Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.
Household resilience among fish value chain actors during the COVID-19 pandemic in Malawi

Levison S. Chiwaula *, Gowokani Chijere Chirwa, Jupiter Simbeye, Mangani Katundu

University of Malawi, P.O. Box 280, Zomba, Malawi

ARTICLE INFO

Keywords:
COVID-19
Household resilience
Fisheries sector
Malawi

ABSTRACT

We analyse household resilience capacities during the COVID-19 pandemic in the fishing communities along Lake Malawi by using FAO’s resilience index measurement assessment (RIMA) methodology. The study is based on a sample of 400 households, and we employ the multiple indicators multiple causes (MIMIC) model to estimate resilience capacities. The model uses household food security indicators as development outcomes. Our findings show that the COVID-19 pandemic significantly reduces household food security and resilience capacity. COVID-19 shocks that significantly reduce household resilience capacities are death and illness of a household member. Important pillars for resilience building are assets, access to basic services and adaptive capacity. These findings point to the need to build assets of the households, build their adaptive capacity, and identify innovative ways of improving access to basic services to build household resilience capacities in the fishing communities. We recommend providing external support to households that have been directly affected by the pandemic through the death or illness of a member because their capacities to bounce back on their own significantly declines.

1. Introduction

The impacts of COVID-19 on food systems have been through several overlapping and reinforcing dynamics which include disruptions to food supply chains; loss of income and livelihoods; a widening of inequality; disruptions to social protection programmes; altered food environments; and uneven food prices in localised contexts (HLPE, 2020). The fisheries sector is one of the food systems that has been significantly affected by COVID-19, and this may be due to the perishability of fish products (FAO, 2020a, 2020b), which require fish to move quickly from one node of the value chain to another and because of how closely actors in the value chain must work together (Nyiawung, 2021). Further, fish production is localised, which increases the sector’s dependency on the transport system for distribution. Both the need to quickly move fish from one node of the value chain to another and the dependence of the fisheries sector on human interactions do not support COVID-19 preventive measures because the measures aim at minimising human interactions. As such, the effects of COVID-19 in the fisheries sector are significant.

Negative consequences of COVID-19 on the fisheries include complete shutdowns of some fisheries, knock-on economic effects from market disruptions, increased health risks for fishers, processors and communities, additional implications for marginalised groups, exacerbated vulnerabilities to other social and environmental stressors, and increased Illegal, Unreported and Unregulated fishing (Bassett et al., 2021; Bennett et al., 2020). Empirical studies have shown that COVID-19 has disrupted fish markets in Bangladesh and the Philippines (Kabir, 2020; Manlosa, Hornidge, & Schlüter, 2021) and reduced demand for fish and fish products in Bangladesh and Kenya (Aura et al., 2020; Kabir, 2020). These effects have mainly been through preventive measures and lockdowns, which lead to reduced economic activities and incomes. The reduction in incomes lowers the effective demand for the fisheries product and reduces fish prices, leading to loss of income for the fisherfolk (Aura et al., 2020).

The impacts of COVID-19 in Malawi have also been widespread. UNDP found that COVID-19 affected people’s incomes through low demand (39%), closed markets (20%), closed business (17%) and being laid off (12%) (UNDP, 2020). The same study also found that households were affected through reduced access to produce markets, mainly influenced by transport disruptions (69%) and reduced number of produce buyers in the community (62%) and produce market closures. Specific to the fisheries sector study by the Food and Agriculture...
Organisation (FAO) reported a 0.2 percentage points decline in fishing activities due to COVID-19 (FAO, 2021). The decline in fishing activities would have broader effects because fish and the fisheries sector are significant in Malawi. Fish contributes over 70 per cent of Malawians’ dietary animal protein intake and 40 per cent of the total protein supply (Malawi Government, 2021). Fish is also the most consumed animal-source food among children (Kaimila et al. 2019). The sector also supports the livelihoods of many Malawians. In 2020, it directly employed 65,160 individuals while indirectly employing over half a million people engaged in ancillary activities, such as fish processing, fish marketing, boat building and engine repair. Further, the fish value chain supports over 1.6 million people and substantially contributes to their livelihoods (Malawi Government, 2021).

Recognising the need to build the capacity of households to withstand the effects of COVID-19 and other shocks, we assess the resilience of the fisheries sector during the COVID-19 pandemic. More specifically, we aimed at determining whether COVID-19 affects food security and household resilience. Resilience is the capacity of households and individuals to ensure that adverse stressors and shocks do not have long-lasting negative development consequences (d’Errico, Romano, & Pietrelli, 2018). Resilience assessment helps identify activities that can build households’ capacity to withstand shocks. Building the ability of households to withstand the effects of shocks is important because shocks to food systems such as COVID-19 will continue to have significant implications for the well-being of the people who are directly employed by fisheries and aquaculture as well as those who are involved in processing, distribution, and sales and depend on seafood for nutrition (FAO, 2020c). It is imperative to assess household resilience during the COVID-19 pandemic because it would enhance the development of programs that would secure the livelihoods of households and individuals in the face of shocks. We measure the resilience of households operating in the fisheries sector in Malawi using the FAO’s Resilience Index Measurement and Analysis (RIMA) framework. We also assess the effects of COVID-19 shocks on household resilience in the fisheries sector. While we recognise that resilience capacities reduce the impact of shocks on household development outcomes, we argue that some shocks would affect the households’ development outcomes and resilience (Brück, d’Errico, & Pietrelli, 2019).

Presently, it is not clear how COVID-19 related shocks impact the capacity of households to cope with shocks. This information is vital because it would assist in designing policies that protect households not only from COVID-19 related shocks but also prepare households to manage future shocks. The rest of the paper is organised as follows: In section 2, we present the conceptual framework. Section 3 is the methodology, while section 4 is the presentation of the results. Section 5 is the discussion, and we conclude the paper in Section 6.

2. Conceptual framework

Resilience refers to the ability of households and communities to bounce back to the initial level of livelihood, ability to adapt, and ability to transform (Béné, Wood, & Newsham, 2012). The concept is appealing and daunting because it compels a coherent, multidisciplinary explanation of the interrelated dynamics of risk exposure, multi-scalar human living standards, and broader ecological and social processes (Barrett et al., 2021). One of the appealing features of resilience is that it is inherently forward-looking. It looks at how ready households are to withstand the effects of shocks and not how shocks have affected the households. Resilience focuses on the capacity to respond to short-run shocks and stresses constructively and creatively (Alinovi, Mane, & Romano, 2010).

In the face of shocks such as COVID-19, households activate a series of coping strategies, including consumption smoothing, assets smoothing, and new livelihood strategies (FAO, 2016). The effectiveness of coping strategies depends on the resilience capacities owned by the household. Resilience thus gives households abilities to absorb, cope with, and transform livelihoods to bounce back to the previous state of well-being (FAO, 2016; TANGO International, 2018). Based on these abilities, TANGO International identifies three dimensions of resilience – absorptive capacity, adaptive capacity, and transformative capacity (TANGO International, 2018). Absorptive capacity is the ability to minimise exposure to shocks and stresses through preventative measures and appropriate coping strategies to avoid permanent, negative impacts (Béné et al., 2012). This resilience capacity seeks to mitigate the effects of shocks and include the availability of assets and savings (Barrett et al., 2021). A higher level of absorptive capacity implies the ability to absorb the impacts of a shock without consequences for its function, status, or state (Béné et al., 2012). Adaptive capacities relate to the ability to spread risk by diversifying livelihoods and relying on social safety nets (Barrett et al., 2021). It refers to people’s various adjustments to continue functioning without significant qualitative changes in function or structural identity (Béné et al., 2012). According to TANGO International (2018), adaptive capacity is the ability to make proactive and informed choices about alternative livelihood strategies based on understanding changing conditions. Households showing high adaptability and high stability will likely have high resilience to food insecurity, while those showing low adaptability and low stability will have low resilience (Alinovi et al., 2010).

Transformative resilience capacity refers to the ability of governance mechanisms, policies/regulations, infrastructure, community networks, and formal and informal social protection mechanisms that constitute the enabling environment for systemic change (TANGO International, 2018). These transformational changes often involve shifts in the nature of the system, the introduction of new state variables and possibly the loss of others, such as when a household adopts a new direction in making a living or when a region moves from an agrarian to a resource extraction economy (Béné et al., 2012). The three dimensions of resilience capacities of absorptive, adaptive, and transformative are organised into five pillars of access to basic services (ABS), assets (AST), social safety nets (SSN), sensitivity (S), and adaptive capacity (AC) in FAO’s resilience measurement approach (FAO, 2016). In this study, we adopt these pillars and express the resilience index of household $i$, $R_i$ as

$$R_i = f(ABS, AST, SSN, S, AC)$$ (1)

Based on the availability of data and the context, other pillars such as climate change and institutional environment can be added (FAO, 2016). We have not been included these in our study. In this study, we have left indicators for sensitivity due to data challenges.

A critical feature of the concept of resilience developed by FAO is linking the indicators to the development outcomes (d’Errico et al., 2018). This paper has adopted household food security to measure development outcomes. We use household dietary diversity score (HDDS) and household food insecurity assessment scale (HFias) as our food security measures. The HDDS measured the number of food groups consumed by any household member using 24-hour recall. In contrast, HFias measured the degree of food insecurity in the household in the past four weeks. Household food security levels increases as the values of HDDS increases and HFias declines.

3. Methodology

3.1. Empirical estimation

Resilience is a latent variable that depends on the resilience pillars, as expressed in equation (1). The pillars themselves are also latent variables because they cannot be directly measured in a survey. This conceptualisation implies that the measurement of household resilience capacities index is a two-stage process that first involves the estimation of the pillars and then the estimation of the overall resilience index. Initially, the two stages were estimated using factor analysis (Alinovi et al., 2010). However, FAO’s RIMA II approach recommends using factor analysis in constructing pillars in the first stage and the multiple
indicators multiple causes (MIMIC) models in constructing the overall resilience index in the second stage (d’Errico, Garbero, & Constas, 2016). We adopted this approach to resilience capacities in this study, and the model is presented in Fig. 1.

Factor analysis is a multivariate statistical method that uses the relationship among observed variables to identify one or more underlying factors (TANGO International, 2018). It produces an index that best summarises the inter-correlations among variables (FAO, 2020d). The analysis helps to reduce observed indicators based on their correlations and linear combinations to a smaller number of latent variables. To test for the suitability of the data for factor analysis, we used the Kaiser–Meyer–Olkin (KMO) test. This measure varies between 0 and 1; high values mean that the variables are correlated, and the analysis is feasible (Lima, Barreto, & Assunção, 2012). KMO values of <0.5 are considered unacceptable (TANGO International, 2018).

We estimated the second stage using the MIMIC model (Fig. 1) that explains the relationship between observable variables and the unobservable variable by minimising the distance between the sample covariance matrix and the covariance matrix predicted by the model (d’Errico et al., 2016). The advantage of the MIMIC model is that it incorporates the development outcome in the estimation process (FAO, 2020d), which conforms to the guidance by Constas, Frankenberg, and Hoddinott (2014). The MIMIC model is focused on measuring an underlying latent variable, “resilience”, that is hypothesised to have multiple indicators (food security indicators) as well as multiple causes (resilience capacities) (FAO, 2020d). This implies that the MIMIC model jointly estimates the household resilience index by its causes, pillars, and food security indicators (Brück et al., 2019). The model is made up of two components, namely the measurement Eq. (2)—reflecting that the observed indicators of food security are imperfect indicators of resilience capacity—and the structural eq. (3), which correlates the estimated attributes to resilience (FAO, 2016; d’Errico et al., 2018):

\[
\begin{bmatrix}
\text{HFIAS} \\
\text{HDD}
\end{bmatrix} = \begin{bmatrix}
\gamma_1 \\
\gamma_2
\end{bmatrix} [\text{RCI}] + \begin{bmatrix}
\epsilon_1 \\
\epsilon_2
\end{bmatrix}
\]

(2)

\[
[\text{RCI}] = \begin{bmatrix}
\beta_1 \\
\beta_2 \\
\beta_3 \\
\beta_4
\end{bmatrix} \begin{bmatrix}
\text{ABS} \\
\text{AST} \\
\text{SSN} \\
\text{AC}
\end{bmatrix} + \begin{bmatrix}
\epsilon_3
\end{bmatrix}
\]

(3)

The estimated Resilience Capacity Index (RCI) is not anchored to any measurement (d’Errico et al., 2016). Further to measuring the resilience indices, this study aimed at assessing whether the COVID-19 shocks reduced the resilience of households hence their chances of being food secure. We realised that resilience enables households to withstand the effects of shocks, but some can affect the resilience, thereby making the households suffer from this shock and other shocks. An econometric model was used to assess the effects of COVID-19 shocks on household resilience capacities index, and the model was specified as follows:

\[
\text{RCI}_i = \beta_0 + \beta_1 \text{COVID}_i + \beta_2 \text{age}_i + \beta_3 \text{female} + \beta_4 \text{education} + \beta_5 \text{hhsize} + \epsilon_i
\]

(4)

For household \(i\), \(\text{RCI}\) is the measure of resilience index, \(\text{COVID}\) is a vector of COVID-19 related shocks that are equal to 1 if a household reported to have been affected by that shock and zero otherwise; \(\text{age}\) is the age of the household head; \(\text{female}\) is the sex of household head taking the value 1 if the head is female and 0 if male; \(\text{education}\) is the highest education level of the household head measured as an ordinal variable, and \(\text{size}\) is the number of individuals in the household. COVID-19 related shocks included the death of a household member, illness of a household member, inaccessibility of markets, inability to fish, increase in fish prices, reduction in fish prices, reduction in fish supply, and losing a job. These are expected to be exogeneous, and we obtain unbiased and consistent estimates of the parameters using the ordinary least squares estimation technique. Cognizant of the potential heterogeneity in resilience between districts, we estimated a district fixed-effects model to control for district unobserved heterogeneities. We also used robust standard errors to correct for any potential heteroskedasticity. We estimated the model in STATA 16.

3.2. Data and sampling

We implemented the study in four Lakeshore districts of Mangochi, Nkhota-Kota, Nkhata Bay, and Salima. The study was conducted among fish value chain actors selected using a two-stage process. In the first stage, we randomly selected 10% of the 479 fish landing sites found in the four districts as per the 2019 Annual Frame Survey. In the second stage, we randomly selected individual value chain actors from the chosen fish landing sites. The allocation of sample sizes to the landing sites was proportional to the number of actors plying their trade within the area. A total of 400 fish value chain actors were involved, and this sample size was determined using standard formulas (Cochran, 1963) with some adjustments to non-response.

We collected data through face-to-face interviews using a modified TANGO household resilience questionnaire (Tango International, 2018). Data on COVID-19 related shocks was self-reported by the respondents. This approach could result in measurement errors because we will not be sure that some of the shocks happened because of COVID-19. At the time of the study, this was the best way to collect this data. This questionnaire collected data from value chain actors who ply their trade on the fish landing sites. We used Computer Assisted Personal Interview (CAPI) to capture the data, and we programmed the questionnaire using CSpro 7.4.1.² We obtained ethical review and approval for the study from the University of Malawi Research and Ethics Committee (UNIMAREC). During the data collection, written informed consents were obtained from all participants.

4. Results

4.1. Descriptive statistics

We begin by describing the sample, and the findings for this analysis are presented in Table 1.

Findings in Table 1 show that the average age of the household heads was 41 years, and these ranged between 20 and 78 years. We also found that 20% of household heads were female, implying that 80% were male. The average household size was 5.6, higher than the national average of 4.4 (NSO, 2020). The level of educational attainment for the household heads was low, with 17% of them not attaining any form of formal education. In comparison, 65% only achieved primary school education. Only 18% of the household heads had attained secondary school education.

We also collected information about the primary income source four months preceding the survey period and found that most household heads (32%) obtained most income from using their fishing gears; they were fishers. It was also found that 18% of the household heads obtained most of their income from fish trade while 11% obtained most of their incomes from casual work in the fisheries sector. In total, 70% of the households received income from activities in the fish value chain four months before the survey date. The sample’s important non-fishing income sources include small businesses (10%) and farming (8%). Having 30% of household heads not involved in fishing-related activities in the previous four months before the survey reflects the seasonality nature of fishing activities. This also shows that fishing-related activities were not the primary income source for those household heads, although they were

---

1 The Department of Fisheries conducted an annual survey to monitor fishing activities.

2 https://www.census.gov/data/software/cspro.html.
involved.

4.2. COVID-19 related shocks and household food security

We asked respondents to indicate whether they were affected by different COVID-19 shocks to assess their incidence. Respondents were also requested to indicate the shocks that were not listed. Using self-reported shocks can introduce measurement errors because there is no way of validating if the shock occurred because of COVID-19. However, this was the best way we could at the study. The findings are presented in Table 2.

We found that few households were directly affected by COVID-19 through morbidity (1.5%) and mortality (2.5%) of household members. However, COVID-19 affected the livelihood activities of the households substantially through COVID-19 prevention measures that restricted human interactions and movements. Our findings show that 59% of the respondents reported that they experienced reduced fish prices. In comparison, 58% indicated that they could not access fish markets because of COVID-19, similar to Aura et al. (2020) in Kenya and Kabir (2020) in Bangladesh. The findings also agree with FAO’s observations that the COVID-19 pandemic would make markets inaccessible to fishers and other actors in the fish value chain (FAO, 2020b).

Further, the findings show that 26% of the respondents reported that they could not usually fish or not fish because of COVID-19. Although there was no shutdown for the fishery, fishers reduced their fishing activities because they feared contracting the disease. The number of crew members per fishing trip was reduced to maintain social distance. Though differing magnitudes, the result also agrees with FAO’s finding that COVID-19 reduced fishing activities. The findings further showed that 35% of the respondents experienced a low supply of fish they could use to process due to COVID-19. Only 4% of the households experienced job losses because of the COVID-19 pandemic. UNDP found that 12% of the population lost jobs due to COVID-19 (UNDP, 2020), which is within

![Fig. 1. A MIMIC model for measuring household resilience in Malawi.](image)

| Variable                  | Obs | Statistic   |
|---------------------------|-----|-------------|
| Age head (years)          | 400 | 41.44 (11.72) |
| Head female (%)           | 400 | 20.30       |
| Household size (individuals) | 400 | 5.56 (2.22) |
| None (%)                  | 66  | 16.5        |
| Junior Primary (%)        | 128 | 32          |
| Senior Primary (%)        | 133 | 33.25       |
| Junior Secondary (%)      | 41  | 10.25       |
| Senior Secondary (%)      | 30  | 7.5         |
| Tertiary Education (%)    | 2   | 0.5         |
| Total (%)                 | 400 | 100         |

| Main occupation for head in past four months |
|----------------------------------------------|
| Wage employee (%)                           | 5   | 1.25       |
| Farmer (%)                                  | 31  | 7.75       |
| Business (%)                                | 40  | 10         |
| Household work (%)                          | 11  | 2.75       |
| Casual work (Fisheries) (%)                | 33  | 8.25       |
| Casual work other (%)                       | 8   | 2          |
| Fishing/gear owner (%)                      | 127 | 31.75      |
| Fish processing (%)                         | 45  | 11.25      |
| Fish Trading (%)                            | 73  | 18.25      |
| Other (Specify) (%)                         | 27  | 6.75       |
| Total (%)                                   | 400 | 100        |

![Table 1](image)

![Table 2](image)
these ranges.
To assess the impacts of COVID-19 shocks on household food security, we estimated two regressions with household food security indicators as our dependent variables. We present the results in Table 3.

The results show a weak negative relationship between HDDS and the inability to fish because of COVID-19. There is also a strange weak positive relationship between HDDS and households that reported to have experienced an increase in purchase prices of fish because of COVID-19. The results also show a significant positive relationship between HFIAS and the shocks on the inaccessibility of markets, inability to fish, and reduction in fish supply which shows that these shocks were associated with high food insecurity levels. The incidence of COVID-19 illnesses in the household was weakly negatively related to HFIAS.

4.3. Level of household resilience

We first estimate the four resilience pillars using factor analysis, and the results are presented in Appendices 1 to 4. The signs of the factor loadings are consistent with our expectation, and all the KMO statistics used to assess the validity of the factor analysis are more significant than 0.50, which shows that the factor analyses for deriving the pillars are valid. We present the scoring coefficients for the variables used to estimate the pillar in Table 4.

The size of the coefficients indicates the relevance of the coefficients in the pillar. The findings show that variables that have been used to construct the access to basic services pillar have a similar level of relevance in the pillar as the values ranged between 0.17 and 0.24, which is a narrow band. Agricultural and other assets are the more critical in building the assets pillar. Fishing assets are also significant. These are the assets that have a more substantial contribution to building the resilience of the households in fishing communities. Social safety nets in the form of food or cash and gifts have high loadings in building the social safety nets pillar. The contributions of humanitarian assistance, remittances, and informal safety nets had a low influence on the social safety nets pillar of resilience. The coefficients show that the most important variables are education and dependency ratio regarding adaptive capacity. Households with high dependency ratios have the low adaptive capacity, while households with highly educated individuals have high adaptive capacity.

The pillars constructed from these variables were used to estimate the household resilience capacities index. The estimated mimic model is presented in Table 5.

We find that access to basic services (ABS), assets (AST), and adaptive capacity (AC) are the resilience pillars that significantly influence the household resilience capacities index. The estimated mimic model is presented in Table 5.

Table 3
Regression results on the effects of COVID-19 shocks on household food security.

| Variable          | HDDS             | HFIAS            |
|-------------------|------------------|------------------|
| Death             | −0.1214 (1.1332) | −3.2458 (2.1956) |
| Illness           | −0.8676 (0.8867) | −3.5663* (1.8511)|
| Markets          | 0.3571 (0.2799)  | 1.5283* (0.7194) |
| Fishing          | −0.5093* (0.2973) | 2.7122 (0.8120) |
| Fish supply      | 0.2072 (0.3322)  | 1.7810* (0.7111) |
| Purchasing price | 0.6111* (0.3346) | −0.8607 (0.7625) |
| Selling price    | 0.3878 (0.2633)  | −0.1941 (0.7240) |
| Lost job         | −0.6772 (0.7673) | 1.1979 (1.9210) |
| Household size   | −0.0019 (0.0599) | 0.2183 (0.1497) |
| Female head      | −0.3253 (0.3122) | 1.1752 (0.9137) |
| Education of head| 0.4834* (0.1188) | −0.7636* (0.3127)|
| Age of head      | 0.0099 (0.0116)  | −0.0307 (0.0290) |
| Constant         | 5.3019* (0.6934) | 11.0646*** (1.7222) |
| Adjusted R-squared| 0.19           | 0.10              |
| Wald chi2(12)    | 53.14***         | 50.31***          |
| N                | 400              | 400               |

Standard errors in parentheses.

Table 4
Scoring coefficients for individual factors in estimating pillars.

| Variable                  | Scoring Coefficient |
|---------------------------|---------------------|
| Access to Basic Services  | 0.1841              |
| Access to primary school  | 0.2481              |
| Access to health services | 0.2290              |
| Access to extension services | 0.1915          |
| Access to veterinary Services | 0.2219       |
| Access to mobile phone    | 0.1747              |
| Access to agricultural markets | 0.2175       |
| Assets (AST)              | 0.3632              |
| Fishing assets             | 0.3948              |
| Other assets               | 0.3923              |
| Landholding               | 0.2643              |
| per capita total livestock units | 0.2760    |
| Social Safety Nets (SSN)  | 0.5288              |
| Receive gifts              | 0.1210              |
| Remittances                | 0.1180              |
| Social safety nets         | 0.5206              |
| informal safety nets       | 0.1416              |
| Adaptive Capacity (AC)     | −0.5789             |
| Dependency ratio           | 0.1420              |
| Income sources             | 0.2902              |
| Skills                     | 0.5804              |
| Education                 |                     |

Table 5
Results of the estimated MIMIC model for estimating household resilience index.

|         | Coefficient | Standard Errors |
|---------|-------------|-----------------|
| RCI     | 1.0000      |                 |
| var(e)  | 7.9090**    | (0.1230)        |
| HFIAS   | −1.5313***  | (0.3299)        |
| var(e)  | 11.0050***  | (0.3259)        |
| / var(e)HDDS | 4.1134*** | (0.7256)        |
| var(e.HFIAS) | 37.9436*** | (3.1029)       |
| var(e.RCI) | 1.9418***   | (0.6781)        |
| N       | 400         |                 |

Standard errors in parentheses.

4.4. COVID-19 shocks and household resilience

The resilience indicator that has been estimated in this study does not necessarily reflect household resilience to COVID-19 shocks, but it
reflects household resilience to any shock during the COVID-19 pandemic. We argued that while the level of resilience would enable households to maintain expected development outcome levels in the face of a shock, some shocks would also reduce household resilience. We, therefore, tested whether COVID-19 related shocks reduced household resilience capacities. We used bootstrapped standard errors to control low frequencies in some COVID-19 shocks. The results are presented in Table 6.

The regression analysis has a significant F-statistic, and the adjusted R-squared is also good at 0.22. In terms of the effect of COVID-19 related shocks on household resilience, we find that the death of a household member and illness of a household member is the only shocks that significantly reduced the household resilience index. The death of a household member had a more significant impact on household resilience than illness. Therefore, the results show that COVID-19 sicknesses and deaths affect the current level of food security and the household’s ability to withstand future shocks. The effects of COVID-19 on the household security’s resilience capacity would impact the household’s future food security status.

To understand how COVID-19 shocks impact household resilience, we regressed individual household resilience pillars on the dummy variables for COVID-19 shocks and present the results in Table 7.

The results in Table 6 show that the death of a household member due to COVID-19 and an illness of a household member from COVID-19 only affected the access to the basic services pillar and the social safety net pillars. However, the two COVID-19 shocks did not significantly affect the assets and adaptive capacity pillars. The findings also show a significant negative relationship between the dummy variable for households that reported to have experienced an increase in the purchase price of fish because of COVID-19 and the asset pillar of household resilience. The results also present a weak negative relationship between the inability to go fishing by household members and the access to basic services pillar of resilience and a weak positive relationship between those that reported a decrease in selling price and the social safety net pillar.

5. Discussion

Literature on resilience mostly assumes that households will be able to withstand the effects of the shocks if they are endowed with more resilience capacities (d’Errico et al., 2018; TANGO International, 2018). There is, however, a possibility that the shocks may erode the resilience capacities themselves, thereby making households more vulnerable to the effects of shocks (Brück et al., 2019; von Uexkull, d’Errico, & Jackson, 2020). The immediate adverse effects of a shock on the development outcomes may be called first-generation effects. In contrast, the future effects of a shock on household development outcomes through the erosion of the resilience capacities may be called second-generation effects of the shock.

In this study, we have measured household resilience capacities during the COVID-19 pandemic among fish value chain actors and assessed the effects of COVID-19 related shocks on household resilience capacities. Our findings show that the resilience capacities index among fish value chain actors in Malawi is influenced by access to basic services, assets, and adaptive capacities. Social networks, which were also assessed, was not significant. We attribute the insignificance of social networks in building resilience capacities to the covariate nature of the COVID-19 shocks, which meant that all households were affected. When all households are affected, social networks would not be of help to assist households in attaining the desired level of development outcomes. That is why social support in food aid, financial support, and institutional livelihood assistance was one of the critical responses to COVID-19 (Jackie, Sowman, Taryn, & Elisa, 2020; Manlosa et al., 2021). In some fishing communities, social networks in the form of food sharing and revival of local food networks emerged as a response to COVID-19 (Bennett et al., 2020). For access to basic services and assets, this finding is widely supported by results from other studies that have shown that in some communities, small-scale fishers adapted to the COVID-19 pandemic by creating platforms that dedicated marketing for fish and direct marketing and deliveries (Bennett et al., 2020). Bennett et al. (2020) also found that small-scale fishers adapt by changing fishing gears, targeting different species in some places. This shows the role of fishing assets in building the resilience of households in the fish value chain. These findings suggest the need for building significant pillars in building the resilience of the fish value chain actors.

Based on other studies (Bennett et al., 2020; HLPE, 2020) and this study, COVID-19 affects the current food security status. The findings of this study further show that COVID-19 shocks reduce household resilience capacities. These findings are significant because they imply that households that have been directly affected by COVID-19 through death and illness will take longer to normalise their food security status. After all, the same shock erodes their ability to do so. These households will require more external support in the form of food and financial assistance for a more extended period than households that are only suffering from the covariate COVID-19 shocks, such as inaccessibility of markets or fishing grounds.

The findings suggest that households that experienced the death of a member and an illness of a member due to COVID-19 did not use the basic services and social safety nets to reduce the effects of the shock. This outcome may result from the need for households with a COVID-19 case to isolate. Isolation is usually associated with more extended periods of discrimination, which affects the resilience capacity building within the household. During the isolation, households do not access basic services, nor are they visited by friends and relatives as regular as they would in a different disease. As for the assets and adaptive capacity, pillars are built over time and could not be affected by death and illness within the short period the pandemic had been in the country by the time we conducted the study.

6. Conclusion

This study has shown that COVID-19 shocks among fishing households impact household food security directly by reducing worsening the household food security status (first-generation effects) and indirectly by reducing the household resilience capacity (second generation effects). More importantly, households that experienced death or sickness of a member due to COVID-19 had their current food security and resilience capacities are reduced. Two important implications emerge from these findings. Firstly, there is a general need to build households’ assets in fishing communities, build adaptive resilience capacities (d’Errico et al., 2018; TANGO International, 2018).

Table 6

Regression analysis results of the effects of COVID-19 shocks on household resilience.

| Coefficient | Standard Error |
|-------------|----------------|
| Death       | -0.7621***     |
|             | (0.2925)       |
| Illness     | -0.5857*       |
|             | (0.3479)       |
| Markets     | 0.0951         |
|             | (0.1111)       |
| Fishing     | -0.0870        |
|             | (0.1244)       |
| Fish supply | -0.0575        |
|             | (0.1180)       |
| Purchasing price | -0.0236   |
|             | (0.1161)       |
| Selling price | 0.0733   |
|             | (0.1104)       |
| Lost job    | 0.0401         |
|             | (0.2164)       |
| Household size | -0.0106    |
|             | (0.0225)       |
| Female head | -0.1041        |
|             | (0.1286)       |
| Education of head | 0.3775*** |
|             | (0.0449)       |
| Age of head | 0.0248**       |
|             | (0.0046)       |
| Constant    | -1.9035***     |
|             | (0.2759)       |
| Adjusted R-squared | 0.23      |
| Wald chi2(12)| 123.12*** |
| N           | 400            |

Standard errors in parentheses.

* p < 0.10, ** p < 0.05, *** p < 0.01.
capacity, and identify innovative ways of improving access to essential services to enable households to withstand the effects of the pandemic and other shocks. Secondly, households that have experienced COVID-19 illness or death require external support to normalise their food security status quickly.

CRediT authorship contribution statement

Levison S. Chiwaula: Conceptualization, Funding acquisition, Project administration, Writing – review & editing. Gowokani Chijere Chirwa: Writing – review & editing. Jupiter Simbeye: Study design, Data collection, Data management, review draft. Mangani Katundu: Data collection, review draft.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

This work was carried out with the aid of a grant from the International Development Research Centre (IDRC), Ottawa, Canada [Grant number: 108865-002]. We acknowledge the technical guidance of Dr Edidah Ampaire the Senior Program Officer for IDRC throughout the implementation of this study.

Table 7

Relationship between COVID-19 shocks and the household resilience pillars.

| Variable | Access to Basic Services | Assets | Social Safety Nets | Adaptive Capacity |
|----------|--------------------------|--------|-------------------|------------------|
|          | Coefficient | Standard Error | Coefficient | Standard Error | Coefficient | Standard Error | Coefficient | Standard Error |
| Death    | –0.8767*** | (0.2565) | –0.3245 | (0.2700) | –0.2275*** | (0.1064) | –0.2578 | (0.3084) |
| Illness  | –0.7951*** | (0.2633) | –0.1988 | (0.2848) | –0.2153*** | (0.1274) | –0.1071 | (0.3360) |
| Markets  | 0.0371     | (0.1112) | 0.0032 | (0.1043) | –0.0246 | (0.1041) | 0.1223 | (0.1047) |
| Fishing  | –0.2048     | (0.1218) | 0.1586 | (0.1122) | –0.0789 | (0.1180) | –0.0275 | (0.1078) |
| Fish supply | –0.0833   | (0.1195) | 0.0559 | (0.1192) | –0.1447 | (0.0924) | –0.0379 | (0.1072) |
| Purchasing price | 0.1078 | (0.1238) | –0.2977*** | (0.1142) | –0.0579 | (0.1095) | 0.0134 | (0.1029) |
| Selling price | 0.0311     | (0.1071) | 0.1557 | (0.1085) | 0.2271* | (0.1228) | 0.0016 | (0.0993) |
| Lost job | –0.0909 | (0.2374) | –0.1974 | (0.2071) | –0.2272 | (0.1452) | 0.2645 | (0.1780) |
| Household size | 0.0008    | (0.0230) | 0.0393 | (0.0270) | 0.0275 | (0.0261) | –0.0397* | (0.0208) |
| Female head | –0.0364  | (0.1200) | –0.1246 | (0.1247) | 0.0384 | (0.1353) | –0.0766 | (0.1242) |
| Education of head | 0.1541*** | (0.0467) | 0.1233*** | (0.0471) | 0.0723 | (0.0486) | 0.4138*** | (0.0446) |
| Age of head | 0.0025   | (0.0044) | 0.0206*** | (0.0051) | 0.0021 | (0.0043) | 0.0283*** | (0.0039) |
| Constant | –0.4608* | (0.2698) | –1.4966*** | (0.2963) | –0.4497*** | (0.1947) | –2.0791*** | (0.2482) |
| Adjusted R-squared | 0.12     | 0.11 | 0.03 | 0.28 |
| Wald chi2(12) | 400       | 400 | 400 | 400 |

Standard errors in parentheses. * p < 0.10, ** p < 0.05, *** p < 0.01.

Acknowledgements

This work was carried out with the aid of a grant from the International Development Research Centre (IDRC), Ottawa, Canada [Grant number: 108865-002]. We acknowledge the technical guidance of Dr Edidah Ampaire the Senior Program Officer for IDRC throughout the implementation of this study.

Appendix 1. Factor loadings and Kaiser-Meyer-Olkin measure of sampling adequacy for indicators used to estimate access to basic services pillar

| Variable | Description | Factor1 | Factor2 | Uniqueness | kmo |
|----------|-------------|---------|---------|------------|-----|
| prim     | Access to primary school | 0.5908  | 0.1574  | 0.6262  | 0.8809 |
| health   | Access to health services | 0.7961  | –0.1388 | 0.3469  | 0.7752 |
| extrn    | Access to extension services | 0.7348  | 0.4238  | 0.2804  | 0.7985 |
| vet      | Access to veterinary Services | 0.6145  | 0.6341  | 0.2203  | 0.7532 |
| elec     | Access to electricity | 0.7121  | –0.4489 | 0.2914  | 0.7646 |
| phone    | Access to mobile phone | 0.5607  | –0.1863 | 0.651   | 0.8123 |
| agricmkp | Access to agricultural markets | 0.6981  | –0.3716 | 0.3746  | 0.8563 |
| Overall  |             | 0.0008  | 0.0021  | 0.0246  | 0.0897 |

Appendix 2. Factor loadings and Kaiser-Meyer-Olkin measure of sampling adequacy for indicators used to estimate the assets pillar

| Variable | Description | Factor1 | Factor2 | Uniqueness | kmo |
|----------|-------------|---------|---------|------------|-----|
| f_ast    | Fishing assets | 0.6180  | –0.3094 | 0.5224  | 0.6306 |
| a_ast    | agricultural assets | 0.6718  | 0.3401  | 0.4331  | 0.6994 |
| o_ast    | Other assets | 0.6675  | –0.3284 | 0.4467  | 0.6121 |
| land     | Landholding | 0.4496  | 0.7651  | 0.2125  | 0.5676 |
| perTLU   | per capita total livestock units | 0.4697  | –0.3452 | 0.6603  | 0.6847 |
| Overall  |             | 0.0008  | 0.0021  | 0.0246  | 0.0897 |
Appendix 3. Factor loadings and Kaiser-Meyer-Olkin measure of sampling adequacy for indicators used to estimate the social safety net pillar

| Variable   | Description          | Factor1 | Factor2 | Uniqueness | kmo    |
|------------|----------------------|---------|---------|------------|--------|
| gifts      | Receive gifts        | 0.8823  | -0.1849 | 0.1873     | 0.5044 |
| h_assit    | Humanitarian assistance | 0.2019  | 0.7947  | 0.3277     | 0.5037 |
| remit      | Remittances          | 0.1969  | 0.1155  | 0.9479     | 0.7281 |
| ssnet      | Social safety nets   | 0.8687  | -0.2371 | 0.1892     | 0.5026 |
| isn        | Informal safety nets | 0.2362  | 0.7969  | 0.325      | 0.5108 |
| Overall    |                      |         |         |            | 0.5062 |

Appendix 4. Factor loadings and Kaiser-Meyer-Olkin measure of sampling adequacy for indicators used to estimate the adaptive capacity pillar

| Variable | Description          | Factor1 | Uniqueness | kmo |
|----------|----------------------|---------|------------|-----|
| dep ratio | Dependency ratio | -0.7457 | 0.4439 | 0.5164 |
| incomes   | Income sources      | 0.1829  | 0.9666 | 0.5703 |
| skills    | Skills               | 0.3737  | 0.8603 | 0.6179 |
| educated  | Education            | 0.7476  | 0.4412 | 0.5159 |
| Overall   |                      |         |         | 0.5231 |

References

Aliño, L., Mane, E., & Romano, D. (2010). Measuring household resilience to food insecurity: Application to Palestinian households. In Agricultural Survey Methods (pp. 341–368). Chichester: John Wiley and Sons.

Aura, C., Nyamweya, C. S., Odoli, C. O., Owiti, H., Njuru, J. M., Otou, P. W., et al. (2020). Consequences of calamities and their management: The case of COVID-19 pandemic and flooding on inland capture fisheries in Kenya. Journal of Great Lakes Research, 46 (6), 1677–1775.

Barrett, C., Ghezzi-Kopel, K., Hoddinott, J., Homami, N., Tennant, E., Upton, J., et al. (2020). The COVID-19 Pandemic, Small-Scale Fisheries and Coastal Fishing Communities. Coastal Management, 48 (4), 336–347.

Brück, T., d’Errico, M., & Pietrelli, R. (2019). The effects of violent conflict on household resilience and food security: Evidence from the 2014 Gaza conflict. World Development, 119, 203–223.

Cochran, W. G. (1963). Sampling Techniques (2nd ed). New York: John Wiley and Sons.

Constas, M., Frankenberg, T., & Hoddinott, J. (2014). Resilience Measurement Principles: Toward an Agenda for Measurement Design. Food Security Information Network Technical Series, 1, p. 35 pp.

d’Errico, M., Garbero, A., & Constas, M. (2016). Quantitative Analyses for Resilience Measurement. Guidance for constructing variables and exploring relationships among variables. Resilience Measurement Technical Working Group, Rome: Food Security Information Network, FAO.

d’Errico, M., Romano, D., & Pietrelli, R. (2018). Household resilience to food insecurity: Evidence from Tanzania and Uganda. Food Security, 10, 1033–1054.

FAO, (2016). Analysing Resilience for better targeting and action, Rome: Food and Agriculture Organisation of the United Nations.

FAO, (2020). COVID-19 and smallholder producers’ access to markets, Rome: Food and Agriculture Organisation.

FAO, (2020). How is COVID-19 affecting the fisheries and aquaculture food systems, Rome: Food and Agriculture Organisation.

FAO, (2020c). The State of World Fisheries and Aquaculture, Rome: Food Agricultural Organization of the United Nations.

FAO, (2020). Comparison of FAO and TANGO measures of household resilience and resilience capacity., Rome: FAO.

FAO, (2021). Malawi: COVID-19 Rapid Response - Emergency Agriculture Surveillance, Rome: Food and Agriculture Organisation of the United Nations.

HLPE, (2020). Impacts of COVID-19 on food security and nutrition: developing effective policy responses to address the hunger and malnutrition pandemic, Rome: FAO.

Jackie, S., Sowman, M., Taryn, P. & Elina, M., (2020). COVID-19 impacts on the South African small-scale fisheries sector, s.l. s.n.

Kabir, K. A. (2020). The impact of COVID-19 on the aquaculture value chain. Bangladesh: WorldFish.

Lima, E., Barreto, S., & Assunção, A. (2012). Factor structure, internal consistency and reliability of the Posttraumatic Stress Disorder Checklist (PCL): An exploratory study. Trends Psychiatry Psychoth, 34(4), 215–222.

Malawi Government, (2021). Annual Economic Report 2021, Lilongwe: Ministry of Economic Planning & Development and Public Sector Reforms.

Manfous, A. O., Hornidge, A.-K., & Schlüter, A. (2021). Aquaculture-capture fisheries nexus under Covid-19: Impacts, diversity, and social-ecological resilience. Marine Studies, 20, 75–85.

NSO, (2020). The Fifth Integrated Household Survey (IHS5) 2020 Report, Zomba: Malawi National Statistical Office.

Nyiwaw, R., et al. (2021). COVID – 19 and Small-scale fisheries in Africa: Impacts on livelihoods and the fish value chain in Cameroon and Liberia. EcolVolvitz.

TANGO International, (2018). Resilience and Resilience Capacities Measurement Options, Full Approach: Methodological Guide: A Guide for Calculating Resilience Capacity, Arizona, USA: TANGO International.

UNDP, (2020). COVID-19 Pandemic in Malawi: FINAL REPORT, Lilongwe: United Nations Development Program in Malawi.

von Leckull, N., d’Errico, M., & Jackson, J. (2020). Drought, Resilience, and Support for Violence: Household Survey Evidence from DR Congo. Journal of Conflict Resolution, 64(10), 1994–2021.