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NAVIGATIONAL AND TECHNICAL SKILL OF INDIAN DEEP-SEA FISHERMEN: A QUANTITATIVE ANALYSIS BETWEEN FISHERMEN OF MALABAR AND COROMANDEL COAST

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INTRODUCTION:

One of the occupations that helps coastal communities maintain their standard of living is marine fishing. Using a variety of fishing gear, the fishermen venture into the deep oceans to capture fish. In order to guarantee that the sea voyages are carried out safely and effectively, navigation is crucial. The fishing vessel's driver, who serves as its navigator, must be able to determine the position of the vessel, the direction of its movement, and the time at sea in order to navigate across the ocean. Additionally, using such skills and adhering to regulations will assist the fishermen in ensuring that the voyages are completed safely. Due to depleting coastal resources, fishermen in India are driven to change to deep-sea fishing or go farther in pursuit of fish because of the loss of the country's coastal fisheries resources. The Malabar Coast fishermen may probably come into contact with merchant ships that are adhering to IMTR during this time. To pass or fish in the IMTR safely, the fishers must possess strong technical and navigational abilities. Even while fishermen utilized celestial objects to guide them in the past, technological advancements have led to the introduction of several electronic devices that help make maritime navigation safer and more effective. In the past, fishing vessel navigators knew their position, direction, and time at sea by observing celestial bodies such as the sun, moon, and stars (D'Cruz, 2004), and also used the direction of the wind and waves to find their destination (Agarwal, 2003). However, in the recent past, depletion of near-shore fishery resources and the availability of modern electronic equipment made such fishing operation to be conducted efficiently at far distance at sea. For the far distance navigation, determining the position by using celestial objects during emergency and electronic navigational equipment during routine navigation becomes vital (Sharma, 2022).

Despite the employment of such sophisticated technological equipment for vessel navigation, collisions between vessels continue to occur, especially in the crowded IMTR

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off Indian Coast. Table 1 shows the number of fishing vessel collisions that occurred between 2012 and 2021 in the Coromandel and Indian Malabar Coasts. It is clear that MC has a far higher rate of fishing vessel damage, fisherman injuries, and fatalities than CC.

Table 1: Collision incidents involving fishing vessel from 2012 to 2021

Coast	Fishermen died	Fishermen injured	Boat damaged	Total incidents
Malabar Coast	37	50	7	23
Coromandel Coast	0	4	1	2

Source: Indian Coast Guard website

Thus, it is necessary to comprehend the reason behind these high rates of maritime collision events, especially along the Malabar Coasts. By comparing the technical and navigational abilities of fishing vessel navigators on the Malabar Coast (MC) and Coromandel Coast (CC), this study aims to identify the reasons behind the increase in collision incidences along India's South West Coast. The main research topic was whether the technical and navigational abilities of fishermen from the Malabar Coast met the requirements for safe maritime navigation. Null hypotheses were constructed for statistical testing in order to further direct the inquiry. The approach, findings, and discussion will be covered in detail in the following parts, which will also provide important insights into the technical and navigational abilities of the fishermen of the Malabar Coast.

LITERATURE REVIEW:

Navigational accidents

There are a lot of marine incidents involving fishing vessels operating off the South West Coast of India. During 454 search and rescue (SAR) operations from January to December 2012, maritime agencies (Indian Coast Guard) responded to distress alarms and rescued up to 3,046 fishermen from the high seas off Kerala. 44 fishermen perished in various maritime accidents during that time, while 11 fishermen went missing. In 2016, there were three collision accidents involving fishing vessels and merchant vessels; in 2017 and 2018, there were ten such accidents, resulting in several fatalities (Neethu, 2019). Two incidents involving collisions between fishermen and commerce vessels occurred on India's southwest coasts in 2021.

Navigational and technical skills

Navigation in the Bay of Bengal was happening with the help of stars, suns and other celestial objects and the navigators could use them for fishing, to know their position and time at sea (Nayak, 2020). By presenting the location, courses, time, and arrival time, as well as the real-time position of the vessel on the electronic charts when used in conjunction with them, modern electronic technology like the Global Navigation Satellite System (GNSS)

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makes such voyages more efficient. Among the GNSS utilized by seagoing vessels, the Global Positioning System (GPS) is one of the most crucial positioning tools. It lets fisherman know where they are and warns them when they are about to cross the country's border. It provides position information in latitude and longitude (Kiruthika, 2014), (Nandhini, 2016). As a result, the navigator could reach their destination precisely and quickly without wondering for their destination. Additionally, by sharing a vessel's navigational data with other vessels, the Automatic Identification System (AIS) helps to prevent collisions at sea and ensures that sea voyages are completed safely.

Skill application and collision regulations

Sea voyages are not safer or more effective just because of the skipper's technical and navigational abilities. However, using these skills while navigating and adhering to collision regulations by maintaining a vigilant watch, displaying the appropriate day and night signals for navigation, using the appropriate sound signals when needed, and notifying the authorities when needed could make the voyages safer. Navigation-related incidents at sea are caused by a lack of technical and navigational skills and a poor use of those skills in the vessel's navigation. Failure to follow watch-keeping procedures is one of the human variables reportedly responsible for a large number of fishing vessel-related accidents. The Convention on the International Regulations for Preventing Collisions at Sea, 1972 (COLREGs) establishes rules for preventing collisions when a vessel is navigating or at anchor, as well as during the day and at night and in situations with limited visibility. Technical skills are evaluated through the use of equipment in navigational elements, according to the Oil Companies International Marine Forum's (OCIMF) "A Guide to Best Practice on Navigational Assessment and Audits."

The "Bridge Procedure Guides," published by the International Chamber of Shipping (ICS), describe how to navigate restricted and coastal waters and maintain watch when a vessel is at sea. Training and watch-keeping standards for fishing vessel personnel participating in navigation are outlined in the Standards of Training, Certification, and Watch-keeping for Fishing Vessel Personnel (STCW-F). The watch keepers must be completely familiar with the limitations and functionality of the radar plotting aids when on navigational watch (MCA, 2008). Conduct of vessel's navigation should always be in compliance with the international regulations for the prevention of collision at sea and avoiding action shall be taken in amble time and monitored until the target is finally passed and clear (NI, 2016).

METHODS:

This study, which is more quantitative in nature, compares the navigational and technical skills of fishermen on the Malabar Coast with those on the Coromandel Coast using a

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descriptive research methodology. Ten questions about open sea, coastal, and harbour navigation were used to assess the fishermen's navigational and technical skills. An ordinal scale of four points ("none," "little," "medium," and "high") was used for assessing navigational and technical skills.

Sampling

Data from fishermen who navigate fishing vessels from fishing harbours in two distinct geographic areas-the Malabar Coast (MC) and the Coromandel Coast (CC)-was gathered using a standardized questionnaire. Comparative analysis was used to evaluate their navigational and technical skills. Table 2 provides the sample details. The data was gathered using the random sample approach. Where necessary, unstructured interviews were also conducted to provide a deeper understanding of the respondents' responses. The respondents were one among the fishermen who are responsible for the navigation of the vessel and generally called as engine driver.

Table 2: Sampling region and frequency

Geographical region	Fishing Harbour	Frequency	Total	Grant Total
Malabar Coast	Thengappatinam	125	175	350
	Colachel	50		
Coromandel Coast	Chennai	120	175	
	Cuddalore	15		
	Nagappatinam	40		

SW - South West

Data Analysing

For each navigational and technical tasks, the MC and CC responder's "medium" and "high" answers were considered proficient and their proficiency in the tasks were compared and presented in percentages. Further, based on the respondents' answers to each question, navigational and technical skills were also evaluated. On an ordinance scale, "none," "little," "medium," and "high" were given scores ranging from one to four. The mean scores of all the MC and CC respondents were computed and compared.

The average score obtained by the respondents for all the ten questions was used to test the hypothesis. Basis that, following null and alternate hypothesis were framed as below and z test was employed to test.

H0 = Navigational and technical skills of the MC fishermen are same as that of CC fishermen

H1 = Navigational and technical skills of the MC fishermen differ from that of CC fishermen

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Limitations

Despite its excellent design, the study may have certain limitations because its goal is to compare two fishing harbours that are geographically located. These fishermen use a variety of fishing techniques, which could have an impact on their technical and navigational abilities. Additionally, depending on how far they operate from the coast, these distinct fishing techniques also affect how different nautical equipment is used.

RESULTS:

The result of the navigational and technical skill of the respondents from MC and CC are given below. The results were compared based on the proficient respondents from both the regions.

Navigational and technical skill comparison

The navigational and technical skills comparison between the MC and CC respondents is shown in Table 3. The MC respondent's proficiency in the first five electronic equipment related tasks are 100%, 98.9%, 97.8%, 99.4%, and 99.4%, respectively. For the CC respondents, it is, however, significantly lower at 54.9%, 56.6%, 77.7%, 85.7%, and 47.4%, respectively. Both MC (98.9%, 97.8%, and 88.8%) and CC (93.1%, 96.0%, and 82.3%) respondents demonstrated nearly equal proficiency in coastal navigational and technical skills. However, compared to CC (97.7% and 97.1%) respondents, the MC (48.6% and 52.0%) respondents had significantly weaker in celestial navigational skills (last 2 tasks). Overall, it is shown that the MC respondents had an average navigational and technical skill of 88.2%, whereas the CC respondents had an average of 78.9%.

Table 3: Navigational and technical skill comparison between MC and CC respondents

Navigational and Technical Skill	MC %	CC %
Reading latitude and longitude from GPS	100.0	54.9
Reading inter-cardinal direction from the compass	98.9	56.6
Finding distance of other vessels	97.8	77.7
Finding Estimated arrival time to the way point	99.4	85.7
Finding distance travelled from noon to noon	99.4	47.4
Using shore objects and light houses for navigation	98.9	93.1
Avoiding restricted areas, and obstructions when navigating	97.8	96.0
Using transit bearings for positioning of vessel	88.8	82.3
Using celestial objects such as sun, star for finding time at sea	48.6	97.7
Using celestial objects for finding direction at sea	52.0	97.1
Average	88.2	78.9

GPS - Global Positioning System

Navigational and technical skill score comparison test of the respondents

The independent z-test for comparing the navigational and technical skill scores of the MC and CC respondents is shown in Table 4. The mean scores for all navigational and technical skills that the MC and CC respondents received differ significantly. With z(350)=-12.593 and p=0.000, the z-test for the GPS's latitude and longitude readings revealed a significant difference between the MC (M=3.971, SD=0.167) and CC (M=3.034, SD=0.97) respondents. GPS is one of the equipment used extensively by the MC respondents due to their longer voyages and fishing at high traffic areas. The respondents from MC (M=3.937, SD=0.324) and CC (M=3.006, SD=0.938) differ significantly, according to the z-test for reading the inter-cardinal direction from the compass. MC respondent's skill score is higher for reading the direction from compass due to their routine navigation is through the traffic areas. With z(350)=-12.421 and p=0.000MC (M=3.937, SD=0.358) and CC (M=3.177, SD=0.869) respondents differ significantly in finding the distance of other vessels. AIS makes it very easy to find the distances of other vessels and that equipment are commonly used by the respondents of MC in the high traffic areas. With z(350)=-10.693 and p=0.000,similarly, with z(350)=-8.463 and p=0.000, the arrival time to the route point shows a significant difference between MC (M=3.96, SD=0.27) and CC (M=3.451, SD=0.748) respondents. In order to prevent needless delays, the vessels involved in lengthier trips meticulously plan their routes. GPS is a device that allows you to enter a waypoint and instantly determine how long it will take to get there. It can instantaneously provide the time to the way point and the distance to any way point when used with electronic charts. MC (M=3.966, SD=0.212) and CC (M=2.823, SD=0.933) respondents differed significantly in finding the distance traveled between noon and noon, with z(350)=-15.797 and p=0.000. Fuel and water consumption are calculated from noon to noon and proper check is done to ensure that the bunkers lost for the entire voyage without any shortage. With z(350)=-5.668 and p=0.000, a significant difference between MC (M=3.926, SD=0.339) and CC (M=3.611, SD=0.650) respondents is seen when it comes to employing shore features and light houses for navigation. A substantial difference between MC (M=3.909, SD=0.446) and CC (M=3.760, SD=0.577) has been found when avoiding restricted areas and obstructions during navigation (z(350)=-2.697 and p=0.007). Many restricted and fishing-banned areas are mapped in coastal areas, and coastal features are used to facilitate coastal navigation. As a result of their coastal fishing activities, the MC respondents scored better on these features. Similarly, there is a significant difference between MC (M=3.691, SD=0.862) and CC (M=3.486, SD=0.999) respondents when utilizing transit bearings for vessel location (z(350)=-2.062 and p=0.039). When approaching the ports, transit bearings are utilized. On the Malabar Coast, the custom of off-landing fish is practiced at any suitable port. As a result, the MC respondents are familiar with the coastline and know how to go to various harbors.

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Using celestial objects like the sun and stars to determine time at sea, the MC (M=2.594, SD=0.898) and CC (M=3.783, SD=0.556) respondents showed a significant difference in the z test with z(350)=14.890 and p=0.000. Lastly, a comparable significant difference between the MC (M=2.72, SD=0.926) and CC (M=3.789, SD=0.563) respondents with z(350)= and P=0.000 is also shown for using celestial objects to determine direction at sea. It's interesting to note that MC respondents scored less on celestial navigation since they depend on modern electronic devices, mostly for long-distance fishing.

Table 4: Independent sample z-test results for the navigational and technical skill of the MC and CC respondents

Navigational technical skill	Region	n	M	SD	z	p
Reading latitude and longitude from GPS	MC	175	3.971	0.167	-12.593	0.000
	CC	175	3.034	0.97		
Reading inter-cardinal direction from the compass	MC	175	3.937	0.324	-12.421	0.000
	CC	175	3.006	0.938		
Finding distance of other vessels	MC	175	3.937	0.358	-10.693	0.000
	CC	175	3.177	0.869		
Finding arrival time to the way point	MC	175	3.96	0.27	-8.463	0.000
	CC	175	3.451	0.748		
Finding distance travelled from noon to noon	MC	175	3.966	0.212	-15.797	0.000
	CC	175	2.823	0.933		
Using shore objects and light houses for navigation	MC	175	3.926	0.339	-5.668	0.000
	CC	175	3.611	0.65		
Avoiding restricted areas, and obstructions when navigating	MC	175	3.909	0.446	-2.697	0.007
	CC	175	3.76	0.577		
Using transit bearings for positioning of vessel	MC	175	3.691	0.862	-2.062	0.039
	CC	175	3.486	0.999		
Using celestial objects such as sun, star for finding time at sea	MC	175	2.594	0.898	14.890	0.000
	CC	175	3.783	0.556		
Using celestial objects for finding direction at sea	MC	175	2.72	0.926	13.041	0.000
	CC	175	3.789	0.563		

M- Mean, SD - Standard deviation, CC - Coromandel Coast, MC - Malabar Coast

Hypothesis testing

In order to test the MC fishermen's navigational and technical skills, the following null and alternate hypothesis were framed.

μ1 = Mean of navigational and technical skill score of MC respondents (n=175)

μ2=Mean of navigational and technical skill score of CC respondents (n=175)

H_0 = Navigational and technical skills of the MC fishermen are same as that of CC fishermen

H_0: μ1 = μ2 (for means)

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H1 = Navigational and technical skills of the MC fishermen differ from that of CC fishermen

H1: μ1 $\neq$ μ2 (for means)

Table 5: Independent sample z-test results for the mean navigational and technical skill of the MC and CC respondents for hypothesis testing

Region	n	M	VAR	z	z critical
MC	175	3.661	0.0924	7.137	1.96
CC	175	3.432	0.0884		

The alternative hypothesis H1 is accepted and the null hypothesis, H0, is rejected since the z value exceeds the critical value. Therefore, there is a difference in the mean navigational and technical skills of MC and CC fisherman, and it is evident from the mean score that MC fishermen are more proficient than CC fishermen.

DISCUSSION

One of the most important navigational tools for locating, determining movement direction, and determining time at sea when a vessel travels a great distance is the Global locating System (GPS) (Hentry, 2011). According to the study, MC fisherman use GPS to the fullest degree possible for vessel navigation in far-off waters. In addition to GPS, they use terrestrial objects when in coastal waters. However, the advent of GPS to obtain those data has made celestial navigation-the antiquated techniques for positioning, determining direction, and determining time at distant waters-less significant. Nearly all MC fishermen are able to use the GPS's features, which include setting a waypoint and measuring distances travelled. They were experts because they used these tools frequently. On the other hand, because they used GPS less frequently for navigation, many CC fisherman were unable to use it.

Although fishermen's navigational and technical skills aid in successful navigation, adherence to the collision regulation guarantees safe, collision-free operation. For the other vessel to comprehend and respond appropriately, the fishing vessel's status-whether she is at anchor or fishing or making way-must be communicated by day and night signals. Additionally, the "responsibility between vessels" guideline must be adhered to when avoiding other vessels at sea. The lack of professional training for the fishermen results in their relatively poor application of collision regulations. Additionally, interactions with the fishermen reveal that the vessel's construction does not support the display of day and night signals and this inadequate display facilities prevent the navigator from learning anything more. Due to their limited understanding of navigational signals, they are unable to comply with collision regulations(IMO, 2018). Moreover, when fishing in or close to traffic lanes, fishing vessels are prone to move suddenly to protect their gear from other vessels, which could cause confusion to the other vessels and result in accident situations(Viswanathan, 2018).

CONCLUSION

The main factors affecting a vessel's ability to navigate safely are adherence to COLREG 1972 standards and appropriate watch-keeping practices. Fishermen need to develop navigational knowledge and skills on their own since no official training programs comparable to those of merchant vessels have been established. However, because MC fisherman are self-learning, their exposure to high traffic areas helps them develop their technical and navigational skills. Furthermore, the type of vessel and operating location have a major impact on the fishermen's technical and navigational skills and their degree of exposure at sea is closely related to this. The fishermen from the Malabar Coast frequently traverse the IMTR. Conversely, fisherman in the Coromandel Coast work close to the coast and, to a lesser extent, the Bay of Bengal. Therefore, using GNSS equipment becomes essential for MC Coast fishermen to manage the lengthy voyages and congested traffic. Overall, MC fishers are more technically skilled than CC fishermen in navigation of the vessels. Direct communication with the fisherman, however, reveals that the MC fishermen do not adhere to the collision regulation and their fishing vessel lack proper construction that would help them display required navigational signs. It is possible to conclude that even if MC fisherman have superior technical and navigational skills to CC fishermen, their understanding of the COLREGs-1972 and watch-keeping do not match the international standards that commerce vessels adhere to. This needs a shore based training to enhance the navigator's navigational and technical skills (Uturlu, 2015). Additionally, the design of the fishing vessel does not allow for the display of the day and night signals, which is another requirement under COLREGs.

Though the study indicates that navigational and technical skills of the MC fishermen are good, the accidents are taking place in the South West Coast of India. Their navigational skills are self-taught, further, technological developments and knowledge on the new regulatory compliances have not reached the fishermen fully due to inadequate professional training. So, there could be a gap in these areas which affects the safe navigation of the fishing vessel at sea. A further study is recommended on the collision regulation compliance and the construction of the vessel for safe navigation of the fishing vessels.

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References

1. Agarwal. (2003). Traditional Navigational Knowledge among Tribes of the Andaman and Nicobar Islands by D.P. Agrawal.
2. D'Cruz, T. (2004). Artisanal Deep-Sea Fishing in Kerala?: Prospects and problems. In Discussion Paper (Issue 74).
3. Hentry. (2011). Application of GPS in fisheries and marine studies.International Journal of Advanced Research in Computer Science, 2(6), 259-263.
4. IMO. (2018). Convention on the International Regulations for Preventing Collisions at Sea , 1972. 62.
5. Kiruthika. (2014). Implementation Of GPS Based Surveillance Navigation System For Fisherman. International Journal of Scientific Research and Engineering Studies, 1(5), 58-62.
6. MCA. (2008). MGN 379 (M + F) Navigation?: Use of Electronic Navigation Aids. Marine Guidance Note, 379(1473), 1-12. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/833107/MGN_379.pdf
7. Nandhini. (2016). Intelligent navigation system for fishing boats using gps.International Research Journal of Engineering and Technology (IRJET), 1169-1172. https://www.academia.edu/download/54686167/IRJET-V3I1202.pdf
8. Nayak. (2020). Coastal navigation in the bay of Bengal , a study of eastern coast of Orissa. 9(4), 8-12.
9. NI. (2016). Bridge-Procedures-Guide.
10. Sharma. (2022). Exploring technical and non-technical competencies of navigators for autonomous shipping.Maritime Policy and Management, 49(6), 831-849. https://doi.org/10.1080/03088839.2021.1914874
11. Uturlu. (2015). Analysis of grounding accidents caused by human error. Journal of Marine Science and Technology (Taiwan), 23(5), 748-760.https://doi.org/10.6119/JMST-015-0615-1
12. Viswanathan, M. (2018). Fisherfolk at sea?: Rise in incidents of ships colliding with fishing boats. July, 1-10.