Indian J. Fish., 70 (2): 116-125, 2023 doi:10.21077/ijf.2023.70.2.120615-15

Available online at: epubs.icar.org.in/index.php/IJF

# The impact of COVID 19 pandemic on marine fisheries sector: A case study from Andhra Pradesh, India

**J. Charles Jeeva[1*], Muktha Menon[1], S. S. Raju[1], R. Narayanakumar[2], L. Loveson Edward[1], M. Satishkumar[1] and Shubhadeep Ghosh[1]**

[1]Visakhapatnam Regional Centre of ICAR-Central Marine Fisheries Research Institute, Visakhapatnam-530 003, Andhra Pradesh, India
[2]Madras Regional Station of ICAR-Central Marine Fisheries Research Institute, Chennai-600 028, Tamil Nadu, India

## Abstract

This study discusses the impact of first and second waves of the COVID-19 pandemic on marine fisheries sector of Andhra Pradesh, India, covering the aspects of active fishing days, perception on reduction or enhancement of demand for fish, trends in price realisation, challenges encountered in marketing the fish, perceptions on government interventions as well as changes in socio-behavioural issues. The study was conducted during the period from June to September 2021, among a sample of 152 stakeholders involved in fishing and allied activities from Srikakulam, Vizianagaram, Visakhapatnam, East Godavari and Krishna districts in Andhra Pradesh. Average number of active fishing days in a month was found to be 11.44 during the first wave and 15.10 during the second wave periods. Nearly three-fourth of the respondents (73.68%) perceived that there was reduction in demand for fish during the first wave of the pandemic, and it was to the tune of 40%. Reduction in the daily earnings was reported to the tune of 37.09%. The challenges encountered in marketing the fish were, getting export orders, access to market, availability of storage, transportation and logistics. Peer interaction, time spent with family members and time spent in social media were higher than usual during both waves of the pandemic. Changes or disruptions in usual marketing channels were reported during both the periods. Satisfied perception was expressed on government interventions such as ration, timely advisories, health care and sanitary measures. A few positive impacts on fisheries observed during the pandemic were product innovations, new distribution channels such as online marketing, e-commerce and home deliveries, shortening of supply chains including elimination of auction at fishing harbour, lowering of ocean pollution as well as government reforms. From the results of the study, we propose socio-economic interventions to be taken up by concerned governments for ensuring that the impact of the pandemic is mitigated and also that any future pandemic can have minimal impacts on the fishing community.

*Correspondence e-mail:
jcjeeva@gmail.com

Keywords:
Export market, Livelihood, Lockdown, Nutritional security, Policy interventions, Socio-behavioural issues, Supply chains

Received : 27.01.2022
Accepted : 18.05.2023

## Introduction

The world has been battling with the COVID pandemic since early 2020 with disruptions to almost every aspect of human life. The primary sectors of agriculture including fisheries have also been impacted significantly putting at risk the livelihood and nutritional security of the stakeholders. The fisheries sector and seafood industry have been beset with disruptions in demand, distribution, labour and production (Love *et al.*, 2021). Many countries saw a significant decline in capture fisheries production with the US reporting a drop of 40% in their fish catches (White, 2020; FAO, 2021). Demand for fresh fish also saw a decline globally particularly with the shutdown or restrictions on food supplying services like restaurants in many countries (FAO, 2021). Consumers also shifted from fresh fish to frozen,

canned or processed in some form (FAO, 2021). Distribution channels across the world were disrupted severely by the lockdowns and/or travel restrictions in place resulting in severe impacts on the transportation and distribution industry (FAO, 2021). Lockdowns as well as the reduction in demand and distribution of fish also impacted labour in the global fisheries sector (FAO, 2021).

India by then had to contend with two 'waves' of the COVID infection, the first during March 2020-February 2021 and the second during March-September 2021. The strategies to combat the COVID pandemic included a lockdown in India during March-May 2020 which was lifted gradually over several phases, each with its own set of regulations. The restrictions placed by the government led to cessation of almost all major economic activities in the country (Sharma *et al.*, 2021) and in turn this had spill-over effects across multiple sectors of the country (Avtar *et al*, 2020; Yunus *et al.*, 2020).

The fisheries sector in India too was not spared by the impacts of the COVID 19 pandemic. Small-scale fishermen of wetlands in India have reported loss in fishing days, loss in production, loss in income and consequent psychological impacts due to the pandemic (Das *et al.,* 2021). Marine fishing along the north-west coast of India along the state of Gujarat totally stopped for ten weeks during March to May 2020 and the capture production of fish and shrimps showed a 25% decline post-pandemic (Avtar *et al.*, 2021). As a result, the livelihood security of fishermen and associated workers in the marine fisheries sector of the region declined (Avtar *et al.*, 2021). The Covid 19 pandemic resulted in an economic loss of ₹3481 crores for 60 days in the marine fisheries sector of Kerala (Ramachandran *et al.,* 2020). This loss was estimated from fish landings, price realisation both at the landing centre and retail markets as well as reduction in export earnings. With a marine fisheries sector that supports 8,93,258 fishermen families of which 67.3% are below the poverty line (CMFRI-DoF, 2020), impact of COVID on the sector will not be trivial and could have major repercussions on the nutritional and livelihood security of dependent communities.

With a production of 1.95 lakh t, Andhra Pradesh was the sixth highest in terms of annual marine landings in 2020 (CMFRI, 2020). Nearly 1.55 lakh fishermen families (CMFRI-DoF, 2020) depend on the marine fisheries sector of the State for their nutritional and livelihood security. The fisheries and aquaculture sector of the State also has been impacted by the COVID-19 pandemic in terms of reduction in number of fishing days from 25 during pre-pandemic months to a range of 13-18 in the post-lockdown months (Middleton *et al.*, 2020). In this context, we conducted this study to understand the impact of the first and second waves of the COVID-19 pandemic on marine fisheries sector of the State of Andhra Pradesh. We covered aspects related to active fishing days, perception on reduction or enhancement of demand for fish, trends in price realisation, challenges encountered in marketing of fish, household expenses and savings pattern, perceptions on government interventions, changes in socio-behavioural issues, socio-economic or livelihood issues and the probable positive impacts on fisheries. From the results of the study, we propose socio-economic interventions to be taken up by concerned governments for ensuring that the impact of the pandemic is mitigated and also that any future pandemic can have minimal impacts on the fishing community. The results of the study though, from a small region, is applicable to almost all tropical marine fishing regions of the world and the suggestions put forth here can be a guide for policy interventions in other similar regions also.

## Materials and methods

The study was conducted during the period from June to September 2021, among a sample of 152 stakeholders involved in fishing and allied activities from Srikakulam, Vizianagarm, Visakhapatnam, East Godavari and Krishna districts in Andhra Pradesh (Fig. 1.). Stakeholders included fishermen operating in the mechanised and motorised sectors. The mechanised sector pertains to the fishing sector which uses mechanisation for travelling to fishing grounds and to operate fishing gears. The major constituents of the mechanised sector are the trawl fishermen. Motorised sector refers to the sector which uses motorisation to travel to the fishing grounds but operation of fishing gears is done manually. This sector includes fishermen operating gillnets, single hooks and lines as well as longlines. In addition to fishermen, respondents covered were those dealing with fish trade and marketing. The responses were collected using pre-tested interview schedules. Frequencies and percentages were used to draw meaningful conclusions.

## Results and discussion

### Socio-personal profile

The mean age of the respondents was 43 years. More than one-third of the respondents (43.42%) had primary school level of education followed by illiterate (42.10%) and secondary school level (14.47%). Nearly, 92% of the respondents belonged to below poverty line. The occupational profile of the respondents is given in Fig. 2.

### Active fishing days during first and second phases of COVID pandemic

Average number of active fishing days by motorised and mechanised crafts in a month was found to be 11.44 (standard deviation, SD: 2.50) during the first wave and 15.10 (SD: 6.32) during the second wave. The same during the pre-pandemic period was 19.05 (SD: 3.75). This equates to an average reduction in fishing days by 39.9% during the first wave and 20.7% in the second wave. The figure arrived

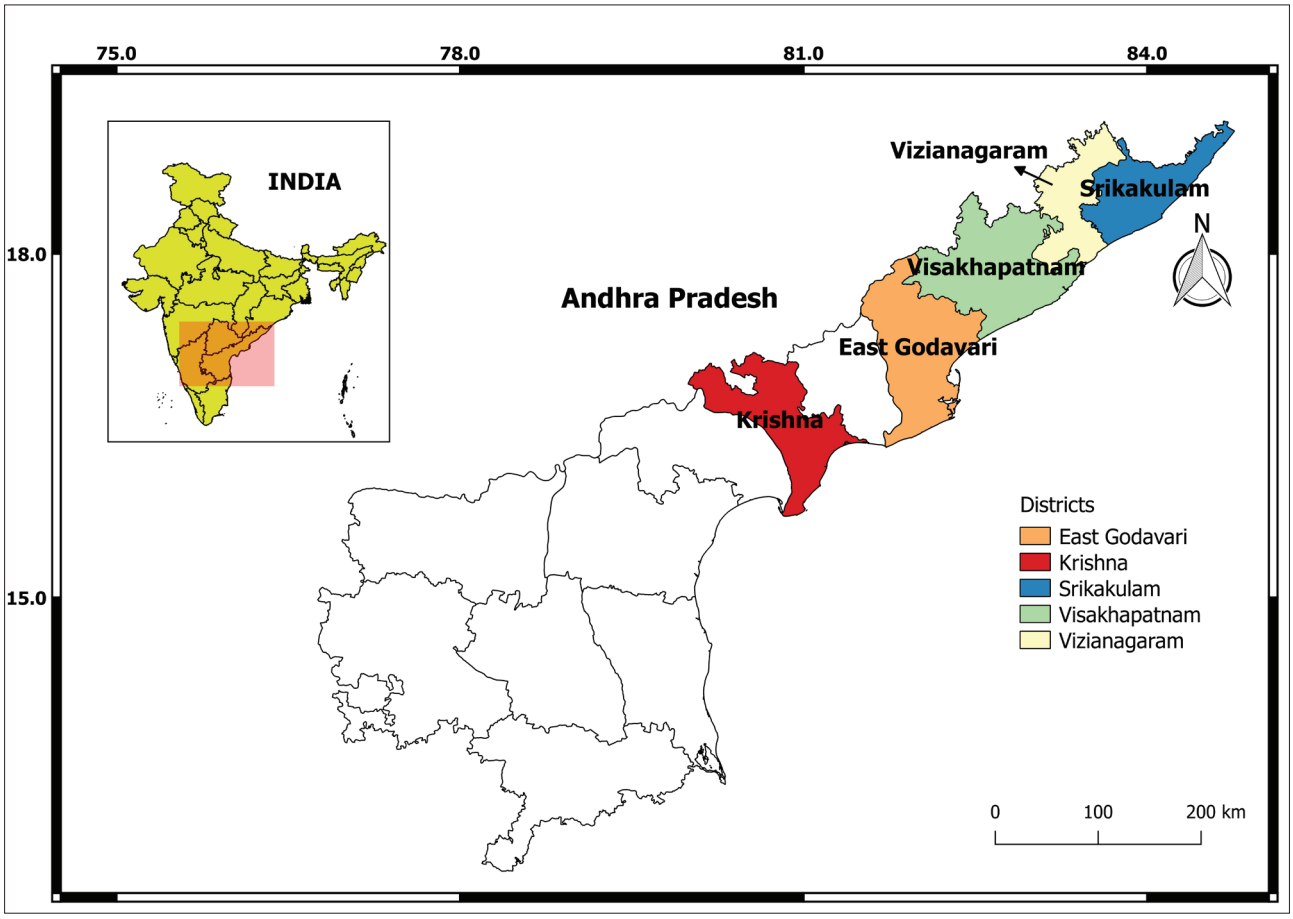


Fig.1. Locale of the study

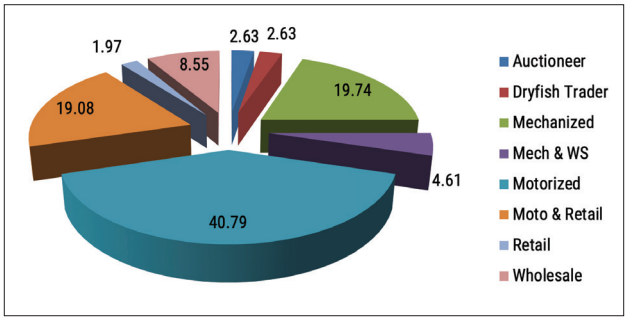


Fig. 2. Occupational distribution of the respondents (%)

at include the fishing ban imposed by the government for a period of 61 days, from April 15 to June 16. Similar reduction in fishing was seen in other parts of the country. In a case study from three harbours in Western India, Avtar *et al.* (2021) reported that during the peak of the lockdown, the 'area under fishing boats' near the docks and those parked on the land area increased by 483, 189 and 826% at Mangrol, Veraval, and Vanakbara harbours, respectively. As a result, a reduction of 25% was reported from these three harbours due to the pandemic (Avtar *et al.*, 2021). In the wetland fisheries sector of the country, a 100% reduction in active fishing days was seen during the lockdown period in the states of Bihar, West Bengal and Assam (Das *et al.*, 2021). During the second wave of the pandemic, there was a decrease in fishing days by 73%, 56% and 30% in the three states (Das *et al.*, 2021). Thus, a direct impact of the pandemic and subsequent lockdown was a cessation of fishing and reduced income for fishermen across the country, both in marine and inland sectors.

## Perception on reduction/ enhancement of demand for fish

Nearly three-fourth of the respondents (73.68%) perceived that there was reduction in demand for fish during the first wave of the pandemic to the tune of 40%. The fear factor on fish consumption during the initial stages of the spread of the pandemic was the major reason for the reduction in demand. However, mixed perception was observed during the second wave of the pandemic, as 49% of the stakeholders perceived reduction in demand for fish to the extent of 48.51 and 51% of them perceived increase in the demand for fish (26.65% increase).

Globally, the reduction in demand for fish was mostly related to reduction in demand from the service sector such as restaurants and hotels, due to lockdowns as well as international trade restrictions (Menhat *et al.*, 2021). In countries like Bangladesh, the disruptions in supply chains reduced the diversity of fish available for consumers which led to decreased demand for fish (Sunny *et al.*, 2021). In India also, a similar situation was seen in the inland fisheries sector. A reduction in consumption of fish was reported from West Bengal (Das *et al.*, 2021) but this was more due to reduction in supply of fish and subsequent price rise rather than fear factor. The demand for fish remained high even during the lockdown in high fish consuming states like West Bengal (Das *et al.*, 2021).

## Changes in price of fish

As reported by 86.18% of the respondents, there was a reduction in the price of fish at various levels of the marketing channels *viz.* landing centre, whole sale and retail levels with 40, 30 and 20% reduction of prices respectively. It also depended on the market situation in Kerala, as most of the commodities were sent for export through Kerala, and the initial lull in the export orders affected the fish price. An interaction with a wholesale trader at Visakhapatnam Fishing Harbour revealed that during the first wave of the pandemic, he sold the catches worth ₹1,50,000/-for ₹30,000/-, incurring a loss of ₹1,20,000/-. During the second wave too, he sold commodities worth ₹1,20,000/-for just ₹90,000/-incurring a loss of ₹30,000/-. Another wholesale trader from Pudimadaka Landing Centre in Andhra Pradesh, trading tuna, reported a loss of ₹30.00 lakhs during the initial stages of the first wave, as the export company in Kerala, to which he used to send the commodities, incurred a loss of about ₹1.50 crore due to decline in export orders. Hence, the commodities were sold in domestic markets or sold as dry fish and hence incurred losses. However, the situation was better during the second wave, as 52% of them reported 20% increase of prices at the three levels of the marketing channels *viz.,* at landing centre, whole sale and retail levels.

From the trends in price realisation as given in Fig.3, it could be understood that though it was predominantly lower than usual at landing centre (58.55%) and wholesale (60.52%) levels in the first wave, the situation was higher than usual during the second wave at these two levels (50.66 and 51.31% respectively). However, there was no change in price realisation at retail level both during the first wave (51.32%) and second wave (52.63%). It could be observed that during second wave, the situation was almost as usual like pre-pandemic period.

Almost all the respondents reported reduction in the daily earnings during the first wave, which was to the tune of 37.09%. However, it was a mixed response during the second wave, as 45% of them reported reduction in daily earnings (49.22% reduction), and 55% of them reported enhancement in daily earnings, to the extent of 25.78%. By the time the Central Government recognised the marine and aquaculture fisheries sector, it was already 10 April 2020, 16 days into the lockdown. This group was hard hit by the sudden lockdown. Customarily, 15 April 2020 was the start of the annual two-months ban on marine fishing that allows fish to breed and stock to be maintained. The delay in permitting these activities had already hurt the fishing community in some states, for whom the weeks before 15 April typically accounted for a disproportionate share of their annual earnings (Narayanan and Saha, 2020).

## Challenges encountered in marketing the fish during the COVID period

The challenges encountered in marketing the fish during first and second waves of the pandemic were assessed on a three-point continuum *viz.,* 'very difficult', 'difficult' and

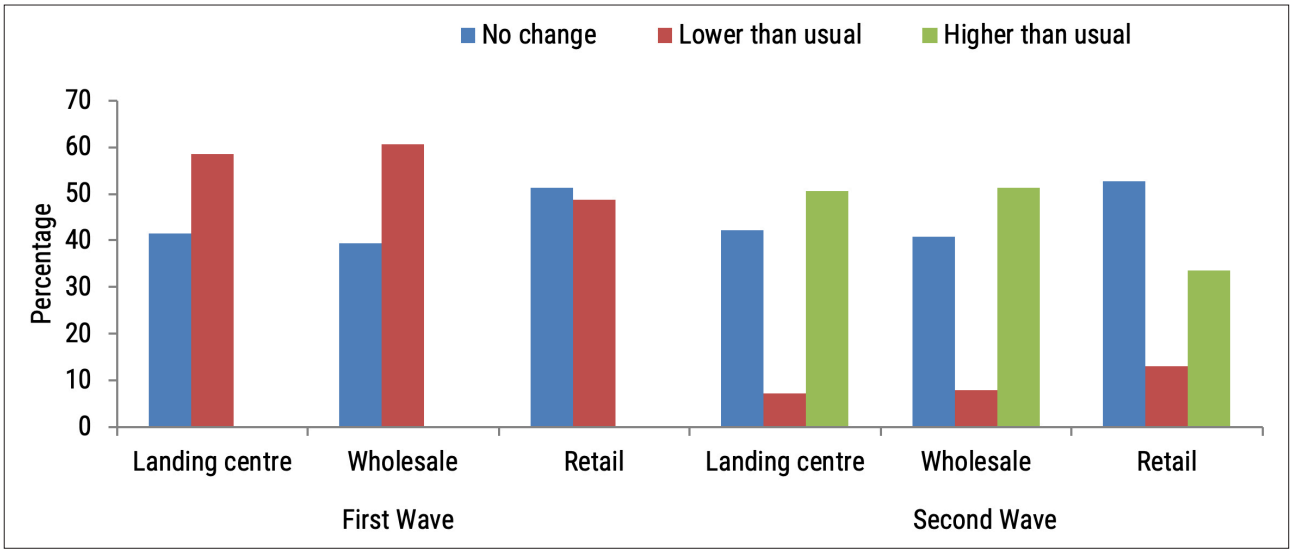


Fig. 3. Trends in price realisation (%)

'no problem' (Fig. 4). It was observed that getting export orders was reported as 'difficult' (40.13%) to 'very difficult' (32.24%); access to market (61.84%), availability of storage (40.79%) and transportation and logistics (35.53%) as 'difficult' during the first wave. However, there was mixed response regarding getting export orders during the second wave, as nearly equal percentage of them reported it as 'difficult' (48.68%) and 'no problem' (49.34%). Availability of crew/ labourers, availability of diesel, availability of ice and most importantly, availability of fish were not reported as major constraints during both the waves. The fish production and export were affected due to lack of transportation facility, difficulties in sending export documents due to non-availability of courier services, containers and difficulties in clearing containers in importing countries.

The demand was reduced in the food service segment as a result of the closure of family functions, restaurants, canteens and institutional catering, due to the lockdown. Most faced serious difficulties in getting their produce to markets, both on account of transport restrictions and intermittent closure of regulated markets or *mandis* (Rawal and Kumar, 2020). Traders were reluctant to transport produces because of uncertainties in moving goods, and in the face of a collapse in demand, especially in large urban centres, prices crashed. Many fisherfolk who were at sea when the lockdown was announced were left with unsellable catch. Evidence based on data, newspaper reports, and detailed narrative accounts from villages confirm large-scale disruptions in agri-food chains (Narayanan and Saha, 2020a; Seth and Vishwanathan, 2020). In a reply to Rajya Sabha unstarred question no.1384, answered on 12 February, 2021, it was reported that the Government of Andhra Pradesh has estimated a loss of about ₹282.24 crore in marine fisheries, inland fisheries, shrimp hatcheries and aquaculture business activities in the State (Rajya Sabha Unstarred Question No.1384, 12 February, 2021, Department of Fisheries, Ministry of Fisheries, Animal Husbandry and Dairying, Govt. of India).

COVID-19 also affected the export of agricultural products, and in the first three months of 2020-21, the export of agricultural products such as fresh as well as processed fruits and vegetables, food grains including rice, spices, sugar, molasses and cotton were comparable or even higher than the corresponding period in 2019-20. Exports of animal and marine products, tea and coffee, oilseeds and oil meals, as well as other processed items declined. Monthly exports data indicated that export of agricultural products got impacted to some extent in March 2020 and greatly in the month of April (lockdown period in most of the countries), although export of non-basmati rice, food grains and sugar had increased in April. Agricultural exports rebounded in May and June and were even higher than in the corresponding month of previous year for many of the commodities. The disease has certainly reshaped the consumer behaviour (may be temporarily) in terms of declining demand for animal protein sources to vegetative sources, and the decline in the export of these products signifies this behaviour (Sharma *et al,* 2021).

FAO studies reported that the drop in demand, which in some cases had resulted in reduced prices of fish and fish products, have stopped or reduced activity for many fishing fleets, as their work had become unprofitable. Fleets relying on export markets were more impacted than those serving domestic markets. Sanitary measures (physical distance between crew members at sea and use of facial masks), and lack of necessary equipment (*e. g.* masks and gloves) were making fishing difficult (and in some cases more dangerous)

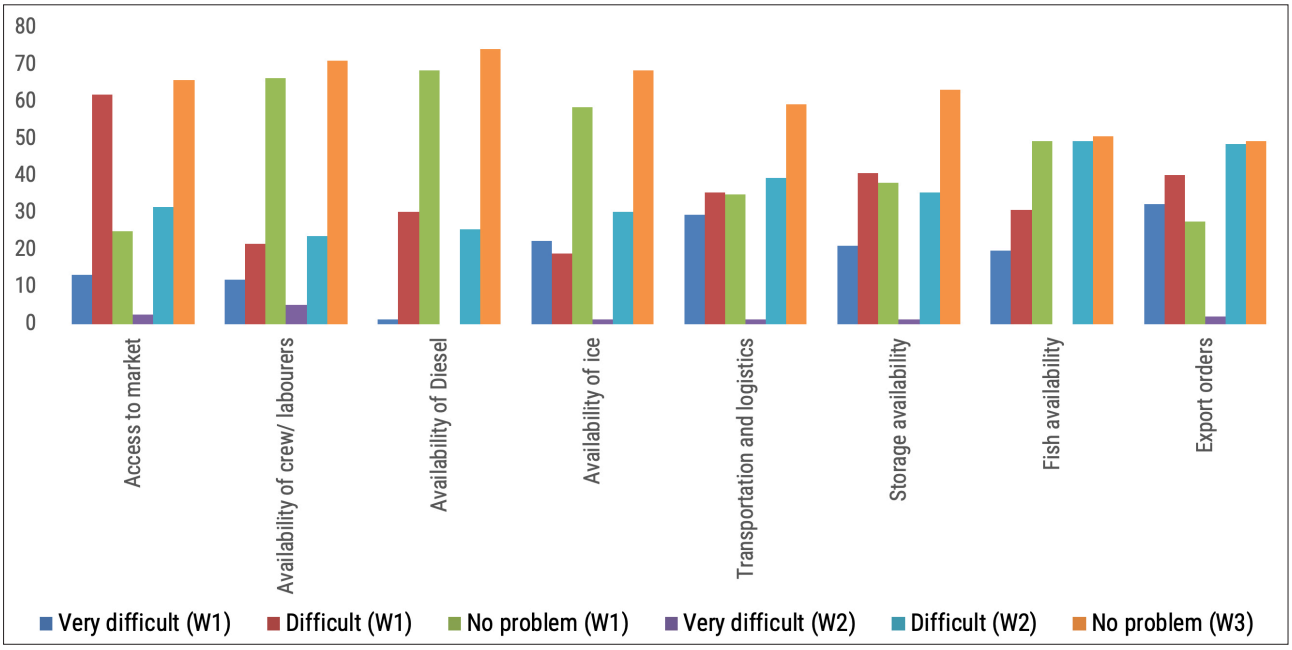


Fig. 4. Challenges encountered in production and marketing the fish during the COVID period (%; W1-Wave 1; W2-Wave 2)

and could also cause a cease of activity. Limitations of input supplies (*e. g.* ice, gear, bait) due to suppliers being closed or unable to provide inputs on a credit basis was yet another constraint on the fishing industry (White, 2020; FAO, 2021).

## Sources of household items during COVID times

The findings on sources of household items during COVID times are presented in Fig. 5, from which it could be seen that savings due to reduction in family expenditure (58.55 and 73.68%) and free public distribution system by the government (58.55 and 58.55%) were the major sources, followed by government pension and other employment such as business, agriculture and labour, during both the waves. Non-institutional finance through private money lenders and gold loans also supported household expenditure to an extent.

## Household expenses and savings pattern

From Table 1, it could be seen that the household expenses on health care and food/nutrition have increased, and the same has decreased on recreation, education, marriages/ festivals, charity and savings during the first wave. A similar trend was observed during the second wave with reference to the expenditure on health care and food/nutrition.

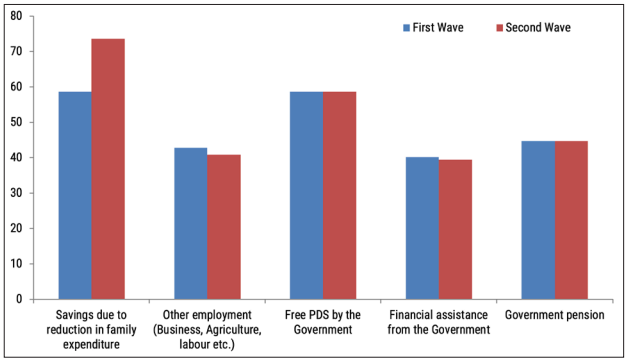


Fig. 5. Source of household items during COVID times (%)

Composition of food basket varies across expenditure classes. With an increase in income, an average household diversifies its food basket and allocates relatively higher food budget to high-value food commodities (Carmelia *et al.*, 2019). Conversely, in case of a decline in income, they would tend towards consumption of staple foods and necessary expenses. As non-food items are relatively more elastic than food items, decline in the expenditure on non-food items would be relatively steeper than on food. The decline in the non-food expenditure was estimated to range between 7.69 and 32.79%, whereas food expenditure was expected to squeeze by 4.98% to 21.24% during 2020-21 under the different scenarios. In absolute terms, *per capita* monthly non-food expenditure in 2020-21 would be ₹101 to ₹432 less than in the year 2019-20. Within the food basket, cereals would witness the lowest decline in consumption (2.32 to 9.89%) as compared to the other food commodities. The decline in the consumption of high value food commodities such as milk, non-vegetarian products, fruits, and other food products (beverages, dry fruits and processed food) would be comparatively higher than the staple foods such as cereals, pulses, and edible oils (Sharma *et al.*, 2021).

## Perceptions on government interventions

Perceptions on government interventions were assessed on a five-point continuum. From Fig. 6, it could be seen that they expressed highly satisfied perception on the parameters 'ration' (47.37%), and satisfied with the parameters such as 'timely advisories' (71.71%), 'health care' (69.08%) and 'sanitary measures' (65.79%). They expressed 'undecided' perception on 'fishery regulations' (43.42%) and 'elimination of auctioning' (50.00%).

Table 1. Household expenses and savings pattern

| Expenses and savings pattern | First wave | | | | Second wave | | | |
|---|---|---|---|---|---|---|---|---|
| | Reduction | | Increase | | Reduction | | Increase | |
| | Yes (%) | % Reduction | Yes (%) | % Increase | Yes (%) | % Reduction | Yes (%) | % Increase |
| Food/Nutrition | 42.77 | 37.00 | 57.23 | 26.71 | 22.37 | 45.81 | 77.63 | 18.53 |
| Health care | 21.71 | 37.58 | 78.29 | 52.73 | 10.53 | 3.95 | 96.05 | 42.71 |
| Recreation | 78.94 | 57.67 | No | No | 36.18 | 87.78 | 42.11 | 23.64 |
| Education | 73.02 | 55.81 | No | No | 27.63 | 86.43 | 48.68 | 39.07 |
| Marriage/Festivals | 78.94 | 65.56 | No | No | 36.18 | 87.31 | 42.76 | 51.70 |
| Charity | 58.55 | 74.25 | No | No | 42.11 | 73.00 | 16.45 | 38.00 |
| Savings | 77.63 | 66.42 | No | No | 36.84 | 86.67 | 39.47 | 26.34 |

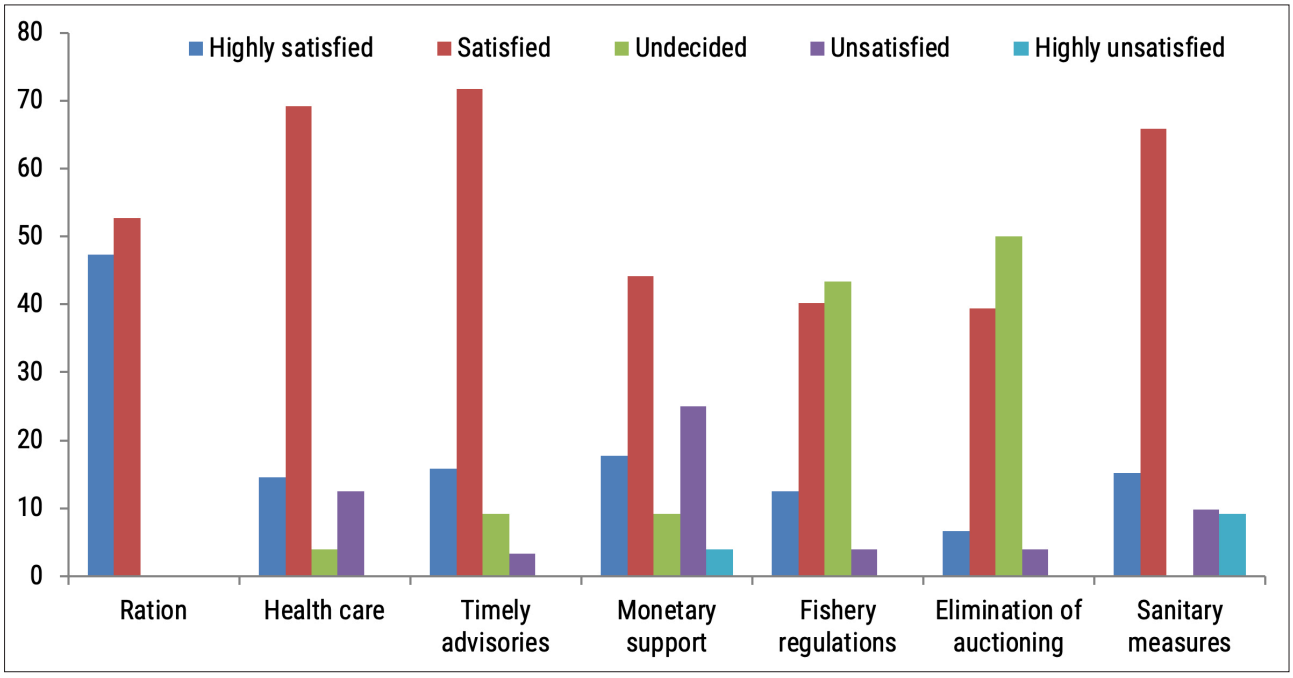


Fig. 6. Perceptions on government interventions (%)

In view of the spread of COVID-19 pandemic and in order to mitigate the impact of the crisis to fishers and fish farmers, several measures were taken to facilitate the activities during the lockdown including exemption of operation of marine fisheries and aquaculture activities from the restrictions under the lockdown issued by Ministry of Home Affairs. The Pradhan Mantri Matsya Sampada Yojana (PMMSY) scheme supports aquaculture activities such as establishment of hatcheries, construction of rearing ponds (nursery/seed rearing ponds), grow-out ponds, inputs for aquaculture and construction of RAS/biofloc ponds. MPEDA had intervened at various levels to reduce the impact of COVID 19 pandemic in the aquaculture sector. Various measures have been taken by MPEDA in coordination with Central and State Governments to build confidence among the aquaculture farmers and provide them both forward and backward linkages (Sharma *et al.*, 2021).

The government also issued a detailed note specifying standard operating procedures for different activities. Among other stipulations, it emphasised that people engaged in maintaining supply chains would be allowed to commute with an e-pass or any other certification issued by the concerned local authorities and a valid photo identity card. In the case of the unorganised sector, persons engaged in the supply of essential goods would be allowed to commute with the approval of local authorities. Here again, the focus was overwhelmingly on distribution. Many coastal states began addressing the issue of marine fishing fairly early during the lockdown. Many key states, where marine fishing is of crucial importance had already established guidelines to permit such activities (Narayanan and Saha, 2020).

## Changes in socio-behavioral issues

From Table 2, it could be seen that peer interaction, time spent with family members and time spent in social media were higher than usual during both the waves of the pandemic.

Table 2. Changes in socio-behavioral issues (%)

| Socio-behavioural issues | First wave | | | Second wave | | |
|---|---|---|---|---|---|---|
| | No change | Lower than usual | Higher than usual | No change | Lower than usual | Higher than usual |
| Peer interaction | 21.05 | 38.16 | 40.79 | 34.87 | 22.37 | 42.76 |
| Time spent with family members | 20.39 | 0.66 | 78.95 | 39.47 | 18.42 | 42.11 |
| Domestic violence | 40.79 | 49.34 | 9.87 | 48.68 | 48.68 | 2.63 |
| Depression due to pandemic | 22.37 | 19.74 | 57.89 | 32.89 | 44.74 | 22.37 |
| Alcoholism | 14.47 | 73.68 | 11.84 | 25.66 | 64.47 | 9.87 |
| Interaction with line departments | 32.24 | 35.53 | 31.58 | 35.53 | 32.24 | 32.24 |
| Time spent in social media | 21.71 | 2.63 | 75.66 | 23.03 | 25.00 | 51.97 |

With reference to domestic violence, no change or lower than usual trend was reported during both the waves. Though the depression due to pandemic was higher than usual (57.89%) during the first wave, it was perceived as lower than usual (44.74%) during the second wave. Alcoholism was lower than usual during both the waves, which might be due to the closure of liquor shops.

## Other socio-economic/livelihood issues

The other socio-economic/livelihood issues observed during the pandemic are presented in Table 3. Majority of the respondents did not report any migration out of fishery or reverse migration into fishery, changes in gender roles, livelihood of fisherwomen, limitations of input supply, stranding of fishing crew and reduction in food, fish consumption/ malnutrition during both the waves of the pandemic. Changes or disruption in usual marketing channels were reported during both the periods. Though few cases of stranding of fishing crew were reported, mostly it was within the state, and a few cases of inter-state stranding of crew as a few crew from Andhra Pradesh were stranded in Gujarat. The disruption in distribution channels happened due to decline in export orders during the initial period of the pandemic.

Women are traditionally and predominantly involved in post-harvest sectors, where the reduction of fishing and fish farming activities affects women's livelihoods and income due to shortage of fish available for processing and trade. The restrictions in mobility affecting logistics and the transfer of fish to the markets is further limiting the quantum of fish to be processed and sold by women. There is also an increased risk for women processors, of food loss and waste if they do not have appropriate storage and cold chain systems (FAO, 2021).

Globally, movement restrictions for professional seafarers and marine personnel, who have not been permitted to disembark in ports and transit through national territories, have prevented crew changes and repatriation. This has resulted in cases where fishing crews have been stranded for many months at sea on vessels or in foreign countries and without wages, thus becoming a human rights crisis, especially for migrant and transitory workers. This is an area that needs building back better, to ensure in future situations these vulnerable workers have social protection (Santos, 2020).

## Positive impacts on fisheries observed during the pandemic

A few positive impacts on fisheries observed during the pandemic were product innovations (17.11%), new distribution channels such as online marketing or WhatsApp group based domestic fish marketing (1.32%), e-commerce and home deliveries (9.21%), shortening of supply chains including elimination of auction at fishing harbour (3.29%), lowering of ocean pollution (19.08%), and government reforms (19.74%) such as the implementation of *Matsyakara Bharosa* scheme in Andhra Pradesh under which, government provides financial assistance to fishing families who lose their livelihood during the ban on fishing. The state government had increased the allowance from the earlier ₹4,000 to ₹10,000.

Demand for packaged, canned and frozen products had spiked as households look to stock up on non-perishable food. At the same time, online distributors reported increased interest as house-bound consumers explore retail alternatives like private box schemes (FAO, 2020a). Overall, however, demand has sharply reduced and prices had fallen for many species, particularly those that are targeted at the food service industry. Changes in demand also affected storage of fish and seafood, which is a high value perishable food product, resulting in increased food loss and waste (Freedonia, 2020). In aquaculture production, overloaded storage facilities are common, due to delayed production cycles, associated with

Table 3. Other socio-economic/livelihood issues observed

| Socio-economic issues | First wave | | Second wave | |
|---|---|---|---|---|
| | Yes (%) | No (%) | Yes (%) | No (%) |
| Any family members tested COVID positive | 1.97 | 98.02 | - | 100.00 |
| Migration out of fishery | 14.47 | 85.53 | 9.21 | 90.79 |
| Reverse migration into fishery | 13.82 | 86.18 | 12.50 | 87.50 |
| Changes in gender roles | 30.26 | 69.74 | 19.74 | 80.26 |
| Livelihood of fisherwomen | 37.50 | 62.50 | 28.29 | 71.71 |
| Limitations of input supply | 28.89 | 71.71 | 3.29 | 96.71 |
| Stranding of fishing crews | 44.08 | 55.92 | 27.63 | 72.37 |
| Any changes/disruption in usual marketing channels | 65.79 | 34.21 | 49.34 | 50.66 |
| Reduction in food, fish consumption/ malnutrition | 42.11 | 57.89 | 24.34 | 75.66 |

broken supply chains and uncertain demand. Transportation by road or sea must contend with closed or restricted borders and customs and health inspection delays, while the large-scale cancellation of flights has directly affected trade in some high-end fresh products that are transported by air. All these aspects have increased transport costs. Despite the falling global demand for air transport, the cost of air shipment has risen significantly (Lennane, 2020).

Amidst the challenges during the Covid 19 Pandemic, a group of fisher youths from Pudimadaka Village in Visakhapatnam District ventured into an innovative marketing to earn income during the pandemic. The fisher youths formed a WhatsApp group of about 120 contacts in their vicinity. The fresh landings were captured on mobile and circulated among the group. The interested consumers placed orders and the same were delivered at their doorsteps. As the consumers were within a radius of about 10 km, the commodities could be home delivered within a short time. The main groups of fish traded were seer fish, shrimps, threadfins, mackerel and tuna. The fisher youths were able to generate an initial gross monthly income of approximately ₹14,000/-. This retail alternative became very popular, especially among those consumers who were reluctant to step out during the pandemic. Occasionally, they also encountered constraints such as their inability to meet the consumers' demand for specific fishes, *i.e.*, the non-availability of commodities as preferred by the consumers. Though this marketing channel was spontaneous and unorganised, it realised success in ensuring their livelihood through additional income generation.

Many wholesale and retail fish markets, particularly in less developed countries, are often congested and crowded providing infection risks to traders as well as consumers. In some countries, retail markets have become highly regulated to secure physical distancing and other sanitary rules, which indirectly refrain consumers from accessing the market and thus reduce income for fish traders and fishers. In more developed countries, retailers adopted home delivery and e-commerce services to address infection risks (Anthonysamy, 2020).

We studied the relative impacts of the two waves of the COVID-19 pandemic on the marine fisheries sector of Andhra Pradesh. As expected, the impacts of the first wave were far more disruptive than the second wave. The first wave and the subsequent lockdown caught the sector unawares and stakeholders had no options for adjusting to the new normal. However, by the time the second wave of the pandemic hit the sector, they were far more equipped to deal with it. Though the second wave also led to decrease in fishing days and resultant lowered fish production, it was offset by increase in demand for fish, increase in fish prices and restoration of export orders. The time delay also gave the sector time to come up with innovations in their operations which included product innovations, new distribution channels, e-commerce and home deliveries and shortening of supply chains. The youth of the fishing community were able to successfully utilise technology to improve livelihoods particularly through the use of WhatsApp groups. Furthermore, stakeholders spent more time with their families and friends. The government machinery in terms of providing rations and other interventions was also felt to be positive. Thus, the marine fisheries sector of Andhra Pradesh was able to offset the effects of the second wave of the pandemic possibly due to the experiences and lessons learnt from the first wave of the pandemic. This gives hope that the marine fisheries sector can withstand potential disruptions (if any) caused by any future waves of the pandemic.

## Acknowledgements

This article is drawn from the ICAR-CMFRI funded project titled "Resource Assessment and Management Framework for Sustainable Marine Fisheries of Andhra Pradesh". We express our sincere thanks to the Director, ICAR-CMFRI for providing resources for undertaking this study. We also thank the fishermen of Srikakulam, Vizianagaram, Visakhapatnam, East Godavari and Krishna districts of Andhra Pradesh for sharing valuable data on Impact of COVID on marine fisheries sector of Andhra Pradesh. The authors are thankful to P. Bhaskar Rao, V. Venkateswarlu, V. Ravikanth and Y. Prasad Babu for help with data digitisation.

## References

Anthonysamy. S. M. 2020. Impact of COVID-19 on the seafood market in Asia-A new wave. *FAO, INFOFISH*. Food and Agricultural Organisation of the United Nations, Rome, Italy. http://www.fao.org/fileadmin/user_upload/COFI/VirtualDialoguesCOFI34.

Avtar, R., Kumar, P., Supe, H., Jie, D., Sahu, N., Mishra, B.and Yunus, A. 2020. Did the COVID-19 lockdown-induced hydrological residence time intensify the primary productivity in lakes? Observational results based on satellite remote sensing. *Water,* 12(9): 2573. https://doi.org/10.3390/w12092573

Avtar, R., Singh, D., Umarhadi, D. A., Yunus, A. P., Misra, P., Desai, P. N., Kouser, A., Kurniawan, T. A. and Phanindra, K. B. V. N. 2021. Impact of COVID-19 lockdown on the fisheries sector: A case study from three harbors in Western India, *Remote Sens*., 13 (183):1-20. https://doi.org/10.3390/rs13020183.

Carmelia, A. C., Frances, A. B., Choudhury, S., Harris, F., Aleksandrowicz, L., Milner, J., Joy, E. J. M., Agrawal, S., Dangour, A. D. and Green, R. 2019. Future diets in India: A systematic review of food consumption projection studies. *Global Food Secutity,* 23: 182-190. https://doi.org/10.1016/j.gfs.2019.05.006

CMFRI 2020. *Annual Report 2019*. ICAR-Central Marine Fisheries Research Institute, Kochi, India, 284 p.

CMFRI-DoF 2020. *Marine fisheries census 2016, Andhra Pradesh*. ICAR-Central Marine Fisheries Research Institute, Ministry of Agriculture and Farmers Welfare, Department of Fisheries, Ministry of Fisheries, Animal Husbandry and Dairying, Govt. of India, 286 p.

Das, B. K., Aparna, R., Sukanya, S., Som Chandra, G., Kumari, S., Sarkar, U. K., Bhattacharjya, B. K., Das, A. K. and Pandit, A. 2021. Impact of COVID-19 lockdown on small-scale fishers (SSF) engaged in floodplain wetland fisheries: Evidences from three states in India. *Environ. Sci. Pollut. Res.* https://doi.org/10.1007/s11356-021-16074-9.

FAO 2020a. *Food loss and waste in fish value chains. A renaissance in canned fish consumption during COVID-19. Is it good for food loss and waste?* Food and Agricultural Organisation of the United Nations, Rome, Italy. http://www.fao.org/flw-in-fish-value-chains/resources/articles/a-renaissance-in-canned-fish-consumption/en.

FAO 2020b. *COVID-19: Impact on global fish trade, GLOBEFISH*. Food and Agricultural Organisation of the United Nations, Rome, Italy. http://www.fao.org/in-action/globefish/news-events/details-news/en/c/1326499. (Accessed 13 November 2020)

FAO 2020c. *Food outlook*. *Biannual report on global food markets. COVID-19*. Food and Agricultural Organisation of the United Nations, Rome, Italy. http://www.fao.org/documents/card/en/c/cb1993en/

FAO 2021. *The impact of COVID-19 on fisheries and aquaculture food systems, possible responses: Information paper,* November 2020. Food and Agricultural Organisation of the United Nations, Rome, Italy. https://doi.org/10.4060/cb2537en

Freedonia 2020. *COVID-19 economic impact tracker. COVID-19 impact analysis and forecasts*. https://www.freedoniagroup.com/Content/COVID-19-economic-impact-tracker.(Accessed 17 June 2020).

Lennane, A. 2020. Air freight rates on the up again, driven by more demand for less capacity. *The Load Star*. https://theloadstar.com/air-freight-rates-onthe-up-again-driven-by-more-demand-for-less-capacity (Accessed 22 October 2020)

Love, D., Allison, E. H., Asche, F., Belton, B., Cottrell, R. S., Froehlich, H. E., Gephart, J. A., Hicks, C., Little, D. C., Nussbaumer, E. M., DaSilva, P. P., Poulain, F., Rubio, A., Stoll, J. S., Tlusty, M. F., Thorne Lyman, A. L., Troell, M. and Zhang, W. 2021. Emerging COVID-19 impacts, responses, and lessons for building resilience in the seafood system. *Global Food Security,* 28: 100494. https://doi.org/10.1016/j.gfs.2021.100494

Menhat, M., Zaideen, I. M. M., Yusuf, Y., Salleh, N. H. M., Zamri, M. A. and Jeevan, J. 2021. The impact of Covid-19 pandemic: A review on maritime sectors in Malaysia. *Ocean Coast. Manage*., 209: 105638. https://doi.org/10.1016/j.ocecoaman.2021.105638.

Middleton, L., Mohan, A. B. C., Ravi Babu, Shieh, J., Ghazali, S., Dhar, G. and Belton, B. Impacts of COVID-19 on aquatic food supply chains in Andhra Pradesh, India, *CGIAR Research Program on Fish Agri-Food Systems. Program Report*, February-July 2020. Consultative Group for International Agricultural Research, Penang, Malaysia.

Narayanan, S. and Saha, S. 2020. One step behind: The government of India and agricultural policy during the Covid-19 lockdown, *Rev. Agrarian Stud*. 10 (1): 114.

Narayanan, S. and Saha, S. 2020a. Urban food markets and the lockdown in India. *Working Paper WP-2020-017,* Indira Gandhi Institute of Development Research (IGIDR), Mumbai, India.

Ramachandran, C., Suresh, A., Shinoj, P., Jayasankar, J., Gopal, N., Alias, K. M., Harold, L., Surendran, P. P., Jose, M., Saju, M. S., Dolasankar, T., Anilkumar, P., Thomas, J. V., Gills, R., Gopalakrishnan, A. and Ravishankar, C. N. 2020. *CMFRI Marine Fisheries Policy Series No. 18/2020,* Streamlining the supply chain of marine fish in Kerala: COVID-19 and beyond. ICAR-Central Marine Fisheries Research Institute, Kochi, India.

Rawal, V., and Kumar, A., 2020. Agricultural supply chains during the Covid-19 lockdown: A study of market arrivals of seven key food commodities in India. *SSER Monograph 20/1*, Society for Social and Economic Research, New Delhi, India. http://archive.indianstatistics.org/sserwp/sserwp2001.pdf.

Santos, A. P. 2020. *Philippine fishermen stranded at sea by pandemic: "We think about jumping overboard"*. Los Angeles Times, 08 September 2020. https://www.latimes.com/ world-nation/story/2020-09-08/philippine-fishermen-stranded-at-sea-by-the-pandemic-wethink-about-jumping-overboard.

Seth, A. and Vishwanathan, V. 2020. What Covid-19 means to us: Voices from the Indian hinterland, *The India Forum*, 01 May 2020.

Sharma, P., Jumrani, J., and Srivastava, S. K. 2021. Impact of COVID-19 on Indian agriculture, In: Saxena, R., Chand, P., Balaji, S. J. and Suresh, P. (Eds.), *ICAR-NIAP Agricultural Development Report 2020-21*. ICAR-National Institute of Agricultural Economics and Policy Research, New Delhi, India, pp. 5-12.

Sunny, A. R., Sazzad, S. A., Prodhan, S. H., Ashraffuzzaman, Md., Datta, G. C., Sarker, A. K., Rahman, M. and Mithun, M. H. 2021. Assessing impacts of COVID-19 on aquatic food system and small-scale fisheries in Bangladesh. *Marine Policy,* 126: 104422. https://doi.org/10.1016/j.marpol.2021.104422.

White, C. 2020. Study provides first comprehensive look at COVID's impact on US seafood industry. *Seafood Source*, 22 November 2020. https://www.seafoodsource.com/news/supply-trade/study-provides-first-comprehensive-look-at-covid-s-impact-on-us-seafood-industry?.

Yunus, A. P., Masago, Y., Hijioka, Y. 2020. COVID-19 and surface water quality: Improved lake water quality during the lockdown. *Sci. Total Environ*, 731: 139012. https://doi.org/10.1016/j.scitotenv.2020.139012