FISH CONSUMPTION IN KERALA: EXTERNALITIES AND LESSONS LEARNED DURING COVID PANDEMIC

SHYAM. S. SALIM*, ANUJA. A. R. ATHIRA. N. R AND AKHILA KUMARAN

ICAR- Central Marine Fisheries Research Institute, Cochin-682018

*Corresponding author email: shyam.icar@gmail.com

The COVID 19 pandemic induced stringent stress all across the food supply chain in the country causing perceptible changes in people's food consumption patterns. The spread of Corona virus has shaped tailbacks in the production, distribution and processing, leading to momentous shifts in fish consumption patterns as well as the demand and supply of fish. The present study analyses the changes in fish consumption patterns of Kerala state during three time periods viz, Pre COVID, COVID, and Post COVID in addition to assessing the determinants of fish consumption and the constraints towards fish consumption. The study was conducted in March 2022, using primary data gathered from the different households across Kerala with a total sample size of 440 across the state through a hybrid approach of online (Google Forms) and telephone questionnaire surveys. Qualitative, quantitative, and descriptive data analysis with statistical tools such as Wilcoxon's rank test and Maxdiff Cluster analysis was used for interpreting viable results for the study. The study identified that the consumption levels of fish during the COVID time have reduced considerably, thereby altering the consumption pattern and taste preferences. During the Pre COVID, most of the respondents consume fish daily (68.89 per cent), while in the pandemic phase, most of the respondents rely on weekly fish consumption of about 30.52 per cent. The consumption pattern has regained to a daily basis during the post-COVID, COVID, however, there is a decrease to 30.52 per cent. The source of purchase has shifted from retail centres to online markets. The consumption of local fish increased due to the no availability and distortions in the supply chain. The lockdown disruptions have severely affected the fish trade and thereby fish consumption. It was important to identify that the consumers resorted to less preferred fish from a known source rather than a preferred fish from an unknown source. Efforts to increase the local supply of fish with sufficient storage facilities were used to cope with such an unprecedented situation. However, more stringent measures should be identified with the governmental support of a resilient supply chain for enhancing the fish supply chain.

Keywords COVID 19, Fish consumption, Lockdown, Maxdiff analysis

Introduction

The COVID-19 pandemic is an unsurpassed disturbance for the economy as a whole (Gazzeh *et al.,* 2022). The pandemic protocols and provisions interfere with the supply chain of the market with impaired production and distribution accompanied by a lack of labour and supply of inputs (Poudel, 2020). The major consequences have included complete shut-downs of some fisheries, knock-on economic effects from market disruptions, increased health risks for fishers, processors, and communities, additional implications for marginalized groups, exacerbated vulnerabilities to other social and environmental stressors, and increased illegal, unreported, and unregulated fishing (Bennett, 2020; Bollido, 2020). The innate risk of the crowded population at the landing centre affected the landings (Okyere, 2020) coupled with hazardous fishing operations and instability of income and employment affected the marine fisheries sector (Madai, 2021). The fishers grappled with low prices and disruptions to export and domestic markets, leaving many tied to the dock, while others found ways to adapt to the changing circumstances brought about by the

pandemic (Smith, 2020). Subsequent lockdowns are creating health and economic crises that threaten food and nutrition security (Love, 2021) thereby catapulting to a severe food crisis (Sunny, 2021). Some deceptive perceptions about fish and fishery products in some countries have led to decreased consumption, a drop in demand, and resulting price drops of fish (Pahari, 2020; Alam *et al.,* 2022, Campbell *et al.,* 2021)

The seafood sector is likely to be upset, both because of the seasonal nature of many of its domestic fisheries and its global position (White, 2021). Disease outbreaks and global pandemics have been the greatest threat to the sustainability of human existence. The COVID-19 epidemic was not only an international issue, the hazards of COVID have disrupted some entire regions as a whole (Bhat, 2020). The annual production of fish and fisheries products is estimated to be lost due to the lockdown (Kundu and Santhanam, 2021) When comparing the fishing activities before and after the lockdown, the fishing effort, landings, and revenue were dropped during the lockdown period (Coll, 2021; Gosh *et al.,* 2022) the most negative impact of the pandemic in terms of trade (in quantity, kg) was on the exporter with 65% decrease followed by wholesalers (35%), retailers (17% for fishing products and 14% aquaculture products (Demirci, 2020). The complete shutdown of all the economic activities in fishing created an economic crisis with massive job losses and rising food insecurity (Bene *et al.,* 2021).The pandemic of COVID 19 and the sudden lockdown, have severely affected India's fisheries sectors. The functionaries involved in fisheries and allied activities such as fishers, hatchery owners, fish processors, sea-food exporters, traders, fish vendors, and vehicles carrying fish -have been badly impacted (Pahari, 2020). The lockdown and social distancing rules due to COVID 19 affected every area of the fisheries sectors from catching

to landing, processing, and marketing (Gopal, 2020). In India, it affected the production, distribution, and consumption and also the millions of people associated with the fisheries sector (Purkait 2020). The blue economy sectors in India have diminished due to disruptions in the fish catch, market, and supply chain (Avtar, 2021). The volume and value of fish catches have declined significantly in response to the COVID-19 pandemic (Campbell, 2021). Mainly the employment of the fishermen depends on the landings. Due to the decrease in landings employment also decreased. This leads to a decrease in the income of the fishermen (Marschke, 2021). A significant reduction in seafood exports from India will affect the economy of the country (Meharoof, 2020). The storage and marketing problem greatly affected the livelihood of the fishing community. Considering the impact of COVID-19 in terms of consumption, the frequency of fish consumption in India significantly reduced during the pandemic due to the decrease in the catch (Minahal, 2020; Mandal, 2021). This was especially apparent in affluent segments of the community.

Kerala marine fisheries since the last decade have grappled with many disquieting factors which include climate change, declining fish catch, unsustainable fishing practices, lower catch per unit effort (CPUE), high cost of fishing, marketing exploits, discard and low-value addition (Shyam *et al.,* 2023). Presently the effect of the unexpected nationwide lockdown triggered severe disruptions in the livelihood of the fishermen. The logistic restrictions related to COVID-19 have induced a considerable reduction in efforts, landings, and revenue realization thereby shattering the marine fish distribution system of Kerala. The fishers across Kerala - from the large-scale mechanized fleets to the small-scale fishers across the coastline have suffered an economic blow due

to the lockdown. (Tandon *et al.,* 2022). Marine capture fisheries are already a stressed sector, the loss of fish has created a decline in the economy and food security for several people. The lockdown had a multiplier effect -with dwindling catches, followed by lesser price realization lack of catch, and with no fishing during the peak season of a stressed time (Avtar *et al.,* 2021).

COVID-19 outbreaks have deemed and unraveled extreme shock for the Kerala economy. The nation witnessed a complete slowdown of activities since March, 2020 and it has impacted disruptions of demand and supply chain of agricultural commodities like fish and fishery products all over Kerala. The COVID pandemic and lockdown nationwide resulted in the prolonged lowering of economic activity including the magnitude of the versatile impact across production distribution and marketing of marine capture fisheries and seafood export. Coping strategies/measures were put forward by the government and the concerned authorities to control the spread of this deadly virus which include social isolation directives through lockdown, limiting the transport service for essential services, restriction of business opening hours, etc. On one side the restrictions imposed have put control on the spread of the deadly virus but at the same time it has completely shattered the on one hand we can say that due to such restrictions, only our country with a very high population can restrict the spread of COVID -19, but at the same time, it is important to analyse the side effect of the total shutdown on the fishery industry which includes seafood fishery sector, freshwater fishery sector and brackish water fishery sector along with the majority of fishery dependant allied industries, who have to deal with a bleak demand outlook and face an array of supply challenges.

A Rapid impact assessment by ICAR- CMFRI on the COVID pandemic in the marine fisheries sector estimated a total loss of Rs.10, 000 crores for 21 days across the marine fish value chain constituents in India and also cautioned that the impact would continue for three months amounting to losses of Rs. 25000 crores. The fishing operations get disrupted and continue to impose an unabated serious threat to the fisher livelihood, and fisher income thereby registering a decreasing revenue trend in the fishing sector. These created alterations in the fish consumption - trend and pattern. The unavailability of fish due to the restrictions of the pandemic and hygiene issues in the fear of attack of COVID-19 is one of the two major reasons for the alterations in the fish consumption pattern. As fish is a perishable item, there is high demand for packaged and frozen products due to panic buyers but the processing and canning industry will not be able to cater to this demand due to the non-availability of manpower. The high-end fresh products that are transported by air are also directly affected due to the cancellation of flights, thus directly affecting the trade. Overall, a sharp decline in demand resulted in a price drop for many species, particularly those which were served as a delicacy in restaurants

Thus, the current study examines the culturally diverse attributes of fish consumption across households in Kerala. There is an absence of detailed data on fish consumption patterns and varieties of fish consumed in households during COVID times. The study delves more into the socio-economic implications of the COVID -19 pandemic across the marine fisheries value chain constituents, identifying the existing adaption/ mitigation measures adopted by the households amidst the pandemic towards alternative livelihoods. The study aims to provide an assessment of the fish consumption basket of the consumers across the period of Pre COVID, COVID and Post COVID in terms of species, expenditure, and source of purchase. The overall

objective of the proposed study was to investigate the changes in the fish consumption patterns over the different periods during COVID; however, the specific objectives are to:

· Analyse the trends and patterns of fish consumption across the different COVID periods
· Assessing the changes in the fish distribution pattern over the period.
· Identify the different constraints in fish consumption-distribution patterns.

Data and methodology

The study was conducted in March 2022, using primary data gathered from different households across Kerala. Accordingly, 440 consumer households from Kerala were selected for the study. A purposive random sampling method was used for choosing the respondents. In this study, a hybrid approach of online (Google Forms) and telephone questionnaire survey was used to assess the fish food consumption patterns of the inhabitants of the state at the household level. The study collected data from the respondents for the three-time period was categorised as Pre COVID (2019), COVID (2020), and Post COVID (2021) times. A well-structured questionnaire eliciting information on the fish consumption pattern was developed for the study. These respondents were randomly selected from rural as well as urban areas of the districts of Kerala as the state has quite an equal proportion of rural as well as urban people. The study was conducted with a pilot study for assessing the fish consumption pattern, the factors that affect the consumption, and the major fish species preferred. One of the major objectives of the study was to assess the trends and patterns of fish consumption and analyse factors that drive people to consume fish and also to assess the major constraints faced by the consumers. The study elicited information on the socio-economic profile which included age, education, income,

expenditure, fish consumption pattern, major preferred species, major buying source, the factors that drive people to consume fish and the major constraints in fish consumption. To analyse the data, the primary statistical tool of percentage analysis, Wilcoxon rank test, Maxdiff cluster analysis and Garrette ranking were carried out to assess various parameters of consumer preferences and patterns of fish consumption among the respondents.

Analytical Tools

The analytical tools used in this study are discussed below. The analysis was done based on the opinion of the respondents. Descriptive statistical analysis was done on the data using MS Excel and R language.

Maxdiff Clustering Analysis

MaxDiff is a trade-off methodology derived from Random Utility Theory (Thurstone 1927) MaxDiff maintains noted measurement advantages over traditional survey techniques, other ranking methods and some discrete choice analysis methods, which may confuse participants with too many options in a given choice set. MaxDiff requires subjects to identify both the 'best' and 'least desirable' options available within a given set of choices and it is also referred to as 'best-worst scaling' and identifies the 'maximum difference' in preference between the 'best' and 'worst' choices available. The consumer preferences in buying fish or the factors responsible for fish consumption were analysed using this technique.

MaxDiff- derived utilities were subjected to *k-means* cluster analysis for identifying the consumer preferences. Data is assigned to its closest centroid using an Euclidean distance

minimization equation. Next, centroids are recomputed in an iterative process until they show no further signs of change (Tan *et al.,* 2019) The goal of clustering was to identify similarities among groups of individuals in how they prioritize their factors in consumer preferences in buying fish and thereby fish consumption. We selected a 3-cluster model a priori for analysis. Finally, Maxdiff utility rankings were calculated for each cluster and these rankings sum to 100.

Wilcoxon sign rank test

The sign test and Wilcoxon signed rank test are useful non-parametric alternatives to the one-sample and paired t-tests The sign test and Wilcoxon signed rank test are useful non- parametric alternatives to the one-sample and paired t-tests The sign test and Wilcoxon signed rank test are useful non- parametric alternatives to the one-sample and paired t-tests The sign test and Wilcoxon signed rank test are useful non-parametric alternatives to the one-sample and paired t-tests. The Wilcoxon signed rank is more powerful than the sign test because it considers the magnitude of the difference while the sign test does not. It uses more information from the sets of scores than the simple sign test Whitley and Ball (2002) The Wilcoxon test statistic throws away the true differences and replaces them with ranks that crudely approximate the magnitudes of the differences. This loss of information gained computational ease and allowed the tabulation of an analytical solution to the distribution of possible rank sums. One refers to the test statistic in this table to determine the p-value of the Wilcoxon test statistic. To clarify the quality concerns of the respondents regarding fish consumption we used the Wilcoxon signed rank test over the periods to clarify the same.

Garrette Ranking

The Garette ranking technique is used to analyse the rankings given by the respondents for the constraints they faced in fish consumption during the Pre COVID, COVID and Post COVID periods. Garrett's ranking technique is usually used to rank the preference indicated by the respondents on different factors. The ranks assigned by the respondents for different factors are converted into scores. The factors with the highest mean value or Garrett score are considered to be the most important factors. (Garett and Woodworth, 1969)

Results and discussions

The data was collected, analysed and the results are discussed under the following heads

Demographic profile

Respondent socio-demographic data included age and educational qualification (Table 1). The age profile of the respondents indicated that 14.09 per cent of the respondents belong to 20-29 age group, 44.32 per cent of the respondents belong to 30-49 years age group, 25.45 per cent of the respondents belong to the age group of 40-49 while the rest 16.14per cent of them are the over 50 years age group. The educational status of the respondents indicated that 32.27 per cent of them had education up to higher secondary. 22.27 per cent of the respondents having degree level education and 4.09 per cent have professional level education. Among the respondents, just 35 per cent had possessed high school education and 6.36 per cent had possessed the primary level of education. The level of education level was high as demonstrated by zero illiterates among the sample respondents.

Table 1. Demographic profile

Age (years)	
Age	Respondents
20-29	62 (14.09)
30-39	195 (42.04)
40-49	112 (25.45)
>50	71 (18.4)
Total	440 (100)
Education	
Education level	Respondents
Illiterate	0 (0.00)
Primary	28 (6.36)
High School	154 (35.00)
Higher Secondary	142 (32.27)
Degree	98 (22.27)
Professional	18 (4.09)
Total	440 (100.00)

Figures in parenthesis indicates percentage to total

Household expenditure pattern

The average income elicits importance in the fish consumption pattern, demand, and consumer preference. The study identified that most of the respondents consume fish daily despite their household income and expenditure level. The average monthly expenditure of the respondents was studied and the results show that the household expenditure during the Post COVID recorded the highest average monthly household expenditure (Rs. 20,700) followed by Pre COVID (Rs.19,000) and COVID (Rs. 14,850) period respectively (Fig. 1)

The item-wise expenditure analysis (Fig. 2) indicates that over the three time periods highest expenditure is for the food items ranging from Rs 5000 - Rs 6500 respectively. Among the food items, the mean monthly expenditure on fish is Rs. 1,500 ranging from Rs. 300 to Rs 2,000 during the Pre and Post COVID periods. The expenditure for education holds the second highest during the pre-COVID and post-COVID periods
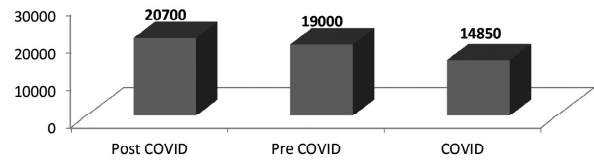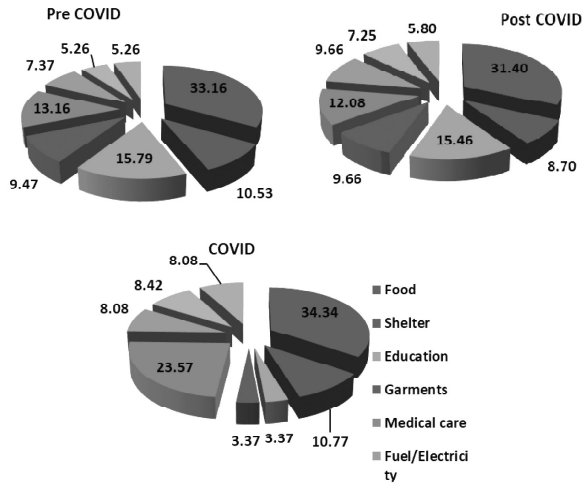

Fig. 1. Household expenditure pattern

Fig. 2. Item-wise expenditure pattern

at about Rs. 3000- Rs. 3200 respectively. During the COVID period, the respondents spent more on food items (34.34 per cent) and medicines (23.57 per cent). Due to the shutdown of schools and colleges to online classes, the expenditure on education was reduced to Rs 500-Rs.1000 respectively. The unavailability of fish and hygiene issues during the COVID period has changed the consumption pattern of fish where most of the respondents preferred more inland or local fishes than marine fishes.

Fish consumption profile

Frequency of consumption

The frequency of fish consumption in the selected areas was assessed and the outcomes are shown in Table II. The results point out that the frequency of fish consumption has reduced from the pre-COVID to the post-COVID period. The consumption levels of fish during the COVID

Table. 2 Frequency of fish consumption

Frequency	Pre COVID	COVID	Post COVID
Daily	303 (68.89)	62 (14.08)	238 (54.17)
Alternatively	105 (23.89)	69 (15.67)	92 (20.83)
Twice in a week	4 (0.83)	104 (23.61)	40 (9.17)
Weekly	28 (6.39)	134 (30.52)	61 (13.89)
Fortnightly	0 (0)	35 (7.95)	6 (1.39)
Seasonal	0 (0)	22 (4.99)	2 (0.56)
Monthly	0 (0)	14 (3.18)	0 (0)
Total	440	440	440

Figures in parenthesis indicates percentage to total

period have reduced considerably and altered the taste preferences. During the pre-COVID, most of the respondents consume fish daily (68.89per cent), while in the pandemic phase, most of the respondents rely on weekly fish consumption of about 30.52 per cent. The consumption pattern has registered normalcy during the Post COVID, however, there is a decrease to 30.52 per cent when compared to Pre COVID fish consumption level. The respondents opined that the restrictions imposed by the government caused anomalies in the logistics as well as transportation of fish leading to the non-availability of fish and the fear of hygienic concerns as the two main reasons for the reduced consumption status. The people were afraid of consuming the fish due to fear of COVID at the source as well as health concerns. Most people have changed their taste preferences and people have started consuming more inland fish than marine fish as marine fish were not available during the COVID period and also some people avoid the fish species themselves due to the fear of attack of COVID-19. Many households have substituted fish with poultry, eggs, and dried fish. The consumers preferred a known source of inland fish over unknown marine fish during COVID times

Quantity of fish consumption

The annual per capita fish consumption estimated over the study locale was found to be 19.6 kg ranging from 23.16 kg during pre-COVID to 20.04 kg during post-COVID. The effect has completely collapsed the quantity of fish consumption pointing to low consumption of 15.62 kg during the COVID period. The quantity of fish consumption and normal species composition as reported by the respondents were indicated in Table 3.

The species composition during pre-COVID, COVID and post-COVID COVIDwere investigated and the quantum of fish consumption across households for the three time periods was computed. Among the species during the Pre COVID period sardine (0.53 kg) was the most consumed fish followed by anchovies (0.22 kg) and mackerel (0.28 kg) among the sample respondents. During the COVID period, Prawns/shrimp (0.23 kg) and Tilapia (0.23 kg) registered as the most consumed fish species as these were the most available fish during the COVID time. Sardine remained as to be the most consumed fish during the post-COVID time, nevertheless, the streaks of COVID retained the preference of Tilapia and other inland fishes. The availability and consumer preferences are remarked as the major reasons for the highest utilization rate.

The fish prices showed exorbitant price changes during the COVID pandemic with approximately 72% of the respondents mentioning that fish prices increased during the pandemic, and about 28% opined a decrease in prices. The price fluctuation varied between different market settings (super shop/open market), shopping times and market locations and species. The effects of the pandemic have not yet completely gotten rid of the fish markets and the fish trade is on the voyage of recovering from the COVID pandemic.

Table 3. Species Composition

Species	Pre COVID	Species	COVID	Species	Post COVID
Anchovies	0.22	Anchovies	0.10	Anchovies	0.12
Cephalopods	0.09	Carps	0.06	Cephalopods	0.12
Mackerel	0.28	Clam/ Mussel/ Oyster	0.1	Clam/ Mussel/ Oyster	0.08
Others	0.16	Crab	0.06	Mackerel	0.15
Pomfret	0.09	Mackerel	0.12	Others	0.18
Prawns/ Shrimp	0.17	Others	0.21	Prawns/ Shrimp	0.18
Sardine	0.53	Prawns/ Shrimp	0.23	Ribbon fishes	0.13
Threadfin bream	0.15	Sardine	0.12	Sardine	0.48
Tilapia	0.1	Seabass/Milkfish/ Mullet	0.07	Seer fish	0.08
Tuna	0.14	Tilapia	0.23	Tilapia	0.15

Figures in parenthesis indicates percentage to total

Table 4. Source of purchase

Source	Pre COVID	COVID	Post COVID
Landing centre	16 (3.64)	2 (0.45)	22 (5.00)
Retail market	177 (40.23)	80 (18.18)	140 (31.82)
Fish vendors at the doorstep	118 (26.82)	0 (0.00)	15 (3.41)
Wholesale market	24 (5.45)	15 (3.41)	15 (3.41)
Online (Whats-app/phone call)	15 (3.41)	313 (71.14)	93 (21.14)
Supermarket	16 (3.64)	0 (0.00)	5 (1.41)
Wayside market	74 (16.82)	30 (6.82)	150 (34.09)
Total	440(100)	400 (100)	440 (100)

Figures in parenthesis indicates percentage to total

Source of purchase

The Source of purchase was reported to vary across consumers (Table 4). Among the respondents, 40.23 per cent opined that the retail market was the source of fish purchase followed by fish vendors at the doorstep (26.82per cent) during the pre-COVID period. The wayside markets (34.09 per cent) and retail markets (31.82 per cent) hold the major source of purchase during the Post COVID period. However, the source of purchase has completely changed to online during the COVID period. A majority of 71.14percent of the respondents depend on online sources such as phone calls (47.28 per cent), WhatsApp (32.58 per cent), and online sites (20.12 per cent) respectively for purchasing fish. Trusted local mobile vendors were also available during the COVID period which lessened the burden of buying fish during the pandemic. Due to the restrictions of COVID people were not able to buy fish from other sources. Despite that, fish consumption was poor during the COVID period because of fear of the deadly virus attack. It was important to identify that the consumers resorted to less preferred fish from a known source rather an preferred fish from an unknown source

Constraints in fish consumption

The Garrett ranking scores for the limitations in fish consumption are mentioned in Table V. The significant limitation in the consumption of fish was found to be the unavailability of favoured fishes in the state while the absence of fresh fish is the second important constraint in the study regions. The respondents opined that the purchase and demand for the fish have not been yet reduced due to these reasons and their fish consumption has only increased fairly despite the high prices. Yet, the irregular supply, as well as the poor access and different reasons, have also affected the consumption pattern of the consumers. Due to this, they have to rely upon the different hotspots for the utilization of fish.

Table 5. Constraints in fish consumption

Attributes	Pre COVID		COVID		Post COVID	
	Score	Rank	Score	Rank	Score	Rank
Irregular supply	43.28	IV	81.63	I	52.35	IV
Lack of fresh fish	40.82	V	52.13	V	52.13	V
Wide fluctuations in price	44.81	III	43.28	VII	63.44	III
High price	55.12	I	75.23	II	75.23	II
Poor access to buying	35.18	VI	63.44	III	30.25	VIII
Lack of hygiene at the source	31.96	VII	30.25	VIII	45.69	VI
Unavailability of preferred fishes	50.00	II	52.35	IV	81.63	I
Restricted to social function	22.74	VIII	19.81	X	19.81	X
Fear factor	18.32	IX	45.69	VI	43.28	VII
Lack of awareness	12.79	X	22.58	IX	22.58	IX

Table 6. Factors of consumer preference in buying fish for consumption

Factors	Pre COVID	Rank	COVID	Rank	Post COVID	Rank
Quality	15.67 (6.12)	III	15.45 (9.18)	II	16.89 (3.42)	I
Nutrition	10.12 (5.34)	V	8.9 (6.77)	V	11 (5.77)	III
Taste & preference	8.99 (4.56)	VII	4.22 (5.67)	IX	5.67 (8.12)	VII
Persuasion	2.33 (9.80)	IX	0.89 (9.87)	XIII	2.34 (4.67)	XII
Tradition	2.02 (2.33)	X	1.12 (5.45)	XII	1.11 (3.33)	XII
Availability	13.56 (5.00)	III	13.45 (3.45)	III	9.22 (4.09)	VII
Accessibility	12 (3.44)	IV	12 (8.00)	IV	10.12 (5.23)	IV
Distance	10 (6.78)	VI	3.45 (4.67)	X	2.67 (6.85)	X
Variety of species	16.77 (9.60)	I	7.89 (8.77)	VI	10.67 (8.45)	V
Credit	5.67 (3.33)	VIII	5.55 (4.12)	VII	10 (2.39)	VI
Cheap	1.12 (5.34)	XI	4.6 (6.90)	VIII	3.33 (4.33)	IX
Trust	1.00 (4.22)	XII	20.12 (3.66)	I	15.03 (5.67)	II
Time	0.67 (6.89)	XIII	2.25 (5.66)	XI	1.45 (2.78)	XII

Consumer preferences in buying fish

The consumer preferences in buying fish have a prominent role in defining the fish consumption pattern. The outbreak of the pandemic has altered consumer preferences in buying fish to a very large extent. The lockdown has resulted in a varied way of purchasing fish leading to changing the taste preferences, choice of fish, buying fish substitutes etc. To identify the consumer preferences in buying fish a max diff cluster analysis was done to understand the different factors of fish consumption over the three time periods viz, Pre COVID, COVID and Post COVID (Table 6).

The Maxdiff cluster analysis results indicate that the variety of species (16.77) is the most noteworthy factor of consumption followed by quality (15.67) and availability of fish species (13.56) during the Pre COVID period. The consumers were highly concerned about the variety, quality, and availability of the fish where the consumption of fish was at its peak due to the wide varieties of species available during the Pre COVID period. However, during the COVID period, consumers highly rely on the factor of trust (20.12). People were very eager to know from where the fish was coming, from where to buy fish safely, etc. The concerned trusted mobile vendors, WhatsApp calls for fish from the local nearby areas

were mostly used by the consumers for buying fish due to the fear of attack of COVID. The quality (15.45) of fish holds the second major factor of consumer preference in buying fish during the COVID lockdown. The Post COVID period marked the quality of fish and trust as the prime factor of consumer preference in buying fish followed by nutrition, accessibility etc. The factors of tradition, distance, taste, preferences and persuasion account for just the lowest effect among the respondents in fish consumption. Likewise, the least preference has been given for cheap, credit, and time over the study analysed that most of the respondents don't consume fish as a substitute for meat.

The study identified the quality of fish as the common factor of consumer preference in buying fish and the Wilcoxon signed ranked test was done to analyse the significance of the quality of fish over the three time periods. According to the respondents, quality means fresh, smell, and size. People prefer to buy fish if it seems fresh and of accurate size with the right smell. It was found that freshness, size, and smell were significantly affected when the consumers in buying fish in all three time periods. People were more concerned about these three features as freshness, size, and smell when they chose better quality fish. Even though the pandemic coupled with the lockdown affected the fish availability and the supply chain, then people, even more, stick to the quality of fish when they choose to buy fish. The increase in fish prices attributed to a disruption in the supply of fish from outside the states has not compromised the mindset of people to buy poor-quality of fishes. However, an increase in the prices of fish impacted some people from accessing fresh fish resulting in a decline in fish consumption during the COVID period.

Table 7. Quality of fish

Quality of fish	Wilcoxon Z	Significance
Fresh	-4.495	0.000**
Smell	-5.432	0.000**
Size	-3.789	0.003*

** indicates significance at 5% level and * indicates significance at 1% level.

Conclusion

The COVID 19 pandemic has not only affected the fish availability, market availability, prices of fish, and quality of fish but also limited the fish consumption pattern to a new level. Fishing operations encountered difficulties due to the national lockdown measures that prohibited fishers from going out to sea to catch fish. The non-availability of fish and the fear of attack of COVID-19 has widely reduced fish consumption and completely changed taste preferences. Consumers preferred inland fish from a known source rather than marine fish from an unknown destination. Accordingly, the consumption of local and inland fish has increased and some of the low market-efficient species like Tilapia have increased their consumer demand. The hike in fish prices has resulted in the shift of processed fish products to a small extent. The disruption in transportation, logistics, lockdown, etc during COVID 19 impacted the fish trade, and efforts for increasing of local supply of fish were increased with sufficient storage facilities to cope with such an unprecedented situation. COVID fish consumption amongst consumers provided a varied fish consumption basket with inland fishes and also exposed online sources as a potential source of fish purchase. In the aftermath of COVID and its possible recurrence relief measures and coping strategies should be developed according to the necessities of the people in coordination with LSG enabling the different stakeholders towards the

development of the resilience of the fish supply chain.

Acknowledgments

References

Alam, G. M., Sarker, M. N. I., Gatto, M., Bhandari, H. and Naziri, D. 2022. Impacts of COVID-19 on the fisheries and aquaculture sector in developing countries and ways forward. *Sustainability*, **14**(3) : 1071.

Avtar, R., Singh, D., Umarhadi, D. A., Yunus, A. P., Misra, P., Desai, P. N., ... & 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 Sensing*, **13**(2) : 183.

Béné, C., Bakker, D., Chavarro, M. J., Even, B., Melo, J. and Sonneveld, A. 2021. Global assessment of the impacts of COVID-19 on food security. *Global Food Security,* **31** : 100575.

Bennett, N. J., Finkbeiner, E. M., Ban, N. C., Belhabib, D., Jupiter, S. D., Kittinger, J. N., ... & Christie, P. 2020. The COVID-19 pandemic, small-scale fisheries and coastal fishing communities. *Coastal Management,* **48**(4) : 336-347.

Bhat, B. A., Gull, S. and Jeelani, G. 2020. A study on COVID-19 lockdown impact on food, agriculture, fisheries and precautionary measures to avoid COVID-19 contamination. *Galore International Journal of Applied Sciences and Humanities,* **4**(2) : 8-18.

Bollido, M. E. and Irene, E. A. 2020. Lived experiences of fishermen in the midst of coronavirus (Covid-19) pandemic. *Journal of the Austrian Society of Agricultural Economics,* **16** : 169-177.

Campbell, S. J., Jakub, R., Valdivia, A., Setiawan, H., Setiawan, A., Cox, C., ... & Box, S. 2021. Immediate impact of COVID-19 across tropical small-scale fishing communities. *Ocean & Coastal Management*, **200** : 105485.

Coll, M., Ortega-Cerdà, M., & Mascarell-Rocher, Y. 2021. Ecological and economic effects of COVID-19 in marine fisheries from the Northwestern Mediterranean Sea. *Biological Conservation*, **255** : 108997.

Demerci, A., Şimşek, E., Can, M. F., Özkan, A. K. A. R. and Demirci, S. 2020. Has the pandemic (COVID-19) affected the fishery sector in regional scale? A case study on the fishery sector in Hatay province from Turkey. *Marine and Life Sciences*, **2**(1) : 13-17.

Garett, H. E. and Woodworth, R. S. 1969. *Statistics in psychology and education*. Vakils, Feffer and Simons Pvt. Ltd., Mumbai, India, 329 pp.

Gazzeh, Karim, Ismaila Rimi Abubakar, and Emad Hammad. 2022. "Impacts of COVID-19 Pandemic on the Global Flows of People and Goods: Implications on the Dynamics of Urban Systems." *Land,* **11, 3** : 429.

Gopal, N., Edwin, L. and Ravishankar, C. N. 2020. COVID-19 Throws The Indian Fisheries Sector Out Of Gear **4** : 21-28

Gosh, K., Chowdhury, S., Acharjee, D. C., Mamun, A. A. and Ghosh, R. 2022. Assessing the Economic Impacts of COVID-19 on the Aquaculture and Fisheries Sectors in Relation to Food Security: A Critical Review. *Sustainability*, **14**(14) : 8766.

Kundu, S. K. and Santhanam, H. 2021. All pain and no gain: Factors impacting local and regional sustainability due to COVID-19 pandemic with respect to the Indian marine fisheries. *Current Research in Environmental Sustainability*, **3** : 100086.

Love, D. C., Allison, E. H., Asche, F., Belton, B., Cottrell, R. S., Froehlich, H. E. and Zhang, W. 2021. Emerging COVID-19 impacts, responses, and lessons for building resilience in the seafood system. *Global Food Security*, 100494.

Madai Boukar, A., Mbock, O. and Kilolo, J. M. M. 2021. The impacts of the Covid-19 pandemic on employment in Cameroon: A general equilibrium analysis. *African Development Review,* **33** : S88-S101.

Mandal, S. C., Boidya, P., Haque, M. I. M., Hossain, A., Shams, Z. and Mamun, A. A. 2021. The impact of the COVID-19 pandemic on fish consumption and household food security in Dhaka city, Bangladesh. *Global Food Security*, 100526.

Marschke, M., Vandergeest, P., Havice, E., Kadfak, A., Duker, P., Isopescu, I. and MacDonnell, M. 2021. COVID-19, instability and migrant fish workers in Asia. *Maritime Studies,* **20**(1) : 87-99.

Meharoof, M., Gul, S. and Qureshi, N. W. 2020. Indian seafood trade and COVID-19: Anticipated impacts and economics. *Food and Scientific Reports,* **1**(8) : 54-58

Minahal, Q., Munir, S., Kumal, W., Fatima, S., Liaqat, R. and Shehdzadi, I. 2020. Global impact of COVID-19 on aquaculture and fisheries: A review. *International Journal of Fisheries and Aquatic Studies,* **8**(6) : 1-7.

Okyere, I., Chuku, E. O., Ekumah, B., Angnuureng, D. B., Boakye-Appiah, J. K., Mills, D. J., ... & Crawford, B. 2020. Physical distancing and risk of COVID-19 in small-scale fisheries: a remote sensing assessment in coastal Ghana. *Scientific Reports*, **10**(1) : 1-13.

Pahari, T. 2020. Pandemic COVID-19's Probable Impacts on Indian Fisheries Sectors & Its Protective Measures. *Biotica Research Today*, **2**(11) : 1130-1134.

Poudel, P. B., Poudel, M. R., Gautam, A., Phuyal, S., Tiwari, C. K., Bashyal, N. and Bashyal, S. 2020. COVID-19 and its global impact on food and agriculture. *Journal of Biology and Today's World,* **9**(5) : 221-225.

Purkait, S., Karmakar, S., Chowdhury, S., Mali, P., & Sau, S. K. 2020. Impacts of novel coronavirus (COVID-19) pandemic on fisheries sector in India: *A Minireview. Indian Journal Pure Applied Bioscience,* **8**(3) : 487-492.

Shyam S. Salim, N. R. Athira, P. V. Sunil, Akhila Kumaran and N. K. Harshan 2023.Price fluctuations and species diversity across fish markets in Kerala *Indian Journal of Fisheries*., **70**(1) : 126-135, DOI: 10.21077/ ijf.2023.70.1.105674-18

Smith, S. L., Golden, A. S., Ramenzoni, V., Zemeckis, D. R. and Jensen, O. P. 2020. Adaptation and resilience of commercial fishers in the Northeast United States during the early stages of the COVID-19 pandemic. *PloS One*, 15(12), e0243886.

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

Tan, P-N., Steinbach, M., Karpatne, A. and Kumar, V. 2019. *Introduction to data mining* (2nd ed.). Hoboken, NJ: Pearson.

Tandon, N., Basu, P., Krishnan, O. and Bhavani, R. V. 2022. *Emerging Work Trends in Urban India*: *COVID-19 and Beyond*. Taylor & Francis.

Thurstone L .1927. A law of comparative judgment. *Psychological Review*, **34** : 278-286. doi: 10.1037/ h0070288.

White, E. R., Froehlich, H. E., Gephart, J. A., Cottrell, R. S., Branch, T. A., Agrawal Bejarano, R. and Baum, J. K. 2021. Early effects of COVID-19 on US fisheries and seafood consumption. *Fish and Fisheries,* **22**(1) : 232-239.

Whitley, E. and Ball, J. 2002. Statistics Review 6: Nonparametric Methods. *Critical Care*, **6** : 509-513.