 | 0 | 70 |
| Income loss in COVID-19                        | 493 | 170583.2 | 162346.4 | 10,000 | 950,000 |

Source: authors.
trader households in five markets randomly selected from the 40 markets closed. Households were selected in a reasoned manner from among those affected by market closures. Thus, two selection criteria were retained. On the one hand, a trader must have premises in the market for the sale of products. The latter is affected by the fact that his premises are no longer accessible from the closing of the market. On the other hand, the choice fell on vulnerable trading households that did not benefit from specific support from the state during the COVID-19 pandemic. These traders were identified with the help of the manager of each market through its association. The data collected cover household food status without and with COVID-19 conditions, household coping strategies, household resilience capacity, the effect on household trading activity, etc. In particular, data on food security were collected from the household members in charge of preparing meals. This data collection took place during October 2020.

3.3.2. Socioeconomic and demographic characteristics of the respondents

This section presents descriptive statistics for household characteristics and variables subject to our analysis.

The descriptive statistics shown in Table 1 indicate that on average, the majority of the respondents are men (72.7%). Most of the respondents are uneducated (54%), 33.9% have received formal education, and 12.05% are literate. These features demonstrate heterogeneity between the respondents in terms of levels of education.

On average, COVID-19 caused a drop in all food security indicators, namely, the food consumption score, dietary diversity and food expenditure. In addition, our analysis of the resilience capacity indices shows that the index of household adaptive capacity and that of assets and access to basic services are above 50 at 79.08 and 77.51, respectively, on average. In contrast, the social security index is relatively low (28/100) on average. This low level of social security could be explained by the fact that these households did not benefit from specific state support and that social relations are limited. As Scott (1988) points out, in rural areas, there are close-knit social networks in which everybody knows and interacts with everyone else, while in urban settings, social networks are less close-knit.

For Lubben et al. (2006), a household scoring <12 points is considered to be socially isolated. Such a situation reduces a household’s capacity for resilience in the event of unforeseen events such as the COVID-19 pandemic. Overall, the index of household resilience capacity is on average 48.64/100. This level of resilience could justify the trends observed in food security scores with COVID-19. These trends should also be linked to the observed level of the coping strategy index, the average of which is above the resilience threshold (CSI < 10). Income losses recorded for the households are 25.5% of the average annual income per capita of the households surveyed. Finally, the mean comparison test showed that the difference between food security indicators without COVID-19 and with COVID-19 is significant (see Table A5 in appendix).

3.3.2.1. Descriptive analysis of food security. This analysis relates to the so-called objective (food consumption score and food expenditure per capita) and subjective measures (coping strategy index) of food security.

4. Analysis of coping strategies and coping strategy index

Fig. 1 shows that COVID-19 has led households to resort to several coping strategies. The most important strategies include reducing the consumption of favorite foods (67.2%), purchasing foods (63.9%) and reducing the size or quantity of meals (53.4%). Only 0.2% of households had sent their children to beg. Ninety-seven percent of respondents indicated that the coronavirus disease had caused the prices of some basic necessities that they have purchased to increase, which would have had an effect on the household’s nutritional status.

By constructing a coping strategy index (CSI), a proxy for food insecurity and household resilience, we found more than one-third of the households (35.5%) to be resilient, i.e., those with a CSI of less than or equal to 10. Fig. 2 shows the distribution of households according to

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**Fig. 1.** Household coping strategies during the covid-19 lockdown. Source: authors.

**Fig. 2.** Analysis of coping strategy index. Source: authors.
5. Analysis of food security indicators

This analysis is based on two food security indicators: the food consumption score and dietary diversity.

For the food consumption score (see Fig. 3), it appears that COVID-19 has led to a deterioration in the food status of households. A total of 23% of the households were food insecure before the onset of the COVID-19 pandemic, while 38.4% became food insecure due to the pandemic. Likewise, 76.9% of the households were food secure before the pandemic, while 61.4% became food secure as a result of the pandemic. In general, the pandemic resulted in 15.5% of the households experiencing food insecurity. This result may be linked to a reduction in accessibility to the market due to its closure but also to an increase in the prices of basic products, as indicated by 97% of the respondents. The level of food insecurity observed as a result of COVID-19 (38.4%) is relatively higher than what was observed in rural areas (37% of households) of Burkina Faso by Alpha and Fouilleux (2018). This is justified by the fact that the food security of urban households, particularly of trading households, is strongly linked to the market, while that of rural households is dependent on their production. The observed proportions of food-insecure households due to COVID-19 are relatively lower than those found in Kenya (38%) and Uganda (44%) by Kansiime et al. (2020).

Fig. 4 highlights the food diversity levels of the studied households with and without COVID-19 conditions. The figure shows that COVID-19 has caused a decline in dietary diversity. Indeed, as a result of the pandemic, 3.4% of households followed a poorly diversified diet, and 12% of households followed a moderately diversified diet. Likewise, the proportion of households with a high level of dietary diversity by 15.5 percentage points (46.9–31.4). This last result is consistent with our analysis of the food consumption score, which is a quantitative measure. The household dietary diversity score (HDDS) is a qualitative measure of food consumption and reflects households’ access to a variety of foods. With limited access to the market as a result of closures, households’ food variety has also been affected by the rise in prices or by the fall in their incomes due to the cessation of commercial activity.

Violin plots offer the advantage of simultaneously representing kernel density estimates and quantiles across all plots. Fig. 5 shows the distribution of the consumption score for a COVID-19 period for affected and unaffected households. The plot shows that the median for affected households is low compared to that of unaffected households. Likewise, the shape of the distribution shows that consumption scores are more centered on the median for affected households. However, the range of observations is greater for unaffected households.

Regarding the dietary diversity score, the median is approximately 5 for both distributions, and the observations have a similar distribution around the median. Finally, food expenditure, a measure of household food security, is also important to consider. These expenditures capture household vulnerability to food insecurity. The figure shows that for households affected by COVID-19, the median expenditure is lower. Overall, the observations tend to be more homogeneous for affected households.

6. Econometric results and discussion

The effect of income loss due to COVID-19 on well-being is measured by the variation of the food security indicators following the pandemic (Eq. (1)), the coping strategies (Eq. (3)) and poverty (Eq. (4)). The first estimates concern FCS dummy of the total sample including affected (FCS < 0) and unaffected households (FCS ≥ 0). Since the total sample can hide the situation of affected households, we used FCS in a subsample of affected households. Similarly, categorization by food security status allowed us to assess the robustness of the analyses. This section presents the results.
### Table 2
Effect of income loss with COVID-19 on food consumption.

| Variables | Total sample (1) | Total sample (2) | Total sample (3) | Affected households sample (4) | Affected households sample (5) | Affected households sample (6) | Food secure (ordered logit) (7) | Food secure (ordered logit) (8) | Food secure (ordered logit) (9) |
|-----------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Gender of household head (1 = male) | −0.075 (0.060) | −0.044 (0.057) | −0.044 (0.055) | −6.86*** (2.350) | −6.041*** (2.249) | −5.332*** (2.299) | −0.579*** (0.230) | −0.645*** (0.220) | −0.524*** (0.211) |
| Age of household head | −0.004*** (0.002) | −0.004*** (0.002) | −0.004*** (0.002) | 0.109 (0.091) | 0.121 (0.090) | 0.119 (0.091) | 0.0181** (0.0089) | 0.018** (0.0089) | 0.016* (0.008) |
| Household size | 0.0132* (0.0071) | 0.015** (0.0070) | 0.015** (0.0060) | −0.306 (0.257) | −0.194 (0.252) | −0.128 (0.240) | 0.0015* (0.0024) | 0.0015* (0.0024) | 0.0015* (0.0024) |
| Adaptive capacity index | −0.000666 (0.000123) | −0.00094 (0.00018) | −0.00094 (0.00018) | 0.0028 (0.0078) | −0.028 (0.0076) | −0.0085 (0.0075) | 0.0015 (0.0008) | 0.0015 (0.0008) | 0.0015 (0.0008) |
| Assets and access to basic services index | 0.00028 (0.00018) | −0.00075 (0.00018) | 0.00028 (0.00018) | −0.053 (0.076) | −0.053 (0.076) | −0.053 (0.076) | 0.0008 (0.0081) | 0.0008 (0.0081) | 0.0008 (0.0081) |
| Social security index | −0.00020 (0.00020) | −0.00020 (0.00020) | −0.00020 (0.00020) | 0.062 (0.062) | 0.062 (0.062) | 0.062 (0.062) | 0.0009 (0.0009) | 0.0009 (0.0009) | 0.0009 (0.0009) |
| Educated household head | 0.046 (0.054) | 0.062 (0.053) | 0.062 (0.052) | −3.560 (2.508) | −3.175 (2.420) | −3.114 (2.418) | −0.373** (0.217) | −0.395** (0.212) | −0.388* (0.211) |
| Literate household | 0.192** (0.082) | 0.190** (0.080) | 0.190** (0.080) | −0.127 (3.126) | −0.042 (3.117) | 0.231 (3.091) | −0.603** (0.303) | −0.652** (0.296) | −0.573* (0.294) |
| Income loss with COVID-19 (log) | 0.0150 (0.028) | 0.0112 (0.027) | 0.0112 (0.027) | −0.702* (0.060) | −0.728* (0.058) | −0.251** (0.049) | −0.10 (0.109) | −0.232** (0.108) | −0.232** (0.108) |
| Household income per capita (log) | −0.06466 (0.032) | −0.07667 (0.031) | −0.07777 (0.0306) | 1.395 (1.765) | 1.898 (1.821) | 2.243 (1.794) | 0.018 (0.125) | 0.048 (0.122) | 0.120 (0.116) |
| Household resilience capacity index | −0.000366 (0.00019) | −0.000366 (0.00019) | −0.000366 (0.00019) | −0.00031* (0.0078) | 0.16** (0.0078) | 0.00073* (0.0074) | 0.000035* (0.000016) | 0.00005* (0.000065) | 0.00005* (0.000062) |
| Income loss with COVID-19 (log)* Household resilience capacity index | −0.00031* (0.00016) | 0.012** (0.0065) | −0.00031* (0.00016) | −0.00031* (0.00016) | 0.127 (2.021) | 0.127 (2.021) | 0.143 (1.979) | 0.143 (1.979) | 0.143 (1.979) |

Source: authors. Note: Robust standard errors in parentheses ***p < 0.01, **p < 0.05, *p < 0.1.

### 6.1. Income loss due to COVID-19 and food security

The results for the effects of income loss due to COVID-19 on food security are shown in Table 2. The relevance of the logit is assessed through the likelihood ratio (Greene, 2003), while that of the ordered logit is given by the Brant test (Long, 2014). The ordered logit model assumes that the relationship between each peer (low, moderate, and high) is the same. The Brant test shows that this assumption of proportional ratios is not violated. Likewise, the likelihood ratios and Pearson test show that the logit model is globally significant.

Certain socioeconomic characteristics affect the likelihood of household food insecurity as a result of COVID-19. The age of the head of household is negatively associated with the probability of food insecurity. Thus, households with an older household head have a high likelihood of becoming food secure due to COVID-19 (logit and ordered logit estimates). The household, with time and experience becomes risk averse and makes decisions to protect itself (Mitiku et al., 2012) and guard against fluctuations in the prices of food products and its items. Likewise, these households may have accumulated assets or include grown children who may contribute to the purchase of food (Sharaunga et al., 2016).

In addition, when the household head is literate, the likelihood of being food insecure is higher than when he or she is uneducated. This result is counterintuitive in that human capital theory suggests that education is associated with both productivity and efficiency in terms of income growth and decision-making (Becker, 1964). However, the mechanisms by which education influences food security depend on the given context. While in rural areas, the level of education influences food security through access to information on the best production techniques and their use, in urban areas, different mechanisms are involved (Bashir et al., 2012).

For urban areas, it is estimated that nearly 90% of households buy their food and are more vulnerable to price fluctuations. This is especially the case for households whose main activity is trading. Therefore, this result could be explained by the given context and the main activities carried out by these households. This result is also in line with Kansimle et al. (2020), who show that households whose food source is linked to the market are more heavily exposed to the deterioration of their food security. Considering the consumption score due to COVID-19, households headed by a man are more food insecure than households headed by a woman. This result is in line with Kennedy and Peters (1992), who indicate that in Kenya and Malawi, female-headed households are more food secure. The authors justify this result by the fact that women spend more of their income on domestic food than men.

Analyses show that per capita household income negatively influences the probability of food insecurity resulting from COVID-19. Income is considered to be an important determinant of food security, as the accessibility of food depends on it. Thus, a high income allows a household to cope with fluctuations in the price of food products linked to COVID-19. When markets were closed in the city of Ouagadougou, only certain large shops were allowed to remain open. As a result, having a high income made it possible to purchase products with limited accessibility.

Finally, the results indicate that income loss due to COVID-19 has
had effects on food security. Indeed, the associated losses of income increase the probability of a household becoming food insecure (estimates 7 and 8). These results are consistent with those found using FCS for affected households sample (estimates 4 and 5) Decreasing household income combined with rising commodity prices has reduced household food purchasing power. Descriptive statistics (see Table 1) show that these losses represent 25.5% of the average income per household head.

These losses are linked, among other factors, to the payment of electricity bills, to the perishability of products sold, etc. In particular, households that sell perishable products are sellers of condiments (21%) and of fruits and vegetables (17%). However, for the three main commercial areas that the respondents focus on (clothing, condiments and fruits and vegetables), it appears that the nature of the commercial activity has no effect on the probability of food insecurity onset due to COVID-19. Kansiime et al. (2020) also found COVID-19 to have negative effects on food security. This study did not explicitly take into account the resilience capacity of households. By taking into account the effect of household resilience capacity in the face of COVID-19, our results clearly show the relevance of this factor to the analysis of food security. Among the indices of resilience capacity, only adaptive capacity has a significant effect, contributing to a decrease in the probability of a household becoming food insecure (estimate 1). Improvement in this adaptive capacity translates into an improvement in the food consumption score (estimate 5) and allows a household to absorb the shock resulting from COVID-19 (estimate 6).

Thus, having an asset that generates income or precautionary savings explain the adaptive capacity of the households surveyed. In Uganda, rural residents use approximately 50% of their savings to buy food (Mahmud & Riley, 2021). In Tanzania and Uganda, D’Errico et al. (2018) also find that the most important dimension of resilience capacity is adaptive capacity, which itself depends on the level of education and the proportion of those who have income in the household.

Table 3 shows the effects of COVID-19 on the probability of being food insecure based on indicators for dietary diversity and food expenditure, respectively.

From our analysis of household dietary diversity scores, we find that gender, age, literacy and household income have the same effects as those found for the food consumption score. In particular, income reduces the probability of a household becoming insecure (logit estimates) because it is associated with higher levels of dietary diversity (ordered logit and OLS estimates).

In contrast, a loss of income from COVID-19 does not have a significant effect on the likelihood of becoming food insecure. This result could be explained by the fact that households have shifted towards purchasing various lower-cost products or by the fact that some of our respondents are sellers of fruits and vegetables and condiments. The latter individuals can self-consume their products, which is taken into account in the analysis of dietary diversity. With the closing of markets, households are no longer able to sell their products and should therefore be tempted or even obliged to consume them, especially in the case of perishable products.

When we only consider households whose dietary diversity has declined due to COVID-19, income losses are an explanatory factor (estimate 4). This result could be related to households that do not sell food. However, the effect is only significant at 10%. It appears that the capacity for resilience helps mitigate the effect of COVID-19 on dietary diversity. This resilience capacity is linked to the assets that a household has and that can be liquidated and to access to social services. Harris

Table 3

| Variables | ResilienceCSI ≤ j | Coping strategy index |
|-----------|------------------|----------------------|
|           | Total sample     | Affected households sample |
| Gender of household head (1 = male) | 0.231*** 0.294*** 0.251*** | -4.981*** -6.274*** -5.932*** |
| Age of household head | 0.003 0.003* 0.0044*** | 0.046 0.033 0.0368* |
| Household size | -0.005 0.0008 0.0041 | -0.0411 -0.116 -0.084 |
| Adaptive capacity index | -0.0004 (0.0001) | 0.0008 (0.0416) |
| Assets and access to basicservices index | 0.008*** (0.0021) | -0.145** (0.060) |
| Social security index | 0.0017 (0.002) | -0.035 (0.0727) |
| Educated household head | 0.104* (0.054) 0.136** (0.054) 0.199*** (0.053) | -0.962 (1.688) -1.441 (1.623) -1.515 (1.615) |
| Literate household | -0.103 (0.085) -0.119 (0.085) -0.097 (0.083) | 1.135 (2.426) 1.500 (2.211) 1.454 (2.198) |
| Income loss with COVID-19(log) | -0.072** (0.028) -0.066** (0.028) | 0.523 (0.824) 0.393 (0.849) |
| Household income per capita (log) | -0.0048 (0.032) 0.0301 (0.031) 0.0043 (0.0295) | -0.721 (0.897) -1.289 (0.895) -1.031 (0.885) |
| Household resilience capacity index | 0.0045** (0.0019) | 0.00026 (0.00016) |
| Income loss with COVID-19(log)× Household resilience capacity index | 0.00026 (0.00016) | -0.007* (0.004) |
| Constant | -0.121 (0.523) -0.271 (0.479) -0.611 (0.412) | 41.25*** (14.43) 44.70*** (14.58) 45.22*** (12.79) |
| LR stat | -246.59 (0.21) -253.62 (0.4) -258.3 (0.43) | 0.275 (0.085) 0.275 (0.070) 0.275 (0.067) |
| Prob (Pearson) | 0.2 (426) 0.4 (426) 0.43 (426) | 0.085 (0.070) 0.070 (0.067) 0.067 (0.067) |

Source: authors. Note: Robust standard errors in parentheses ***p < 0.01, **p < 0.05, *p < 0.1.
Janssens et al. (2021) find that food expenditures have remained at their
the trade-off that households must make between food and nonfood
some of the previous results are robust. Indeed, the results indicate that
increasing household food expenditures (p<0.05, *p<0.05, **p<0.01, ***p<0.001)
susceptibility for resilience. The results show that the susceptibility for resilience
results confirm that during the COVID-19 pandemic period, households
spending. Indeed, households could reduce nonfood expenditures in
vegetables, but their work does not allow us to assess the resilience
diversity of Indian producers who are both producers and consumers of

Source: authors. Note: Robust standard errors in parentheses ***p<0.001, **p<0.01, *p<0.05, p<0.1.

Table 4
Effect of income loss due to COVID-19 on household income and the risk of poverty.

| Variables | Household income (log) | Poverty (dummy) |
|-----------|------------------------|-----------------|
|           | (1)                    | (2)             | (3)             | (4)  | (5)  | (6)  |
| Gender of household head (1 – male) | 0.026 | 0.172* | 0.313*** | –0.004 | –0.024 | –0.056* |
| Age of household head | –0.003 | –0.00283 | –0.00397 | 0.00214*** | 0.0021** | 0.0024*** |
| Household size | –0.078*** | –0.071*** | –0.062*** | 0.013*** | 0.012*** | 0.011*** |
| Adaptive capacity index | 0.005*** | (0.002) | 0.002 | 0.0006 |
| Assets and access to basic services index | 0.009*** | (0.0025) | –0.0017** |
| Social security index | –0.004 | (0.002) | 2.76e-05 |
| Educated household head | 0.150* | 0.238*** | 0.253*** | 0.006 | –0.004 | –0.0073 |
| Literate household head | 0.327*** | 0.335*** | 0.307*** | –0.019 | –0.015 | –0.018 |
| Income loss with COVID-19 (log) | –0.192*** | –0.227*** | 0.040*** | 0.0450*** |
| Household resilience capacity index | –0.0039 | (0.0031) | –0.0009 |
| Income loss with COVID-19 (log)* Household resilience capacity index | –7.48e-05 | (0.0002) | 0.227 | 0.226 | –0.00013* |
| Constant | 11.32*** | 11.01*** | 13.44*** | 0.227 | 0.226 | –0.274*** |
| LR stat | –139.1 | –141.8 | –147.2 |
| Prob (Pearson) | 0.28 | 0.51 | 0.33 |
| Observations | 485 | 485 | 485 |
| R-squared | 0.258 | 0.207 | 0.146 |

et al. (2020) found that COVID-19 has led to a decline in the dietary
diversity of Indian producers who are both producers and consumers of vegetables, but their work does not allow us to assess the resilience
capacity of these producers.

Regarding food expenditures, another measure of food security, some of the previous results are robust. Indeed, the results indicate that COVID-19 has had no effect on the probability of households becoming food insecure. This result could be explained by two factors. The first is the trade-off that households must make between food and nonfood spending. Indeed, households could reduce nonfood expenditures in favor of food expenditures. Estimates 4, 5 and 6, show that an increase in income leads to an increase in household food expenditures. These results confirm that during the COVID-19 pandemic period, households would have directed their income to food expenditures. Likewise, Janssens et al. (2021) find that food expenditures have remained at their pre-COVID-19 levels. The second factor is linked to a household’s
capacity for resilience. The results show that the capacity for resilience reduces the probability of falling into food insecurity (estimate 1) by increasing household food expenditures (estimates 5 and 6). Thus, household may also convert their assets into income in favor of food expenditures. The important role of household resilience capacity in shock mitigation is well known in the literature (d’Errico et al., 2018; Knippenberg et al., 2019). In particular, d’Errico et al. (2018) found in the case of Tanzania and Uganda that households with high resilience capacity are better equipped to absorb and adapt to shocks.

6.2. Coping strategies and implications for food security

For a health shock situation such as the COVID-19 pandemic, the coping strategy index (CSI) has been recommended as a means to analyze household food insecurity (Maxwell et al., 2008) with CSI < 10 as the threshold (Knippenberg et al., 2019). Such an analysis helps explain food insecurity based on coping strategies and the underlying explanatory factors.

The results are shown in Table 3. It appears that socioeconomic variables such as gender and education level significantly and robustly explain household resilience to COVID-19. In fact, when the head of the household is a man, the household is resilient and manages to maintain an acceptable level of well-being. This result is consistent with results obtained by directly using the coping strategy index as a dependent variable and with those of Zhou et al. (2019). A household headed by a man has a lower index (less food insecurity) than a household headed by a woman. This result could be explained by two phenomena. On the one hand, psychological factors are linked to the coronavirus disease (Song, 2020), and on the other hand, there are uneven effects of COVID-19 by gender (Dang & Nguyen, 2020). When considering the coping strategies used by a household, taking into account psychological factors seems important. It is generally accepted that men are better able to cope with stress and fear than women (Pragholapati, 2020). These psychological factors reduce the propensity for women to identify coping strategies compared to men. On the other hand, women are the most affected by this disease and tend to save rather than consume, as indicated by Dang and Nguyen (2020). This situation reinforces household food insecurity.

On the other hand, an educated household head is more resilient to COVID-19 than an uneducated household head (estimates 1, 2 & 3). The selection of coping strategies depends on the level of education. This result is consistent with human capital theory, which states that an educated person is able to benefit from information and be productive. The higher the level of education is, the more a household adopts active coping strategies (Lokshin & Yemtsov, 2004). In this case, a household headed by an individual who is educated will adopt strategies that enable it to cope with COVID-19, including strategies such as engaging...
Poverty could be further exacerbated by income loss due to COVID-19. Following Lekohane and Seleka (2017), we used also income as a measure of household welfare to analyze the effect of COVID-19. By analyzing the effects of income loss due to COVID-19 on income and the probability of a household falling into poverty, we are better able to appreciate the resulting effects beyond those related to food security.

Our results on the effects of COVID-19 on household income and the risk of falling into poverty are reported in Table 4. It appears that variables such as household size and level of education significantly and robustly affect household income. In particular, the size of a household has a negative effect on household income (estimates 1, 2 & 3) and increases the risk of a household falling below the monetary poverty line (estimates 4, 5 & 6). Increasing household size translates into a dilution of wealth and lower per capita income, all else being equal. This result could be explained by a high dependency ratio and limited income opportunities available to members of the households surveyed. For Kenya, Mitiku et al. (2012) find that large household size is associated with higher food burden and food insecurity.

The income losses linked to COVID-19 have caused a decline in household income (estimates 1 & 2), increasing their risk of falling into poverty (estimates 4 & 5). The closure of markets and quarantine measures had major repercussions for household income. Respondents explained that with the breakdown of food marketing chains due to quarantine measures, they no longer had access to products to buy and resell, and the products they had could not be sold. All of these factors had lowered their income.

Several studies have also shown that COVID-19 has had negative effects on household income-generating activities (Janssens et al, 2021; Kanssime et al, 2020; Mahmoud & Riley, 2021). For Indonesia, Suryahadi et al. (2020) found that millions of people will end up in poverty due to COVID-19. The resilience capacity of households is nonetheless an important factor to take into account. In this sense, the results indicate that the ability to adapt and especially the endowment of assets and access to basic services positively affect household income (estimates 1 and 2) and reduce an individual’s probability of falling into poverty due to COVID-19 (estimate 4).

Overall, if adaptive capacity is associated with a high level of food consumption (Table 2) and asset endowment and access to basic services, increasing dietary diversity (Table A1) and consumption expenditures (Table A2), it is important to observe that social security has no effect in all our analyses. The level of household social security does not allow households to cope with the effects of COVID-19. While for rural areas, several studies recognize the role of social security in crisis mitigation (Bassier et al, 2020; Cordoba et al., 2020; Dapilah et al., 2020; ; this is not the case for urban areas such as the city of Ouagadougou. This result can be explained by two factors. The first refers to the social dilemma indicated by Harring et al. (2020). Indeed, coping with such a virus requires many sacrifices that people are not ready to make, and individuals prefer to isolate themselves rather than cooperate or act altruistically in the management of such a disease. In the face of uncertainty and given that households are going through such an experience for the first time, they play it safe by conserving their resources for their own needs rather than helping the poor. The second factor is linked to the fact that in urban areas, households are less close-knit than they are in rural areas (Scott, 1988).

Thus, beyond the fact that this virus has caused individuals to withdraw, social support networks are already almost nonexistent in urban areas, as “each person lives his or her own life.” These two factors partly explain why only 3% of households have resorted to support from friends or relatives in coping with COVID-19 (see Fig. 1). In addition, the absence of the state through social safety nets is very noticeable. Vulnerable households, particularly those in different markets, have not received food support from the state. Likewise, our surveys reveal that those who have been assisted by the state have received food that lasts no more than one day. However, such social assistance is necessary in dealing with COVID-19, as Bassier et al. (2020) showed in the case of South Africa. The establishment of a social security system is necessary insofar as populations living in poverty are not able to respect barrier measures designed to stop the spread of the virus. This is what was observed in Ouagadougou, where traders, through several social demands, have forced authorities to open large markets as well as others. According to Durizzo et al., (2021) this lack of cooperation with governmental regulations seems to be more related to a lack of infrastructure or poverty.
differential access to income and outcomes. The decrease in income has led such households to resort to other coping strategies and to harness their capacity for resilience to adapt to the resulting shock. At all levels of our analysis, social security was not found to be a mitigating factor for the shock.

While resilience capacity has been of critical importance in mitigating the effects of COVID-19, one might wonder how far into the crisis households can rely on themselves. As uncertainty about the virus remains, this questioning leads us to draw urgent policy implications. First, there is an urgent need to identify and put in place an effective system of control at all levels. Finally, urban households must be organized around strong social networks to ensure collective action against the spread of the virus.

Table A1

| Variables                                           | Dietary diversity dummy (logit) | Dietary diversity score with COVID (OLS) | Food secure (ordered logit) |
|-----------------------------------------------------|---------------------------------|----------------------------------------|----------------------------|
|                                                     | Total sample                    | Affected household sample               | Total sample               |
|                                                     | (1)                             | (2)                                    | (3)                        |
| Gender of household head (1 = male)                 | –0.146**                       | –0.140**                               | –0.134**                   |
|                                                     | (0.056)                         | (0.054)                                | (0.052)                    |
| Age of household head                               | –0.0021                         | –0.002                                | –0.0002                    |
|                                                     | (0.002)                         | (0.002)                                | (0.002)                    |
| Household size                                       | –0.003                         | –0.003                                | –0.002                     |
|                                                     | (0.006)                         | (0.006)                                | (0.006)                    |
| Adaptive capacity index                             | –0.0016                         |                                       | 0.0013                     |
|                                                     | (0.001)                         |                                       | (0.0042)                   |
| Assets and access to basic services index           | –0.001                          |                                       | 0.0155*                   |
|                                                     | (0.001)                         |                                       | (0.0081)                   |
| Social security index                                | –0.0003                         |                                       | 0.0076                     |
|                                                     | (0.0018)                        |                                       | (0.0067)                   |
| Educated household head                             | 0.051                           | 0.056                                 | 0.056                      |
|                                                     | (0.049)                         | (0.048)                                | (0.048)                    |
| Literate household head                             | 0.174**                         | 0.181***                              | 0.179**                    |
|                                                     | (0.07)                          | (0.069)                                | (0.069)                    |
| Income loss with COVID-19(log)                      | 0.003                           | 0.003                                 | –0.183**                   |
|                                                     | (0.025)                         | (0.025)                                | (0.025)                    |
| Household income per capita (log)                   | –0.183**                       | –0.20**                               | –0.243**                   |
|                                                     | (0.029)                         | (0.028)                                | (0.027)                    |
| Household resilience capacity index                  | –0.002                          |                                       | 0.0126*                    |
|                                                     | (0.001)                         |                                       | (0.006)                    |
| Income loss with COVID-19(log)* resilience capacity index | –0.0002                          |                                       | 0.0008*                    |
|                                                     | (0.0001)                        |                                       | (0.0005)                   |
| Constant cut1                                       | 9.458**                         | 9.146**                               | 9.967**                    |
|                                                     | (2.136)                         | (1.973)                                | (1.760)                    |
| Constant cut2                                       | 12.71***                        | 12.39***                              | 13.20***                   |
|                                                     | (2.176)                         | (2.017)                                | (1.811)                    |
| LR stat                                             | 410.33                         | 410.33                                | 410.33                     |
|                                                     | (2.176)                         | (2.017)                                | (1.811)                    |
| Brant test (P > Chisq2)                             | 0.33                            | 0.36                                 | 0.37                       |
|                                                     | (0.33)                          | (0.36)                                | (0.37)                     |
| Observations                                        | 485                             | 485                                   | 485                        |
|                                                     | 154                             | 154                                   | 154                        |
| R-squared                                           | 0.187                           | 0.174                                 | 0.155                      |

Source: authors. Note: Robust standard errors in parentheses *** p < 0.01, ** p < 0.05, * p < 0.1
Table A2
Effect of COVID-19 on household food expenditure per capita.

| Variables                                    | Food expenditure dummy (logit) | Food expenditure with COVID-19 (OLS) |
|----------------------------------------------|--------------------------------|-------------------------------------|
|                                              | (1)                           | (2)                                 |
|                                              | (3)                           | (4)                                 |
|                                              | (5)                           | (6)                                 |
| Gender of household head (1 = male)          | 0.06                          | 0.279***                            |
|                                              | (0.055)                       | (0.0975)                            |
|                                              |                                | (0.0942)                            |
|                                              |                                | (0.090)                             |
| Age of household head                        | -0.002                        | 0.378***                            |
|                                              | (0.002)                       | (0.00036)                           |
|                                              |                                | (0.000935)                          |
|                                              |                                | (0.0009)                            |
| Household size                               | 0.008                         | 0.000324                            |
|                                              | (0.002)                       | (0.00342)                           |
|                                              |                                | (0.00335)                           |
|                                              |                                | (0.003)                             |
| Adaptive capacity index                      | 0.001                         | 0.00101                             |
|                                              | (0.001)                       | (0.00162)                           |
| Assets and access to basic services index    | -0.0037**                    | 0.011***                            |
|                                              | (0.0018)                      | (0.00315)                           |
| Social security index                        | 0.0009                        | 0.000616                            |
|                                              | (0.0009)                      | (0.00281)                           |
| Educated household head                      | 0.045                         | -0.194**                            |
|                                              | (0.052)                       | (0.0844)                            |
|                                              |                                | (0.0853)                            |
|                                              |                                | (0.0850)                            |
| Literate household head                      | 0.096                         | -0.204**                            |
|                                              | (0.077)                       | (0.115)                             |
|                                              |                                | (0.121)                             |
| Income loss with COVID-19(log)               | 0.008                         | 0.0215                              |
|                                              | (0.026)                       | (0.0392)                            |
|                                              |                                | (0.0412)                            |
| Household income per capita (log)            | -0.0152                       | 0.369***                            |
|                                              | (0.029)                       | (0.0609)                            |
|                                              |                                | (0.0585)                            |
| Household resilience capacity index          | 0.0016                        | 0.418***                            |
|                                              | (0.0018)                      | (0.0552)                            |
| Income loss with COVID-19(log)*resilience    | -0.000115                    | 0.423***                            |
|                                              |                                | (0.0029)                            |
|                                              |                                | 0.00047*                            |
|                                              |                                | (0.0001)                            |
|                                              |                                | (0.00024)                           |
| Constant                                    | 0.506                         | 4.009***                            |
|                                              | (0.492)                       | (0.817)                             |
|                                              |                                | (0.786)                             |
|                                              |                                | (0.747)                             |
| LR Ratio                                    | -3.161                        | 3.650***                            |
|                                              | (3.35)                        | (7.84)                              |
| Prob (Pearson)                               | 0.35                          | 3.996***                            |
|                                              | (0.42)                        | (7.47)                              |
| Observations                                | 485                           | 298                                 |
|                                              | 485                           | 298                                 |
|                                              | 485                           | 298                                 |
| R-squared                                   | 0.350                         | 0.315                               |
|                                              | 0.315                         | 0.314                               |

Source: authors. Note: Robust standard errors in parentheses ***p < 0.01, **p < 0.05, *p < 0.1.

Table A3
Variables description.

| Variables                                    | Description                                                                 |
|----------------------------------------------|------------------------------------------------------------------------------|
| Gender of Household Head                     | Dummy (male = 1, female = 0)                                                 |
| Household size                               | Continuous                                                                   |
| Age of household head                        | Continuous                                                                   |
| Adaptive capacity index                      | CATPCA representing household precautionary savings, level of education, income-generating activities. |
| Assets and access to basic services index    | MCA representing dummies for household assets (maintained house, telephone, computer, television, radio, motorcycle, land, animals (poultry or livestock) and access to basic services (schools, health centers, water, electricity). |
| Social security index                        | MCA representing dummies for formal transfers (state and credit institutions) and informal transfers (relatives and friends) |
| Resilience capacity index (RCI)              | Simple average of the three indices (Adaptive capacity index, Assets and access to basic services index and Social security index) |
| Educated Household Head                      | Dummy (educated = 1, non educated = 0)                                       |
| Literate household head                      | Dummy (literate = 1, 0 non literate = 0)                                     |
| Income loss with COVID-19 (log)              | Continuous                                                                   |
| Household income per capita (log)            | Continuous                                                                   |

Source: authors.

Table A4
Multicolinearity test.

| Variables                                    | Variance inflation factor (VIF) |
|----------------------------------------------|---------------------------------|
| Gender of Household Head (1 = male)          | 1.27                            |
| Age of Household Head                        | 1.20                            |
| Household size                               | 1.32                            |
| Adaptive capacity index                      | 1.25                            |
| Assets and access to basic services index    | 1.20                            |
| Social security index                        | 1.07                            |
| Educated Household Head                      | 1.22                            |
| Literate household head                      | 1.22                            |
| Income loss with COVID-19 (log)              | 1.22                            |
| Household income per capita (log)            | 1.35                            |
| Mean VIF                                     | 1.23                            |

Source: authors.

Table A5
Mean comparison test, assuming equal variances.

| Variables                                    | Obs | Mean | Std. Dev. | t | degrees of freedom |
|----------------------------------------------|-----|------|-----------|---|-------------------|
| FCS (Without COVID-19)                       | 503 | 54.205 | 18.607 | 5.974*** | 1002 |
| FCS (with COVID-19)                         | 501 | 47.357 | 17.701 |           |      |
| Food expenditure (Without COVID-19)          | 502 | 69413.5 | 57394.5 | 4.327*** | 1001 |
| Food expenditure (with COVID-19)             | 501 | 55160.57 | 46319.73 |           |      |
| Household dietary diversity score (Without COVID-19) | 503 | 5.648 | 1.882 | 5.039*** | 1003 |
| Household dietary diversity score (With COVID-19) | 502 | 5.087 | 1.634 |           |      |

Source: authors.
