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ANALYSIS OF NAVIGATIONAL KNOWLEDGE, SKILLS, AND PROCEDURE COMPLIANCE OF THE DEEP-SEA FISHERS OF THOOTHUR ZONE, SOUTHWEST COAST OF INDIA.

Capt. S. Viswanathan[1], Dr N. Neethiselvan [2] & Dr Uma Maheshwari[3]

Abstract

Growing number of accidents involving fishing vessels at sea particularly collision between vessels and loss of vessels due to heavy weather is a serios concern. Poor navigation being the main reason, a study was conducted on the Navigational Knowledge, Skills and Procedure Compliance of the deep-sea fishers (125 respondents) of Thoothur zone, Southwest coast of India during 2022-2023 which revealed Navigational knowledge index of the fishers as 4.29. Further their Navigational skill index was estimated at 7.90 and the Navigational procedure compliance being 6.73. The low Navigational knowledge index indicated inadequate knowledge level and could be attributed to the low educational level with the mean schooling years of 6. Relatively better Navigational skill index could be attributed to higher level of interpersonal skills (Interpersonal skill index 9.06) besides terrestrial and celestial navigational skills (Index value 9.02). The reason for the relatively lesser adoption of Navigational procedure compliance observed in the study could be due to the fact that the fishing vessel design itself did not comply with the standard design and without basic navigational facilities. The study warranted need for the up gradation of navigational knowledge level of the deep-sea fishers of Thoothur zone through trainings. Further, the Navigational equipment operational skills and cognitive skills are to be improved through practical demonstration and awareness trainings respectively. The design of the deep-sea fishing vessels also needs to be standardised besides equipping the vessels with adequate modern navigational equipment such as RADAR (Radio Detection and Ranging), NavIC, Automatic Identification System (AIS) and Electronic Navigational Chart which are required for safe navigation in deep-sea fishing vessels.

Keywords: Thoothur zone, deep-sea fishers, Navigational knowledge, skill and procedure compliance index.

[1] Dean, College of Fisheries Nautical Technology, Thoothukudi
Email: capt.viswanathan@rediffmail.com
[2] Professor and head, Department of Fishing Technology and Fisheries Engineering, Fisheries College and Research Institute, Thoothukudi
Email: neethiselvan@tnfu.ac.in
[3] Assistant Professor, Department of Fisheries Extension, Economics and Statistics, Fisheries College and Research Institute, Thoothukudi

1. INTRODUCTION

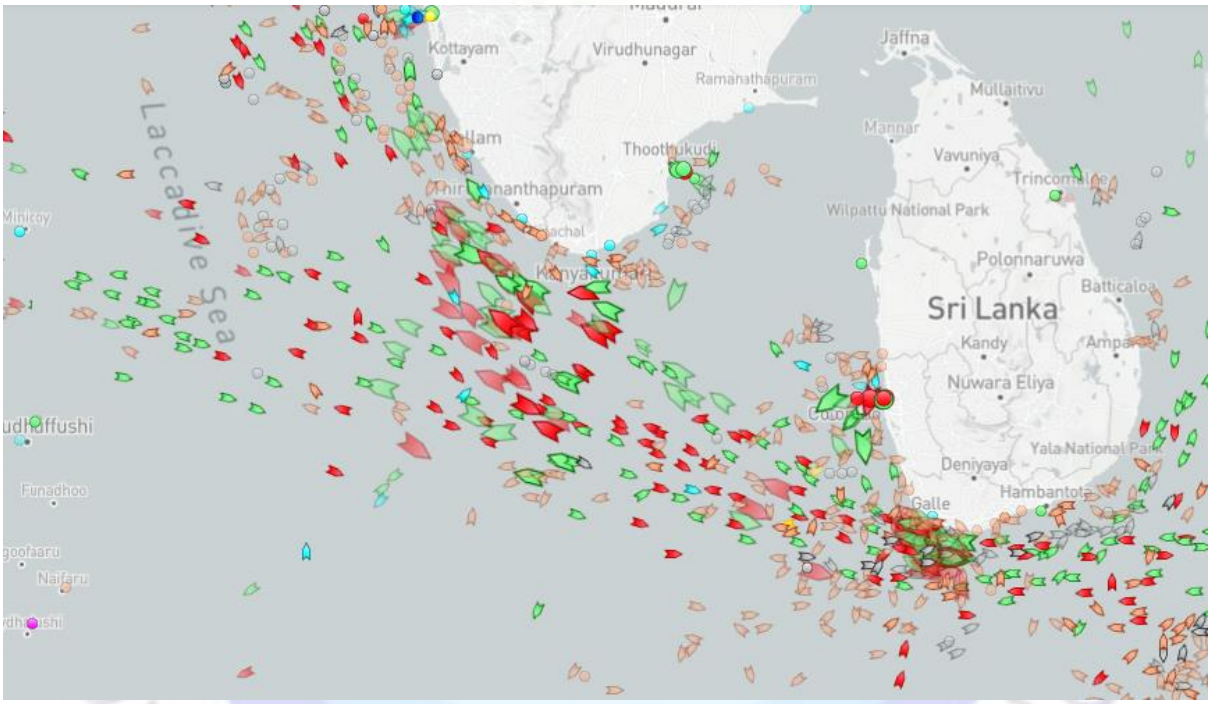
Fishing vessels have been facing navigation related incidents quite often during navigating and fishing at sea. Marine insurance company GARD had claims from 49 collision incidents involving fishing vessel between 2015 and 2020 with loss of life to 54 fishers besides major injury to 15 fishers. Grounding (30%) and collision (9%)were the 2nd and 4th most accidents accounted for Canadian fishing vessel from 2011 to 2021(TSB, 2021). For the year 2014-2021, out of 177 vessels lost at sea, 61% belongs to fishing vessel category in European Union(EMSA, 2022). In UK, out of 90 vessels, 5 vessels were lost due to collision and 2 due to contact for the year 2012-2020(MAIB, 2021).

In Indian during Ockhi cyclone, the fishermen dead and missing in Tamil Nadu were 218 and in Kerala 143. In Kerala from Thiruvananthapuram district alone 91 fishers were found missing during the Ockhi cyclone(FAO, 2019). For the year 2020, In Indian ocean region 60% and 35% of the incidents were collision and grounding respectively involving small vessels including fishing vessels and the capsizing incident was found to be 125 in which 90% accounted for small craft including fishing vessels(MMSU, 2020). 15 fishing vessels had capsized at mid-sea off Gir Soamnath Nava Bandar port due to neglect of the weather warning issued by Indian Meteorological Department (IMD) for the strong wind (Methri, 2021). National Federation of Fishers Cooperatives (FISHCOPFED) found that on an average, they received reports of 100-200 fishermen deaths every year – with “more deaths on the east coast than on the west coast” during the year 2021. From April 2013 to Dec 2021, 278 incidents had occurred at sea involving fishing vessels (IFC-IOR) which included 26 collisions and 13 grounding.

During the year 2012, there was a sharp rise in the number accidents to the fishing vessels at sea in the state of Kerala, as evidenced through 433 rescue operations against 176 during the year 2010. There were 3 collision accidents occurred between fishing vessels and merchant vessels in the year 2016. It rose to 10 for the next two years which claimed several lives (Neethu, 2019). Kerala fishermen welfare fund board found that 327 fishermen were dead due to accidents at sea in the past 5 years (2016 to 2021 Nov) across Kerala, of which 145 died in Thiruvananthapuram district followed by 68 in Kollam district. In these incidents capsizing accounted to 19 followed by 8 collisions, 8 grounding incidents and 6 engine failures incidents. During the year 2021, there were 2 collision accidents between fishing vessels and merchant vessels in the southwest coast of

India. The accidents involving fishing vessels in Indian waters are a great concern as it leads to loss lives besides loss of property. The reason for so much of navigational related indents could be due to their poor navigational activities. This study was conducted at Southwest coast of India with the objectives of finding Navigational knowledge, skills, procedure compliance of the deep-sea fishers and to recommend necessary corrective measures.

Figure 1 - Marine Traffic condition near Southwest coast of India



2. MATERIALS AND METHODS

The study was conducted covering 125 Thoothur zone deep-sea fishers involved in navigation of the vessel during 2022-2023. Thoothur zone is located in Tamil Nadu, Southwest coast of Indian, close to international maritime traffic route and consists of 8 fishing villages namely Chinnadurai, Vallavilai, Eraviputhenthurai, Poothurai, Erayumanthurai, Marthandanthurai, Neerodi and Thoothur. A detailed survey was made with structured interview schedule. Simple random sampling method was employed, and perception analysis was carried out during the data collection. Descriptive analysis and regression analysis were used to analysis the data to test the hypothesis and finding Navigational knowledge, skill and procedure compliance indices.

Socio democratic characteristics such as age(X1), educational status(X2), experience at sea(X3), fishing vessel type (X4), length of fishing vessel worked (X5), fishing distance (X6), duration of voyage (X7), fishermen income (X8), number of trips per year (X9), trainings attended (X10), innovativeness (X11), self-confidence (X12), scientific orientation (X13), risk orientation (X14), economic motivation (X15) and safety orientation (X16) were kept as independent variables and Navigational knowledge, Navigational skill and Navigational procedure compliance were kept as dependent variable and regression analysis was carried out for each dependent variables to measure the correlation among them.

Navigational knowledge is defined as information and understanding about moving the vessel from one place to another place by plotting the track, knowing position, speed and directing the vessel along the track. The Navigational knowledge level of the deep-sea fishers was measured by interviewing them with 10 Navigational knowledge related questions. The correct answer was given one mark and Navigational knowledge index was arrived based on the below formula.

$$\boldsymbol{Navigational\ knowledge\ index} = \frac{\sum_{i=1}^{n}(\mathrm{K}i)}{n}$$

K*i* – *Marks obtained by the* i^{th} *respondent*

n= Total number of respondents (n=125)

Navigational skill is defined as the ability to use one's Navigational knowledge effectively and readily in execution or performance of the navigation of the vessel. Navigational ability can be classified under two broad categories, i.e. Technical skills and Non-technical skills. The technical skills were further subdivided into terrestrial, celestial navigational skill and equipment operational skill. The non-technical skills were also sub divided into cognitive skill and interpersonal skill. The sub divided 4 skills were assessed through 10 questions each and each answer was assigned score in ordinal scale with 4 as the maximum score. The Navigational skill index was arrived based on the below formula.

$$\boldsymbol{Navigational\ skill\ index} = \frac{\sum_{i=1}^{n}(TCi + NEi + Ci + IPi)}{Ks\ x\ n}$$

TCi = Marks obtained by the i^{th} respondent on terrestrial, celestial navigational skill

*NE*i = Marks obtained by the i^{th} respondent on navigational equipment operational skill

*C*i = Marks obtained by the i^{th} respondent on cognitive skill

*IP*i = Marks obtained by the ith respondent on interpersonal skill

n= total number of respondents (*n*=125)

$$Ks = \frac{\text{Max. marks for one question x Total number of questions on navigational skills}}{10}$$

Procedures are a series of steps followed in a regular definite order. Navigational procedures are being followed on vessels for a safe and efficient navigation of the vessel from harbour to the deep-seas and back. Ordinal scaling technique (maximum marks of 4) was employed to measure Navigational procedure compliance with 10 questions. The navigational procedure compliance index was arrived based on the below formula.

$$\boldsymbol{Navigational\ Procedure\ compliance\ index} = \frac{\sum_{i=1}^{n}(\mathrm{PC}i)}{Kp\ x\ n}$$

PC*i* = Marks obtained by the ith respondent on procedure compliance skill

n= total number of respondents (*n*=125)

$$Kp = \frac{\text{Max. mark for one question x Total number of questions on navigational procedure compliance}}{10}$$

Psychological factors such as innovativeness, self-confidence, scientific orientation, risk orientation, economic motivation and safety orientation were measured with 5 questions each and assigned mark from 1 to 3 for each question. Each psychological factor mark was arrived after adding all the marks and mean of all the 6 factors were calculated to classify them into the following 3 categories.

Low: <= mean of psychological factors -1

Medium: = mean of psychological factor ±1

High: >= mean of psychological factor + 1

3. RESULT AND DISCUSSION

In the exploration of deep-sea fisher socio-democratic characteristics and their profound impact on navigational knowledge, skill, and procedural compliance, this section unveils the study's critical findings and offers insightful discussions. It delves into the diverse aspects of the

respondents' characteristics and how these factors influence their knowledge, skills, and adherence to navigational procedures. Let's delve into the detailed results and engage in a thoughtful discussion of these significant findings.

3.1 Socio-Democratic Characteristics

The respondents had a mean age of 42.9 years with education level of 7th standard and professional experience of 27 years. Majority of them worked on two types of fishing vessels and average length of the vessel being 59. 7ft.The fishers travelled up to an average distance of 773 nm from the coast. Their average voyage days extended to 26 days with an income of Rs.20,000 per voyage. Due to their long-distance voyages, most of them could make only 9 voyages per year. Only 17 (13.6%) of the respondents underwent any kind of training for navigation of the vessel. Their psychological factors for the fishers such as innovativeness (12.56) found to be medium, self-confidence (13.88) high, scientific orientation (7.26) low, risk orientation (10.70) medium, economic motivation (13.98) high and safety orientation (11.81) medium.

Table 1 - Correlation between the socio democratic characteristics of the Deep-sea fisher and Navigational knowledge, Navigational skill and Navigational procedure compliance

Variable code	Variable	Correlation coefficient		
		Navigational Knowledge	Navigational skill	Navigational procedure compliance
X1	Age	-0.023 NS	0.078*	0.048 NS
X2	Education status	-0.028 NS	-0.015 NS	-0.082 NS
X3	Experience at sea	0.009 NS	-0.066 NS	-0.060 NS
X4	Fishing vessel type	-0.012 NS	0.617 NS	0.284 NS
X5	Length of the vessel worked	0.027*	0.001 NS	0.011 NS
X6	Fishing distance	0.0002 NS	0.002**	0.003**
X7	Duration of voyage	-0.019 NS	-0.014 NS	-0.102**
X8	Income of the fishermen	-.00002*	0.000 NS	0.000 NS
X9	Number of fishing trip	-0.003 NS	0.005 NS	-0.011*

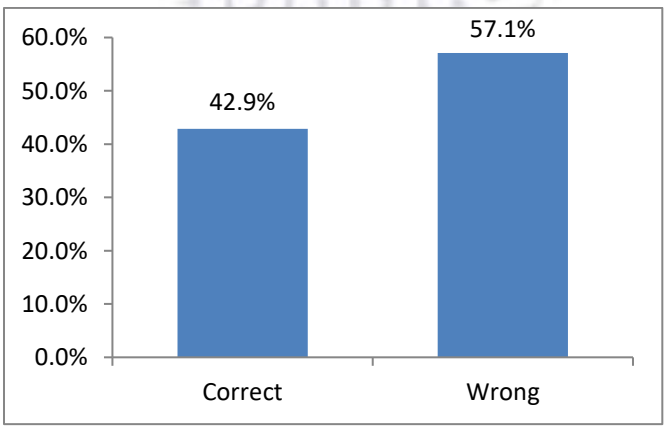
X10	Participation in training	0.401 NS	0.823*	0.261 NS
X11	Innovativeness	0.0240 NS	0.097 NS	-0.211 NS
X12	Self confidence	0.198 NS	0.514**	0.672**
X13	Scientific orientation	-0.202*	-0.093 NS	-0.314*
X14	Risk orientation	-0.151 NS	0.311**	0.055 NS
X15	Economic motivation	-0.005 NS	0.628**	0.527**
X16	Safety orientation	0.038 NS	0.283*	0.296 NS

Note: * - Significant at 5% level, ** - Significant at 1% level, NS – Non-significant

3.2 Navigational Knowledge

The study revealed that Navigational knowledge index of the Thoothur zone deep-sea fishers was 4.29. The lower navigational knowledge index could be due to their lower educational level with mean schooling years of 6 and the navigational knowledge acquired was through tradition and personal experience alone. This is evident through the socio democratic characteristics X5 (length of the vessel worked) alone having positive correlation with navigational knowledge of the deep-sea fishers and Income of the fishermen (X8) and scientific orientation (X13) being negatively correlated at 5% significant level. Age, education and experience did not have any significant correlation with the navigational knowledge of the deep-sea fishers of Thoothur zone.(Gopal et al., 2018) has also confirmed in his study on traditional knowledge of Kerala fishermen that they were using wind, current, stars, constellations, lunar cycles and weather conditions for the navigation of the vessel into sea for fishing.

Figure 2 - Navigational knowledge of the fishers – number of correct and wrong answers

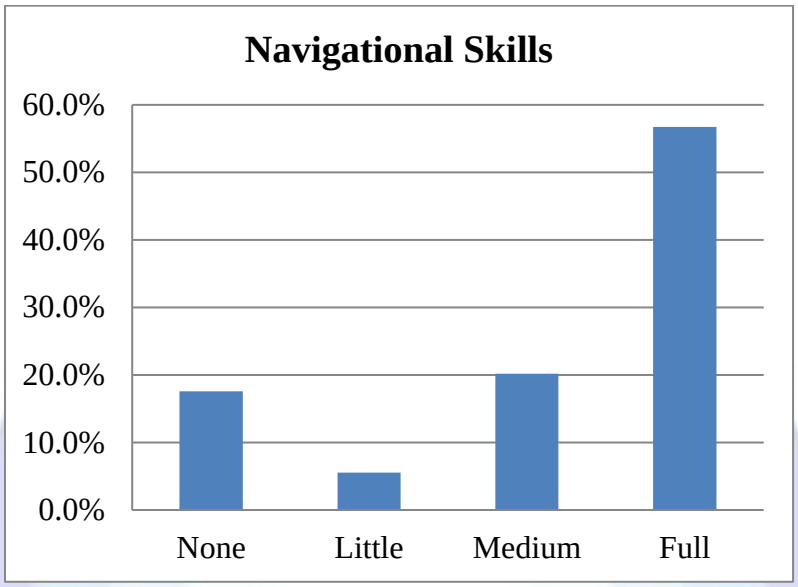


3.3 Navigational Skill

Navigational skill index of the deep-sea fishers of Thoothur zone was calculated as 7.90. It is evident from the study that age (X1), Participation in training (X10) and Safety orientation (X16) had positive correlation with Navigational skills at 5% significant level. However, Fishing distance (X6), Self-confidence (X12), Risk orientation (X14) and Economic motivation (X15) had positive correlation with Navigational skills at 1 % significant level. It is evident from the study that self-confident of the deep-sea fishers could have played a major role in developing these skills. However, the lack in the skills could have been caused due to the lack in formal training. They could develop the skills on their own to the limit of their exposure to the sea. Similar finding was seen when (Yi, 2015) in his study on collision between fishing vessels and merchant vessels in China, reported that deficiency in training led to unawareness of the danger involved in marine navigation to the fishing vessel personnel. This was also caused due to their poor education level. The study further reveals that their terrestrial, celestial navigational skill is high (9.02) and it could be due to the routine practice of arrival and departure from the same fishing harbour. Less equipment operational skill (5.69) indicated that even though the fishing vessel were fitted with modern electronic equipment which made their navigation more safe and efficient, navigational decision making lacked due to unavailability of the modern meteorological, communication equipment such as NavIC messaging system onboard deep-sea fishing vessel to predict the weather conditions well in advance(Thara, 2018)(Suresh et al., 2018) and to avoid Ockhi cyclones (P. Punya et al., 2021). This study is in confirmation with the study conducted on the need for navigational decision making for avoiding maritime environmental factors such as unpredictable weather conditions, navigational errors and human factors(Roberts et al., 2010) and impact of hydro meteorological conditions in safety of fishing vessel in polish fisheries (Pleskacz, 2015). The study further revealed that cognitive skill (7.84) was considerably less among Thoothur fishers. Poor cognitive skill could lead to poor situational awareness. This is in line with the study conducted by (Baker & McCafferty, 2005) that human failures caused nearly 80% of the maritime accidents at sea. High Interpersonal index (9.05) indicated that onboard management, teamwork and leadership skills were better. This could be due to the fact that onboard working culture in Thoothur zone boats were practically designed to continuously improve and directly related to the catch output. The small lagging in index could be due to non-availability of the formal awareness training to the deep-sea fishers in crew resource management. (Pietrzykowski, et al., 2017)

concluded that conversion of navigational information system into decision support system would reduce human errors and thus accidents at sea.

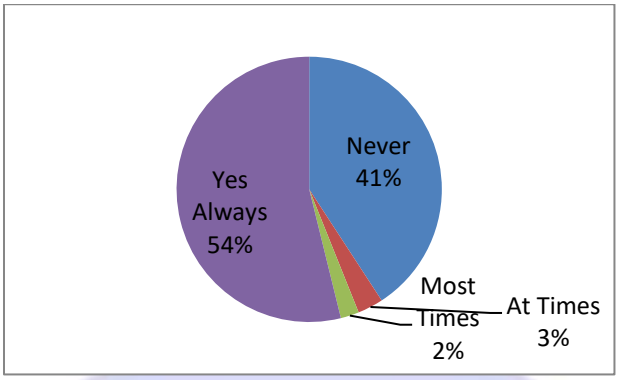
Figure 3 - Navigational skill of the Thoothur fishers – ability of the fishers



3.4 Navigational Procedures

Deep-sea fishers of Thoothur zone had procedure compliance index of 6.73. It is evident from the study that compliance with the collision regulations and watch keeping procedures were less. Fishing distance (X6), Duration of voyage (X7), self-confidence (X12) and economic orientation (X15) had correlation at 1% significant level. Number of fishing trips (X9) and scientific orientation (X13) had correlation at 5% significant level. The poor procedure compliance is evident through their practice of keeping the navigational bridge unmanned during night and in some cases lights off to save batteries. This was in line with the study conducted by (Shankar et al., 2014) on knowledge level of fishers on marine policies and regulatory measures and reported that 61.34% of the fishers knowledge level was medium. (Yi, 2015) had reported that poor lookout and unaware of the collision regulations caused many accidents in Chinese coastal waters. Many accidents and close quarter situations were encountered by these fishing vessels in the past. This could be due to less manpower and excessive workload demanded the whole crew of the vessel involved in fishing operations keeping the bridge watch in the darkness. In addition, this excessive work load caused fatigue and led to the crew to fall asleep when kept for keeping watch. (Kongsvik et al., 2012) studied the impact of different watch keeping regimes at sea on sleep, fatigue and safety and concluded 8-8-4-4 system of watch keeping had better sleep efficiency.

Figure 4 - Navigational procedure compliance of the Thoothur fisher



4. CONCLUSION

Thoothur zone fishers were doing a successful fishing at sea through sailing to very long distance in Indian Ocean and stay for long period of time at sea. They had acquired their navigation related knowledge through their own experience and developed the navigational skills by themselves and passed on to the next generation. The Navigational knowledge was low as they could not get any training to enhance their knowledge. It was always thought by the fishers that as long as they did not involve in collision incidents and there were no loss of fishing gears or damaged to fishing gear by other vessels, they were perfect and safe in navigation of the vessel. However, recent accidents involving fishing vessels in the south west coast of India indicates the need for bringing the deep-sea fishing vessel operations and knowledge of the fishing vessel personnel on par with the internationals standard. The navigational skills were little better as they could develop the skills through their day to day activities. However, this lacked as there is no formal training was given to enhance their skills on par with the international standard as shown in STCW-F. Navigational procedures are set of procedures followed by the vessels on the bridge in watch keeping at sea and compliance of collision regulations. Collision regulation classify the vessels into power driven vessel, vessel engaged in fishing etc(COLREG, 1972) and the regulation is common to all the vessels at sea. Poor understanding of the collision regulations and less observance of the watch keeping procedures on fishing vessels led to many navigational related accidents in Indian fishing vessels. This brings a need to enhance the knowledge and procedures followed by the fishers to come on par with the other vessels being operated at sea.

5. RECOMMENDATION

The low Navigational knowledge index demands the need for uplifting their knowledge level in par with the international standard. This could be possible only through education and training. Standardisation of the Training, Certification and watch-keeping for fishing vessel (STCW-F) convention is in force and stipulates training standards for fisheries personnel(STCW-F, 1995). Even though India did not ratify the convention, training structures which is similar to the STCW-F and suitable to the Indian marine fishing industry can enhance the knowledge and technical skills of the deep-sea fishers. Awareness program can be conducted to enhance the non-technical skills of the fishers. The design of the vessels also needs to be upgraded to be COLREG compliant and fitted with modern electronic navigational equipment. The fishing vessels need to be fitted with light and mast for displaying various signals as required by the COLREG. Further modern electronic communication and navigational equipment can be fitted onboard for effective decision making. Moreover, the vessels need to be manned with sufficient licensed personnel for navigational activities besides fishing personnel.

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AUTHORS[4]

Capt. S. Viswanathan, MBA, has been working as Associate Professor, School of Nautical Science, Indian Maritime University, Chennai, since October 2023. He has work experience of 23 years at sea in Oil tankers and offshore vessels. Then he had worked in Maritime training institutes as principal and headed Fisheries Nautical College for about five and half years. Further, he has been pursuing his PhD in Indian Maritime University, Chennai.

Dr. N. Neethiselvan, MFSc, PhD, has working experience of 34 years in the field of Fisheries. His field of specialisation is fishing technology and fisheries engineering. He is one of the seniors most professors in the fishing technology field in India and guiding many MFSc and PhD students.

Dr. T. Uma Maheswari, MFSc, PhD, has been working as assistant professor in Tamil Nadu Dr. J. Jayalalithaa Fisheries University, Nagappatinam for last 11 years. She has handled 4 external funded projects. Her field of specialisation includes value chain analysis, Coastal vulnerability assessment, Socio-economic impact assessment.

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ISF Software and Publications
www.ispelearning.net

ISF Management and Consultancy Services

ISF Surveys, Testing, Audits Research & Rating Services

ISF HR Services

www.iire.in, www.inner-search.org, www.isfgroup.in, www.isfgi.com,
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ISF Institute of Research and Education (IIRE)

A Divsion of Inner Search Foundation
410 Gemstar Commercial Complex, Ramchandra Lane Extension, Kachpada,
Off Link Road, Malad (W), Mumbai- 4000 64, India.
www.iire.in; www.inner-search.org; www.isfgroup.in