Indian Journal of Agricultural Economics 80: 2 (2025): 310-334
DOI:10.63040/25827510.2025.02.004

Impacts of Coping Strategies of Marine Fisherfolk during COVID-19 in India: Insights from a Survey in Four Maritime States

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ABSTRACT

This paper analyses the impacts of COVID-19 on the livelihood of marine fisherfolk in India, the coping strategies followed, and their socio-economic correlates, based on field-level data. We interviewed about 850 fishers from four states of India- Andhra Pradesh, Gujarat, Kerala, and Maharashtra between November and December 2020. We report the major impact of COVID-19 on employment, income, and psychosocial effects. The fishers were affected negatively in all these dimensions, and the impact was felt disproportionately higher on women. The fishers adopted several coping strategies falling in the realms of food-related coping strategies, expenditure reduction, and participation in social welfare schemes. The correlates of coping strategies were examined by a multivariate probit model. We report that the adoption is correlated with the personal attributes of the fishers, ownership of economic and social capital, and their economic status. The study calls for containment policies factoring in the tradeoff between COVID-19 and loss of livelihood and protecting the vulnerable sections, should such circumstances arise in the future.

Keywords: COVID-19, food security, income risk, coping strategies, social security

JEL codes: D91, I32, I38, O13, Q22

I

INTRODUCTION

The COVID-19 pandemic has impacted human life and livelihood in a multitude of ways (Corlett *et al.*, 2020). The fisheries sector all over the world has been seriously affected due to the disruption in the supply chains owing to social distance norms and various other restrictions to contain the spread of the virus (Bennett *et al.*, 2020; Dias *et al.*, 2023; Gonzalez-Pestana *et al.*, 2023; White *et al.*, 2021). There were reports of declining fish catch, revenue, and exports (Klassen and Murphy, 2020; Fernández-González, 2021). Disruptions in the international seafood trade have further trickled down to the life and livelihood of fisherfolk. Allied workers were also affected by livelihood loss and food insecurity (Lau *et al.*, 2021; Nyiawung, 2024). Food and Agricultural Organisation (FAO) pointed out the impacts of Covid-19 on fisheries as loss of market, economic uncertainty, labour migration, slowdown in market demand, and reduction in information availability, to mention a few (FAO, 2020).

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There were reports that the Small-Scale Fisheries (SSF) value chain was constrained by disruption in trade, a decline in price, lack of domestic buyers, and issues related to transportation and storage (Bennett *et al.*, 2020; Pita *et al.*, 2021; Bassett et al, 2022; Jaikumar *et al.*, 2023; Bolognini *et al.*, 2023; Macusi *et al.*, 2024). The pandemic has affected the psychological and social well-being of the fishers, in addition to impacting food and livelihood security, as the frequent communication and contact with friends, family members, and other stakeholders in the fisheries sector were interrupted (Lau *et al.*, 2021; Abdelbaset, 2024; Macusi *et al.*, 2022).

India, with an 8118 km long coastline and 2.02 million km^2 of exclusive economic zone (EEZ), is a major contributor to global fish production. The marine fisheries sector of India provides livelihood to about 16 million fishing workers and their families spread across 3477 marine fishing villages. COVID-19 also impacted the fisheries sector in India. The restrictions in India were initiated with a curfew and a subsequent national-level lockdown announced on 24th March 2020, initially for a period of 54 days, and the fisheries sector was completely closed (MSSRF, 2020; Avtar *et al.*, 2021). The immediate closure of the harbours consequent to the announcement of nationwide lockdown had constrained many fishers returning from multiday fishing trips as the sale of the harvest became impossible (MSSRF, 2020). The sector was unlocked gradually with intra- and interstate variations in restrictive measures (Ceballos, 2020). The reduction in seafood exports was to the tune of 7-8 percent in India in both quantity and value in 2019-20 (Business Line. 2020). As estimated by the Central Institute of Fisheries Technology (CIFT), Cochin, India. India's marine fishery sector was inflicted with a daily loss of INR 2.24 billion, and a monthly loss amounting to INR 68.38 billion (Business Line, 2020b). The migrant labourers, who have a significant share in the marine fishery labour force, were also severely affected due to the sudden loss in employment and livelihood (MSSRF, 2020), which in turn triggered reverse migration to native villages (Avtar *et al.*, 2021).

All over the world, fishers have practiced many coping strategies (Pita, 2021). Some include reduction in production costs, diversifying business activities, leveraging social capital, sourcing alternative inputs and borrowing, alternative employment, and reducing food consumption (Belton *et al.*, 2021; FAO, 2021; Suresh *et al.*, 2022). SSF actors utilised their networks to cope and innovate (Bassett *et al.*, 2021; Macusi *et al.*, 2022). Literature on COVID-19-induced livelihood risk and its coping strategies points to the need for better infrastructure and institutions, social security incentives, and policy support.

1.1 Stress and coping strategies

Adaptive capacity normally denotes the ability of individuals, communities, or systems to adapt to a stressful situation (Mathias *et al.*, 2024). It is a component of resilience (Carpenter, 2001) and depends on access to resources (Adger *et al.*, 2004;

Fergen et al, 2024), socio-economic context (Cáceres *et al.*, 2024), education and knowledge, and governance structures. Adaptive capacity is related to a multitude of ideas like coping ability, managerial capacity (Preston *et al.*, 2009), stability and robustness, as well as the capacity of institutions and communities. In the short-term vision, the adaptations can be rather coping strategies, measured in numerous ways.

Coping strategies are adjustments that are reactive and short-term in nature, while longer-term proactive adjustments are designated as adaptive capacities (Quinn *et al.*, 2011). Both the adaptive capacity and coping ability are not static but dynamic depending on the resource, technology, institutions, etc. Studies suggest that institutional rules, norms, and similar factors play an important role in transforming short-term coping abilities into longer-term adaptive capacity (Berman *et al.*, 2012; Turchi *et al.*, 2024). Coping is defined as a mechanism of minimising or tolerating stress or conflict (Lazarus and Folkman, 1984; Folkman, 2020). Coping strategies of vulnerable households are shaped by many factors, like intensity of shock, household characteristics, and socio-economic factors like access to resources, services, markets, etc. Coping strategies are classified into different types. Active coping aims to directly control the stressful situation (Compas *et al.* 2001; Carver *et al.*, 1989), while adaptive coping involves adjusting to it (Carver *et al.*, 1989). Reactive coping strategies are those employed after a shock has occurred (Lazarus and Folkman,, 1984).

Vulnerable households adopt a range of coping strategies, such as buying food on credit, consuming low-quality food items, reducing the frequency and quantity of food, engaging in additional occupational activities for income generation, and depending on friends and relatives, among others (Knippenberg *et al.*, 2019). A wide range of reactive coping strategies includes the sale of assets (Dercon, 2002; Mukherjee and Fransen, 2024). Upon experiencing shocks, households actively manage a portfolio of coping strategies based on their access to natural and social capital (Paumgarten *et al.*, 2020). Consumption reduction, adjustments in food and healthcare, and liquidation of productive assets are widely reported (Bhattacharjee and Behera, 2018).

During the COVID period, the fisherfolk in India had also undertaken several coping mechanisms. Information on the impact of COVID-19 on fisherfolk and the coping mechanisms followed would throw light on the course of actions during the continuing COVID situations and similar circumstances in the future. In this background, this study was undertaken in four states of India, namely Andhra Pradesh (AP), Gujarat, Kerala, and Maharashtra with the objectives of (a) to examine the COVID-19 impact on fishers engaged in marine capture fisheries in India, and (b) to profile the coping strategies followed by the fisherfolk and identify its potential correlates.

II

THEORETICAL FRAMEWORK

2.1 Pressure-State-Response Model

The Organization for Economic Co-operation and Development (OECD) introduced the Pressure-State-Response (PSR) framework to systematically identify sustainability indicators, which has since gained widespread acceptance for this purpose (Woodhouse *et al.*, 2000). The framework is based on the principle of causality, wherein human activities exert pressures on the environment, altering its state and prompting societal responses. The PSR model comprises three main components: pressure, state, and response. Pressure includes human activities that affect environmental quality (state), which in turn trigger responses through environmental, economic, and sectoral policies. Variants of the PSR model include the Driving Force-State-Response (DSR) model and the Driving Force-Pressure-State-Impact-Response (DPSIR) framework (Woodhouse *et al.*, 2000; Suresh *et al.*, 2022).

The DPSIR (Drivers, Pressures, State, Impact, Response) framework is particularly effective in analyzing and addressing environmental issues by examining the interactions between human activities and environmental changes (Georgiou *et al.*, 2024; Samal and Dash, 2024). In this framework, drivers—such as economic, social, and cultural factors—are the root causes of environmental changes. These drivers exert pressures, like pollution, that directly affect the environment. The state refers to the resulting condition of the environment, including aspects like air and water. Impact encompasses the effects on ecosystems and human health, such as biodiversity loss and pollution-related health problems. The response involves actions taken to address these issues, including policy implementation, regulations, and raising public awareness (Gabrielsen and Bosch, 2021; Santos *et al.*, 2024).

The impact of COVID-19 on fisherfolk in India can be effectively analyzed using the DPSIR framework, as similar studies have been conducted in Sri Lanka and globally (Amaralal *et al.*, 2023; Nyiawung *et al.*, 2024). The DPSIR model framework for assessing the impact of COVID-19 on the fisheries sector is depicted in Figure 1 (Amaralal *et al.*, 2023). The pandemic, driven by the global outbreak and subsequent government policies such as lockdowns and social distancing measures, served as the primary driver. These measures exerted significant pressures, including an economic downturn, labour shortages due to worker migration, supply chain disruptions, and heightened health risks, leading to a substantial reduction in fishing activities (Nyiawung *et al.*, 2024). Consequently, the state of fisherfolk's livelihoods worsened, with notable income losses, increased vulnerability, reduced access to essential services, and social disruptions, particularly affecting education, health, and overall welfare. The impacts were severe, manifesting as economic hardship, nutritional deficiencies, mental health issues, and widening social inequalities within

fishing communities. In response, governments and organizations implemented various measures, such as financial aid, food distribution, loan relaxation schemes, and the promotion of online marketing platforms to mitigate these effects. Additionally, long-term strategies are being developed to enhance resilience in the fisheries sector, including diversifying income sources, improving access to education, and promoting sustainable fishing practices.

The DPSIR framework serves as a powerful tool for decision-makers to systematically analyze and address complex environmental issues. By understanding the relationships between human activities and environmental changes, decision-makers can develop informed and effective responses to promote sustainability (Nyiawung *et al.*, 2024; Gule *et al.*, 2024; Gupta *et al.*, 2021).

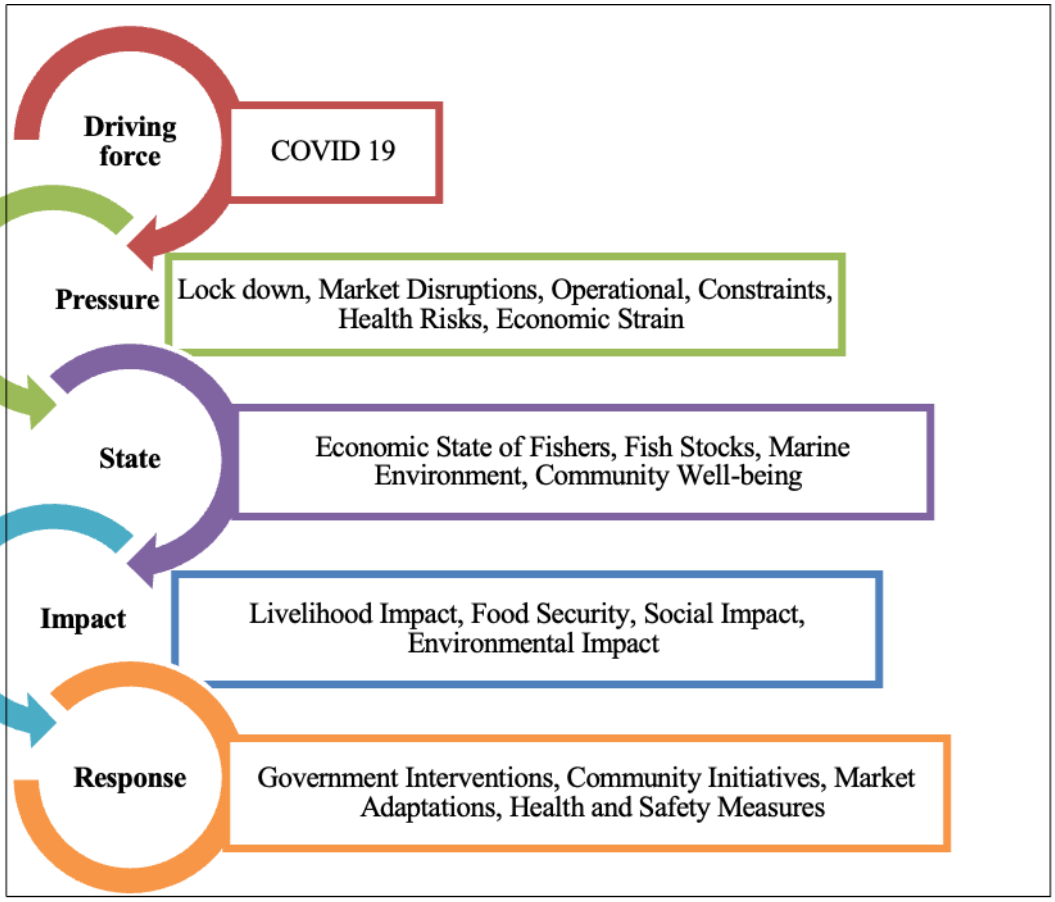

Figure 1. DPSIR Model framework on the impact of COVID-19 on the fisheries sector

Source: Amaralal, *et al.*, 2023

III

MATERIAL AND METHODS

3.1 Description of study location

India has nine maritime states, spread across both the Eastern and Western Coasts. The Western Coast accounts for 64 percent of the total marine fish production. Three states from the Western Coast (Gujarat, Kerala, and Maharashtra) and one state (Andhra Pradesh) from the Eastern Coast were purposively selected based on their relative contribution to marine fisheries and the convenience of data collection. The primary data was collected using a hybrid mode of telephonic interview and direct interview from respondents, following prescribed COVID protocols. From every state, fishers based on a major fishing ground were selected purposively. Accordingly, the centres selected include Vizag from Andhra Pradesh, Veraval from Gujarat, Kochi from Kerala, and Mumbai from Maharashtra.

3.2 Data

The study was carried out among fishers (owners/ labourers) of all four locations engaged in marine fishing. The samples were selected based on a snowball sampling technique. Firstly, some familiar fishers in the harbour or landing centres were contacted, and from the respondents, contact information, mainly the mobile number of other fishers, was collected. The respondents were limited to those engaged in fishing activities. A hybrid method of either personal interviews/or telephonic interviews was followed. A structured interview schedule was prepared after consultation with various stakeholders in the marine fisheries sector. The survey schedule was pre-tested with selected fishers and was re-formatted based on pre-test observations. The questionnaire contained information on the social and economic background of the fishers; information on their household; ownership of fishing assets; the impact of COVID-19 on fishing, employment, and income; and the coping strategies followed. The reference period used for the data collection was six months, starting from 25th March 2020, when the country went into full lockdown. The data collection was done during November- December 2020.

3.3 Precautions during the Survey process and ethical considerations

As the time period of the survey was falling during the COVID period, the norms prescribed during the COVID-19 as a measure to contain the pandemic were strictly followed. This included measures for the "break the chain" strategy aimed at containing the spread of the pandemic that included social distancing, usage of masks and other protective measures, and washing of hands with soap. The consent of the enumerators and respondents was obtained and secured for data collection.

3.4 Data Analysis

The coping mechanisms were grouped into three broad categories- coping strategies in food consumption, income smoothing strategies, and participation in social security measures operated by the state.

Econometric method

Studies have highlighted that households tend to rely on a diversified portfolio of mechanisms to cope with stress that include both asset smoothening and consumption smoothening mechanisms (Dercon *et al.*, 2002). Given the complementarity and substitutability among various coping mechanisms employed by households, a multivariate probit model is used in the analysis as it helps to identify the positive and negative correlation between various coping mechanisms. Further, multivariate probit has the added advantage of simultaneously identifying the factors that influence one or more coping strategies while allowing the error terms to be correlated freely (Mabe *et al.*, 2021).

The choice of households to cope with or refrain from external choices can be explained using the neo-classical random utility model for discrete choice decision-making (Greene, 2003). The model assumes that utility is derived by choosing several alternatives and each coping mechanism has a distinct set of attributes that influences the household's choice of alternatives. The choice of coping mechanisms of households to economic shocks and natural disasters are interdependent, thereby increasing the likelihood of correlated error terms.

Let U_0 be the utility the household receives when it does not use any of the coping strategies. Likewise, let U_k denote the utility the household receives when it adopts the coping mechanism 'k'. A household shall opt to adopt the coping strategy 'k' if the net benefit received from employing the coping mechanism $k = U_k - U_o > 0.$

The net benefit the household derives from a coping strategy (B_{ik}) is a latent variable that is determined by a vector of covariates (household-specific characteristics in our case) and unobserved characteristics represented by stochastic error term μ_i.

$$B_{ik} = \beta k\, X_i + \mu_i$$

Where, k= coping strategies 1,2,3.

An indicator function can be used to translate the unobserved preferences into observed binary outcomes for each coping strategy as:

$$Y_{ik} = \begin{cases} 1, & B_{ik} > 0 \\ 0, & B_{ik} \leq 0 \end{cases}$$

Since using any coping strategy is possible, the error terms jointly follow a multivariate normal distribution (MVN) with zero conditional mean and normalised unity variance ((where (U1, U2, . . ., Uk) ≈ MVN (0, Ω)) with the symmetric covariance matrix Ω:

$$\Omega = \begin{vmatrix} 1 & p_{12} & p_{13} \\ p_{21} & 1 & p_{23} \\ p_{31} & p_{32} & 1 \end{vmatrix}$$

Here the off-diagonal elements represent the pairwise correlation between the error terms and the diagonal elements assume a value of unity corresponding to the above-mentioned assumption of unit variance. Non-zero pairwise correlation coefficients validate the necessity of using multivariate probit (MVP) models in place of univariate probit models for each coping mechanism. The MVP is estimated using the simulated maximum likelihood method using the GHK smooth recursive conditioning simulator. This follows the product of sequentially conditioned univariate normal distribution functions with a joint probability.

Variables used

The explanatory variables considered were gender the fisherman head identifies with (male/ female), age, family size, number of earning members, education, the status of the fishers in the fishery, type of fishing vessel, ownership of a house, poverty, membership in fishers collectives, possession of *Kisan Credit Card* (KCC a means to avail short term loans for fisher through institutional sources), number of income sources and size of land owned. According to education, the fisherfolk were classified into illiterate, primary level, high school education (HSE), and above HSE. The types of vessels were classified into two: mechanised and others (like traditional and motorised vessels). With respect to poverty, fisherfolk were classified into those below the poverty line (BPL) as per the classification of the government and others. The fisher collectives were captured by using membership in cooperatives, the most widely prevalent collective institution. KCC facilitates access to short-term credit. The discrete variables were captured by using dummy variables. It is hypothesised that those with better social and economic capital are more likely to adopt welfare-reducing coping strategies.

IV

RESULTS AND DISCUSSION

4.1 General information

The household data shows that fishers across major Indian states are generally middle-aged, with the household decision-makers average age ranging between 43 and 51 years. Family sizes range from 4.0 in Kerala to 5.9 in Gujarat. Female representation in the family is low, except in Kerala, where the sex ratio is 1,049 females per 1,000 males among the general population. Households have few earning members, averaging 1.8 in Andhra Pradesh and 2.5 in Maharashtra, with

female workforce participation particularly low (0.3 to 1.1 per household). The ratio of earning members to family size is highest in Andhra Pradesh and Maharashtra (0.53-0.54). Educational attainment is limited, with 12-60% of fishers having only basic education (Figure 2). These findings highlight the socio-economic challenges faced by fisher communities, including low female work participation, limited occupational diversity, and high dependency ratios, particularly in regions with larger family sizes and fewer earning members.

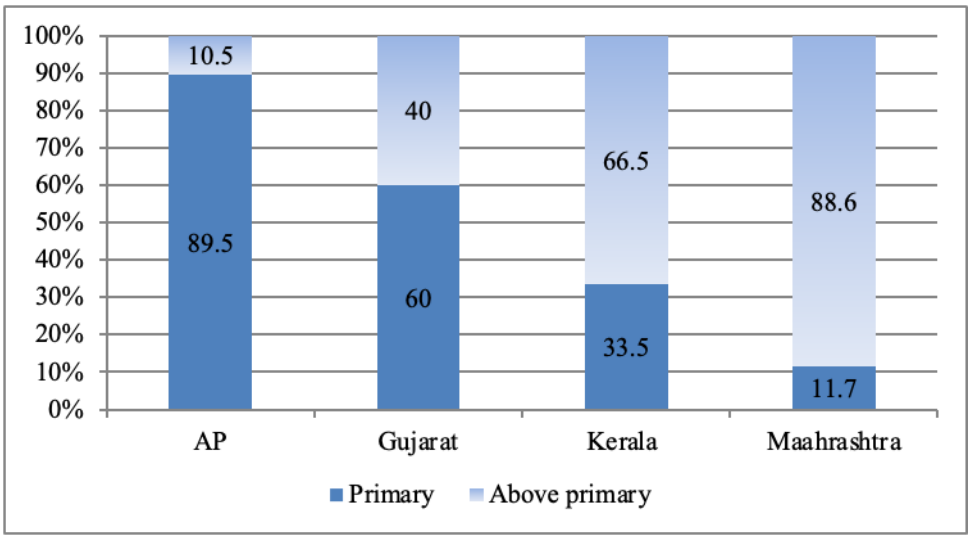

Figure 2. Distribution of fishers with respect to education across states

4.2 Fishing assets and fishery activities

Fishers were either owner of vessels (sole ownership or shared) or participated in fishing activities as labourers without ownership. Owners might or might not participate in fishing activities. Owner-workers, who both owned and

worked on fishing vessels, constituted nearly 20 percent of respondents in Andhra Pradesh, 50 percent in Kerala, 65 percent in Gujarat, and 74 percent in Maharashtra (Table 1). Ownership in fishing vessels was reported by 28 percent of respondents in Andhra Pradesh, 61 percent in Kerala, 74 percent in Maharashtra, and 95 percent in Gujarat. Those engaged in fishing activities included 70 percent in Gujarat, 88 percent in Kerala, 99 percent in Andhra Pradesh, and 100 percent in Maharashtra. Most fishers used traditional or non-mechanized fishing vessels, ranging from 4 percent to 30 percent.

TABLE 1: DISTRIBUTION OF CATEGORIES OF THE RESPONDENTS WITH RESPECT TO OWNERSHIP AND WORKING STATUS (%)

S. No.	Category	Andhra Pradesh	Gujarat	Kerala	Maharashtra
1	Vessel owner and fish worker (owner-worker)	20	65	50	74
2	Vessel owner and not a fish worker (owner only)	2	30	11	0
3	Non-owner, only worker (worker only)	78	5	39	26
	Overall	100	100	100	100

4.3 Characteristics of respondents and accessibility to assets and facilities

The study indicates that more than 90% of respondents in Kerala, Maharashtra, and Gujarat own houses, compared to only 43% in Andhra Pradesh. Access to safe drinking water is highest in Kerala (78%) and Andhra Pradesh (59%), but notably low in Gujarat and Maharashtra (7%). Toilet facilities are widely available across all states, with 94-98% of respondents having access at home. Livestock farming is minimal, with Kerala showing the highest, yet modest, ownership at 21%. Most households own transportation, mainly two-wheelers, with the highest ownership in Gujarat and Maharashtra (83%). Village-level organization membership is strong, especially in Maharashtra (89%), and women's participation in Self-Help Groups (SHGs) is common. Credit access through KCC is minimal, with only 13% penetration in Kerala and 3% or less in other states. Fishing remains the primary income source for all respondents in Andhra Pradesh and Maharashtra, and for 96-97% in Gujarat and Kerala.

4.4 Perceived impact of COVID-19

The COVID-19 pandemic significantly impacted the fisheries sector, disrupting fishing activities and increasing costs across states. In Andhra Pradesh, all respondents reported higher fishing expenses, with similar increases in Gujarat

(90%), Kerala (63%), and Maharashtra (96%). Despite a rise in fish prices, most fishers experienced income reductions due to decreased fishing activities, with reductions ranging from 80% in Kerala to 100% in Andhra Pradesh. The pandemic also altered food consumption patterns, with 100% of respondents in Andhra Pradesh and 31% in Kerala noting changes. Additionally, job losses among family members were notable, with 68% of households in Gujarat and 30% in Kerala reporting such losses. These disruptions reflect the broader economic and social challenges faced by the fisheries sector during the pandemic.

4.5 Impact on employment and income in marine fisheries

Impact on Employment

The COVID-19 pandemic had a significant impact on employment in the fisheries sector, particularly evident when comparing the six months before the pandemic to the six months during the lockdown. Social distancing, travel restrictions, and the reverse migration of labourers severely disrupted fishing activities (Chanrachkij *et al.*, 2020; Northrop *et al.*, 2020; Bennett *et al.*, 2020). In Maharashtra, men lost an average of 91 employment days, while women lost 87 days (Table 2). Overall, the reduction in employment was striking, with Andhra Pradesh experiencing a 69% decrease, Gujarat 33%, Kerala 41%, and Maharashtra 60%. For men, the reduction in employment days ranged from 32% in Gujarat to 62% in Andhra Pradesh. Women were similarly affected, with a reduction ranging from 34% in Gujarat to 94% in Andhra Pradesh. These figures highlight the profound negative impact of the pandemic on employment within the fisheries sector across different states.

TABLE 2: EMPLOYMENT CHANGE DURING PRE- AND POST-COVID PERIOD

Characteristic	During pre-COVID (mean number employment days)				% Reduction			
	AP	Gujarat	Kerala	Maharashtra	AP	Gujarat	Kerala	Maharashtra
During pre-COVID for men	117	149	130	156	62	32	42	59
During COVID for men	45	101	75	64				
Pre- COVID for women	32	35	107	143	94	34	39	62
During COVID for women	2	23	65	55				
Total during pre- COVID	149	184	236	298	69	33	41	60
Total during COVID	47	123	140	120				

Impact on Income

Income contraction emerged as the most significant consequence of the COVID-19 pandemic. During data collection, monthly income from fisheries activities was recorded using an ordered scale: "less than Rs 3000", Rs 3000-5000, Rs 5000-10000, Rs 10000-20000, Rs 20000-30000, and above Rs 30000 (Table 3). During COVID-19, the modal income shifted to lower ranges in all the states: from Rs 10000-20000 (43%) to Rs 3000-5000 (69%) in Andhra Pradesh; from more than Rs 30000 (47%) to Rs 20000-30000 (45%) in Gujarat; from Rs 10000-20000 (43%) to Rs 5000-10000 (30%) in Kerala; and from more than Rs 30000 (55%) to Rs 10000-20000 (41%) in Maharashtra. Domestic fish demand and consumption decreased, mainly due to income contraction and fears of COVID-19 contamination through fish and fish vendors, as reported in several studies.

TABLE 3: DISTRIBUTION OF MONTHLY INCOME BEFORE AND AFTER COVID (%)

Asset status	Andhra Pradesh		Gujarat		Kerala		Maharashtra	
	Pre-COVID	COVID	Pre-COVID	COVID	Pre-COVID	COVID	Pre-COVID	COVID
< 3000	1	24	0	0	2	11	13	19
3000-5000	2	60	0	0	13	23	3	12
5000-10000	50	5	0	7	15	30	10	27
10000-20000	42	1	8	44	43	18	6	41
20000-30000	4	0	45	45	14	6	13	-
> 30000	0	0	47	4	13	12	55	-

4.6 Major impacts on households during COVID

The COVID-19 pandemic had extensive impacts on household well-being beyond economic disruptions. In Andhra Pradesh, 72% of households experienced delays in medical treatments, while in Gujarat 58% faced similar delays. Many children dropped out or moved to lower-fee schools- 67% in Gujarat, 7% in Kerala and 5% in Maharashtra. Obligatory social functions and ceremonies were postponed. The postponement of household purchases and maintenance activities was observed. Loan repayment defaults were high in Kerala (73%) and lower in Maharashtra (39%). Personal and social well-being also suffered: over 80% in all states feared employment and income loss, 82-100% reported general anxiety, and 56-100% felt isolated (figure 3). Worsening societal relations affected 33-100% of respondents Deterioration of relationships within the family was also widely reported (Macusi *et al.*, 2022, WHO, 2022; Collins *et al.*, 2024).

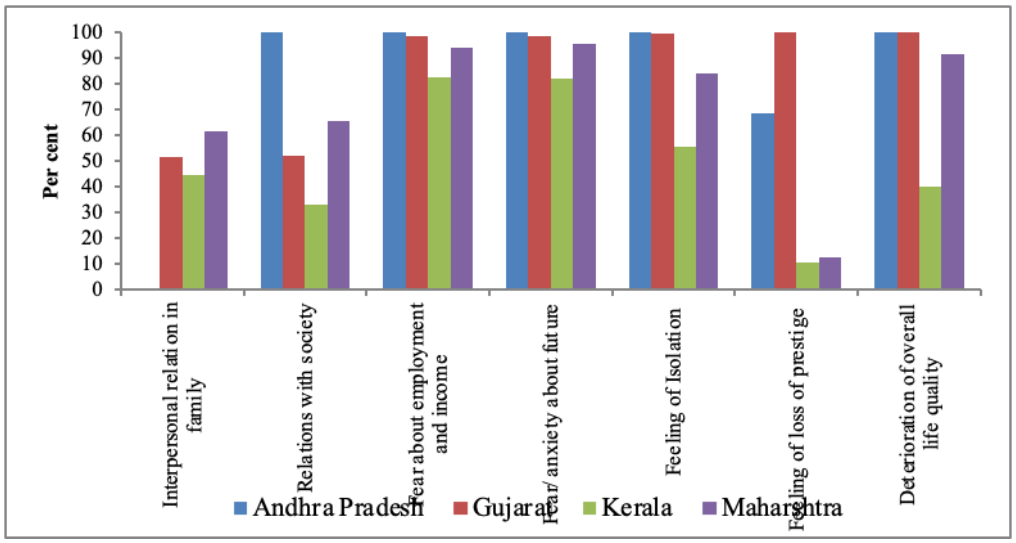

Figure 3. Social and psychological impacts of COVID

4.7 Coping strategies followed

Fishers worldwide adopted various coping strategies to manage the challenges posed by the COVID-19 pandemic (FAO, 2020; Belton *et al.*, 2021; Seixas *et al.*, 2024), which can be categorized into three broad areas: changes in food consumption patterns, non-food-based income smoothing strategies, and participation in social security programmes (Table 3).

Food-Related Strategies

Many fishers compromised on the quantity and quality of food, high-value commodities like animal-sourced foods and fruits. In Kerala, the government alleviated food insecurity by distributing food packets containing cereals, pulses, and essential ingredients through the public distribution system. Community kitchens and cooked meal programs were also established. Similar strategies were observed in coastal Bangladesh and Myanmar's aquaculture sector (Garai, 2024), where people relied on government food supplies and reduced their intake of high-value food items.

Non-Food-Based Consumption Smoothing Strategies

To cope with financial hardships, fishers sought credit from both institutional and non-institutional lenders; 100% of respondents in Andhra Pradesh and 97% in Gujarat did so. The sale of durable household assets was another strategy, particularly in Andhra Pradesh (59%) and to a lesser extent in Kerala and Maharashtra (12-13%). Households also redirected funds from educational and medical expenses towards the consumption of essential commodities, with some postponing medical treatments and opting for lower-cost alternatives.

Participation in Labour Markets and Social Security Programs

Increased participation in the labour market for wage earnings was another coping mechanism, with 59% of respondents in Andhra Pradesh and 8% in Gujarat engaging in such activities (Table 4). The Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) provided crucial labour opportunities to Below Poverty Line (BPL) households, with 19% of respondent households in Kerala participating in this programme.

TABLE 4: COPING STRATEGIES ADOPTED DURING COVID (% RESPONDENTS)

Sl No	Characteristic	AP	Gujarat	Kerala	Maharashtra
A.	*Food related*				
1	Quantity reduction of food consumed	100	36	18	14
2	Quality reduction of food consumed	100	70	34	81
3	Reduced the frequency food consumption	100	37	10	12
4	Relied on food ration from Government	100	49	82	85
B.	*Non-food based income smoothing strategies including credit*				
1	Borrowed money /credit	100	97	56	35
2	Liquidation of durable household assets (furniture/ gadgets/ land/ jewelry)	59	1	12	13
3	Withdrawal of savings	100	86	27	96
4	Reduction of educational expenditure	100	77	20	21
5	Reduction of medical expenditure	100	76	28	29
C.	*Participation in labour markets and social security programmes*				
1	Ventured into wage labour market for a greater number of days/durations	59	8	30	11
2	Social security support and income transfers from Govt	41	18	25	29
3	Participated in employment guarantee programmes (MGNREGA)	0	0	19	1

4.8 Correlates of the coping strategies

All the multivariate probit regressions indicated that the models are of a good fit, as the Wald statistics were significant at a level of <0.001 in all three regressions (Tables 5-7). This highlights the efficiency of the model in accounting for unobserved correlations among the strategies adopted. Furthermore, the likelihood ratio test validates the potential correlation among various coping mechanisms adopted by the fishers.

Food-related coping strategies

The gender of the household head is not significantly correlated with food adjustments, except in the case of reducing the quantity of food consumed (Table 5). In the regression analyses, women served as the base category. Variables such as the age of the household head, family size, and the number of earning members were

generally uncorrelated with food-related strategies, except for the reliance on the Public Distribution System (PDS) in relation to family size. Larger families were less likely to rely on PDS, possibly due to greater labour participation opportunities.

For the education variable, illiterate fishers were used as the base category in the regression analyses. Overall, fishers with higher levels of education were progressively less likely to compromise on the quantity, quality, and frequency of food consumed compared to households headed by illiterate fishers. The positive impact of education on food and nutritional security has been well-documented in earlier studies as well (Ezzeddin *et al.*, 2024). Fishers who owned a house were also less likely to compromise on food consumption, potentially because the savings on rent could be partially allocated toward household expenditures, particularly food.

Regarding work status, the fishers were categorized into three broad groups: "owner only," "worker only," and "owner-worker." The "owner-worker" category, which served as the base category, primarily consisted of small-scale fishers engaged in artisanal fishing with their own vessels. Compared to "owner-workers," "owner-only" fishers were more likely to reduce the quantity and frequency of food consumption. Many of the "owner-only" fishers practised artisanal fishing but were forced to compromise due to income loss. However, those in the "worker only" category did not adopt any food-related strategies other than an increased dependence on PDS.

Membership in cooperatives was negatively correlated with a reduction in the quantity and quality of food consumed and positively correlated with dependence on PDS. As expected, families with multiple income sources were less likely to compromise on food consumption. Additionally, larger ownership holdings were negatively associated with food-related coping strategies, except for reliance on rations (PDS).

TABLE 5: RESULTS OF THE MULTIVARIATE PROBIT ANALYSIS FOR FOOD RELATED COPING STRATEGIES

Particulars	Quantity of food reduced			Quality of food reduced			Frequency of food reduced			Rely PDS and food supplies		
	Coefficient	Standard Error	p value	Coefficient	Standard Error	p value	Coefficient	Standard Error	p value	Coefficient	Standard Error	p value
Gender HH	0.661	0.258	0.010	0.205	0.252	0.417	0.257	0.232	0.269	-0.089	0.300	0.766
Age	-0.003	0.006	0.596	0.001	0.005	0.917	0.000	0.005	0.993	0.001	0.006	0.905
Family Size	-0.034	0.038	0.372	0.038	0.034	0.267	-0.009	0.036	0.795	-0.09	0.044	0.034
Earning Members	0.028	0.063	0.661	-0.020	0.059	0.736	0.092	0.060	0.124	-0.018	0.076	0.811
Primary level	-1.041	0.172	0.000	-0.732	0.151	0.000	-0.951	0.159	0.000	-0.44	0.213	0.037
HSE	-0.810	0.154	0.000	-0.461	0.145	0.002	-0.855	0.145	0.000	-0.375	0.203	0.064
HSE above	-0.714	0.207	0.001	-0.173	0.175	0.322	-0.736	0.196	0.000	-0.215	0.239	0.368
Owner only	0.650	0.209	0.002	0.259	0.191	0.174	0.715	0.202	0.000	-0.508	0.205	0.013
Worker only	0.143	0.142	0.312	0.002	0.136	0.986	0.194	0.137	0.156	0.686	0.204	0.001
Mechanized vessel	0.375	0.126	0.003	0.087	0.113	0.440	0.495	0.121	0.000	-0.524	0.146	0.000
House ownership	-1.483	0.251	0.000	-1.530	0.265	0.000	-1.428	0.227	0.000	-1.263	0.512	0.014
BPL	1.335	0.141	0.000	0.016	0.121	0.897	1.232	0.133	0.000	-0.058	0.150	0.700
Cooperative	-0.623	0.139	0.000	-0.309	0.129	0.017	-0.376	0.133	0.005	1.406	0.146	0.000
KCC	0.565	0.220	0.010	-0.250	0.225	0.266	0.478	0.215	0.026	-0.780	0.254	0.002
Number of income sources	-0.250	0.150	0.096	-0.333	0.135	0.013	-0.358	0.155	0.021	0.127	0.187	0.498
Land holding	-0.060	0.020	0.003	-0.066	0.017	0.000	-0.093	0.018	0.000	0.009	0.014	0.505
Constant	1.645	0.455	0.000	2.774	0.428	0.000	1.130	0.431	0.009	1.961	0.643	0.002

Number of observations =864; Wald Chi-sqr = 630.45; Prob Chi-sqr = 0.001; Likelihood ratio test of rho21 = rho31 = rho41 = rho32 = rho42 = rho43 = 0: chi2(6) = 518.973 Prob > chi^2 = 0.0000

Non-food-based income smoothing strategies

Under this broad dimension, five strategies were considered: borrowing, selling durable household assets, withdrawing prior savings, reducing educational spending, and reducing healthcare expenditure (Table 6). Male-headed households were more likely to liquidate assets. Aside from this, the financial strategies were largely independent of the gender of the household head. The likelihood of borrowing and reducing educational and healthcare expenditures decreases with age. The greater the number of earning members, the lower the likelihood that the family will borrow or sell durable assets, but the higher the likelihood that they will withdraw savings. This could be because larger families may have more income-earning opportunities, particularly as labourers.

Educational status exhibited a complex behavioural pattern: compared to illiterate fish workers, better-educated fish workers were progressively less likely to borrow. In terms of asset liquidation, all education categories showed a negative probability. Better-educated fish workers were also less likely to withdraw savings and reduce expenditures on education and medical care compared to their illiterate counterparts.

Compared to the "owner-worker" category, both "owner-only" and "worker-only" households were more likely to liquidate household assets, withdraw savings, and reduce medical expenses. Being associated with mechanized vessels was significantly related to the withdrawal of savings and reduction of educational expenses, both showing positive correlations. Homeownership was a major factor negatively associated with several strategies. Being in the Below Poverty Line (BPL) category increased the probability of borrowing and reduced educational expenditure. Families with larger landholdings were negatively associated with all strategies except asset liquidation.

Participation in the labour market and relying on social security

Three strategies were considered: participating in the labour market, relying on government-provided social security (including income transfers), and participating in the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) program (Table 7). The MGNREGA scheme ensures gainful employment for at least one member of a Below Poverty Line (BPL) rural household at a fixed wage rate for a minimum of 100 days per year in social asset-generating activities.

Among the variables, gender, employment status (owner only and worker only), and ownership of Kisan Credit Cards (KCC) were not found to be significant. Age was negatively associated with labour participation and reliance on social security contributions but positively associated with participation in MGNREGA programs. Larger family sizes were less likely to participate in wage labour and rely

on social security programs. The number of earning members was positively associated with participation in the labour market and social security programme, but negatively associated with participation in the MGNREGA scheme.

Gender, employment status (owner only and worker only), and Kisan Credit Card (KCC) ownership were not significant. Age was negatively associated with labour participation and social security reliance but positively linked to MGNREGA participation. Larger families were less likely to engage in wage labour or rely on social security. More earning members increased participation in the labour market and social security but decreased involvement in MGNREGA.

Better-educated household heads were less likely to engage in wage labour or rely on social security, with this effect increasing at higher education levels. The MGNREGA programme served as a key safety net during crises. Households with mechanized vessel workers were less likely to adopt these strategies, while homeownership improved access to wage labour and social security. BPL status increased the likelihood of participating in MGNREGA. Cooperative membership reduced wage labour participation but increased reliance on social security and MGNREGA. Landholding size positively influenced labour participation, social security access, and MGNREGA involvement, while multiple income sources reduced reliance on social security. Occupational diversification, social and ecological resilience, and multiple income sources strengthen the adaptive capacity of fishers during periods of vulnerability (Islam, 2024).

V

CONCLUSIONS

COVID-19 and its containment measures, like social distancing and restrictions on transport, have affected the fishers in a multitude of ways. The employment and income loss arising out of reduced activities in the fisheries sector was accentuated by the reduced income flow from other sectors as well. The severity of the employment and income loss fell disproportionately high on women, compared to their pre-pandemic levels. When the restrictions were relaxed and fishing-related activities were resumed, the fishers could sell their fish at higher prices compared to the normal price due to reduced supply. However, the fishing activities could not be resumed completely, as a large number of migrant fishers had left the harbours and landing centres. The income reduction has transcended to other activities, including the education of children, availing medical facilities, and other obligatory social functions. It has affected psychological well-being and interpersonal relationships, feelings of loss of prestige, and overall quality of life. The fishers tried to attenuate the situation by several coping strategies that included availing credit, asset liquidation, and reduction of household expenditure, including food and increased participation in the labour market.

TABLE 6: RESULTS OF THE MULTIVARIATE PROBIT ANALYSIS FOR CREDIT AND NON-FOOD-BASED INCOME SMOOTHING STRATEGIES

Explanatory Variables	Borrow money			Sale household assets			Withdraw savings			Reduced education expense			Reduce medical expense		
	Coefficient	SE	P-value	Coefficient	SE	P-value	Coefficient	SE	P-value	Coefficient	SE	P-value	Coefficient	SE	P-value
Gender HH	-0.279	0.275	0.311	0.835	0.219	0.001	0.169	0.303	0.577	0.100	0.248	0.686	0.093	0.247	0.707
Age	-0.016	0.006	0.010	0.008	0.006	0.194	-0.009	0.006	0.131	-0.013	0.005	0.016	-0.015	0.005	0.005
Family Size	0.035	0.040	0.373	0.104	0.045	0.019	0.021	0.040	0.601	0.029	0.036	0.417	0.036	0.035	0.306
Earning Members	-0.120	0.067	0.073	-0.163	0.072	0.024	0.221	0.072	0.002	-0.032	0.060	0.601	-0.023	0.060	0.708
Primary	-0.495	0.200	0.013	-0.612	0.178	0.001	-0.755	0.195	0.000	-0.752	0.157	0.001	-0.469	0.166	0.005
HSE	-0.883	0.182	0.000	-0.308	0.156	0.048	-1.115	0.181	0.000	-1.075	0.147	0.001	-1.090	0.152	0.001
HSE above	-1.790	0.215	0.000	-0.367	0.236	0.120	-0.522	0.228	0.022	-1.717	0.194	0.001	-1.855	0.193	0.001
Owner only	0.911	0.265	0.001	0.479	0.243	0.049	0.352	0.218	0.106	0.652	0.211	0.002	0.833	0.203	0.001
Worker only	-0.123	0.152	0.418	0.671	0.154	0.001	0.391	0.152	0.010	-0.175	0.139	0.207	0.256	0.139	0.064
Mechanized vessel	0.180	0.133	0.176	0.018	0.133	0.891	0.359	0.133	0.007	0.329	0.120	0.006	0.009	0.118	0.942
House ownership	-1.434	0.391	0.000	-1.288	0.163	0.000	-1.211	0.308	0.001	-1.372	0.240	0.001	-1.120	0.235	0.001
BPL	0.321	0.140	0.022	0.148	0.161	0.358	-0.594	0.140	0.001	0.438	0.122	0.001	-0.042	0.122	0.734
Cooperative	-0.173	0.150	0.249	0.745	0.173	0.000	0.024	0.144	0.866	-0.124	0.132	0.347	0.275	0.129	0.033
KCC	0.008	0.237	0.974	-0.070	0.319	0.826	-0.005	0.252	0.984	0.265	0.230	0.250	0.133	0.223	0.550
Number of income sources	-0.098	0.137	0.475	0.017	0.185	0.929	-0.830	0.152	0.001	-0.154	0.138	0.266	-0.318	0.134	0.017
Land holding	-0.124	0.019	0.000	-0.007	0.019	0.734	-0.053	0.016	0.001	-0.103	0.019	0.001	-0.071	0.017	0.001
Constant	3.769	0.566	0.000	-1.155	0.471	0.014	3.520	0.495	0.001	2.706	0.420	0.001	2.806	0.415	0.001

No. of observations: 864; Wald chi-square= 859.15; Log Likelihood= -1556.741; Prob Chi-Square= 0.001; Note: CE- Coefficient, SE- Standard error

TABLE 7: RESULTS OF THE MULTIVARIATE PROBIT ANALYSIS FOR SOCIAL SECURITY PROGRAMMES

Explanatory Variables	Wage Labour			Rely Social Security			MNREGA scheme		
	Coefficient	SE	p-value	Coefficient	SE	p-value	Coefficient	SE	p-value
Gender HH	-0.237	0.228	0.298	-0.049	0.201	0.808	-0.123	0.468	0.792
Age	-0.018	0.005	0.001	-0.010	0.005	0.040	0.019	0.009	0.040
Family Size	-0.123	0.038	0.001	-0.119	0.035	0.001	-0.016	0.072	0.830
Earning Members	0.325	0.062	0.001	0.167	0.057	0.003	-0.221	0.115	0.054
Primary	-0.091	0.148	0.537	-0.383	0.139	0.006	0.687	0.334	0.040
HSE	-0.280	0.140	0.045	-0.412	0.129	0.001	1.129	0.307	0.001
HSE above	-0.463	0.203	0.023	-0.832	0.178	0.000	0.838	0.415	0.043
Owner only	0.183	0.200	0.36	0.082	0.209	0.696	-0.166	0.443	0.707
Worker only	0.183	0.133	0.167	0.011	0.128	0.934	0.043	0.201	0.831
Mechanized vessel	-0.266	0.116	0.021	-0.480	0.107	0.000	-0.772	0.229	0.001
House ownership	0.483	0.160	0.003	0.426	0.148	0.004	0.120	0.324	0.711
BPL	0.891	0.140	0.001	0.031	0.121	0.798	0.738	0.240	0.002
Cooperative	-0.286	0.129	0.026	0.291	0.128	0.024	0.786	0.319	0.014
KCC	0.052	0.256	0.838	0.205	0.224	0.359	0.405	0.278	0.146
Number of income sources	0.249	0.130	0.055	-0.316	0.139	0.023	0.188	0.167	0.259
Land holding	0.039	0.014	0.006	0.040	0.013	0.003	0.052	0.019	0.007
Constant	-0.886	0.382	0.019	0.364	0.361	0.313	-4.308	0.769	0.001

Number of observations= 864; Wald Chi-Square= 242.82; Log Likelihood= -909.0463; Prob > Chi-square= 0V

The coping strategies also depend on the overall well-being of the family and the capability of rebuilding the assets and repaying the loans in such cases. Better educated fishers were able to cope better in a given circumstance. Ownership of valuable assets was also correlated with the coping strategies. In general, the well-endowed fishers had better access to coping strategies and adopted fewer impinging strategies. Having a diversified income source reduced the propensity to make coping strategies, as the risk is spread across several sources. The social capital of the members - fishers cooperatives, non-governmental organizations, and religion / caste-based organisations, and self-help groups-enabled fishers to have access to several coping strategies, including access to credit, both institutional and non-institutional. Access to housing and education was critical in coping with the situation with less impactful strategies.

One key aspect that affected the fisherfolk was the support by the government and local administrative bodies in the distribution of food through the public distribution system (PDS), provision of financial assistance, relaxation of the norms of loans from the public sector, etc. Such coping measures are being implemented by governments and other agencies worldwide (Love *et al.*, 2021, Ferrer *et al.*, 2021). Governments also promoted newer marketing strategies, including technology-enabled online marketing (Suresh *et al.* 2023). The role of the Government also emerged critical in addressing basic necessities, including food, and medical care, and in cushioning income shocks through income transfer measures. Those who were better educated were able to cope better. Those with their own house had better access to several opportunities and adopted fewer impinging strategies. Therefore, governments have to consider steps to facilitate possession of their own dwellings for the fisherfolk.

Policy-level actions are required to minimise the impact of COVID-19 and similar pandemics on the livelihood and welfare of the fishers despite the trade-off between safeguarding public health and sustaining the economy (Love *et al.*, 2021). Increased diversity could also enhance resilience at the state and local levels, provided that development aligns with local goals. Considering fisheries among essential services was practiced in many countries (Lester *et al.*, 2024). Deliberate effort is required to avoid the exclusion of vulnerable groups from accessing and managing resources and technologies. The experiences of coping with COVID-19 could help develop policies and strategies for the fisheries sector during similar situations in the future too.

Received: March 2025. *Revised: May 2025.*

REFERENCES

Abdelbaset M. (2023) Understanding the impact of COVID-19 on the livelihood resilience of small-scale fisheries: A comparative analysis, Master's thesis, University of Waterloo

Amaralal, K.H.M.L., E.M.A.P. Edirimanna, W.A.S.W. Lakmini, K.K.D. Chamodi, A.U. Kuragodage, R.G. Sanuja, E.G.K.Y.C. Bandara, M.M.A.S. Maheepala, M.N.D.F. Abeykoon, K.P.G.L. Sadaruwan, S. Kuganathan (2023), Impacts of COVID-19 pandemic on the fisheries sector of Sri Lanka, Marine Policy 147 105339.

Avtar, R., D. Singh, D.A. Umarhadi, A.P. Yunus, P. Misra, P.N. Desai, K.B.V.N. Phanindra (2021), Impact of COVID-19 lockdown on the fisheries sector: a case study from three harbours in Western India, Remote Sens. 13 183.

Bassett, H.R., J. Lau, C. Giordano, S.K. Suri, S. Advani, S. Sharan (2021), Preliminary lessons from COVID-19 disruptions of small-scale fishery supply chains, World Dev. 143 105473.

Bassett, H.R., S. Sharan, S.K. Suri, S. Advani, C. Giordano (2022). A comparative study of small-scale fishery supply chains' vulnerability and resilience to COVID-19, Marit. Stud. 21 173-192.

Belton, B., L. Rosen, L. Middleton, S. Ghazali, A.A. Mamun, J. Shieh, S.H. Thilsted (2021) COVID-19 impacts and adaptations in Asia and Africa's aquatic food value chains, Mar. Policy 129 104523.

Bennett, N.J., E.M. Finkbeiner, N.C. Ban, D. Belhabib, S.D. Jupiter, J.N. Kittinger, P. Christie (2020) The COVID-19 pandemic, small-scale fisheries and coastal fishing communities, Coastal Manag. 48: 336-347.

Berman, R., C. Quinn, J. Paavola (2012), The role of institutions in the transformation of coping capacity to sustainable adaptive capacity, Environ. Dev. 2 86–100.

Bhattacharjee, K., B. Behera (2018), Determinants of household vulnerability and adaptation to floods: Empirical evidence from the Indian State of West Bengal, Int. J. Disaster Risk Reduct. 31 758–769.

Bolognini, L. C. Frittelloni, F. Perretta, M. Scanu, F. Grati (2023). From crisis to opportunity: Developing a virtual marketplace to enhance sustainability and resilience in small-scale fisheries, Fishes 8 272.

Business Line (2020), Covid-19 inflicts a daily loss of ₹224 crore to India's fishery sector, The Hindu Businessline,. https://www.thehindubusinessline.com/economy/agri-business/covid-19-causes-a-daily-loss-of-224-crore-to-indias-fishery-sector/article31388582.ece.

Business Line, (2020) Covid impact: Sluggish demand hits India's seafood exports in 2019-20, The Hindu Businessline, https://www.thehindubusinessline.com/economy/agri-business/covid-impact-sluggish-demand-hits-indias-seafood-exports-in-2019-20/article32371582.ece.

Cáceres, R., J. Wandel, J. Pittman, P. Deadman (2024), Insights intended to improve adaptation planning and reduce vulnerability at the local scale, Front. Clim. 6 1345921.

Carpenter, S., B. Walker, J. Anderies, N. Abel(2001),. From metaphor to measurement: Resilience of what to what?, Ecosystems 4 765-781.

Carver, C.S., M.F. Scheier, J.K. Weintraub (1989). Assessing coping strategies: A theoretically based approach, J. Pers. Soc. Psychol. 56(2) 267–283.

Ceballos, F, .S. Kannan, B. Kramer (2020), Impacts of a national lockdown on smallholder farmers' income and food security: empirical evidence from two states in India, World Dev. 136 105069.

Chanrachkij, I., P. Laongmanee, J. Lanmeen, T. Suasi, J. Sornkliang, R. Tiaye, N. Yasook, S. Putsa, S.V. Chumchuen (2020), Severity of the impacts of COVID-19 pandemic on small-scale river fisheries of Thailand: a preliminary assessment, Fish for the People 18 43–47.

Collins, D.G., A.R. Holman, T.S. Hsu (2024), The psychological impact of the COVID-19 pandemic on Black social workers, J. Humanistic Counsel..

Compas, B.E., J.K. Connor-Smith, H. Saltzman, A.H. Thomsen, M.E. (2001) . Wadsworth, Coping with stress during childhood and adolescence: problems, progress, and potential in theory and research, Psychol. Bull. 127(1) 87.

Corlett R.T., R.B. Primack, V. Devictor, B. Maas, V.R. Goswami, A.E. Bates, R. Roth (2020) Impacts of the coronavirus pandemic on biodiversity conservation, Biol. Conserv. 246 108571. https://doi.org/10.1016/j.biocon.2020.108571.

Dercon, S. Income risk, coping strategies, and safety nets, World Bank Res. Obs. 17(2) (2002) 141–166. https://doi.org/10.1093/wbro/17.2.141

Dias, A.C.E., D. Armitage, P.K. Nayak, S.L. Akintola, E.K. Arizi, R. Chuenpagdee, B.K. Das, S.A. Diba, R. Ghosh, M. Isaacs, G.M.N. Islam (2023). From vulnerability to viability: A situational analysis of small-scale fisheries in Asia and Africa, Mar. Policy 155 105731.

FAO (2020). The impact of COVID-19 on fisheries and aquaculture: A global assessment from the perspective of regional fishery bodies. Initial assessment May 2020, No. 1, Rome, 2020. https://doi.org/10.4060/ca9279en.

FAO, 2021. https://openknowledge.fao.org/server/api/core/bitstreams/8976ee6f-e317-49ae-90b8-7e195594f90e/content.

Fergen, J.T. , R.D. Bergstrom, A.D. Steinman, L.B. Johnson, M.R. Twiss (2024), Community capacity and climate change in the Laurentian Great Lakes Region: the importance of social, human, and political capital for community responses to climate-driven disturbances, J. Environ. Plan. Manag. 67 993-1012.

Fernández-González, R., M.I. Pérez-Pérez, R. Pérez-Vas (2021). Impact of the COVID-19 crisis: Analysis of the fishing and shellfishing sectors performance in Galicia (Spain), Mar. Pollut. Bull. 169 112463.

Ferrer, A.J.G., R. Pomeroy, M.J. Akester, U. Muawanah, W.C. Chumchuen, K.K. Lee, P.G. Hai, K.K. Viswanathan (2021). COVID-19 and small-scale fisheries in Southeast Asia: Impacts and responses, Asian Fish. Sci. 34 99–113.

Folkman, S. (2020), Stress: appraisal and coping, in: Encyclopedia of Behavioral Medicine (Springer International Publishing, Cham, pp. 2177–2179.

Gabrielsen, P. (2003) P. Bosch, Environmental indicators: typology and use in reporting, EEA, Copenhagen. pp. 1–20.

Garai J. (2024)., The Aspects of Food Security and Subsistence Systems of Climate-Induced Hazards Affected Coastal People in the Era of the COVID-19 Pandemic in Bangladesh, Nat. Hazards Res.

Georgiou, P (2024). C. Mattas, K. Mattas, D. Lazaridou, S. Nastis, Sustainable Water Resources Management Based on the DPSIR Framework in East and West African Countries, in: Value Chain Dynamics in a Biodiverse Environment: Advances in Biodiversity, Sustainability, and Agri-food Supply Chain Development (Springer Nature Switzerland, Cham,) pp. 77–106.

Gonzalez-Pestana, A.., D.C. Thorne, J. Alfaro-Shigueto, J.C. Mangel (2023) Vulnerabilities of northern Peruvian small-scale fishing communities revealed by the COVID-19 pandemic, Mar. Policy 149 105503.

Greene W.H. (2003), Econometric Analysis (5th ed., Prentice Hall, New York University, Upper Saddle River, New Jersey, 827p.

Gule, T.T., B. Lemma, B.T. Hailu (2024), Factors impacting water quality and quantity in rapidly expanding urban areas based on the DPSIR model: experiences and challenges from Addis Ababa City, Ethiopia, Environ. Sci. Pollut. Res. 31(14) 22131–22144.

Gupta, J., M. Bavinck, M. Ros-Tonen, K. Asubonteng, H. Bosch, E. van Ewijk, M. Hordijk, Y. Van Leynseele, M.L. Cardozo, E. Miedema, N. Pouw (2021) COVID-19, poverty and inclusive development, World Dev. 145 105527.

Islam, M.S (2024). Fishers using social-ecological resilience adapting coastal disasters, Mitig. Adapt. Strat. Glob. Change 29(2) 17.

Jaikumar, M., D. Ramadoss, G.B. Sreekanth, K. Smrithi, R.D. Parihar (2023), Regional impacts of COVID-19 pandemic on aquaculture and small-scale fisheries: Insights and recovery strategies in India, Aquaculture 570 739403.

Klassen, S and S. Murphy (2020), Equity as both a means and an end: lessons for resilient food systems from COVID-19, World Dev. 136 105104.

Knippenberg, E., N. Jensen, M. Constas (2019), Quantifying household resilience with high frequency data: Temporal dynamics and methodological options, World Dev. 121,1–15.

Lau, J., S. Sutcliffe, M. Barnes, E. Mbaru, I. Muly, N. Muthiga, S. Wanyonyi, J.E. Cinner (2021). COVID-19 impacts on coastal communities in Kenya, Mar. Policy 134 104803.

Lazarus, R.S., S. Folkman (1984), Stress, Appraisal, and Coping (Springer Publishing Company, New York

Lester, S.E. R.R. Gentry, H.E. Froehlich, The role of marine aquaculture in contributing to the diversity and stability of US seafood production, Marine Policy 160 (2024) 105994.

Love, D., E.H. Allison, F. Asche, B. Belton (2021), Emerging COVID-19 impacts, responses, and lessons for building resilience in the seafood system, Glob. Food Secur. 28 100494. https://doi.org/10.1016/j.gfs.2021.100494

Mabe, F.N., E. Owusu-Sekyere, O.T. Adeosun (2021), Livelihood coping strategies among displaced small-scale miners in Ghana, Resour. Policy 74 102291.

Macusi, E.D. (2024) M.J.I. Bersaldo, R.E. Katikiro, N. Fadli, K.A. Deepananda, M.M.H. Mozumder, Impacts, challenges, and adaptation of small-scale fishers during the COVID-19 pandemic in selected tropical countries, Aquat. Sci. 86 33.

Macusi, E.D., S.K.V. Siblos, M.E. Betancourt, E.S. Macusi, M.N. Calderon, M.J.I. Bersaldo, L.N. Digal (2022), Impacts of COVID-19 on the catch of small-scale fishers and their families due to restriction policies in Davao Gulf, Philippines, Front. Mar. Sci. 8 770543.

Mathias, J.D., J.M. Anderies, A.S. Crépin, M. Dambrun, T. Lindahl, J. Norberg (2024), Emergence of social-psychological barriers to social-ecological resilience: from causes to solutions, Ecol. Soc. 29.

MSSRF (2020). COVID-19 Impact on Livelihoods of Marine Fishing Communities, M S Swaminathan Research Foundation Web Admin website, Retrieved July 7, 2020. https://www.mssrf.org/content/covid19-impact-livelihoods-marine-fishing-communities-0.

Mukherjee, M. (2024), S. Fransen, Exploring migration decision-making and agricultural adaptation in the context of climate change: A systematic review, World Dev. 179 106600.

Adger, N., N. Brooks, G. Bentham, M. Agnew, S. Eriksen (2004) New indicators of vulnerability and adaptive capacity, Technical Report 7, Tyndall Centre for Climate Change Research,.

Ezzeddin, N., N. Kalantari, M. Abdollahi, P. Amiri, B. Amini, F. Zayeri (2024), Outcomes of a homestead food production program on nutritional knowledge, dietary diversity, food security and empowerment of rural women in Tehran province, Iran, BMC Public Health 24(1) 118.

Northrop, E., M. Konar, N. Frost, E. Hollaway (2020), A Sustainable and equitable blue recovery to the COVID-19 crisis, World Resour. Inst., Washington DC.

Nyiawung, R.A., T. Ehrlick, N.J. Bennett, N.D. Brunet, F. Matos, C. Pita, J.S. Stoll, P.A. Loring (2024). Fisheries and the COVID-19 pandemic: A global scoping review of the early pressures, impacts, and responses in least developed, emerging, and developed countries, Reg. Stud. Mar. Sci. 74 103501.

Paumgarten, F., B. Locatelli, E.T. Witkowski, C. Vogel, (2020) Prepare for the Unanticipated: Portfolios of Coping Strategies of Rural Households Facing Diverse Shocks, J. Rural Stud. 80 91–100.

Pita, C. (2021) Life and livelihoods: the impact of COVID-19 on small-scale fishing communities, 2021. https://www.iied.org/life-livelihoods-impact-covid-19-small-scale-fishing-communities.

Preston, B., M. Stafford-Smith (2009) Framing vulnerability and adaptive capacity assessment: Discussion Paper, CSIRO Climate Adaptation Flagship Working Paper,.

Quinn, C.H., G. Ziervogel, A. Taylor, T. Takama, F. Thomalla (2011), Coping with multiple stresses in rural South Africa, Ecol. Soc. 16.

Samal, R., M. Dash (2024), Stakeholder engagement in advancing sustainable ecotourism: an exploratory case study of Chilika Wetland, Discover Sustain. 5(1) 50.

Santos, E., F. Fonseca, A. Santiago, D. Rodrigues (2024), Sustainability Indicators Model Applied to Waste Management in Brazil Using the DPSIR Framework, Sustainability 16(5) 2192.

Seixas, S. T. Verdelhos, H. Veríssimo (2024), How COVID-19 pandemic affected fisheries (catch volume and price): A case study in Europe, Marine Policy 159 105896.

Sunny, A.R., S.A. Sazzad, S.H. Prodhan, M. Ashrafuzzaman, G.C. Datta, A.K. Sarker, M. Rahman, M.H. Mithun (2021). Assessing impacts of COVID-19 on aquatic food system and small-scale fisheries in Bangladesh, Marine Policy 126 104422.

Suresh, A., P. Krishnan, G.K. Jha, A.A. Reddy (2022), Agricultural sustainability and its trends in India: a macro-level index-based empirical evaluation, Sustainability 14(5): 2540.

Suresh, A., V.K. Sajesh, R.R. Prakash, A.K. Mohanty, L.N. Murthy, A.K. Jha, C.N. Ravishankar (2022). COVID-19 and marine fishers in India: livelihood implications and coping strategies, Agric. Econ. Res. Rev. 35 79-94.

Turchi, A., R. Lumino, D. Gambardella, M.F. Leone (2023), Coping Capacity, Adaptive Capacity, and Transformative Capacity Preliminary Characterization in a "Multi-Hazard" Resilience Perspective: The Soccavo District Case Study (City of Naples, Italy), Sustainability 15(14) 10877.

White, E.R., H.E. Froehlich, J.A. Gephart, R.S. Cottrell, T.A. Branch, R. Agrawal Bejarano, J.K. Baum (2021). Early effects of COVID-19 on US fisheries and seafood consumption, Fish Fish. 22 232-239.

WHO (2022), The impact of COVID-19 on mental health. Available online: https://www.who.int/news-room/feature-stories/detail/the-impact-of-covid-19-on-mental-health-cannot-be-made-light-of

Woodhouse P., D. Howlett, D. Rigby (2000), A Framework for Research on Sustainability Indicators for Agriculture and Rural Livelihoods, Working Paper 2; Department of International Development Research: UK,. Available online: https://www.gov.uk/research-for-development-outputs/a-framework-for-research-on-sustainability-indicators-for-agricultureand-rural-livelihoods-working-paper-2 (accessed on 4 February 2022).