OCCUPATIONAL HAZARDS IN FISHERIES SECTOR IN THE STATE OF ODISHA

Dissertation submitted in partial fulfillment

of the requirements

for the degree of

M.F.Sc. (Fisheries Extension)

by

SUCHISMITA PRUSTY, B.F.Sc.

(FEX-MA7-05)

ICAR-CENTRAL INSTITUTE OF FISHERIES EDUCATION

(Deemed-to-be University Established Under Section 3 of UGC Act 1956)

Panch Marg, Off Yari Road, Versova,

Andheri (W), Mumbai – 400 061

JUNE, 2019

Suchismita Prusty, 2019. Occupational hazards in fisheries sector in the state of Odisha. M.F.Sc. Dissertation, ICAR-Central Institute Of Fisheries Education (University Established Under Section 3 of UGC Act 1956) Panch Marg, Off Yari Road, Versova, Andheri (W), Mumbai – 400 061

Dedication

THIS HUMBLE WORK IS THE SIGN OF BLESSINGS FROM LORD GANESHA AND LOVE TO MY SWEET AND LOVING MAMMA & BAPA. WHOSE AFFECTION, LOVE, ENCOURAGEMENT AND PRAYS OF DAY AND NIGHT IS THE REASON OF WHAT I BECOME TODAY.

भा.कृ.अनु.प.- केन्द्रीय मात्स्यिकी शिक्षा संस्थान
ICAR-CENTRAL INSTITUTE OF FISHERIES EDUCATION
(A University Established Under Sec.3 of UGC Act 1956)
Ministry of Agriculture & Farmers Welfere,
Govt. of India.

Dated: 30th June, 2019

CERTIFICATE

Certified that the dissertation entitled **"Occupational Hazards in Fisheries Sector in the State of Odisha"** is a bonafide record of independent research work carried out by **Miss. Suchismita Prusty** during the period of study from August, 2018 to June, 2019 under our supervision and guidance for the degree of **Master of Fisheries Science (Fisheries Extension)** and that the dissertation has not previously formed the basis for the award of any degree, diploma, associateship, fellowship or any other similar title.

Major Advisor

(Arpita Sharma)
Principal Scientist

FEES Division
ICAR-CIFE, Mumbai

Advisory Committee

Rama Sharma

(Rama Sharma)
Senior Scientist

FEES Division
ICAR-CIFE, Mumbai

(Vinod Kumar Yadav)
Scientist

FEES Division
ICAR-CIFE, Mumbai

पंच मार्ग, ऑफ यारी रोड, वरसोवा, अंधेरी (प), मुंबई - ४०० ०६१. (भारत)
Panch Marg, Off Yari Road, Versova, Andheri (W), Mumbai - 400 061. (India)
कार्यालय /Office : 022-26361446/7/8,
Fax : 022-26361573
Website : www.cife.edu.in

DECLARATION

I hereby declare that the dissertation entitled **"OCCUPATIONAL HAZARDS IN FISHERIES SECTOR IN THE STATE OF ODISHA"** is an authentic record of the work done by me and that no part thereof has been presented for the award of any degree, diploma, associateship, fellowship or any other similar title.

Suchismita Prusty

(Suchismita Prusty)
FEX-MA7-05
M.F.Sc. Student
ICAR-CIFE, Mumbai

Date: 30 June, 2019
Place: Mumbai

ACKNOWLEDGEMENTS

First and foremost, let me thank the ***almighty*** *who had given me strength and courage to complete my dissertation successfully.*

I take great privilege to express my deep sense of gratitude to my major advisor ***Dr. Arpita Sharma,*** *Principal Scientist, Fisheries Economics, Extension and Statistics Division (FEES) CIFE, Mumbai, for her luminous guidance, valuable advice, constant encouragement and timely support during the entire course of my research work. I am indebted to her for all the help, without which this dissertation would not have been possible.*

I express my sincere gratitude to ***Dr. Gopal Krishna,*** *Director & Vice Chancellor CIFE, and* ***Dr. S. N. Ojha,*** *HoD and Advisory member, FEES Division, CIFE, for their valuable advice and support. I also remember the help and support of all the scientists in FEESD.*

I am extremely thankful to my advisory committee members, Dr. ***Rama Sharma,*** *Senior Scientist, FEES Division, CIFE, and* ***Mr. Vinod Yadav,*** *Scientist, FEES Division, ICAR-CIFE for their constant guidance, suggestions and encouragements which strengthened me in executing the research work.*

My deep sense of gratitude to ***Dr. Swadesh Prakash,*** *Principal Scientist,* ***Dr. Ananthan.P.S.,*** *Senior Scientist,* ***Dr. Shivaji Dadabhau Argade,*** *Scientist,* ***Neha W Qureshi,*** *Scientist,* ***Dr. S. K. Pandey,*** *Chief Technical Officer, FEES Division, CIFE for their support and suggestions.*

I express my sincere thanks to ***Ms. Lopamudra Behera, Mr. Amit Padhy, Mr. Abhib Abhinash, Mr. Prahallad Sethy, Mr. Bharat Naik, Mr. Yudhistrir Ping, Mr. Surendra Behera, Mrs. Lipsa Pattnaik, and Ms. Kiran Das*** *from Department of Fisheries in providing me information and all necessary inputs for the completion of my research work.*

I am indebted to all the officials of Department of Fisheries, Odisha and all the fish farmers and fishers from both inland and marine sector, who gave their valuable time and provided me the necessary information.

I am extremely thankful to Mr. Bijayananda Patnaik , Asst. Operator from Chandipur marine Fisheries Department, for constant guidance and support during collection of information from marine vessels.

I extend my sincere thanks to my seniors ***Mr. Bharat Yadav, Mr. Sandesh Vitthal Patil, Mr. Stanzin Gawa, Ms. Shalmol Salas, Ms. Dona P., Mr. SumanDey, Ms. Dileshwari Ratre, Ms. Gomathy, Mr PritamTripathy, Mr. Rajpal Yadav, Mr. Khemraj Bunkar*** *who were very helpful and providing their support, guidance during the writing of dissertation.*

I owe my special thanks to my seniors ***Mr. AdityaAcharya, Ms. Sagarika Swain, Ms. Dhanya M. Lal, Mr. Rajeev Rathod, Mr. Sambit Priyadarshi, Ms. D. Kiranmayi, and Mr. Chinmaya Nanda*** *for their constant encouragement and guidance.*

I am indebted to my batch mates ***Napinder, Shakir, Yateesh, Abhinandan, Atufa, Frencia, Vivek, Sandeep, Powan kumar, Sabah and Shahid*** *for helping me through out and their constant support, patience and encouragement and providing valuable feedback at every step of mobile application development.*

I extend my huge, warm thanks to my beloved friends ***Resma, Swapna, Debasmit, Atul Akankshya, Anwesha, Suman, Hussain, Alok,*** *and* ***Chinmay*** *for helping me through out and their constant support, patience and encouragement.*

I extend my special thanks to my lovely juniors ***Nidhi, Camelia, Arthi, Akilandeshwari, lucas, Abhilash, Bethsy, Shyam, Vansngewbha,*** *and* ***Sanjay stephen*** *for their love, care and support.*

I consider it as my proud privilege and immense pleasure to acknowledge my loving ***Father, Mother,*** *my elder sisters* ***Madhusmita, Nibedita,*** *younger brother* ***Debashis*** *and my* nephew Satish. *Without their love, prayers, blessings, care, and encouragement of it wouldn't have been possible for me to complete this research work.*

Suchismita Prusty
(Suchismita Prusty)

30 June 2019 CIFE, Mumbai

सारांश

वर्तमान समय में सुरक्षा का महत्व बढ़ रहा है। हाल ही में २०१८ में UNFAO ने साझेदारों के साथ मत्स्य पालन क्षेत्र में सामाजिक सुरक्षा और गरीबी के साथ-साथ कामकाजी खतरों का भी आकलन किया है। यह मुद्दे को समुद्री मत्स्य पालन के संबध में भारत एवं अन्य देशों द्वारा सम्बोधित किया गया है। जबकी अन्तः-स्थलीय मत्स्य पालन पर अध्ययन कम हुआ है.इसीलिए अध्ययन का शीर्षक " ओडिशा में मत्स्य पालन के क्षेत्र में कामकाजी खतरों" का मत्स्य क्षेत्र में खतरों का आकलन है। ओडिशा स्थित बालासोर और अंगुल जिले से १८० अन्तः-स्थलीय किसानों/मछुआरों द्वारा पूर्वपरीक्षण साक्षात्कार के माध्यम से सूचना एकत्रित की एवं कामकाजी खतरों पर जानकारी सम्मिलित की। कामकाजी खतरों को कम करने के लिए मत्स्य किसानों/मछुआरों द्वारा अपनाई गयी रणनीतियों का आकलन करने के लिए हायरार्की ऑफ़ हैजर्ड कंट्रोल का पद्धति अपनाया गया था। राज्य मत्स्य पालन के ढांचे में कामकाजी सुरक्षा के संदर्भ में पता लगाने के लिए विभिन्न राज्य /राष्ट्रीय नीतियों की समीक्षा की गयी। समुद्री क्षेत्र से ३० पारम्परिक, मोटर-चलित और यंतिकृत मछुआरों एवं अन्तः-स्थलीय क्षेत्रों से ३० जलयान किसानों, ३० नदी किसानो और ३० बाँध स्तिथ मछुआरों का चयन किया गया। अध्ययन से ज्ञांत हुआ की अन्तः-स्थलीय क्षेत्र में भौतिक, रासायनिक, जैविक , एग्रोनॉमिक्स , प्राकृतिक और मनोसामाजिक खतरों का अंदेशा है मत्स्य किसानो में अधिकांश ९५ % भौतिक, ७७ % अर्गोनोमिक्स एवं ६१ % जैविक खतरों का सामना कर रहे है. खतरों से उत्पन्न औसत चिकित्सा व्यय रु ४८९२७४, जो की भौतिक खतरों के लिए उच्चतम रु.६९.५४८. समुर्दी क्षेत्र में कामकाजी खतरों की सूची में केप्सिज़िंग , सिंकिंग, ग्राउंडिंग, बर्निंग, मीशाप्स, मन-ओवेर्बोरड और इंजुरिएस सम्मिलित है। इनमे से ३९% मछुआरों ने कैप्सिज़िंग के बाद ग्राउंडिंग (३१%) और ग्राउंडिंग (२७%) सिंकिंग (२४%) और बर्निंग में (४%) से ग्रसित हुए थे. कामकाजी खतरों को कम करने के लिए मत्स्य-किसानो / मछुआरों द्वारा अपनाई गई रणनीतियों में मशीनीकृत नावों के मछुआरों के मामले में मध्यम स्कोर था। लेकिन मोटर चलित और पारम्परिक नावों के मछुआरों के लिए कम स्कोर था। अंत:स्थलीय क्षेत्र में अपनाई गई खतरा नियंत्रण रणनीतियों में बहुत कम अंक हासिल हुए. इससे ज्ञात हुआ कि उनके बीच नियंत्रण की रणनीति नहीं अपनाई जाती है। राज्य के मत्स्यपालन ढांचे में कामकाजी सुरक्षा की समीक्षा द्वारा विभिन्न राज्य/ राष्ट्रीय नीतियों से पता चला है कि समुद्र में मछुआरों की सुरक्षा के लिए नीतियाँ और सक्रिय मछुआरों के लिए समूह दुर्घटना बीमा जो केंद्रीय और राज्य प्रायोजित है। दुर्घटना के मामले में बीमा योजनाओ के साथ रियायती दरों पर जीवनरक्षक उपकरण मौजूद है। हालांकि अंत:स्थलीय मत्स्य किसानो की कामकाजी सुरक्षा प्रावधान में कमी है। भारत के अंत: स्थलीय मत्स्य पालन नीतिन की तर्ज पर वर्तमान अध्ययन पर प्रकाश डाला गया है।

ABSTRACT

The importance of occupational safety is gaining grounds in current times. Recently in 2018, UNFAO along with its partners have assessed the state of social protection and poverty dimensions in fisheries sector along with issues of occupational hazards. With respect to marine fisheries these issues have been addressed in India as well as other countries. However, studies on inland fisheries are few. Thus a study was undertaken to assess the 'Occupational Hazards in the Fisheries Sector in the State of Odisha'. Information was collected with the help of pretested interview schedule from 180 inland and marine fish farmers/fishers from Balasore and Angul district, Odisha and information on occupational hazards were collected. In order to assess the strategies adopted by fishers/fish farmers to mitigate occupational hazards, Hierarchy of Hazard Control (HOHC) method was adopted. This was modified in form of a scale with highest score of 5 for elimination followed by substitution, engineering control, administrative control and use of personal protective equipment. To locate the context of occupational safety in state fisheries frameworks various state/national policies were reviewed. Amongst marine sector, 30 traditional, motorized and mechanized fishers each were selected and among inland sector 30 pond farmers, 30 reservoir fishers and 30 river fishers were selected. Study revealed that hazards in inland sector were physical, chemical, biological, ergonomic, natural and psychosocial in nature. Majority (95%) of fishers/fish farmers were affected by physical hazards followed by ergonomics hazard (77%) and 61% faced biological hazards followed by a psychosocial hazards to the tune of 52%. A total of 71% could be classified as minor injuries, 17% of them as serious and 2% as critical. The average medical expenditure due to hazards was reported to be ₹89,274. This was highest i.e., ₹69,548 for physical hazard. Financial losses were also reported due to natural hazard to the tune of ₹46,250. In the marine sector, the occupational hazards reported were capsizing, sinking, grounding, burning, collision, mishaps, man overboard and injuries. Among these 39% of fishers experienced capsizing followed by grounding (31%), collision (27%), sinking (24%) and burning (4%). Among personal hazards, man-overboard was reported by 39% followed by injuries (39%) and mishaps (37%). Fishers with mechanized boats reported to have received first aid treatment but traditional fishers did not receive any medical treatment. The strategies adopted by fishers/fish farmers to mitigate occupational hazards had medium score in case of fishers with mechanized boats but had less score for fishers with motorized and traditional boats. Among inland sector the hazard control strategies adopted also had very less scores. This revealed that control strategies are not adopted among them. A statistically significant difference was found among different hazards and different groups of fishers/fish farmers in inland sector. However, there was no significant difference in case of marine sector except for vessel capsizing, burning and personal injuries. Review of occupational safety in state fisheries frameworks various state/national policies revealed that there are policies for safety of fishermen at sea and Group Accident Insurance for Active Fishermen which are central and state-sponsored. Provisions of life saving equipment at subsidized rates exist along with insurance schemes in case of accidents. These schemes are mainly for the seagoing marine fishers. However, there is a lack of occupational safety provision of inland fish farmers. On lines of India's inland fisheries policy draft document the present study highlights that current welfare and social protection programmes should be further strengthened to provide enhanced safety net to all categories of formal and informal inland fishers, fish farmers, fish workers and their families in convergence with other similar schemes.

LIST OF CONTENTS

LIST OF TABLES

LISTS OF FIGURES

LIST OF PLATES

1. INTRODUCTION

Fisheries play an important role in meeting out the food and nutritional security of the growing population. The sector makes crucial contributions to global food production and prosperity. In the past five decades, the global supply of fish for human consumption has outpaced population growth. The world per capita fish supply has reached 20.3 kg with a total production of 171 million tonnes in 2016. The share of total capture fishery production was 90.9 million tonnes, of which 87.2 million tonnes are from marine waters and 12.8 million tonnes from inland waters. Fisheries and aquaculture sectors form a source of income for millions of people all around the world. FAO (2018) report highlights the importance of fisheries and aquaculture for food, nutrition, and employment of millions of people. Official statistics show that 59.6 million people are engaged in (full time, part time and occasional basis) in capture fisheries and aquaculture. From this 40.3 million are involved in capture fisheries while 19.3 million in the aquaculture sector. People employed in capture fisheries has decreased from 83% in 1990 to 68% in 2016, while this proportion has increased in aquaculture from 17%to 32%.

Amongst all the countries, India ranks second in aquaculture production and third in total fish production. The fisheries sector is considered as an important sector in India as it provides employment and livelihood to many people along with food and nutritional security. Currently, fisheries and aquaculture contribute 1.07% of the national GDP and 5.30% to agriculture and allied activities. Fish production in 2016-17 was 114.10 lakh tonnes out of which 36.41 lakh tonnes were from marine and 77.69 lakh tonnes from inland fisheries. The sector engages 14 million people in different activities. From the domination of marine fisheries, there is a shift towards aquaculture and inland fisheries, which has come out as a significant contributor to the overall fish production in the country. Annual report of DHDF (2017-18)

Fishing is considered a dangerous occupation, and this has been reported by ILO (2007) also. ILO had also given a figure of 24,000 fishermen dying every year. As per the blue growth initiative of the Food and Agriculture Organization of

the United Nations identifies that decent work in fisheries and aquaculture will help to secure sustainable marine and freshwater resource management FAO (2016). Currently, protection of the labour rights of fishers, aquaculture workers and fish workers is limited, and even when regulation exists, but enforcement is poor. Subasinghe (2014)

As per FAO (2018), the ILO Work in Fishing Convention No. 188 entered into force, which was designed to ensure improved occupational safety and health of workers in the fishing sector. It includes provisions to ensure that fishers at sea receive adequate rest and medical care, the protection of a written work agreement, better living conditions while on board fishing vessels and the same social security protection as other workers. The standards of the Convention are remedied by the Work in Fishing Recommendation (No. 199). Further, in 2016, the ILO 2014 Protocol to the Forced Labour Convention, 1930 came into action, providing specific direction for effective measures to be taken to eliminate all forms of forced labor. Committee on Fisheries (COFI) has stressed linkages among safety-at-sea issues. FAO(2016). An on-going multi-country review by FAO is also addressing occupational safety and health (OSH) issues in aquaculture to make informed policy actions. FAO (2016)

There is a limited organizational forum available for the major stakeholders in the sector, especially those, who are in the lower echelon, such as small-scale fishers, fish farmers, and workers in fish value chains. It constrains their capacity to influence policy and legislation. Furthermore, practices such as illegal, unreported, and unregulated fishing in capture fisheries can be closely linked to other social issues. Lund (2014).

In this context, promoting decent work in fisheries and aquaculture by addressing the occupational hazards is important for sustainable and responsible fisheries along with addressing the One Health approach seems to be a good option, and thus this study was planned. Talking about the hazard, it is a situation that poses a level of potential threat or risk, to life, health, property, or environment. A popular way of classifying hazards is by category: biological, chemical, ergonomic, physical, and psychological(Johnson, 2000). For effective fisheries management and responsible aquaculture, also improving livelihoods

and food security addressing occupational hazards, this is important. USAID (2013).

Issues related to occupational hazards in marine fisheries have been reported and addressed. Aquaculture is said that to be associated with most of the same hazards that are present in agriculture. Also, many fish farming tasks entail added danger, including working around water and working at night. Clarke (2002).

Occupational safety of fish farmers in aquaculture is being studied in some countries. For instance, Robertson et al. (1981) reported the cases of leptospirosis in trout farmers. Douglas (1991) reported about the decompression sickness in fish farm workers. Christoffersen and Olsen (1993) reported the injury to the cornea due to fish bile. Clarke (2002) has reported that potential hazard includes drowning, electrocution, crushing-related injury, hydrogen sulfide poisoning, and fatal head injury. Nonfatal injuries are associated with slips, trips, and falls, machines, strains and sprains, chemicals, and fires. In aquaculture, Myers (2010) have reviewed occupational hazards. Turner (2018) reported nonfatal occupational injury and illness incidence rate for aquaculture workers in the United States and found that it exceeded the national rate for all industries combined. Beneet et al. (2015) have reported that occupational safety and health risks, diminishing aquatic resources, exposure to climate risks, further marred with political and social marginalization can lead fishing and aquaculture-dependent communities to get trapped in a vicious circle of poverty.

Concerning India, Sharma (2002) and Sharma (2018 a) have documented the ergonomic Problems of women prawn peelers. Similarly, Sardar et al. (2003) reported that seafood processing workers faced several constraints in West Bengal. Sharma et al. (2007) have reported about the workload of fisherwomen in aquaculture and occupational problems faced by them. Reena et al. (2011) assessed the occupational profile and time utilization pattern of fresh and dry fish retailers and laborers in Dakshina Kannada. Sethulakshmi and Sharma (2017), have reported about the use of sea safety devices in marine fisheries. Biswas (2017) has raised concerns about the gender equitable small-scale fisheries governance and development and occupational safety of women in fisheries.

Sharma (2018 b) have documented usage of sea safety devices by fishers of Kerala.

In literature, the issues of occupational hazards have been reported in the marine sector but not much in inland fisheries. Comprehensive studies of these hazards have not been conducted, and substantial uncertainty exists as to the extent of these hazards. There are only a few studies in the Indian context and not many for the state of Odisha. Odisha has a fisher population of 14,80,704, and it is an important state concerning fisheries (Odisha Fisheries Policy, 2015).

Thus, a study entitled ‘Occupational Hazards in the Fisheries Sector in the State of Odisha’ was undertaken with the following objectives.

Objectives

1. To identify occupational hazards in the fisheries sector
2. To study the strategies adopted by fishers and fish farmers to mitigate occupational hazards
3. To locate the context of occupational safety in state fisheries frameworks

2. REVIEW OF LITERATURE

A literature review provides an outline that explains and justifies the investigation necessary to address while seeking answers to some of the question or gap in the area of research based on current knowledge with substantive findings. It provides theoretical and methodological background for possible interpretation and validation of the hypotheses apart from determining the work done before, concerning the problem area. The chapter of Review of Literature has been incorporated into different sub-headings for meaningful use and clear understanding.

The topic of the present study is “Occupational Hazards in the Fisheries Sector in the State of Odisha." So, the concept of ‘occupational hazard’ is explained first. After that, the studies of occupational hazards in inland fisheries and marine fisheries are presented.

2.1 Occupational Hazard

The International Labour Organization (ILO) (2007) defines a hazard as “The inherent potential to cause injury or damage to people's health." NIOSH (2004) added another dimension to the hazard-definition that it is an "agency of injury or disease," which is defined as "an object, substance or circumstance directly involved in inflicting the injury or disease;" examples include falls, heat, radiation, sound, and pressure, and body stressing, which, conceptually are hazard. A hazard is a source that has potential to damage, harm or adverse health effects on something or someone, for example, to people as health effects, to organizations as property or equipment losses, or the environment. WHO (2016).

Occupational Safety and Health (OSH) defined it as the science of the anticipation, recognition, evaluation of harms arising from the workplace that could impair the health and well-being of workers. Blaikie et al. (2014) defined a hazard as a source of potential damage, harm, or adverse health, which affects something or someone. When this is experienced in the workplace, it is called as

an occupational hazard. It includes various types like chemical, biological, psychosocial, and physical hazards. Ramos et al. (2018) occupational hazard signify both long-term and short-term risks associated with the workplace environment.

2.2 Occupational hazard in fisheries

Commercial fishing is a dangerous occupation. FAO (2016). The degree of danger in fishing is depended on fishers' choices about the risks they can take, such as the weather they fish in, the boats they use, and the safety gear they carry. Accident and fatality rates in the marine fisheries sector remain high in most countries, whereas the inland sector is not exceptional. These issue of occupational hazards in the fisheries sector has been given focus in International organizations like Food and Agriculture Organization of the United Nations (FAO), International Labour Organization (ILO) and International Maritime Organization (IMO).

2.3 ILO Conventions on occupational safety

As per ILO (2007) fishing is a potentially hazardous occupation, as it is demanding the work, which often carried out for long working hours in precarious conditions. Some of the injuries and health impacts in fisheries include hypothermia, wounds, swelling, pain, amputation, sprains, fractures, burns, chemical exposure and poisoning, and smoke inhalation. International labor standards specifically covering young workers in fishing include the following conventions:

- ILO Work in Fishing Convention No. 188 (2007)
- ILO Work in Fishing Recommendation No. 199 (2007)
- ILO Vocational Training (Fishermen) Recommendation No. 126 (1966)

Recently, in 2018 Fifth International Fishing Industry Safety & Health Conference (IFISH 5) was organized in Canada where more than 160 fisheries sector health and safety professionals and researchers from 26 countries discussed various occupational hazards in fisheries and how to improve workplace safety.

Branch (2002) stated that in the marine fisheries sector, the occupational hazards had been broadly classified as vessel hazard and personal hazards. Vessel hazards include sinking, capsizing, collision, burning, etc. and personal hazards include injuries, mishaps, and man overboard. Inland capture fisheries and aquaculture are also fraught with potential hazards and risks, and the hazards are of different kinds. Erondu and Anyanwu (2005) have categorized the hazards into occupational, environmental, food safety, and public health.

Studies reporting occupational hazards in inland fisheries are presented as follows.

2.4 Occupational hazard in the inland fisheries sector

Robertson et al. (1981) studied in the U.K. about the incidence of leptospirosis in fish farm workers and found that a worker on a trout farm died from serologically confirmed leptospirosis. Four other workers at the trout farm had influenza-like illness, and one had jaundice. Mara and Cairncross (1989) recommended that there is a need to consider some technical factors while planning, designing, and implementing schemes in the aquaculture industry for the safe reuse of wastewater for various work.

In the decade of 1990s, there are some studies like Christoffersen and Olsen (1993) reported in chemical eye injuries in northern Norway and found that fish bile was the causal agent in 14% of cases that causes superficial corneal erosions. Boyd and Massaut (1999) reported that the aquaculture industry should work with the Governments to develop regulations for labeling the content and percentage of active ingredients in all chemicals, including liming materials and fertilizers. They suggested that aquaculturists should follow the information on product labels regarding the dosage, withdrawal period, proper use, storage, disposal, and other constraints on the use of a chemical, including environmental and human safety precautions. Durbow (1997) reviewed various interventions for occupational safety in the aquaculture industry in U. K. and U. S. A and suggested that aquaculturists can be benefited mainly by two ways; firstly, by maintaining quality of life during the work and secondly by avoiding economic losses by adopting safety protocols and interventions on their farms.

In the next decade, Sharma (2002) have reported about the ergonomic problems of women prawn peelers in Mumbai, India. Sharma and Ray (2002) studied the physical environment of women workers in fisheries and found that they work in extreme temperatures. Sardar et al. (2003) reported the constraints of prawn processing industries of West Bengal. Sharma et al. (2007) have reported about the physiological workload of women engaged in fish drying. Erondu and Anyanwu (2005) studied in Nigeria about potential hazards and risks associated with the aquaculture industry and found the relevance of a multitude of risks and categorized them into occupational, environmental, food safety and public health. They suggested an immediate need of ensuring guidelines and policies at farm level by aquaculture stakeholders to promote an environmentally friendly and sustainable industry. Watterson et al. (2008) studied towards the integration of environmental and health impact assessments for wild capture fishing and farmed fish with reference to public health and occupational health dimensions and explored some of the complex interactions that occur in fishing activities and proposed the wider adoption of health impact assessment strategies through an integrated public health impact assessment tool. A study conducted by Arthur et al. (2009) studied in Canada regarding the risk posed by the aquaculture industry and recommended there is an urgent need to take actions by FAO members for promoting the use of risk analysis strategies for aquaculture development. Moreau and Neis (2009) studied on Occupational health and safety hazards in the Canadian aquaculture industry and recommended that private industry and Government have to take main responsibility to ensure healthy, safe environment employment opportunities in the aquaculture sector. So, that it will enable to identify potential hazards associated with each of these activities and thereby make recommendations for future research and action. Myers and Cole (2009) identified occupational hazards in fish farming and provided no cost or simple, low-cost solutions to reduce or eliminate them in the USA. They provided simple technologies to eliminate exposure to falling from an elevation, replace the metal paddles on a hatchery to plastic paddles to reduce the entangling of worker's hair or clothing slip and suggested that bubble type aerators are safer than electrically powered paddle.

From 2010 and onwards there have been relatively more studies. Myers (2010) studied on various causes of death in the aquaculture sector, which includes drowning, electrocution, crushing-related injury, hydrogen sulfide poisoning, fatal head injury, and nonfatal injuries are like slips, trips, and falls, machines, strains and sprains, chemicals, and fires. Mayers and Durborow (2012) presented various occupational hazards associated with aquaculture in with some specific species and rearing technologies and provided the information for establishing programs that aim to protect aquaculturists from occupational hazards. Ibendahl et al. (2012) analyzed tractor overturned costs on catfish farms and stated that it is likely a higher probability of tractor overturns on a catfish farm than on a traditional carp farm and suggested the installation of Rollover protection structures (ROPS) on tractors to minimize this injury. Kucera and McDonald (2010) studied the occupational stress of crab fishermen in the USA and found the five most difficult tasks in the sector. These tasks are pulling pots by hand, rough weather, rough water, unloading without mechanical assistance, and long work days. So, they suggested that the researchers should consider issues of fishermen before designing the interventions. Ezekiel et al. (2011) reviewed the risk concept, general principles, applications of risk analysis, management of hazards and risks in culture fisheries and proffered specific management strategy to reduce or minimize hazards and risk in culture fisheries. Courtenay et al. (2012) reported that marine and freshwater scientists are exposed to a wide variety of occupational hazards because their working ground poses potential hazards like animal attacks, physiological stresses, exposure to toxins and carcinogens, and dangerous environmental conditions. Watterson et al. (2012) reported the Public Health Impact Assessment (PHIA) of tilapia aquaculture using a range of health impact assessment (HIA) in the United Kingdom. They analyzed the feasibility, challenges, strengths, and weaknesses by creating a tilapia Public Health Impact Assessment tool and identified occupational and environmental health benefits and risks involved in tilapia production. According to Mert and Ercan (2015), the aquaculture industry faces one of the most important human resource issues attributed to the prevalence of potential health hazards and risks in Turkey. They recommended that the workers, employers, and the government should have a collective responsibility to protect the health, safety, and wellbeing of individuals working in aquaculture

farms. Bringing the issue of One Health for aquaculture workers. Cavalli and Brito (2015) highlighted the aspects associated with occupational health in aquaculture within the concept of “One Health” in Brazil and suggested that from a public health perspective, the aquaculture industry could use the One Health approach to prevent and control occupational diseases in aquaculture workers. Dosman et al. (2015) determined the effect of HOC (Hierarchy of Hazard Control) in the farm injury outcomes in Canada and found that for the farm operators who are adopting four of the six steps in of Hierarchy of Hazard Control (HOHC), there was a significant protective effect for any injury. Martin (2016) studied the risk factors associated with severe Injuries in inland aquaculture farms of British Columbia and pointed out that, the farms that use more advanced technology are less likely to be exposed to severe injuries. Durborow and Myers (2016) focused on mainly two hazards like muscle strains and falls in aquaculture farms in the USA. Their studies have shown that engineering task is the most advanced safety intervention and extension personnel can use the aquaculture occupational safety information and photos presented in their study to help aquaculturists (and farmers, in general) to become more aware of potential hazards and provide ideas on how to avoid or eliminate such hazards. Novaes et al. (2017) applied Ovako Working Posture Analysis System (OWAS) to analyze the Work-related Musculoskeletal Disorders (WRMD) in manual mussel harvesting in the State of Santa Catarina, Southern Brazil. They identified 35 work postures during the removal of mussels from the sea and 28 postures during disaggregation of mussels and found 74.4% of the work positions are harmful during sea withdrawal, which requires immediate and short-term interventions in the workplace. Gertler et al. (2016) studied in Brazil on occupational safety and health management in oyster culture and found the main reasons behind the ergonomic issue are like prolonged physical effort, awkward postures, excessive static and dynamic loads, repetitive movements and reported about the occurrences of muscle pains in shoulders, lower backhands, wrists, and fingers in many workers. The authors suggested that electrical shock, solar radiation, and drowning should be considered as a priority for prevention and control. Holmen and Thorvaldsen (2018) reported the occupational health, safety management, and challenges in the Norwegian aquaculture industry. They found out Occupational injuries, and musculoskeletal problems are the most common

reasons for both sick leave and worry amongst employees. Watterson (2018) reported about the hazards that contribute to occupational health risks which results in occupational injury and disease and identified high-risk activities such as diving, construction works, feeding, harvesting, processing, and transport of produce. He suggested that progressive multinational companies and consultancies can provide another arm of effective intervention work on aquaculture occupational safety and health (AOSH) through the application of existing laws in their own countries and transfer of good practice & technology elsewhere in the world. Turner et al. (2018) suggested that enhancing occupational safety and health programs for the aquaculture industry in Washington state could help to reduce injuries and illnesses as well as the cost of worker's compensation claims. Klase et al. (2018) reported about the high levels of fecal contamination in integrated aquaculture ponds in the Jiangmen city of China. They found all the tested ponds showed positive for the presence of antibiotic-resistant bacteria, which suggests a high risk to pond workers who are directly exposed to the water and possible risks to consumers of fish from these ponds.

In a recent study, Ngajilo and Jeebhay (2019) reviewed on occupational exposures and associated occupational diseases and injuries among aquaculture workers from low and middle-income countries. The study found that the most common occupational diseases include musculoskeletal disorders, respiratory symptoms, skin infections, and dermatitis. They suggested there is a need for more detailed studies in the future, which can explore the interaction between environmental exposures and work organization factors in causing occupational diseases and injuries. Nakahara et al. (2018) have addressed the issues by designing a mobile app. Prusty and Sharma (2019) have identified various occupational injuries faced by shrimp farm and hatchery workers in East Godavari district of Andhra Pradesh and found that workers of shrimp farm/hatchery are facing 33% Physical injuries followed by 17% Chemical, 13% Biological and Ergonomic,17% Psychosocial injuries.

It is clear from the above review that the issue of Occupational Hazard is getting a focus now. However, in the Indian context, there are only very few

studies like Sharma (2002), Sardar et al. (2003), Sharma et al. (2007), Prusty and Sharma (2019).

After a discussion on inland fisheries, a discussion on occupational hazards in marine fisheries follows.

2.5 Occupational hazards in the marine fisheries sector

Srinath and Rajeev (1995) studied on awareness of fishermen regarding the minimum sea safety measures in beach road regions of Cochin. They suggested that besides enforcing legal regulations, it is necessary to educate fishermen regarding the use of safety measures. Training and other methods of intervention may be used to tell them about measures that could be adopted for the management of the crisis, including the use of first- aid.

Kaplan and Kite-Powell (2000) examined the impact of fisheries management on safety at sea and the use of fishermen's input in the safety regulations and management process in New England port. They found that the fisheries management regulations mainly designed to reduce pressure on fish stocks, which can also result in increased pressure on fishers and decreased safety at sea.

Matheson et al. (2001) reviewed the international literature on the health of fishermen and found out two methodological difficulties; one is difficulty in defining or tracing the population at risk. Secondly, when calculating mortality, the registration for the death of fishermen was deficient. The authors suggested that some evidence-based occupational support in the fishing industry is needed.

Kureien and Paul (2001) explained the growth and changing composition of social security programs in the fisheries sector of Kerala State. The study reflected, what more needs to be done to further improve the standard of living of the fishing communities in Kerala and to streamline the delivery of social security.

Roberts and Williams (2005) analyzed the causes of fatal accidents in UK merchant shipping and fishing industries and reported that there were 32 deaths from accidents in the UK merchant shipping industry between 1996 and 2005,

from which twenty-three of these deaths were from on-duty personal, occupational accidents, eight were from off-duty personal accidents and one was from a shipping disaster an explosion.

A study conducted by McDonald et al. (2007) reported North Carolina fishers who work independently in non-industrialized settings to have less access to a union or industry-sponsored safety services and take their own decisions about safety practices which is very dangerous to them.

According to Chauvin and Bour (2007), did a comparative study in two databases created between 1996 and 2001 related to occupational injuries in the French sea fishing industry. They found different prevention measures implemented in France during the last few decades. They reported the handling of fishing gear seems to be a hazardous task which is correlated with the risk of being cut or pricked, making an excessive effort and awkward movement.

Nag and Nag (2007) studied on work-related stresses and health hazards of women in fish processing workers of India and explored interventions to mitigate these hazards. They suggested that there is a need for good work practices and interventions for sustainable development of occupational safety and health in this sector.

The study conducted by Novalbos et al. (2008) on surveying and evaluating the health, safety and working conditions of the fishing fleet of Andalusia, showed that fishery workers had a high prevalence of self-reported medical problems due to poor diets and frequently smoking habits. They suggested that National health services and insurance companies dealing with occupational health should focus more on appropriate health checks, illness prevention, and health promotion activities for this population.

Lincoln et al. (2008) studied on commercial fishing deck hazards with engineering solutions for winch design and suggested that vessel owners having the e-stop installed enthusiastically recommend it to other fishermen and concluded that NIOSH entered into a Proprietary Technology Licensing Agreement with a company to develop the system for commercial use.

Backus and Davis (2011) reported that the falls overboard denote a particular problem in the marine lobster fishery of Boston and 12% of fishermen being unable to swim, which represent the significance of occupational risk factors involved during fishing activities.

A study conducted by Jezewska et al. (2012) on the problems of Polish coastal fishers, referring to some local particularities. The authors suggested the Baltic coastal fishermen demand special attention for Improvement of their occupational health, safety, and quality of life, which require close cooperation with medical staff and marine administrations.

Beriha et al. (2012) studied about an artificial intelligence approach for prediction of different types of accidents (fatal to minor) in an uncertain environment in India. They suggested that it will help the managers to formulate organizational policies for improving safety performance.

Frantzeskou et al. (2012) studied the health risk factor for fishermen's health and safety in Greece on excessive weight, cardiovascular incidents and dermatological, musculoskeletal, respiratory, and anxiety problems.

Beevi (2012) highlighted the occupational health hazards among the coir workers of the west coast of Kerala and observed that the quality of water becomes deteriorated due to retting, and plankton and benthic fauna show low community diversity.

Ray (2013) studied that people involved in fishery-related livelihoods in Chilika lake of Odisha are vulnerable to a variety of factors because fishing as an occupation carries potential health hazards, due to the fleeting nature of the resource, the hostile environment, and perishability of the produce.

Jacobs (2014) reported about Safety at Sea for Alaskan Tender Vessels by analyzing data from men fatalities and tender vessel causalities between 2000 and 2012. The findings show that the most common cause of vessel loss was hitting rocks or the ocean floor, and the most common human fault was falling asleep at the steerage.

According to FAO (2014), Many commercial fishing operations are characterized by hazardous working conditions, strenuous labor, long work hours, and harsh weather. For decreasing the rate of injury and death in the fishing industry, it is essential to mitigate the occupational hazards of this sector.

Lambert et al. (2015) recommended that all fishers should take a class on a marine safety at least once in every 5 years, in order to find a suitable Personal Floating Device (PFD) for them, and fishers should involve in monthly drills comprising abandon ship, flooding, fire, and man overboard.

A study conducted by Lucas et al. (2014) during 2000-2009 in USA, Australia, Poland, Denmark, and England also found that vessel disaster is the basis of the majority of deaths at sea among fishing industry workers. In the U.S. fishing industry during 2000-2009, fishing vessel disasters were the result of a series of events that culminated with a final catastrophic event such as vessel sinking.

Ansuya and Serraro (2014) reported that knowledge and practice regarding safety measures in the fishing occupation are inadequate. So, there is a need to encourage or have/purchase personal safety devices and follow the guidelines on security measures.

Weeratunge et al. (2014) emphasized on the relevance of the three key components of wellbeing – the material, relational and subjective dimensions, each of which is relevant to wellbeing at scales ranging from individual, household, community, fishery to human ecological systems as a whole.

Tiligadas et al. (2014) suggested the provision of health and training programs and maintenance of a healthy working environment is urgently required to prevent occupational accidents in the mariculture industry.

The main fatigue factors which contribute the accident at sea are shift work, irregular working hours, inadequate task and some of the human fatigue-related collision accidents that are associated with wrong/bad time decision, misconception, and poor communication between the vessel (Akhtar and Bouwer, 2015).

Sethhulakshmi and Sharma (2017), in their study in Kerala, found that mechanized fishers had high knowledge and usages of sea safety devices. Traditional fishers were not using most SSDs. However, fishers with motorized boats had adequate knowledge about SSDs, but few used these SSDs. Reasons for not using SSDs were lack of space in vessels, unaffordable price, low durability, lack of training, etc.

Velvizhi and Gopalakrishna (2017) assessed the factors contributing to the occupational health hazards among 'Irular' tribal fisherwomen fishing in Pichavaram mangrove forest areas. They found some occupational injuries like skin softening, mouth ulcer and blistering, lightning and storming risks, itching, and skin rashes, stomach ulcers. They also reported that fisherwomen have leg and knee pain due to the fishing practice and other health hazards such as crab bite, snake bite, hair bleaching, and skin darkening. They suggested that some strategies need to be developed to limit the problem and to promote the health of fisherwomen.

A research was conducted by Mandal et al. (2017) on occupational health hazard and safety of Boga fishermen community in KachuaUpazila of Bagerhat district of Bangladesh. They found that the fishers face some physical problems during fishing like dizziness, vomit, fever, abdominal pain, acidity, and dehydration. As per their observations, the knowledge gap of the fishers and insufficient material support are the main constraints for their health issues.

Correa (2017) reported about the various health problems faced by women vendors of fish-processing units and found the reason behind this are like lack of access to water and toilets, long hours in the sun, and poor access to healthcare facilities.

Sharma (2018 a) performed an ergonomics evaluation of occupational workload of women in fish trade and found that they had the number of ergonomic problems. Sharma (2018 b) assessed the Occupational Hazards and usage of Sea Safety Devices by Fishers of Kerala.

It is clear from the review that occupational hazards in marine fisheries have been addressed in many countries. However, in India, there are few studies

done in the state of Maharashtra, Kerala, and few in Odisha also.

There are international and national conventions and regulations concerning the marine sector. However, there are few concerning inland fisheries. In the field of aquaculture, which is considered as the fastest growing food-producing sector, the occupational hazards faced by fish farmers and workers have been addressed by very few studies. India ranks 2nd in aquaculture (FAO, 2018), but no comprehensive studies are reporting about occupational hazards faced by fish farmers and workers. In this context, the present study will provide information on the gaps in the review of the literature.

3. RESEARCH METHODOLOGY

Research is a scientific and systematic investigation to get pertinent information on a specific topic. The specific procedures or techniques used to identify, select, process, and analyze information about a topic are called as research methods. Hence the methodology section should be able to answer the following three main questions: Where the study was undertaken? How was the data collected or generated? How was it analyzed? So, the present chapter deals with the methodology adopted in carrying out this study and the same are described under the following subheads. The locale of the study includes

- ✓ Selection of study area and rationale
- ✓ Sampling procedure
- ✓ Methods and tools used for data collection
- ✓ Statistical tools

3.1 Locale of the study

A proper description of the study area is always needed to get a clear picture and focus on the issues prevailing in that particular area. It facilitates the analysis of facts observed in that region and aids in drawing possible conclusion and validation of the hypothesis. The current study has been done in Odisha so, a brief profile of the state is discussed first and after that description of the fisheries status of the state is presented.

3.1.1 Geographic description of Odisha

Located on the eastern side of India, the geographical area of Odisha is 155,707 km2. It extends for 1,030 kilometers from north to south and 500 kilometers from east to west. Its coastline is 480 kilometers long. The state is divided 58 Subdivisions and 171 Tahasils into 30 districts. There are 6234 G.P.s under 314 C.D. Blocks in the State. Topography, Govt. of Odisha official portal (2010)

The state of Odisha extends from 17° 31' N latitude to 22° 31' N latitude and from 81° 31' E longitude to 87° 3°' E longitude. Based on homogeneity,

continuity and physiographical characteristics, the state is divided into five major regions, coastal plain in the East, the middle mountainous and highlands region, the central plateaus, the western rolling uplands, and the major flood plains. The coastal plain region is the combination of several deltas of varied sizes and shapes formed by the major rivers of the state, such as the Subarnarekha, the Budhabalanga, the Baitarani, the Brahmani, the Mahanadi, and the Rushikulya. The state is famous for having India's largest coastal lake named Chilika on the Bay of Bengal and south of the mouth of the Mahanadi River. Topography, Govt. of Odisha official porta (2010)

3.1.2 Administration

The state of Odisha was established on 1 April 1936, as a province in British India, and consisted predominantly of Odia-speaking regions. Thirty districts of the state have been placed under three different revenue divisions to streamline their governance. The divisions are North, South, and Central, with their headquarters at Sambalpur, Berhampur, and Cuttack respectively. Annual activity report (F&ARD Department, Odisha (2017-18). Table 1 below presents the Odisha fact file.

Table 1: Odisha Fact File

Geographic Area (Lakh sq.Km)	155,707
Administrative district (No)	30
Capital	Bhubaneswar
Principal language	Odia
Other languages	Hindi, Urdu, Bengali and Telugu
Rainfall	1451.2 mm.(average)
Temperature	The summer maximum temperature ranges between 35-40° C and the low temperatures are usually between 12-14° C.
Season	Summer(March-June) Monsoon(July-October) Winter(November-February

(Source: Topography, Govt. of Odisha official portal, 2010)

3.1.3 Socio-Economic profile

Odisha is the 9th largest state by area and the 11th largest by population. The state has the third largest population of scheduled tribes in India. Table 2 presents the socio-economic profile of odisha.

Table 2: Socio-economic profile of Odisha

Population Density (Person per Sq. Km)	270
Total Population(Million)	41.97
Population growth	14.05%
Male Population(Million)	27.1
Female Population(Million)	25.5
Sex ratio(Females per 1000 males)	979
Literacy rate(%)	75.5
Male literacy rate (%)	83.2
Female literacy rate(%)	67.8

(Source: Economic survey of Odisha 2017-18)

3.1.4 Climate

The tropical climate of the state is characterized by high temperature, high humidity, medium to high rainfall, and short and mild winters. Generally, in the coastal plain, the south-west monsoon sets in between 5th June and 10th June, and by 1st July the whole of the state is under the full way of the south-west monsoons. The south-west monsoon withdraws completely from Odisha by 15th October. Odisha has been categorized into ten agro-climatic zones. The rainfall of the state is 1451.2 mm. From June to September about 75% to 80% of rainfall is received. Almost every year floods, droughts, and cyclones occur in varying intensity (ENVIS Centre of Odisha's State of Environment, 2017)

3.1.5 Fisheries of Odisha

The state Odisha is bestowed with Inland, Brackish Water and Marine resource. Both marine and inland fisheries offer a vast scope for development and investment in several projects. To look after all-round development of fisheries

activities in the State, the Directorate of Fisheries, Odisha was created in the year 1956. It is a service sector and extension oriented technical Department, which promotes scientific aquaculture in the state and look after the welfare fisherfolk. Table 3, table 4, and table 5 represent the freshwater, brackish water and marine fisheries resources of Odisha respectively.

Table 3: Freshwater fisheries resource of Odisha

Resource & Potentiality of Freshwater Aquaculture			
Resources	**Water area (In lakh ha)**	**Total Production Potentiality (In lakh MT)**	**Present Production level (2016-17) (In lakh MT)**
Culture Fisheries(Tank & Pond)	1.32	3.9	3.31
Culture-based capture & fisheries(Reservoir)	2.00	0.20	0.30
Capture Fisheries (lakes/ Swamps/ Bheels)	1.80	0.36	0.05
River & canals	1.71	0.14	0.28
Total	**6.83**	**4.6**	**3.94**

(Source: Annual activity report 2017-18 (F&ARD Department, Odisha)

Table 4 : Brackishwater fisheries resource of Odisha

Resources	**Water area (In lakh ha)**	**Total Production Potentiality (In lakh MT)**	**Present Production level (2016-17) (In lakh MT)**
Area suitable for brackish water tanks	0.330	0.33	0.29
Back waters	0.081	0.02	-
Lakes (Chilika)	0.790	0.11	0.26
Esturies	2.980	0.29	0.05
Total	**4.181**	**0.70**	**0.60**

(Source: Annual activity report 2017-18 (F&ARD Department, Odisha)

Table 5: Marine fisheries resource of Odisha

Coast line (Kms)	480
Continental Shelf area(Sq. Kms)	24,000
Mechanized Boat (in Nos.)	1754
Motorized Boat(in Nos.)	7408
Non - motorized(in Nos.)	10913
District wise coastal length(in Kms)	
Balasore	80
Bhadrak	50
Kendrapada	68
Jagatsinghpur	67
Puri	155
Ganjam	60
Total Coastal length	**480**

(Source: Annual activity report 2017-18 (F&ARD Department, Odisha)

3.2 Rationale for selection of locale

Odisha was selected as a locale of study as it is important concerning marine as well as inland fisheries. It is one of the important maritime as well as inland states of India having excellent scope for fisheries development. The annual per capita fish consumption is 13.49 Kgs. The fisheries potential of Odisha is 5,13,667MT. About 4 percent population (16.96 lakh) depends upon fisheries for their livelihood. Of them, 8.90 lakh depend on inland fisheries and 8.06 lakh on marine fisheries. Information about marine and inland fishers/farmers are presented in Table 6

Table 6: Fishers/farmers population in Odisha

	Marine Sector	**Inland Sector**	**Total**
Fishing village	813	3,065	3,878
Fishers/ Fish farmer	6,05,514 (Active= 1,69,000)	9,09,926 (Active= 1,89,000)	1,515,440

(Source: Draft of Odisha Fisheries Policy, 2014)

In Odisha state, there are 30 districts. Among these majority of the ponds, rivers and reservoirs, aquaculture farms and fishermen population is in Angul district and in marine there are vast resources available in Balasore district. Hence a sample of 90 is selected from each district of Angul and Balasore. Fisheries potential of both the district is presented in table 7 and 8 respectively.

Table 7: Balasore district fisheries resources (Marine Sector)

Resources	**Area/ Production/No**
Coastline	120km
Continental self	200m (It covers an area of 6,000 sq. km, 1.5% of the total area of the country's continental shelf)
Marine fish production	35287.38 MT (43.97%)
No. of Fisher	85000
No. of Mechanized vessel	1561
No. of Motorized vessel	652
No. of traditional vessel	427

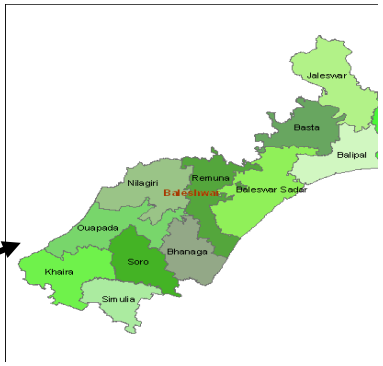
(Source: DoF, marine fisheries, Balasore district, 2018)

Table 8 : Angul district fisheries resources (Inland Sector)

Resources	Water area(Ha)
Private Tanks	1738.74
GP Tanks/Municipality	2029.85
Reservoir/MIP	2029.00
Rivers/Canals	1189

(Source: DoF, Angul district, 2018)

Locale of study in the form of map is presented in fig. 1



Balasore

Marine fisheries sector

Angul

Inland fisheries sector

Fig. 1: Locale of study, 2 districts of odisha

3.3 Sampling plan of study

Sampling plan is presented in fig.2 & 3

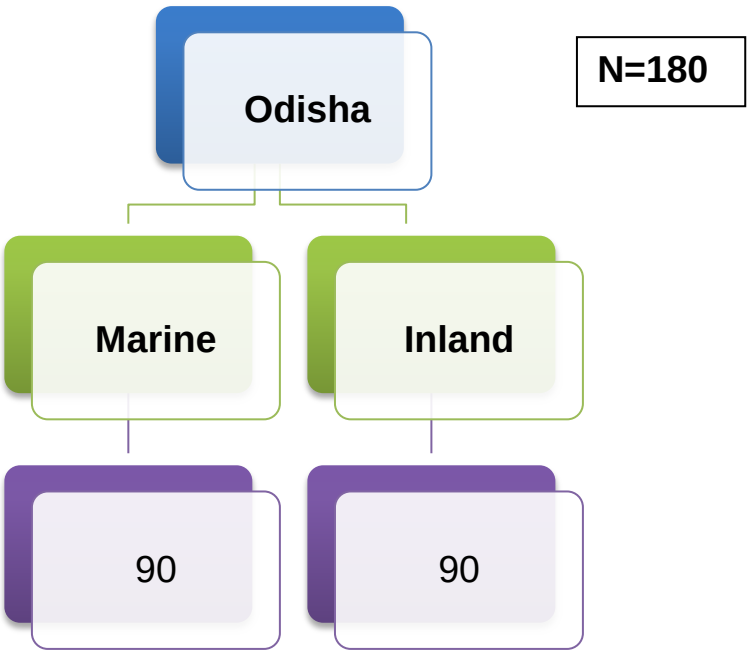


Fig. 2: Sampling plan of marine and inland sector

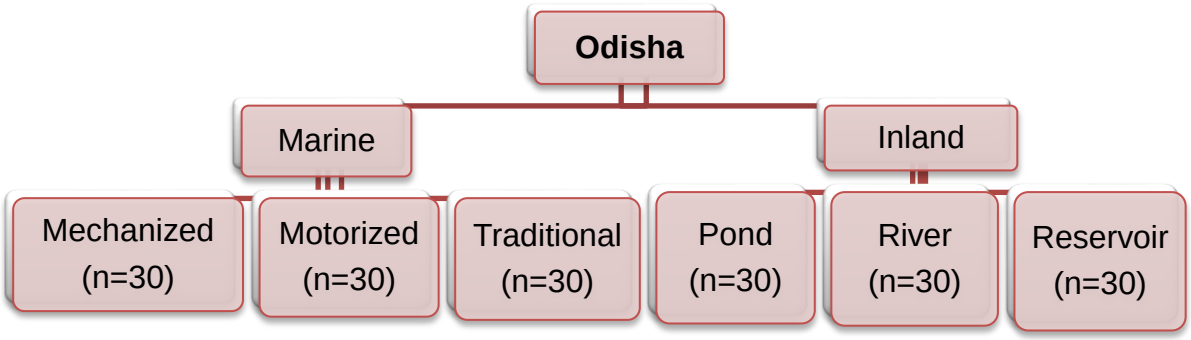


Fig. 3: Sampling plan of different vessels and water bodies

Odisha comprises of thirty districts out of which seven are coastal and remaining are inland districts. Out of these seven coastal districts, Balasore district has the highest coastal length of 80 kms and continental shelf of 5380 sq.kms(Coastal Odisha Development Council, 2015). So Balasore was selected as the study area for the marine sector.

3.3.1 Sampling plan for marine fisheries

There are 15 landing bases located in the coast of Balasore namely Talasari, Bahabalpur, Panchubisa, Kirtania, Udayapur, Chandipur, Kankadapal, Choumukh, Hanskara, Bagar, Mahisali, Khandia, Jamuca, Gadeisagar, and Panchubisa. Out of which Chandipur and Bahabalpur are the two major landing bases of the district where mechanized boats are operated. So Chandipur and Bahabalpur landing bases were selected as the study area. From Chandipur and Bahabalpur landing centers, 30 fishers operating mechanized vessel were randomly selected. A total of 30 motorized boats from Kirtania, Panchubisa landing centers and 30 non-motorized fishers sample from Jamuca and Khandia landing centers were selected randomly. Thus, the sample size for the marine sector was 90.

3.3.2 Sampling plan for inland fisheries

Angul district was selected as it has water spread over 1766.44 area ha of GP tanks and 221.54 ha area of private ponds, 1189Sq.Kms water spread of river basin and reservoir having 18913 ha of water spread area (DoF, Anguldiatrict, 2018).

Angul district consists of 8 blocks, namely Angul, Banrapal, Cheendipada, Talcher, Kaniha, Palalahada, Kishorenagar, and Athamalik. Fishers/fish farmers were selected by the snowball method as information on total inland fishers is not available. Potential key informants were identified from the database of the Department of Fisheries (DoF), Angul, and then through them, fish farmers/fishers were identified.

Pond farmers were selected from the 8 blocks of the district. 8 farmers from Angul block, 3 farmers from Banrapal block, 4 farmers from Talcher, 2

farmers from Kaniha, 5 farmers from Chenndipada, 4 farmers from Athamalik, 2 farmers from Kishorenagar and 2 farmers from Talcher. So, a total of 30 farmers/workers were selected from pond fish farming.

The state has 2.80 lakh ha of water spread area river from which the district has 1189 sq.km water spread area which consists of mainly two tributaries of rivers named Mahanadi, and Bramhani. A total of 30 river fishers were selected from these two rivulets.

The state has 2,56,000 ha of water spread reservoir area. Out of this Angul district contains 18,913 ha of reservoir water area with three major reservoirs are in the district, Derjang, Rengali and Manjore having water spread area of 530ha, 14933ha, and 600ha respectively. Among these fishers from Derjang and Rengali reservoirs were selected, and 30 fishers were selected from reservoir fishing. So 90 fishers and fish farmers were selected form inland fishing with 30 each form pond, reservoir and river fisheries.

3.4 Methodology used for the first objective

3.4.1 Occupational hazards in Inland fisheries sector

The first objective of the study was to identify occupational hazards in the fisheries sector. To gather the information, a series of questions were prepared based on a review of literature and discussion with farmers/fishers. An interview schedule was prepared, and pilot tested.

The interview schedule included general profile about fishers/farmers, and fishing/farming profile are like age, education, caste, religion, farming area/ fishing length, Income, life insurance, farming/fishing experience, fishing trip (Annexure 1)

To study the occupational hazards faced by fishers/farmers in the inland sector, a list of possible hazards and possible injuries was prepared. These hazards could be classified as Physical, Chemical, Biological, Ergonomic, Psychosocial, and Natural. These hazards are conceptualized as follows in table 9.

Table 9: Definition of various hazards in inland fisheries sector

Hazard Type	Definitions
Physical	• Tangible, measurable and observable injury sources by far this is the hazard group given the most attention and focus. • It is an agent, factor or circumstance that can cause harm with or without contact. • Example: Eye injury, fall, cut
Chemical	• When a worker is exposed to chemicals in the workplace and some chemicals can cause illness, skin irritation or breathing problems. • Example: Infection in skin
Biological	• Living organism that can infect or transmit diseases/ injuries to human beings. • Example: Snake bite
Ergonomic	• It exists within the environment that harms the musculoskeletal system. • It includes themes such as repetitive movement, manual handling, workplace/job/task design, uncomfortable workstation height and poor body positioning. • Example: Neck pain, back pain, shoulder pain
Psychosocial	• It may arise from a variety of psychosocial factors that workers may find to be unsatisfactory, frustrating, or demoralizing. • Example: Anxiety and irritation
Natural	• It includes all types of severe weather, which have the potential to pose a significant threat to human health and safety, property, and infrastructure • Example: Cyclone, flood

(Sources: Moreau and Neis, 2009; Myers, 2010; Durborow 1997; Erondu and Anyanwu, 2005.)

3.4.1.1 Consequences of reported occupational hazard

After collecting profile and occupational hazards faced by fishers/farmers/workers, the consequences of reported occupational injuries were calculated based on the degree of severity of the reported occupational injuries on the affected fishers/farmers. These consequences were categorized in to “Catastrophic” refers to death or a lethal disease, “Critical” relates to severe injury or occupational disease, “Serious” relates to injury or disease requiring medical care but is not critical or catastrophic, “Minor” refers to a minor injury or disease, and “insignificant” refers to property damage only (Mayer, 2010).

Seeing the consequences, it is expected that some medical expenditure (ME) might be done for these reported occupational injuries. An inquiry was done by recording an approximate amount of expenditure incurred for medical treatment purpose due to an injury and corresponding hazard. In the case of natural hazard, information was collected on financial losses.

3.4.2 Occupational hazards in the marine fisheries sector

In the case of marine fisheries, occupational hazards are listed in various studies. Few modifications were done in the interview schedule of Sethulakshmi and Sharma (2017), and the same was used. (Annexure 2). The interview schedule included general and fishing profile of fishers like age, education, fishing experience, residential status, religion, caste, fishing trips, and personal insurance.

To study the occupational hazards faced by fishers, hazards were included in two major categories like vessel hazards and personal hazards. The vessel hazards include capsizing, sinking, grounding, and collision, while personal hazards include mishaps, man overboard, and injuries. These hazards are defined as follows in Table 10.

Table 10: Definition of various hazards in marine fisheries sector

Vessel hazards	
Hazard Types	**Definition**
Capsizing	Upside down or poor stability of vessel due to heavy loads,

	rough sea and heavy rain
Sinking	Water starts to enter in to the vessel or vessel gets lower to water level due to human error like extraordinary precautions missed by vessel staff and natural calamities like cyclone and heavy rain
Grounding	The vessel stranding occurs due to the accidental impact of sand bars on seabed or waterway side due to bad navigation, faulty navigational instruments, bad weather and sudden breakage of engine.
Burning	Fire caught in vessel due to leakage of LPG gas from cooking cylinder, bad installation of cooking stoves, excessive heating of engine, sparks or fuel leakage
Collision	This is the structural impact between two vessels or one vessel and a floating or still object such sea rocks due to speed, lack of signals, darkness, improper channels, tired crew, rough sea, storm, rain, wind and currents
Personal Hazards	
Mishaps	It causes a crew member to fall in to the sea unnoticeably due to storm and heavy wind
Man overboard	It is a situation where a crew member falls out at sea from the vessel no matter where the vessel is sailing, in open seas or in still waters in port due to careless walking, slippery deck, while fish dumping in to the deck and operating the otter board
Injuries	Work related injuries happen from the fishing equipments, slipping off the deck and cuts while boat and fishing gear repairing

(Source: Sethulakshmi and Sharma (2018), Kaplan (2000),Chauvin and Bouar (2007),Backus and Davis (2011), Jacobs (2014))

The occurrence of vessels hazards and personal hazards were presented by percentage analysis and to get the significance difference of the reported

hazards among mechanized, motorized and traditional vessels kruskal- wallis test was done. The number fishers affected by these hazards were also measured. The type medical care provided to injured fishers is like first aid and hospital treatment were quantified.

3.5 Methodology used for the second objective

The second objective was to study the strategies adopted by fishers and fish farmers to mitigate occupational hazards.

To achieve the second objective method of Hierarchy of Hazard Control (HOHC) as defined and accepted by NIOSH (2012)was used. This method is explained below

3.5.1 Hierarchy of Hazard Control (HOHC)

Hierarchy of controls has been used to implement feasible and effective solutions for controlling the hazard. HOHC contains five elements like elimination, Substitution, Engineering control, Administrative controls, and Personal protective equipment. One representation of this hierarchy as follows in figure 4.

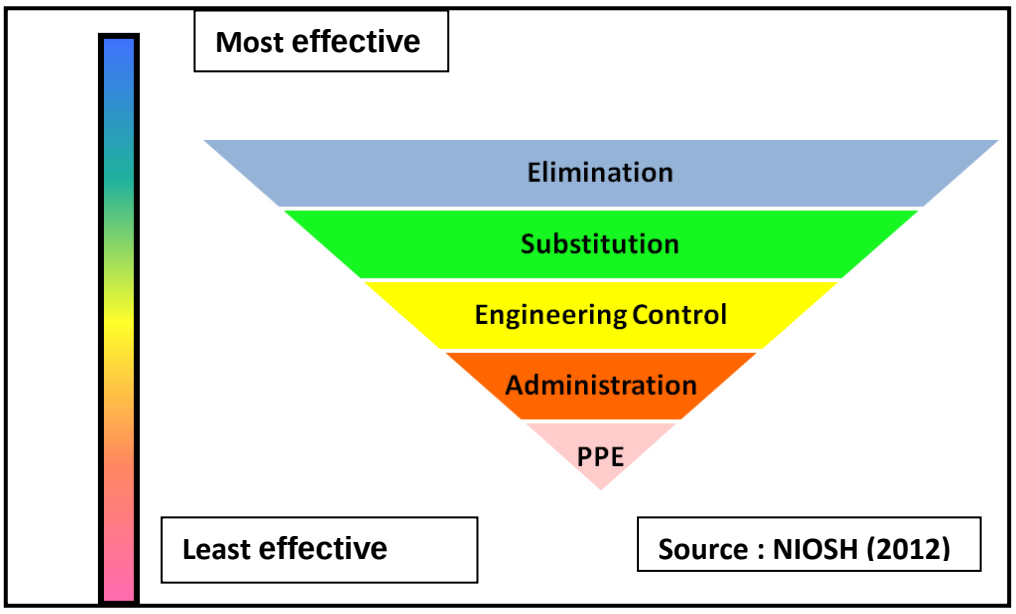


Fig. 4: Hierarchy of hazard Control triangle (HOHC)

According to this hierarchy, the hazard control methods at the top of the graphic are potentially more effective and protective compared to those at the bottom. This hierarchy is a PtD (Prevention through Design) strategy. NIOSH

has initiated a PtD strategy to prevent or reduce occupational injuries, illnesses, and fatalities at the workplace. From this triangle,

Elimination: It is the option, which is used to get rid of the hazard altogether. It is the best way to remove the hazard completely.

Example: Repair the damaged equipment properly; ensuring new equipment meets the ergonomic needs of the users.

Substitution: Replacing a hazardous substance or work practice with a less hazardous one.

Example: Substituting smaller packages or container of feed, while feed spreading or seed selling time to reduce the risk of manual handling of injuries such as back strain, Substituting hazardous chemical with a less hazardous one.

Engineering controls: The provision of mechanical aids, barriers, machine guarding, ventilation or insulation to isolate a hazard from the workplace.

Example: Using trolleys or mechanical lifting aids while taking water pump for pond drying

Administrative Control: Establishing policies, procedures, and work practices designed to reduce a worker's exposure to risk.

Example: Increasing job variety, and introducing job rotation, Redesigning jobs, Training and education to learn how to be professional workers

Personal Protective Equipment: Covering and protecting a worker's body by safety equipment.

Example: Use eye protection when working with chemicals, use gloves to protect against infection or any physical injury, Uselifesaving appliances while working in open water bodies

3.5.2 Hazard Control Score

To quantify the controlling efforts of fish farmers/fishers, a Hazard Control Score (HCS) was developed, which based on the controlling method adopted by them

to reduce the hazard. According to the NIOSH, Hierarchy of Hazard Control triangle the elements were scored as presented in table 11.

3.5.2 Hazard Control Score

In order to quantify the controlling efforts of farmers and fishers, a Hazard Control Score (HCS) was developed, which based on the controlling method adopted by them to reduce the hazard. According to the NIOSH, Hierarchy of Hazard Control triangle the elements were scored as presented in table 11.

Table 11: Scores of Hazard Control Strategies

Hazard Control	**Score**
Elimination(E)	5
Substitution(S)	4
Engineering controls(N)	3
Administrative Control(A)	2
Personal Protective Equipment (P)	1

The obtained hazard control scores were normalized, and their averages were taken to calculate hazards control score for a specific hazard. These Hazard Control scores were categorized based on their effectiveness like least, medium, and most effective strategies. In this procedure, the hazard control score and effectiveness of control strategies for every hazard were determined and presented in table 12.

$$\text{Normalized Score} = \frac{(\text{Actual value} - \text{Minimum value})}{(\text{Maximum value} - \text{Minimum value})}$$

Table 12: Categorization of effectiveness of hazard control

Categorization of Effectiveness of hazard control strategies	**HCS**
Least	< 0.33
Medium	0.34-0.66
Most	>0.67

3.6 Methodology for the third objective

The third objective of the study was to locate the context of occupational safety in state fisheries department. Information was collected from the Department of Fisheries Officials through personal and telephonic contacts about the various schemes which are available at state Fisheries & Animal Resources Development Department. Same was reviewed from the official state websites. Websites of various international and national organizations working in the areas of occupational safety in fisheries were reviewed. This was further supplemented by a review of national legislation and constitutional provision, working for the protection of workers. Qualitative analysis of the collected information was done.

3.7 Statistical tools used

In order to draw and validate meaningful inferences, appropriate statistical tools like MS Excel 2007 and statistical package for Social Sciences (SPSS 16.0) were used for analyzing the data.

3.7.1 Percentage Analysis

Percent analysis, a descriptive analytical tool was done for analyzing different social parameters along with analyzing various occupational hazards in both inland and marine sector by different variables, strategies adopted by fishers and farmers to mitigate the hazard. Based on the result of percentage analysis, suitable graphs, charts and tables have been used to make simple comparison wherever necessary.

3.7.2 Kruskal-Wallis H test

The kruskal-Wallis H test is a non parametric (distribution free) test, developed by kruskal and Wallis (1952) jointly & is named after them. It is used to assess significant differences on a continuous dependent variable by a grouping independent variable (with three or more groups). Kruskal-Wallis test was applied to analyze the difference in occupational hazards in different water bodies like pond, river and reservoir in inland sector and Mechanized, motorized and Non-motorized boat in Marine sector.

The test statistic is given by:

$$H = \left[\frac{12}{n(n+1)} \sum_{j=1}^{c} \frac{T_j^2}{n_j} \right] - 3(n+1)$$

Where:

- n = sum of sample sizes for all samples,
- c = number of samples,
- T_j = sum of ranks in the j^{th} sample,
- n_j = size of the j^{th} sample.

4. RESULTS AND DISCUSSIONS

4.1 Profile of fish farmers/fishers in the state of Odisha

4.1 a) Profile of fish farmers/fishers from Inland fisheries sector

4.1.1 Gender

All the respondents were male. The data was collected from 90 fishers/farmers from pond, river and reservoir. The respondents are mainly involved in culture and capture fishing.

4.1.2 Age Profile

4.1.2.1 Average age

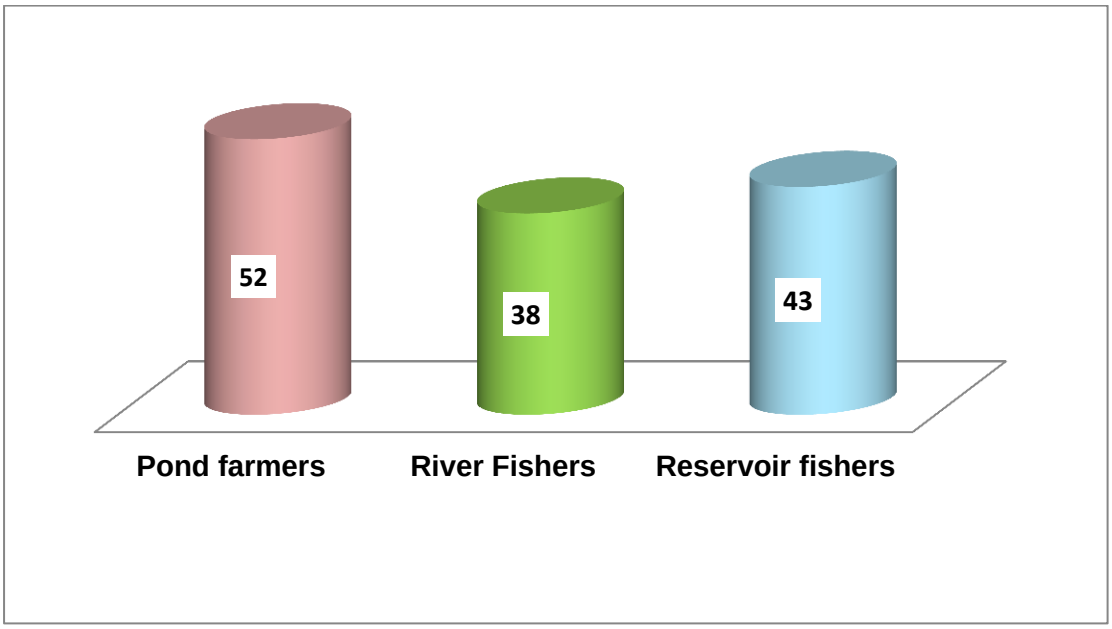


Fig. 5: Average age of fish farmers/fishers

Average age of pond farmers was found to be more (52 years) in comparison to river (38 years) and reservoir fishers (43 years).

4.1.2.2. Age category

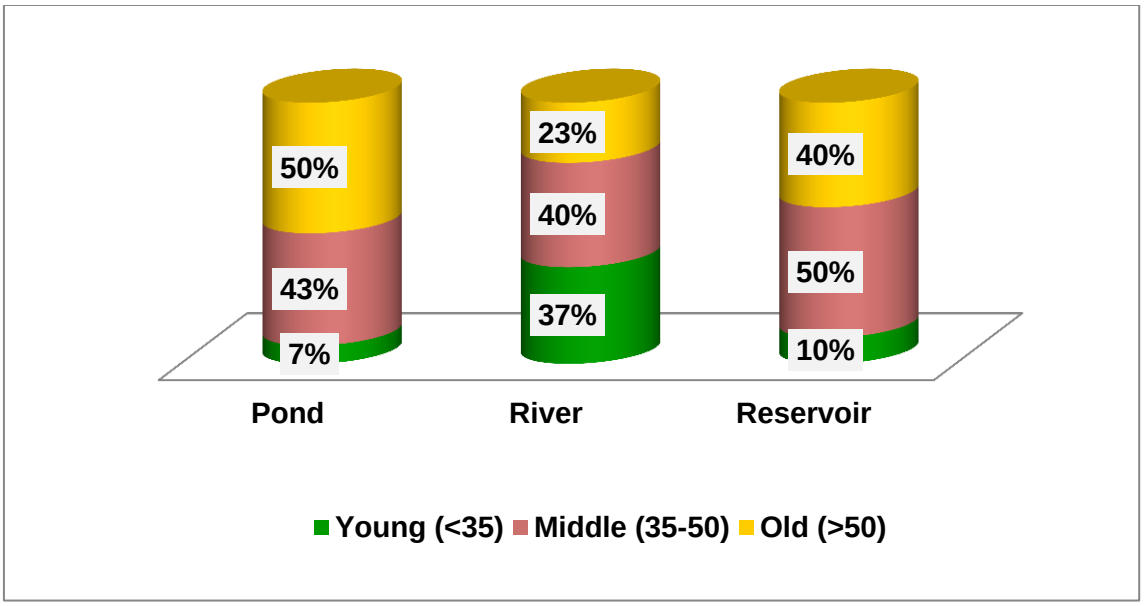


Fig. 6: Age category of fish farmer/fishers

The fish farmers/fishers age ranged from 35 to 50 years. In old age category (>50 years) there were more numbers of pond farmers (50%) followed by reservoir (40%) and river (23%) fishers. In medium age category (35-50 years) more number of reservoir fishers (50%) were there followed by pond farmers (43%) and river fishers (40%).

4.1.3 Education of fish farmers/fishers

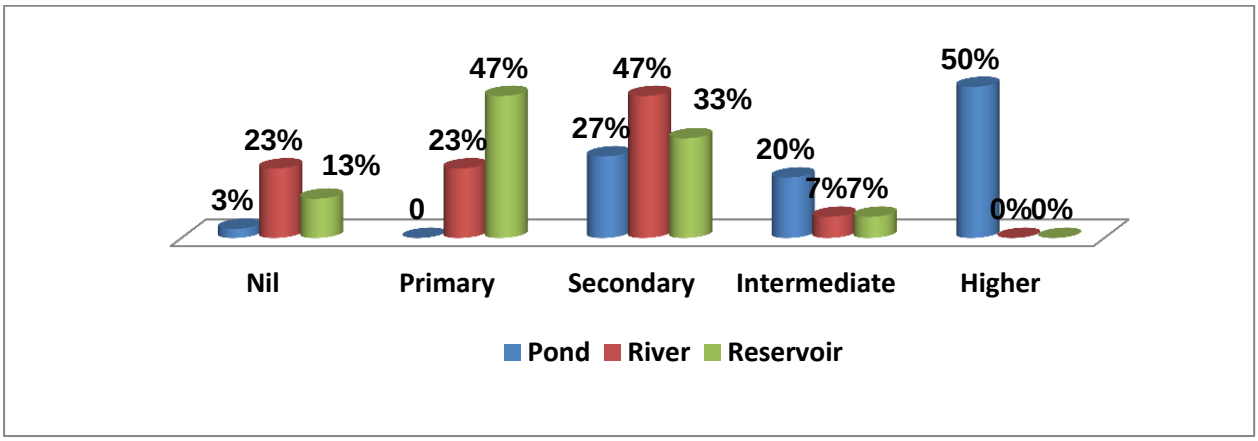


Fig. 7: Education of fish farmers/fishers

More numbers of pond farmers (50%) were graduates whereas; river and reservoir fishers had primary, secondary and intermediary level of education.

4.1.4 Fish farming/ fishing experience

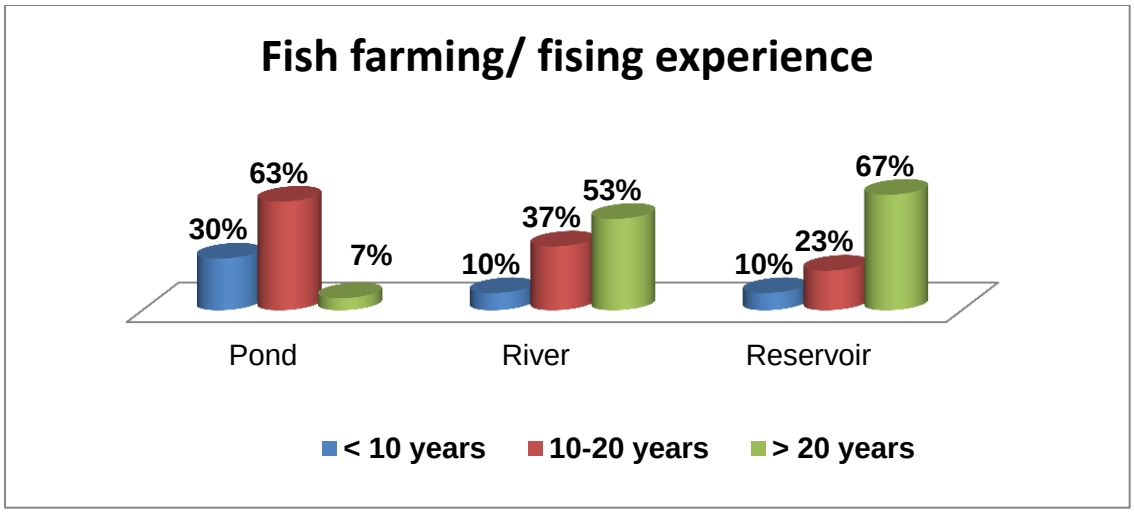
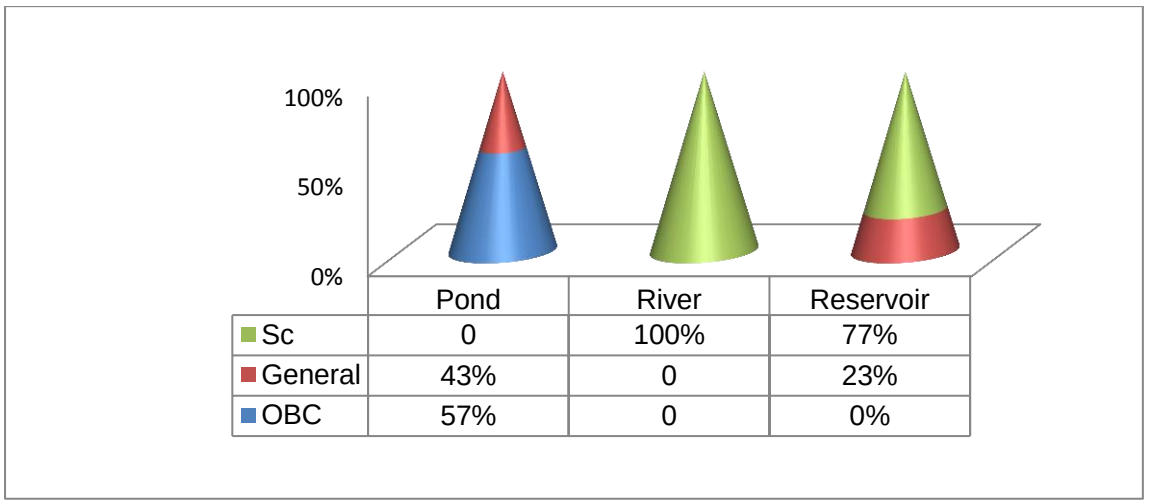


Fig. 8: Fish farming/ fishing experience

River and reservoir fishers have more fishing experience than fish farming experience of pond farmers.

4.1.5 Caste



	Pond	River	Reservoir
Sc	0	100%	77%
General	43%	0	23%
OBC	57%	0	0%

Fig. 9: Caste of fish farmers/fishers

More numbers of fish farmers are from OBC caste category (57%). Among river fishers all are from SC category and among reservoir fishers more are from SC (77%) compared to OBC (23%)

4.1.6 Marital Status

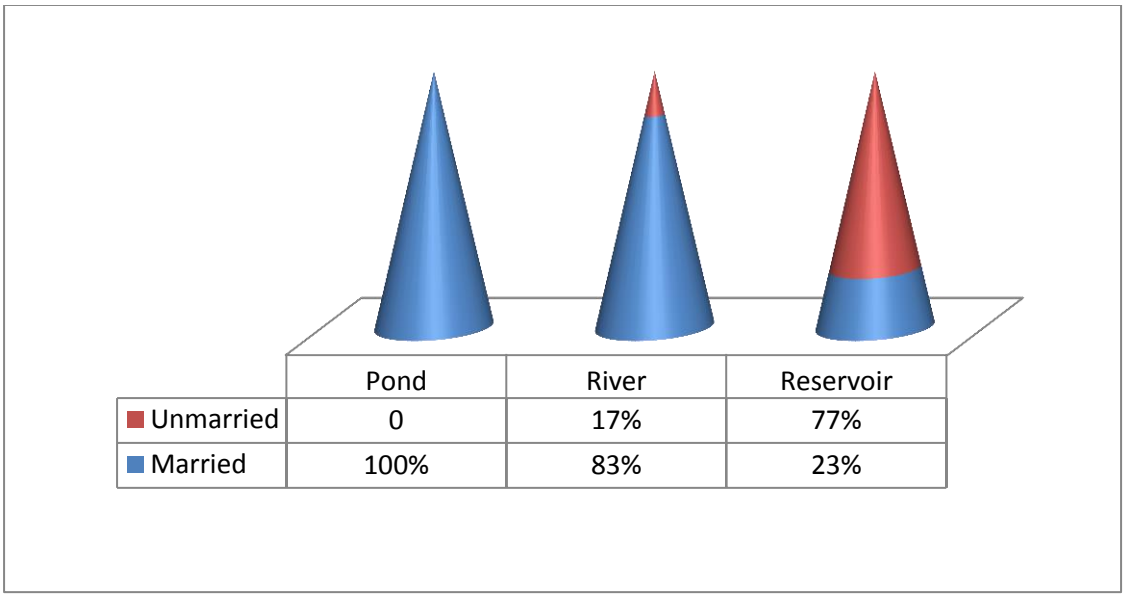


Fig. 10: Marital Status of fish farmer/fishers

All pond farmers are married where as in river and reservoir fishers there are both married and unmarried.

4.1.7 Family type

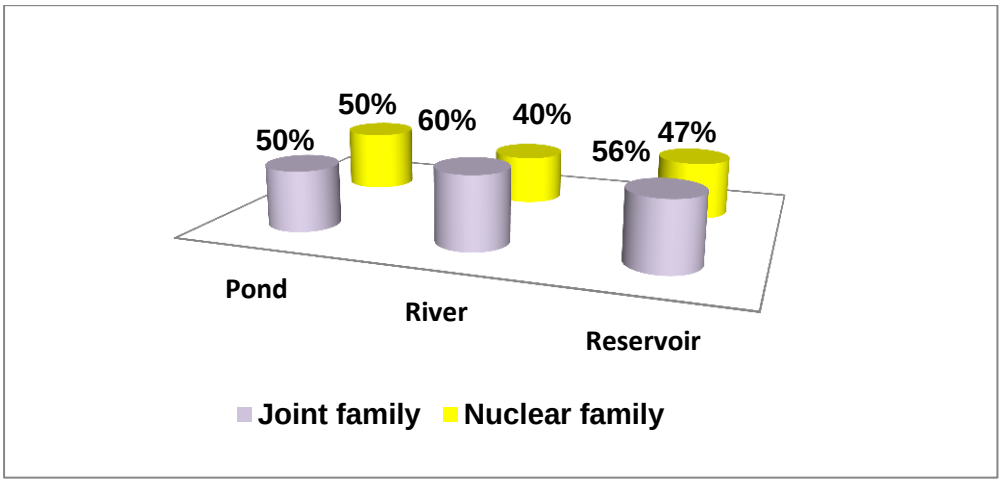


Fig. 11: Family type of fish farmers/fishers

Among pond farmers equal numbers are from joint and nuclear family whereas, among river (60%) and reservoir (56%) fishers more are from joint family.

4.1.8 Life insurance

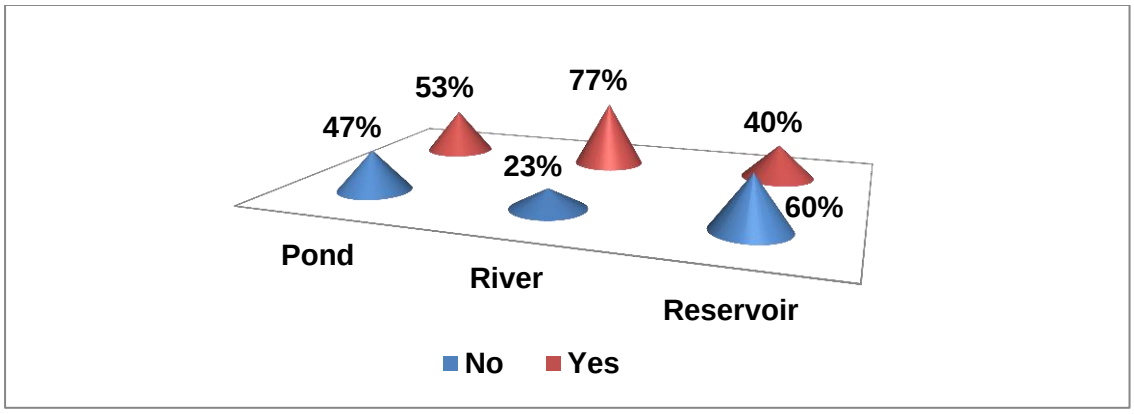


Fig. 12: Life insurance of fish farmers/fishers

More numbers of pond farmers (53%) have personal life insurance than river (23%) and reservoir (40%) fishers

4.1.9 Pond size/ fishing length

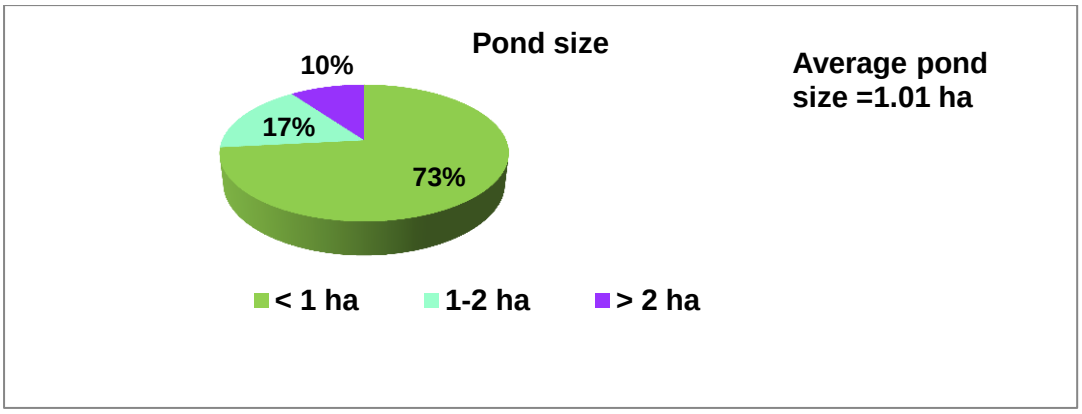


Fig. 13: Pond size of fish farmers

Table 12: Average fish farming area/fishing length and annual income of fish farmers/fishers

Average	Pond	River	Reservoir
Farming area/fishing length	1.01 ha	1.34Nms	1.61Nms
Annual income	₹2.5 lakh	₹78,500	₹96,000

Average farming area was 1.01 hectare and the average fishing length of river fishers was 1.34 Nms and for reservoir fishers it was 1.61 Nms. The average annual income of pond farmers is 2.5 lakh, which is ₹78,500 in case of reservoir fishers and ₹96,000 for river fishers.

4.1.10 Net used for fish farming/fishing

Pond farmers are using drag net for fish harvesting and caste net for sampling purpose. River fishers are using hook& line and caste net. In case of reservoir gill net and caste net are being used for fishing.

4.1 b) Profile of fishers from marine fisheries sector

4.1.1 Gender

All the respondents were male. The data was collected from 90 fishers having mechanized/motorized/traditional fishing vessel.

4.1.2 Age

4.1.2.1. Average age

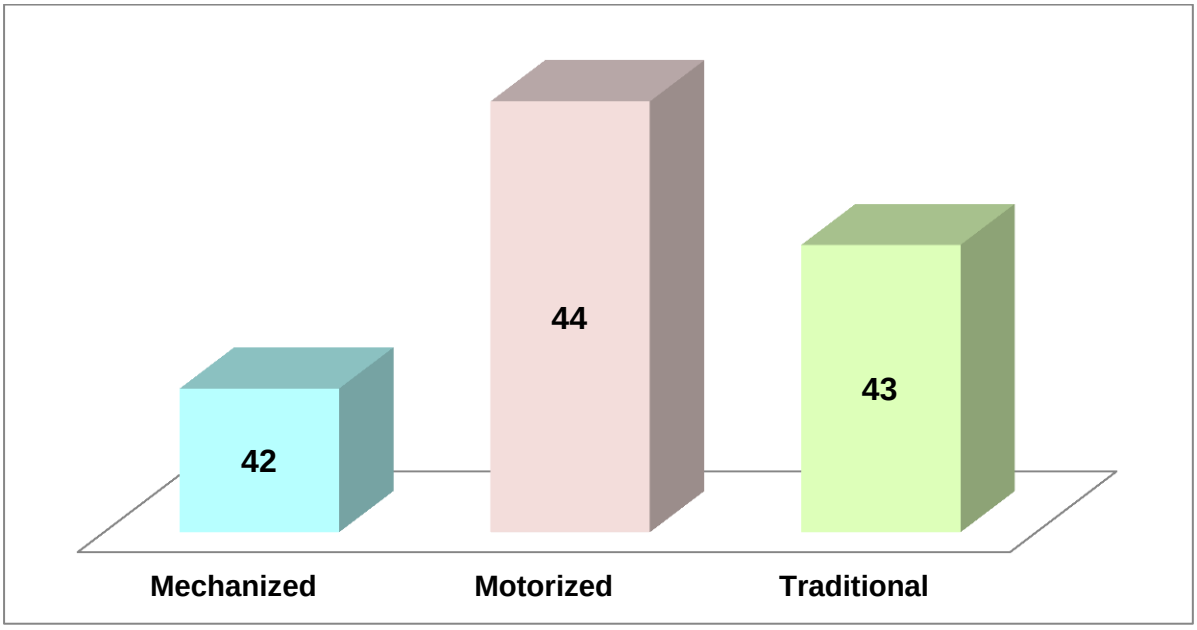


Fig.14: Average age of marine fishers

The average age of fishers from mechanized vessel was lowest i.e., 42 years and highest i.e., 44 years for motorized fishers.

4.1.2.2 Age category

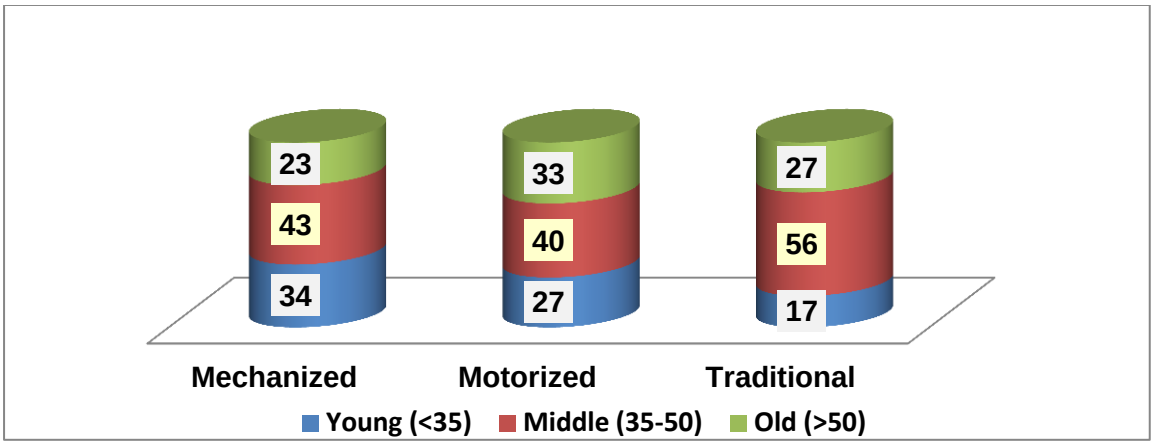


Fig. 15: Age category of fishers

Majority of fishers are of middle (35-50) age group from mechanized, motorized and traditional vessels.

4.1.3 Education

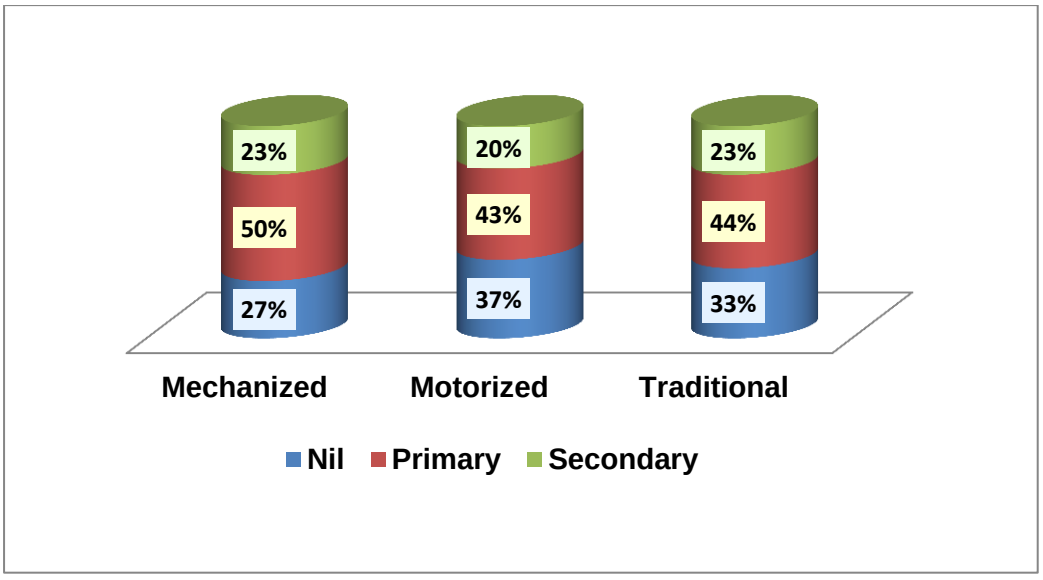


Fig. 16: Education of fishers

Majority of fishers from mechanized (50%), motorized (43%) and non-motorized (44%) have primary level of education.

4.1.4 Local/migrated

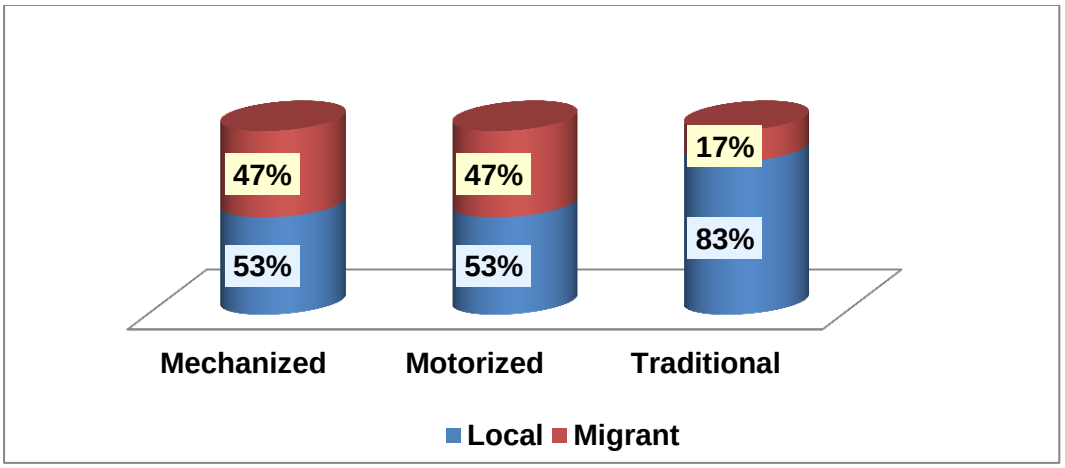


Fig. 17: Local/migrated fishers

Majority of fishers from all the vessels are local and migrants are from West Bengal.

4.1.5 Religion

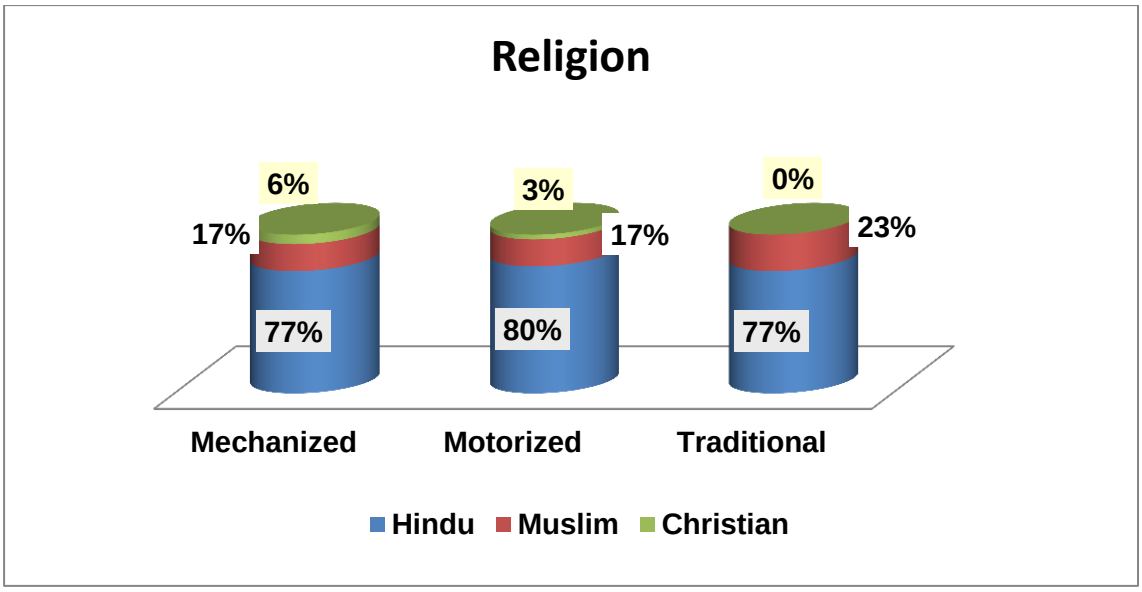


Fig. 18: Religion of fishers

Majority of fishers from mechanized, motorized and traditional vessel are Hindus

4.1.6 Caste

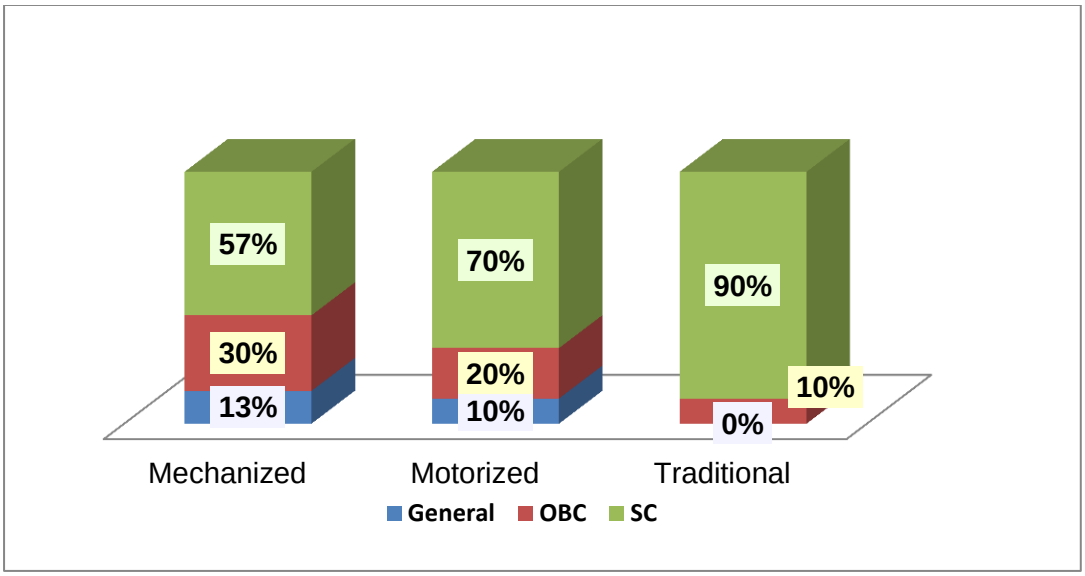


Fig. 19: Caste of fishers

Most of the fishers from mechanized, motorized and traditional vessel are from Schedule Caste.

4.1.7 Family type

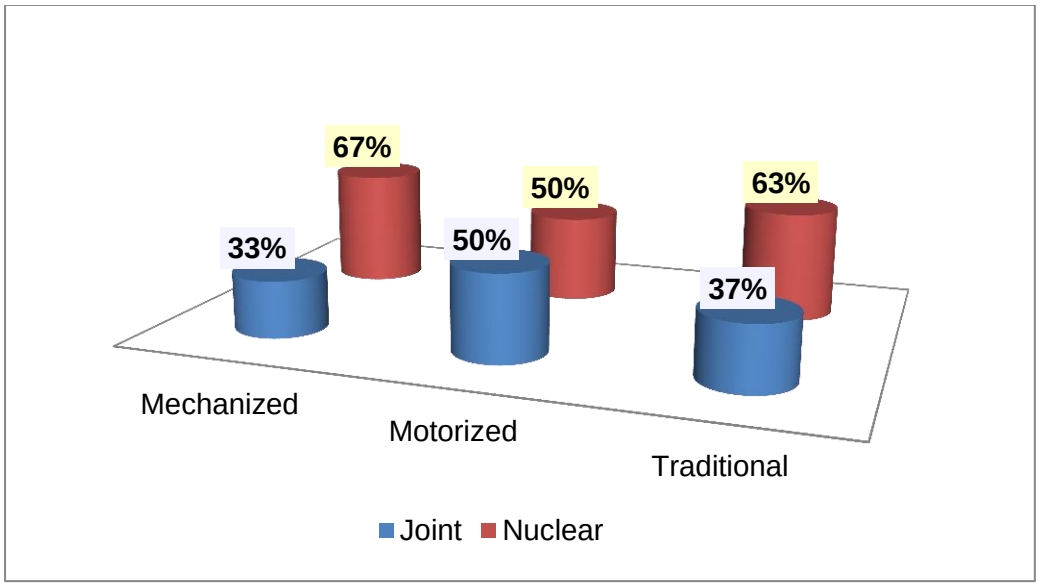


Fig. 20: Family type of fishers

Majority of fishers have joint family from mechanized, motorized and traditional vessels

4.1.8 Life insurance

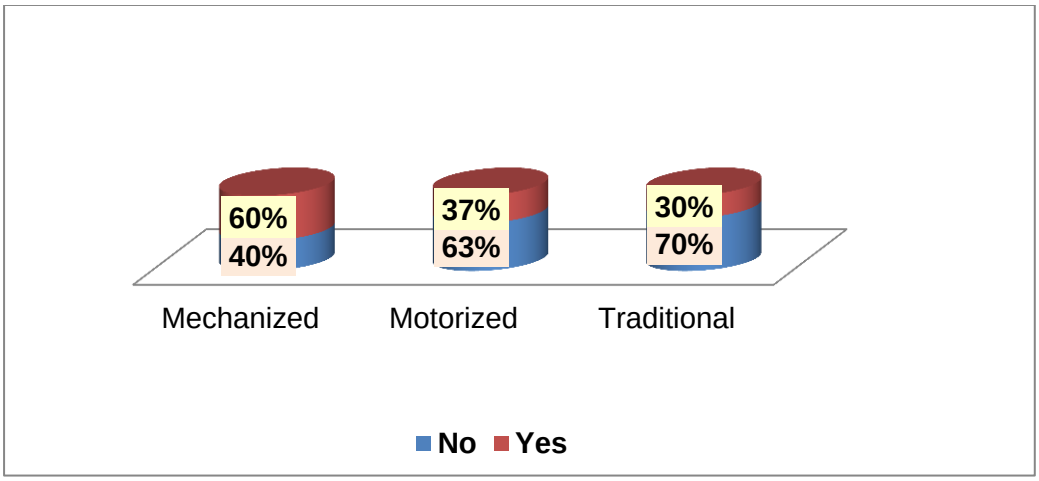


Fig. 21: Life insurance of fishers

Majority of fishers from mechanized vessel had life insurance in comparison to motorized and traditional vessel as it is mandatory for fishers from mechanized vessel to take insurance.

4.1.9. Duration of fishing trips

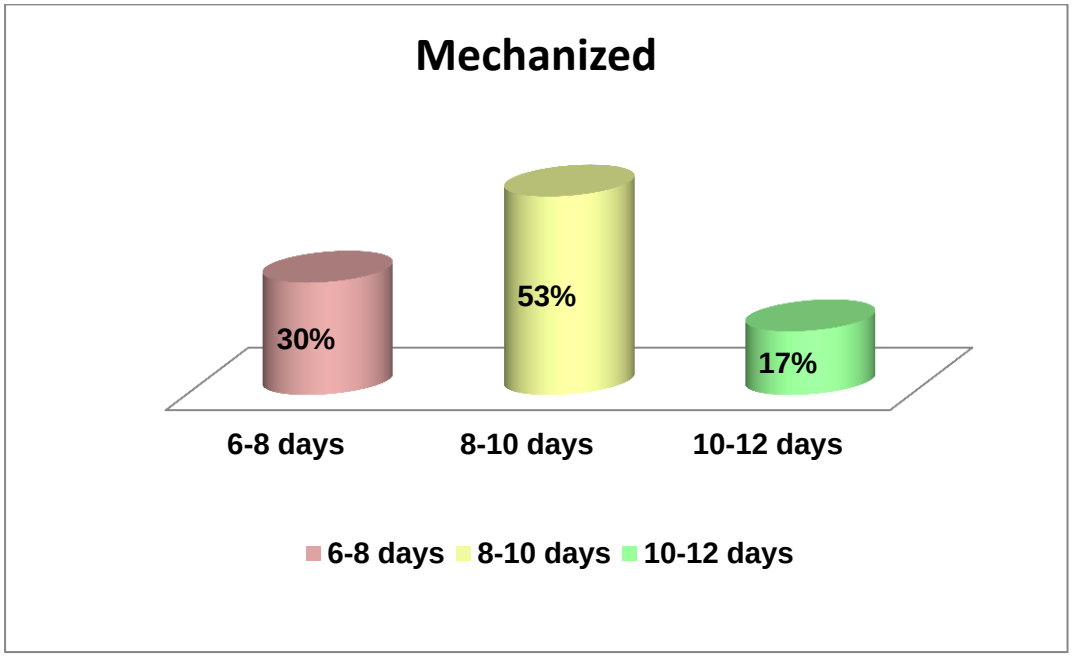


Fig. 22: Duration of fishing trips

In mechanized vessel 53% fishers have (8-10 days) fishing trips, 30% have (6-8 days) fishing trips and 17% of vessel have (10-12 days) fishing trips. Motorized and traditional vessel have single day fishing trips.

Table 13: Average fishing length and annual income of marine fishers

Average	Mechanized	Motorized	Traditional
Fishing length	32.39Nms	4.31Nms	1.07Nms
Annual income	1.25lakh	₹73,500	₹68,000

Average fishing length of mechanized vessel was 32.39 Nms, for motorized vessel 4.31Nms and for Traditional vessel it was 1.07 Nms. The average annual income of fishers from mechanized vessel was 1.25 lakh, for motorized fishers it was ₹73,500 and ₹68,000 for traditional fishers.

4.1.10 Gear used by fishers

The fishers from mechanized vessel using trawl net whereas the fishers from motorized and traditional vessel are using gill net.

4.2 Occupational hazards in fisheries sector

4.2. a) Occupational hazards in Inland fisheries Sector

Odisha has a vast scope for development of inland fisheries. The major inland fisheries activities are carried out in ponds, rivers and reservoirs. Rivers and reservoirs sustain capture fisheries, while ponds contribute in both capture-cum-culture fisheries.

Various occupational hazards like physical, chemical, biological, ergonomic, psychosocial, natural and anthropogenic were identified and number of fish farmers/fishers affected by these hazards was recorded. The inland fisheries sector the water bodies under study was ponds, rivers and reservoirs which is depicted in table 14.

Table 14: Occupational hazards in inland fisheries sector

Hazard Types	**Number of fish farmers/fishers (%)**			
	Pond (n=30)	**River (n=30)**	**Reservoir (n=30)**	**Total (N=90)**
Physical	All	90	97	95
Chemical	57	0	0	19
Biological	63	60	60	61
Ergonomic	90	60	83	77
Psychosocial	53	57	47	52
Natural	40	33	37	37
Average	71	50	54	**57**

It is clear from table 14, that 57% of fish farmers/fishers in the inland sector have been affected by some or the other occupational hazards. Among the seven different types of hazards, majority i.e., 95% of them were affected by physical hazards followed by ergonomics hazard which were 77%. A total of 61% faced biological hazards followed by psychosocial hazards which were 52%. Natural hazards faced were 37%, and Percentage affected by chemical hazard was 19%.

4.2.1 Physical Hazard

In all three water bodies more than 90% fishers/farmers/workers reported some or the other physical hazard. A number of hazards were listed under physical hazard. These are presented in table 15 along with number of fishers/farmers/workers affected by them.

Table 15: Physical hazards in inland fisheries

Physical Hazard	Physical Injury	Activity	Numbers of fish farmer and fisher effected (%)			
			Pond (n=30)	River (n=30)	Reservoir (n=30)	Total (N=90)
Grass cutting sharp instrument • Sickle • Cutting knife	Eye injury Eye irritation	• Site cleaning • Fishing • Feed spreading	13 30	33 0	0 0	16 10
Fishing Instrument • Fishing hook • Net sinkers						
Fish feed • Feed particles						
Working ground	Fall Fracture	• Entering water body through dykes for feed	80 23	77 20	57 7	71 17

• Slippery Surface • Uneven surface (no warning signs) • Trash or debris on working areas • Poor light • Sharp object/ broken glass pieces • Sharp instruments like fishing hook	Cut	spreading or fishing • Checking water level of overhead tank • Pond harvesting/fish catching • Site cleaning • Boat repairing	67	73	37	59
Water environment • Deep water basin	Drowning Infection in skin and water	• Feed spreading • Liming • Pond harvesting • Fish catching	23 40	43 0	30 23	32 21
High temperature	Dehydration Headache Sun burn	• Pond drying, ploughing, harvesting • Fishing and net setting	37 47 27	43 43 17	43 40 13	41 43 19

It was reported and clear from table 15, that uneven and slippery surface of working ground, was the most common cause of injuries like fall, cuts and fracture. A total of 71% fish farmers/fishers/workers had experienced fall and 59% had cut injuries. Fall had caused fracture to 17% of them. It is common that in fisheries, they are more often exposed to slippery surfaces. In pond system fish farmers had the highest fall injuries to the tune of 80%. However, fall was also common i.e., 77% in rivers. However it was relatively less (57%) in the reservoirs. Activities like feeding, sampling, liming, etc. are to be undertaken by them at regular intervals and they are unable to avoid walking on slippery surfaces. Due to fall, cuts can occur on different body parts and 67% working in the ponds and 73% in case of rivers reported this. In reservoirs, cuts were reported by 37%. Fracture in the limbs was also reported by 23% of pond farmers and 20% in case of river fishers. However, 7% fishers reported case of fracture in reservoir. The contributing factors for fall/cut/fracture was reported to be not walking attentively, poor light, trash or debris, presence of broken glass bottles in working area, improper handling of fishing net and hook while fish catching.

High temperature was another hazard listed by them. This causes dehydration, headache and sunburn related injuries and so 43% reported headache, 41% reported dehydration and 19% complained of sunburns. The incidence of dehydration was reported to be 37% in case of pond farmers as compared to river and reservoir which was 43%.

Working with water, it becomes a physical hazard and 32% have experienced drowning like conditions and 21% have faced skin and feet infection. In pond 23% reported that they experienced drowning like condition but this was found to be more in river and reservoirs. This was because rivers and reservoirs have relatively deeper water basin. Pond farmers reported that risks are more in rainy season when the water level is high. Feet infection due to constant touch with water was reported more in reservoirs.

Use of sharp instruments for cutting grass, like sickle, cutting knife, fishing hook are hazardous which can cause eye injury and eye irritation. About 16%

reported eye injury and 21% reported eye irritation. 33% of fishers in rivers suffered from eye injury while operating fishing hook and net. Whereas, 13% of pond farmers have faced eye injury and 63% faced eye irritation while site cleaning and fish feeding.

4.2.2 Chemical Hazard

Chemical hazards were not reported in rivers/reservoirs. But 57% of farmers/workers reported chemical hazard in pond system. This is presented in table 16.

Table 16: Chemical hazards in inland fisheries

Hazard	Chemical injury	Activity	Number of fish farmer or fishers effected (%) (n=30)		
			Pond	River	Reservoir
Lime • Quick lime • Herbicide • Glysphosate **Insecticide & fungicide** • Sipromethine • Dendragard • Amitraj	Burnt Skin Skin irritation Inhalation Problem Eye infection	• Dissolving lime • Collection of lime from the storage • Spraying of liquid lime • Spraying glyphosate to control pond site weeds and grasses.	20 20 17 27	0 0 0 0	0 0 0 0

Table 16 shows that chemical hazards can cause burnt skin, skin irritation, eye infection and inhalation-related problems. Eye infection was reported by 27% of pond fish farmers and this mainly occurs during liming. Burnt skin and skin irritation was also reported by 20% of farmers/workers. Problems of inhalation were reported during lime collection from storage areas and applying chemical for fungal for Argulus control.

4.2.3 Biological Hazard

Biological hazards were reported by 63% of pond farmers and 60% by river and reservoir fishers respectively. Biological hazards include snake, leech, mosquito and crocodile bites, injuries by fish fin, and cuts due to fouling organism. The number of fishers/farmers affected by biological hazards is presented in table 17.

Table 17: Biological hazards in inland fisheries

Hazard	Injuries	Activity	Number of fish farmer or fishers effected (%)			
			Pond n=30	River n=30	Reservoir n=30	Total N=90
Snake	Snake bite	• Pond site grass cutting	20	20	13	18
Leech	Leech bite	• Net dragging • Feed spraying	23	43	27	31
Fish	Injuries by fish fin rays	• Fish harvesting or catching	37	23	20	27
Mosquito	Malaria	• Guarding the pond at night	27	13	17	19
Fouling organisms	Cuts on feet	• Net dragging • Feed spreading • Liming	20	0	0	22
Crocodile	Crocodile bite	• Fishing	0	7	0	8

It is clear from table 17 that common biological injuries reported were snake bite, leech bite, injuries due to fish fin rays, cuts by fouling organisms and crocodile bite. Among these leech bite was most common and 43% reported this in rivers and 27% in reservoir and 23% in ponds.

Injuries by fish fin were also common with 27% reporting the same. This was reported by 37% of pond farmers followed by fishers in river (23%) and reservoir (20%).

Cuts on feet due to fouling organisms were reported by 20% of pond farmers. Malaria was also reported by 19% and incidence of malaria was more among pond farmers (27%) compared to reservoir (17%) and river (13%) fishers.

Snake bite was reported by 18% and this was higher among pond farmers. Incidence of crocodile bite in rivers was also reported by 7%

4.2.4 Ergonomics Hazard

Table 18 represents the various ergonomics injuries like pain in the neck, back, shoulder, upper back, elbow, wrist, lower back, hips/ thighs, knees, ankle/feet, and sprain.

Table 18: Ergonomics hazards in inland fisheries

Hazard	Injuries	Activity	Number of fish farmer or fishers effected (%)			
			Pond n=30	River n=30	Reservoir n=30	Total N=90
• Heavy Loads • Repetitive motion • Prolong standing/ sitting • Force exertion	Neck pain	• Taking water pump from store room to pond site for drying • Seed stocking • Feed spreading • Liming • Sampling • Net setting • Net dragging	70	43	23	45
	back Pain		80	40	33	51
	Shoulder Pain		83	43	47	58
	Upper back pain		77	37	57	57
	Elbow pain		73	23	50	49
	Wrist pain		87	33	40	53
	Lower back Pain		57	30	47	44
	Hips/Thighs Pain		40	3	30	24
	Knees Pain		67	33	30	43
	Ankle Pain		63	27	37	42
	Sprain		27	27	30	27

It is clear form table 18 that among ergonomic injuries most of the pains were reported by 40 to 50% of fishers/fish farmers. Shoulder pain and upper back pain was reported by higher percentage. Pond fish farmers reported higher body pains compared to others because of high repetitive motion required for feed spreading, liming, seed stocking, etc. In addition, prolonged standing for preventing fish poaching was also a reason. Sprain was experienced more by fishers of reservoir.

4.2.5 Psychosocial hazards

Psychosocial hazards which causes high or low blood pressure (B.P.), stress, anxiety, and mental irritation. Psychosocial hazards are presented in table 19.

Table 19: Psychosocial hazards in inland fisheries

Hazard	Injuries	Reasons	Number of fish farmer or fishers effected (%)			
			Pond n=30	River n=30	Reservoir n=30	Total N=90
• Excessive work hours	High/low B.P	• Extended work hours	13	7	10	10
• Conflict	Stress		53	47	23	41
• Night shift	Anxiety	• Violence	27	37	20	28
	Mental Irritation	• Irregular working hour	20	33	33	29

It is clear from table 19 that, 41% of fish farmers/fishers reported about stress followed by mental irritation (29%) and anxiety (28%). Pond fish farmers reported higher i.e. 53% stress, whereas 47% of reservoir and 23% of river fishers reported the same. However, in addition to work related stresses there might be other reasons for stress too. So it may or not be only related to the occupation.

4.2.6 Natural Hazard

Most common natural hazards reported were cyclone, flood and excessive rain. This causes crop/ habitat losses and this information is presented in table 20.

Table 20: Natural hazards in inland fisheries

Hazard	Loss	Pond	River	Reservoir	Total
Cyclone Flood Excessive rain	Crop / habitat loss and Damage of farming/ fishing instrument	40	33	37	37

Table 20 indicates that, due to natural hazards like cyclone, flood, and excessive rain, 37% of fish farmers/fishers have suffered crop/habitat loss and damage of fishing instruments. A total of 33% to 40% reported losses.

It is clear from the results that among the various occupational hazards, physical hazards are more common in which fall is maximum. After physical hazards, ergonomic hazards with shoulder pain was reported to be most prominent. Among biological hazard, fish bite is very common. Stress is the most reported psychosocial hazards. Due to natural hazards, crop/habitat loss was reported.

The results of the present study were seen in relation to other studies reported and it was seen that Mayers (2010) reported ergonomic hazard are more in aquaculture farms. Current study reported that physical hazard (95%) were more followed by ergonomic hazard (77%)

Christoffersen (1993) reported 14% of aquaculture workers had chemical eye injuries. In present study 27% had chemical eye infection.

Durborow and Myers (2016) reported muscle strains and falls are most commonly faced in aquaculture farms in the USA. The present study also reported fall and shoulder pain is most commonly faced.

Holmen and Thorvaldsen (2018) found that physical injuries and musculoskeletal problems are the most common reasons for both sick leave and worry amongst employees. Present study also revealed that among the six types of occupational hazard, majority were reported physical hazards (95%) followed by ergonomic hazard (77%).

4.2.7 Kruskal-wallis test for occupational hazards reported by fishers/farmers/workers

It was necessary to know if there was a statistically significant difference among various type of hazards reported by 3 groups of systems i.e., ponds/rivers/reservoirs. Kruskal-wallis test was done to test this hypothesis. The results are presented in table 21.

Table 21: Difference in hazards in inland fisheries

Hazard Types	Chi-square	Asymptotic. Sign	Decision
Physical	8.831	0.012	**H_0Rejected**
Chemical	41.022	0.000	**H_0Rejected**
Biological	0.193	0.908	H_0Accepted
Ergonomic	15.759	0.000	**H_0Rejected**
Psychosocial	0.936	0.626	H_0Accepted
Natural	0.391	0.822	H_0Accepted

Table 21, indicates that there is statistically significant difference in physical, chemical, and ergonomic hazards among pond/river/reservoir, which indicates that fishers/farmers are differently affected in these water bodies. However, there is no significant difference found in case of biological, psychosocial and natural hazards.

In order to know how seriously these hazards were affecting the injured fishers/farmers, the severity of the reported occupational hazards was studied by finding the consequences of the reported injuries.

4.2.8 Consequences of reported occupational injuries

The consequences of the injuries were categorized based on their severity on affected fishers/farmers/workers. Melvin &mayer (2010), in their study categorised the consequences of occupational injuries which included “Insignificant”, which refers to property damage only, “Minor” refers to minor injury or disease, “Serious” refers to injuries or disease which require medical care, “Critical” refers to severe injury/ occupational disease and “Catastrophic” refers to death or a lethal disease.

In this study consequences were reported in terms of insignificant (INS), minor (MIN), serious (SER) and critical (CRI). This is presented in table 22.

Table 22: Consequences of reported occupational injuries

Types of Injury	Insignificant	Minor	Serious	Critical
	%	%	%	%
Physical	0	81	19	0
Chemical	0	76	24	0
Biological	0	60	40	0
Ergonomic	0	80	11	9
Psychosocial	0	91	0	9
Natural	All	0	0	0
Total	**10**	**71**	**17**	**2**

From table 22 it is clear that among the occupational injuries 71% were minor, 17% of them were serious and 10% were insignificant where as 2% were critical injuries. There were also some reports of deaths in case of reservoir fishers due to natural hazards like cyclone in their fishing trips. The consequences of injuries in three water bodies are presented in table 23.

Table 23: Consequences of reported occupational injuries in different water bodies

Hazard Types	Pond				River				Reservoir			
	INS	MIN	SER	CRI	INS	MIN	SER	CRI	INS	MIN	SER	CRI
	%											
Physical	0	79	21	0	0	81	9	0	0	82	18	0
Chemical	0	76	24	0	0	0	0	0	0	0	0	0
Biological	0	58	42	0	0	59	41	0	0	59	41	0
Ergonomic	0	67	17	21	0	93	7	0	0	88	8	4
Psychosocial	0	88	0	12	0	94	6	0	0	88	0	12
Natural	All	0	0	0	0	0	0	0	0	0	0	0

From table 23, it is clear that among physical injuries mainly pond farmers/workers reported serious injuries (21%), where as in reservoir, and river, it was 18% and 9% respectively. Chemical injuries were reported only in case of pond, out of total, 24% of pond farmers/workers faced serious chemical injuries. Almost 40 % of fishers/ farmers/ workers were reported to have experienced serious biological injuries.

Ergonomic injuries were the most commonly observed for fishers/farmers/workers, where majority were affected in minor category (67% of pond, 93% and 88% of river and reservoir fishers respectively). Critical ergonomic injuries were reported by 21% pond farmer and 4% of reservoir fishers

Among psychosocial injuries minor and critical incidences were reported from fishers/farmers/workers. 88% of injuries were minor and 12% were critical in case of river and reservoir fishers, whereas for river fishers 94% were minor and 6% were serious injuries.

These were insignificant effect due to natural hazard but 5 deaths/catastrophic effect were reported from reservoir fishers due to cyclone.

The medical expenditure and financial loss due to the various hazards were also recorded and presented here.

4.2.9 Medical expenditure and financial loss due to various occupational hazards

When any injury occurs, it is expected that some medical expenditure (ME) will be done by the concerned. An enquiry was done by recording an approximate amount of expenditure incurred for medical treatment purpose due to an injury and corresponding hazard. This information is presented in table 24.

Table 24: Medical Expenditure and financial loss due to various hazards

Hazard	Medical Expenditure (ME) Rupees			
	Pond	**River**	**Reservoir**	**Total**
Physical	32,264	23,174	14,110	69,548
Chemical	84	0	0	84
Biological	7,493	6,708	2,173	16,374
Ergonomic	1,743	73	1,060	2,876
Psychosocial	142	110	140	392
Total	**41,726**	**30,065**	**17,483**	**89,274**
	Financial loss (FL) Rupees			
Natural	46,250	470	545	47,265
Total	**46,250**	**470**	**545**	**47,265**

It is clear from table 24, that the average medical expenditure is highest for pond farmers ₹41,726 followed by reservoir ₹17,483 and river ₹30,065 fishers. Similarly financial loss is also more in case of pond (₹46,250) in compared to river (₹470) and reservoir (₹545)

4.2.10 Kruskal- wallis test for medical expenditure and financial loss for various occupational hazards

It was necessary to know if there was a statistically significant difference among medical expenditure and financial loss occurred due to the hazards reported by fish farmers/ fishers from different water bodies. Kruskal-wallis test was done to test this hypothesis. The results are presented in table 25.

Table 25: Medical expenditure and financial loss occurred by fish farmers/ fishers

Hazard Types	Chi-square	Asymptotic. sign	Decision
Physical	6.702	0.035	**H_0rejected**
Chemical	11.880	0.003	**H_0Rejected**
Biological	1.628	0.443	H_0Accepted
Ergonomic	9.352	0.009	**H_0Rejected**
Psychosocial	1.976	0.372	H_0Accepted
Natural	6.148	0.046	**H_0Rejected**

From the table 25, it is confirmed that there is significant difference among the fish farmers/fishers from three different water bodies in medical expenditure/financial loss occurred for physical, chemical, ergonomic and natural hazards. It seems that the median value of physical, chemical, ergonomic and natural hazards are not equal.

4.2 b) Occupational hazards in marine fisheries sector

Odisha is one of the major maritime states having 480 km long coastline with 24,000 sq. km area within the continental shelf which provide an ample potential for marine fisheries development. In marine fish catching the mechanized, motorized and traditional vessel form the foremost role.

The occupational hazards in marine sector were collected from fishers with three different types of vessels like mechanized, motorized and traditional. There were mainly two types of hazards found one is vessel hazards which include boat capsizing, sinking, grounding, burning, collision and other one is personal hazards which include mishaps, man overboard, and injuries. These occupational hazards were assessed by considering number of boats affected by vessel hazards and numbers of persons affected of that boat. This is presented in table 26.

Table 26: Occupational hazards in marine fisheries sector

Type of hazards	Occupational Hazards	Frequency N=90	Percentage
Vessel hazards	Capsizing	35	39
	Sinking	22	24
	Grounding	28	31
	Burning	4	4
	Collision	24	27
Personal Hazards	Mishaps	33	37
	Man overboard	29	32
	Injuries	35	39

From table 26, it is clear that from the vessel hazards, more number of vessels have experienced capsizing (39%) followed by grounding (31%), collision (27%), sinking (24%) and burning (4%). In personal hazards the dominant occupational hazards was by injuries (39%) followed mishaps (37%) and man overboard (32%).

The dominant occupational hazard among the vessel was capsizing, the main reasons behind this was poor stability due to rough sea, storm, heavy rain and loads. Among the personal hazards the reasons for injuries were slipping off deck, stings and bites, cuts, injuries from fishing equipment. The main reasons for man overboard were careless walking, slippery deck, and fish dumping in the deck.

The findings of Jacobs (2014) reported grounding is the most common vessel hazard due to hitting rocks or the ocean floor, and the most common human fault was falling asleep at the steerage. From the current study it is seen, that capsizing is more common vessel hazard followed by grounding. Vessel capsizing occurs due to rough sea, storm, heavy rain and loads.

4.2.1 Occupational hazards among mechanized, motorized and traditional vessels

The Occurrence of various occupational hazards in mechanized, motorized and traditional fishing vessels is presented in table 27.

Table 27: Occupational hazards among mechanized, motorized and traditional boats

Type of hazards	Types of hazards	Mechanized	Motorized	Traditional
			%	
Vessel hazards	Capsizing	20	47	50
	Sinking	17	27	30
	Grounding	27	23	43
	Burning	13	0	0
	Collision	53	20	30
Personal Hazards	Mishaps	40	43	37
	Man overboard	40	30	23
	Injuries	60	17	40
	Avg. %	33	26	32

It is clear form table 27, that more number of mechanized (33%) vessels/fishers were affected in occupational hazards followed by traditional (32%) and motorized (26%) fishing vessels/fishers.

Among vessel hazards capsizing were mainly affecting to traditional vessels (50%) compared to motorized (47%) and mechanized vessels (20%). A total of 30% of fishers with traditional, 27% of motorized and 17% mechanized fishing vessels experienced sinking hazard. Grounding was experienced by 43% of traditional, 27% mechanized and 23% motorized vessels. Burning was reported in mechanized vessels (13%). Similarly due to collision mechanized (53%), motorized (20%) and traditional (30%) vessels were affected.

Among personal hazards 60% of fishers from mechanized, 43% from motorized and 37% from traditional vessels faced mishaps during fishing trips. In man overboard 40% of fishers from mechanized, 43% from motorized and 37% from traditional boats were affected. More number of fishers from mechanized boat (60%) faced occupational injuries in comparison to motorized (17%) and traditional (40%) fishers.

Most of the personal hazards were reported by fishers of mechanized boats because they are involved in many fishing related activities like handing and repairing of fish catching equipments, maintaining the deck machinery in good working condition, keeping the vessel clean, storing ice in fish hold, sorting the caught fish, sometimes going inside the water when net entangling is happening, unloading the fish in landing centre, cooking the food for crew members during fishing trips etc.

4.2.2 Kruskal-wallis test for occupational hazards in mechanized, motorized and traditional boats

Kruskal-Wallis test was used to determine the significant difference in incidence of occupational hazards in these three types of vessels and the results are presented in table 28.

Table 28: Significance difference in occupational hazards reported in mechanized, motorized and traditional fishing vessel

Hazard Type	Chi square value	Asymptotic Sign	Decision
Capsizing	6.750	0.034	**H_0 Rejected**
Sinking	1.547	0.461	H_0 Accepted
Grounding	3.179	0.204	H_0 Accepted
Burning	8.279	0.016	**H_0 Rejected**
Collision	2.360	0.307	H_0 Accepted
Mishaps	1.987	0.370	H_0 Accepted
Man overboard	1.308	0.520	H_0 Accepted
Injuries	13.528	0.001	**H_0 Rejected**

Table 28 is showing that there is no significant difference in vessels and personal hazards except for capsizing, burning and injuries. The difference is more in case of injuries and burning. This difference is due to the leakage of gas from LPG cooking gas, fishing net entangled under the vessel and fishing related injuries. Number of fishers affected due to various vessel hazards is presented in figure.23.

4.2.3 Number of fishers affected by vessel hazards

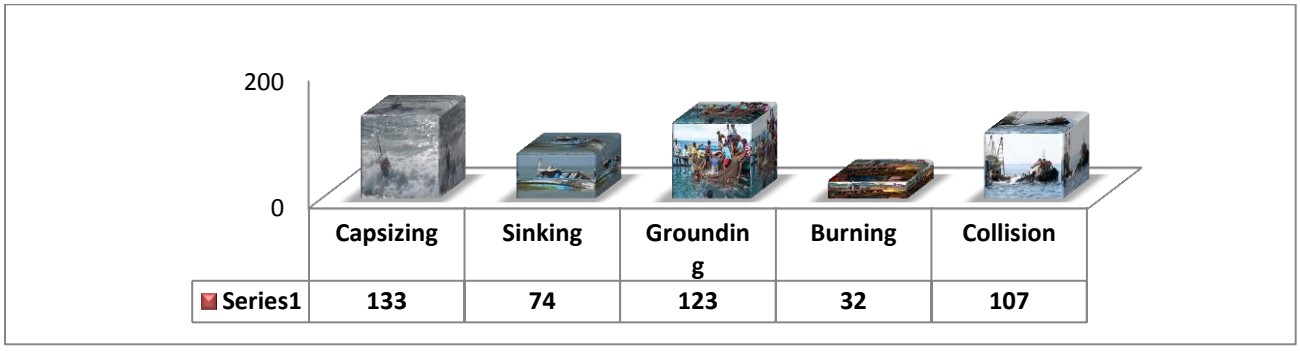


Fig 23: Number of fishers affected by vessel hazards

It is clear from figure 23 that more number of fishers were affected in capsizing (133) followed by grounding (123), collision (107), sinking (74) and burning (32).

4.2.4 Medical care received for occupational hazards

The medical care received for occupational hazards were classified into three categories such as no medical care (N), first aid only (F), and hospital care (H). The number of fishers required the types of treatment incurred due to various occupational hazards is presented in figure 4.

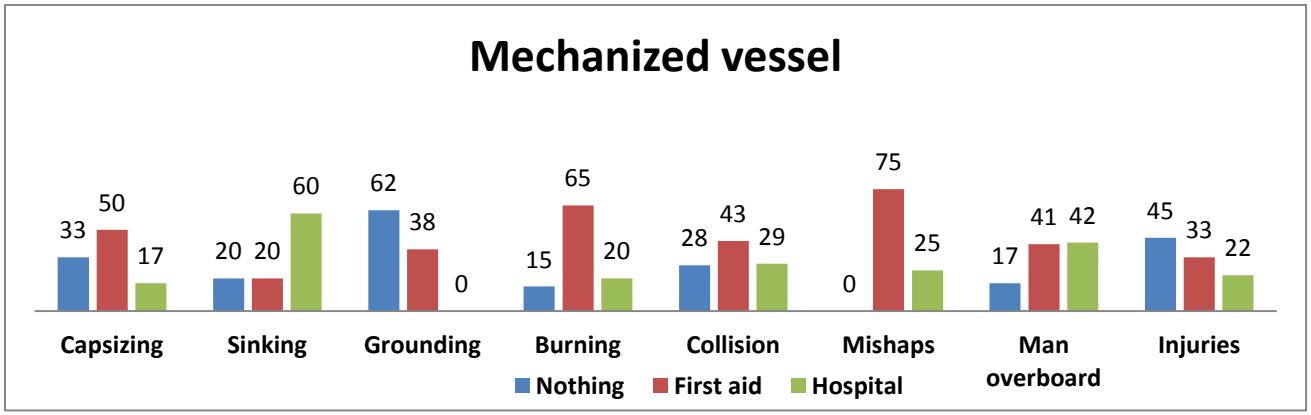


Fig. 24: Medical care received for occupational hazards in mechanized vessel

It is clear from figure 24 that, first aid treatment was mainly received for mishap and burning hazard, and hospital care was availed for sinking hazard for fishers of mechanized vessel.

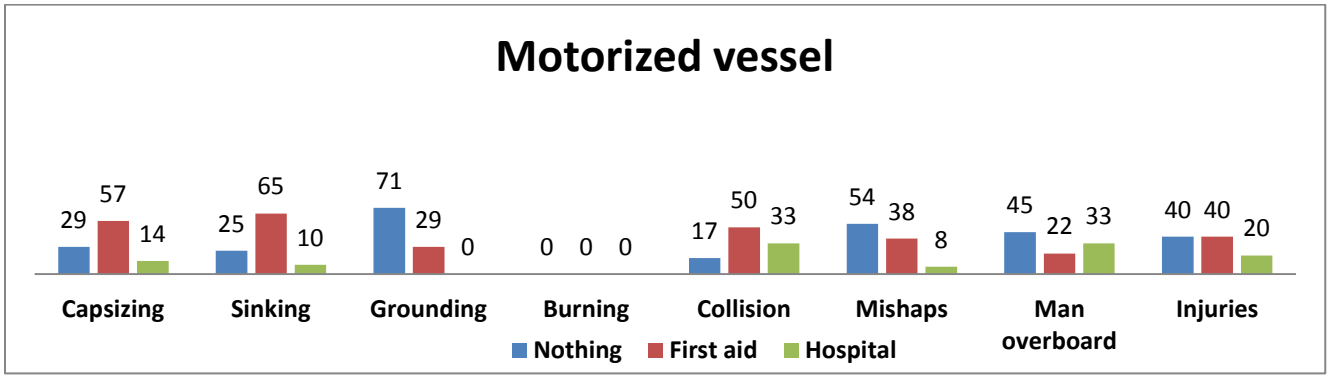


Fig. 25: Medical care received for occupational hazards in mechanized vessel

It is seen from the figure 25 that for injuries and sinking first-aid treatment was needed for fishers of motorized vessel

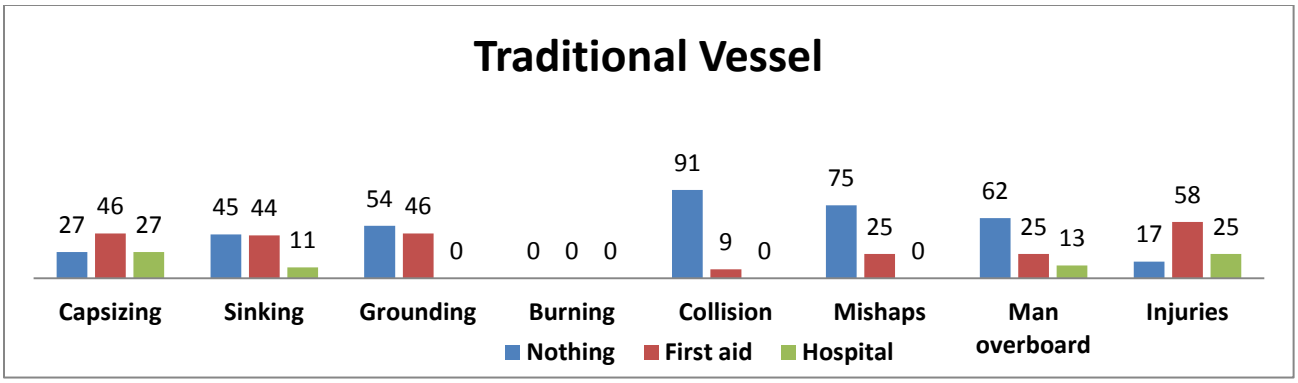


Fig. 26: Medical care received for occupational hazards in traditional vessel

Figure 26 is showing that for injuries and sinking first-aid treatment was needed for fishers of traditional vessel

From the above figures, it is clear that in mechanized vessel mainly first aid treatment were received however in motorized and traditional vessel no medical care was received.

A study conducted by Lucas (2014) during 2000-2009 in USA, found that majority of deaths at sea among fishing industry workers occurred due to vessel sinking. In the present study, it is found that first aid and hospital treatment were mainly availed for vessel sinking hazard.

Backus and Davis (2011) reported that the mishaps denote a particular problem in the marine lobster fishery of Boston. From the current study, it is seen that among the personal hazards, injuries (39%) were more reported followed by mishaps (32%).

4.3 Strategies adopted by fish farmers/fishers to mitigate occupational hazards

Hierarchy of Hazard control (HOHC) method of NIOSH (2012) was applied to measure the strategies adopted by fish farmer/fishers to mitigate the occupational hazards. This Hierarchy of Hazard control inverted triangle contains five types of controlling measures based on their effectiveness such as Elimination (E), Substitution (S), Engineering control (N), Administrative control (A), Personal protective equipments (P).The controlling measures adopted by fishers/farmers were calculated by taking their normalized mean of Hazard Control Scores (HCS).

4.3 a) Strategies adopted by fish farmers/fishers of inland fisheries sector

There are some control measures carried out by pond fish farmers/workers for physical, chemical, biological and ergonomic hazards where as there is no control strategies for psychosocial and natural hazards. Table 29, presents the hazard control strategies of pond farmers/workers.

Table 29: Hazard Control strategies of pond farmers/workers

Hazard	Nos. farmer affected (%)	Nos. of farmer controlled (%)	Normalized mean Hazard Control scores	Effectiveness	Controlling strategies (%)				
					E	S	N	A	P
Physical	All	44	0.149	Least	18	0	0	0	82
Chemical	57	64	0.03	Least	13	0	0	0	83
Biological	63	47	0.11	Least	11	0	0	0	89
Ergonomic	90	14	0.51	Medium	13	33	0	54	0
Psychosocial	53	0	No control	No control	0	0	0	0	0
Natural	40	0	No control	No control	0	0	0	0	0

Table 29, indicates that the Hazard Control Score (HCS) for ergonomic hazard is highest compared to other hazards. Ergonomic hazards include pain in neck, back, shoulder, upper back, shoulder, elbow, wrist, lower back, hips/thighs, knees, ankle and sprain in body. This is reported by 90% of pond farmers/workers and among these 14% were controlled the hazard. The hazard control score lies in medium level (0.51) of effectiveness. The controlling strategies followed for this hazard are elimination, substitution and administrative control. Among these three types of hazard controlling strategies, administrative control (54%) is more commonly adopted. In administrative control the farmers are rotating their working hours based on their health, convenience and redesigning their work by taking some professional skills for the specific jobs like feed spreading, manure preparation, liming and installation of aerators where as in large farms, the farm owner are rotating jobs and making job shifts of among the farm workers to reduce ergonomic hazard. In substitution (33%), farmers are reducing heaving loads in to smaller units like while feed spreading and liming instead of taking heavy containers they are using light containers to reduce the work pressure on their shoulder. In elimination (13%) farmers are changing bench heights to reduce bending while packaging, feed mixing and preparing the slurry for manuring.

Biological hazard includes bites of snake, leech and mosquitoes, injuries by fish fin and cuts due to fouling organisms. This hazard was reported by 63% of farmers from which 47% are controlling the hazard. There is hazard control score (0.11), which implies least effective control strategies were adopted by farmers to control biological hazard The controlling strategies for this hazards are elimination and PPE. A total of 11% of affected farmers are controlling the hazard by elimination. This is done by keeping the farm area clean and cutting the unwanted grasses which can prohibits the entry of snakes. More number of farmers are following (89%) PPE method, in this they are using safety shoes and hand gloves during working at farm site. In these method they are also applying lime which ultimately reducing the leech bite probability. To reduce snake in farm area, carbolic acid has been used.

Chemical hazard was reported by 57% of farmers and among the affected farmers 64% of farmers controlled the hazard. The hazard control score (0.03), indicated in least effective strategies were followed to control the hazards. Farmers are using two types of strategies are like substitution and PPE method. In PPE, farmers (87%) are wearing gloves while liming and applying fungicide and insecticide. To reduce inhalation problem, farmers are using face mask or put some clothes in their nasal part. In substitution (13%) farmers are using other substitute for hazardous chemical like, for reducing argulus and fungal infection, instead of using powdered chemicals; they are using liquid chemicals like Para-quer BT, Killer- AG.

The more commonly reported hazard was physical hazard and 44% of farmers are controlling the hazard. The hazard control score (0.14) implies that least effective strategies were adopted by farmers. Mainly elimination and PPE controlling strategies are followed. PPE is the most commonly adopted strategy where the farmers are using the safety equipments like hand gloves, torch light, head caps and gum shoes. They are also wearing full body coverage separate farm clothing to protect themselves from exposure to high temperature. While 18% of farmers are adopting elimination method for controlling the hazard, in these they are replacing their old or damaged equipments with a new one like change a loss handle fixed sickle to a new one. They are also eliminating fall and fracture related injuries by making earthen grips on pond site and cleaning the farm area in regular interval.

There are no hazard control strategies followed by river and reservoir fishers except in case of physical hazard. These fishers are controlling physical hazard by applying PPE methods. These equipments are used mainly to reduce drowning, dehydration and cut injuries. Occupational protective equipments used by fishers given in table 30.

Table 30: PPE used by river and reservoir fishers

Personal protect equipment	River(%)	Reservoir(%)
Floating buoys	26	43
Head cap	33	36
Know swimming	80	86

Table 30 is showing the protective equipments used by river and reservoir fishers. It is seen more numbers of reservoir fishers are using safety equipments compared to reservoir fishers. Among reservoir fishers (43%) are using floating buoys while in case of river fishers it is 26%. To reduce dehydration, 33% of river fishers are using their head caps, in case of reservoir fishers it is 36%.

Both river and reservoir fishers are not following any hazard control strategies for biological, ergonomic, and psychosocial hazards. Whereas in case of natural hazard early warning messages are given to fishers through phone contacts by state Government.

4.3 b) Strategies adopted by fishers of marine fisheries sector

As ILO (1999) reported that fishing at sea is the most dangerous occupation in the world, so Safety at sea is dependent on how the actual vessel is designed and constructed as well as on the equipment carried onboard. FAO, ILO and IMO are providing guidelines, conventions and codes in relation to fishing vessel safety. In this context the hazard controlling strategy of mechanized vessel is presented in table 31.

Table 31: Hazard control strategies of mechanized vessel

Hazard type	Nos. of vessel/ fishers effected (%)	Controlled (%)	Normalized mean of Hazard control Score	Effectiveness	E (%)	S (%)	N (%)	A (%)	P (%)
Capsizing	20	All	0.54	Medium	50	0	0	17	33
Sinking	17	All	0.5	Medium	40	0	0	40	20
Grounding	27	All	0.43	Medium	37	0	0	26	37
Burning	13	All	0.62	Medium	50	0	0	30	20
Collision	53	71	0.45	Medium	40	0	0	20	40
Mishaps	40	75	0.5	Medium	33	0	0	67	0
Man-overboard	40	42	0.5	Medium	40	0	0	0	60
Injuries	60	50	0.33	Least	22	0	0	44	34

Table 31, shows that in mechanized vessel the controlling strategies were medium effective for most hazards. However, for injuries, least effective controlling strategies were followed.

For the burning hazard the control strategy score was 0.62 and it was reported that strategies followed were elimination, administrative control and PPE. Among them 50% are following elimination, i.e., fishers have attended training on occupational safety at sea, they learn about firefighting methods and usages of sea safety devices like life buoy, life jacket, EPIRB and DAT. Administrative control is followed by 30% of vessel fishers where, they check the flammable equipments like cooking gas and vessel engine. PPE is followed by 20% of fishers. In PPE fishers keep sea safety devices like life jacket, life buoy and DAT for emergency rescue.

The hazard control score (HCS) for vessel capsizing was found to be 0.54, which implies medium level of effectiveness. 33% are controlling this hazard by keeping sea safety devices where as 17% are always remain aware about information regarding weather conditions before their fishing trips and remaining 50% discard the unwanted catches in to the sea, in order to reduce the impact of heavy load.

For vessel sinking the hazard control score (HCS) was 0.5, which implies medium effectiveness. Elimination and administration methods are followed by 40% and 20% are following PPE methods. The crew members are trained about vessel buoyancy management, the fishers are aware about weather information before going for fishing trips. In PPE methods the vessel contains sea safety equipments.

The hazard control score for collision is 0.45, where administrative control is followed by 20% by managing their vessel speed and PPE and elimination are followed by 40%. For grounding, the hazard control score is 0.43, indicating medium level of effectiveness, elimination and PPE method are adopted by 37% each where as 26% are following administrative control. Among personal hazards, mishap and man overboard have medium level of hazard control score, whereas for injuries this score is least effective.

So, in mechanized vessel the hazard control score is high for burning and least for pbzbersonal injuries. Mainly elimination, administrative control and PPE methods are used to control the hazard. The hazard control strategies of motorized vessel presented in table 32.

Table 32: Hazard control strategies of motorized vessel

Hazard type	Nos. of vessel/ fishers effected (%)	Controlled (%)	Normalized mean of Hazard control Score	Effectiveness	E (%)	S (%)	N (%)	A (%)	P (%)
Capsizing	47	62	0.47	Medium	44	0	0	12	44
Sinking	27	All	0.34	Medium	25	0	0	48	27
Grounding	23	28	0.12	Least	0	0	0	50	50
Burning	0	0	0	0	0	0	0	0	0
Collision	20	35	0.25	Least	0	0	0	20	80
Mishaps	43	61	0.25	Least	0	0	0	All	0
Man-overboard	30	55	0.25	Least	0	0	0	All	0
Injuries	17	0	0	No Control	0	0	0	0	0

It is clear from table 32, in motorized vessel there is least effective hazard control strategies are followed for grounding, collision, mishaps and man overboard. Medium effective strategies are followed for capsizing and sinking where as no control strategies are following for personal injuries.

For collision, mishaps and man overboard the hazard control score was 0.25, which implies least effective methods are being used for controlling the hazard. For collision, 20% are following administrative methods by controlling their motor speed where as 80% have tied rubber tubes around their vessel. In mishap and man overboard the fishers are applying administrative control.

The hazard control score for vessel capsizing was 0.44 and this indicates medium level effectiveness where elimination and PPE is adopted by 44% and 12% are following administrative control. In sinking this score is 0.35 and controlling is done by elimination (25%), administrative (48%) and PPE (27%) methods. Grounding is controlled by adopting least effective methods where mainly administrative (50%) and PPE (50%) are followed. Table 33 is showing the hazard control strategies of traditional vessel.

Table 33: Hazard control strategies for traditional vessel

Hazard type	Nos. of vessel/ fishers effected (%)	Controlled (%)	Normalized mean of Hazard control Score	Effectiveness	E (%)	S (%)	N (%)	A (%)	P (%)
Capsizing	50	80	0.16	Least	42	0	0	0	83
Sinking	30	All	0.11	Least	11	0	0	0	89
Grounding	43	All	0	No control	0	0	0	0	0
Burning	0	0	0	0	0	0	0	0	0
Collision	30	72	0.05	Least	18	0	0	0	72
Mishaps	37	37	0	No control	0	0	0	0	0
Man-overboard	23	37	0	No control	0	0	0	0	0
Injuries	40	0	0	No control	0	0	0	0	0

It is clear from table 33 that, in traditional vessel there no hazard control strategies are being followed except for vessel capsizing, sinking and collision. The hazard control score for these hazards are least effective. PPE method and elimination are the main hazard controlling strategy which have adopted by fishers of traditional vessel.

Thus it has been revealed that fish farmers/fishers of inland fisheries sector are not following any hazard control strategies, however pond fish farmers are adopting some hazard control strategies but those are least effective. In case of marine fisheries sector, fishers are following medium and least effective strategies.

4.4 Locating the context of occupational safety in state fisheries frameworks

4.4.1 Occupational safety in State fisheries Schemes

It was found that there are following schemes in fisheries sector in the state of Odisha and these are divided in four major components as follows:

i. Central Plan Schemes (100% central assistance)
ii. Centrally Sponsored Plan Schemes (State Share : Central Share)
iii. State Plan Schemes (100% State assistance)
iv. Central Assistance from outside Budget

(Source: Official Web Portal of Fisheries & Animal Resources Development Department, Odisha)

It was noticed that the central plan schemes and centrally sponsored plan schemes have considered the safety of fishermen at sea and group accident insurance for active fishermen. These schemes are focused in marine sector and some extent to fisher of rivers and reservoirs, however, fish farmers/workers are not covered in these schemes. The schemes which have the provision of occupational safety for the fishers of odisha were described below in table 34, 35, 36 and 37.

Table 34: Netrajyoti scheme for fishermen (State scheme)

Objective	To provide financial assistance to BPL fishermen for ophthalmic complaints, cataract operation and supplying spectacles free of cost to deserving persons.
Salient features	The fishermen are always exposed to adverse environmental conditions while catching fish from the sea, river, reservoirs and wild source which leads frequent ophthalmic disorder. All BPL category fishermen engaged in fishing and ancillary work relating to fishing and marketing operation along with their family members will be covered under this scheme
Modalities	The fishermen should have BPL card issued by competent authority. Financial assistance of Rs.5000/- will be provided to the selected fishermen

Table 35: Financial assistance to fishermen for fatal diseases (State scheme)

Objective	To provide financial assistance to BPL holders suffering from major life threatening diseases
Salient features	The fishermen usually avail 200- 220 fishing days in a year for capture fishing in reservoirs, rivers and coastal waters of the state. Due to poor financial condition, imbalanced diet and lack of literacy the fishermen do not avail health check up at the early stage, which at times leads to fatal diseases like heart problem, malfunctioning of kidney, brain tumour, cancer, paralysis and mental disorder.
Modalities	The Health and FW Department is implementing the Odisha State Treatment Fund (OSTF) for providing financial assistance to BPL holders suffering from major life threatening diseases, which includes the beneficiaries of “Financial assistance for Fatal Diseases” under MUY. Financial up to Rs3.00 lakhs will be given to the affected fishermen through OSTF.

Table 36: Safety of fishermen at sea (State share: Central share) (25:75)

Objective	To provide subsidized life savingequipments to save the sea going fishers at the time of distress.
Salient features	Life saving equipments like DAT is provided to the sea going fishermen
Modalities	Unit cost Rs.1, 50,000/- Pattern of assistance: 75% of the unit of kit consisting of GPS communication equipment, echo-sounder and search and rescue beacon.

Table 37: Group Accident Insurance for Active Fishermen (State share: Central share) (50:50)

Objective	To provide accident insurance cover to poor fishers, free of cost, to enable them to avail compensation, on accident.
Salient features	Under this component fisher folk/licensed/identified or registered with the states/UT Governments would be insured for Rs 2,00,000/- against death or permanent total disability and Rs 1,00,000/- for partial permanent disability and a cover of Rs.10,000/- towards hospitalization expenses in the event of accident. The insurance cover will be for a period of 12 months (starting from 10th December of any year and ends on 9th December of the succeeding year) and a policy would be taken out by FISHCOPFED. In respect of all the participating states / UTs. the scheme would cover fisherman both in Marine and Inland sectors. FISHCOPFED will be the executing agency and would operate the scheme through any insurance company/ companies in case of states /UTs, which opt to subscribe the scheme through FISHCOPFED.
Modalities	The annual premium payable would not exceed Rs 65/- per head - 50% of which will be subsidized as grants- in – Aid by the center and the remaining 50% by the state Government.

4.4.2 Occupational Health Legislation in India

There are presently 16 laws related to working hours, conditions at work, and employment. There are two acts containing the main provisions for legal measures for the protection of health and safety of workers; they are the Factories Act (1948) and the Mines Act (1952). The Factories Act was amended in 1987 and stipulated pre-employment examination as a pre-placement procedure, statutory periodic medical examination for the job in hazardous areas (Saha, 2018).

In India, occupational health is under two ministries:

1) Labour

2) Health and Family

The Ministry of Labour and the Labour departments of the states and union territories are mainly responsible for health and safety of workers. The Ministry of Health and Family Welfare is responsible for providing health and medical care to workers through its facilities. The DGMS (Directorate General of Mines Safety) and the DGFASLI (Directorate General – Factory Advisory Services and Labour Institutes) assist the Ministry in technical aspects of occupational health and safety in mines, ports and factories respectively (Nagpal, 2017).

4.4.2.1 DGFASLI

The Directorate General of Factory Advice Service & Labor Institutes (DGFASLI) serves as the technical arm of the Ministry of Labour and Employment in the formulation of national policies and strategies relating to occupational safety and health (OSH). It coordinates with the State Factory Inspectorates / Directorates for the enforcement of the provisions under the Factories Act, 1948. However, it is the enforcing agency to implement the provisions under the Dock Workers (Safety, Health & Welfare) Act, 1986 and the regulations framed there under in all major ports in India through Inspectorates of Dock Safety (IDS). The DGFASLI organization comprises of the head quarters and Central Labour Institute at Mumbai and Regional Labour Institute at Kanpur, Kolkata, Chennai and Faridabad. A new Regional Labour Institute is being set up in Shillong to cater to the specific needs of the north-eastern part of the country in the field of occupational safety and health as part of the Government of India's initiative to bring this region of the country into the mainstream.

The headquarters consists of the following divisions:

- Factory Advice Service
- Docks Safety
- Construction Safety
- Awards
- MIS Division

Among these divisions Docks Safety concerns for the safety, health and welfare of dock workers.

4.4.2.2 Docks Safety

Consequent to the recommendation of the First National Commission on Labour (Gajendranagar Commission) a common comprehensive law on safety

and health of dock workers titled the Dock Workers (Safety, Health and Welfare) Act,1986 was framed and made applicable from 15th April 1987. Under this Act a set of comprehensive regulations called the Dock Workers (Safety, Health and Welfare) Regulations. 1990 was framed and brought into force with effect from 18th March 1990 and thereby repealing the earlier Regulations and Scheme. The new Act and Regulations are in line with the ILO Convention-152 concerning safety and health in dock work.

4.4.2.3 Constitutional Provisions for occupational safety

There are three articles for ensuring workers' safety and health (Sudhakar, 2017).

Article 24: Prohibits employment of children under the age of 14 years.

Article 39: (e and f) States that the health of men, women and children should be protected, and children should be given opportunity and facility for healthy development and should be protected against exploitation.

Article 42: States that human conditions at work and maternity relief should be provided.

4.4.2.4 Occupational Health Institutions

4.4.2.4.1 NIOH

The National Institute of Occupational Health (NIOH) was established in 1970 at Ahmedabad, Gujarat, as a WHO collaborative and reference centre for occupational health and it works closely with the Ministries of Labour, Health and Family Welfare, Environment and Forests, Agriculture etc. To cater to the local needs of the southern and eastern regions of India, the institute established two Regional Occupational Health Centers-(ROHC), one at Bangalore (1977) and the second at Kolkata (1980) (D'Souza, 2017).

Thrust Areas of Research:

- Occupational and Environmental Epidemiology
- Toxicology (metal, pesticide, reproductive, geno& neurobehavioral)
- Environmental Pollution (air, water, noise, thermal)
- Development of Safety Norms (chemical physical agents)
- Operational Research
- Women Health
- Agricultural Health

4.4.2.4.2 NSCI

The National Safety Council of India (NSCI) was established to promote safety consciousness among workers to prevent accidents, minimize dangers and risks, and arrange related education and awareness programs.

The three main activities of the NSCI are road transportation safety, the safety of health in the construction sector and safety, health, and environment in small to medium-scale enterprises (SMEs).

4.4.2.4.3 Other institutes

Other public institutes include the Central Labour Institute (and its associated institutes) and the All India Institute of Hygiene and Public Health. The Indian Association of Occupational Health (IAOH) is an association of over 3000 members comprising health professionals, industrial hygienists, safety professionals, social workers and others.

It aims to promote occupational health by various measures including conducting training courses, workshops, and conferences, producing a journal with scientific articles, conducting research activities, collaborating with international agencies in the field and preparing a national registry of occupational health.

4.4.3 International organizations on occupational safety in fisheries sector

International Maritime Organization (IMO), the International Labor Organization (ILO) and Food and Agriculture Organization (FAO) are the three specific bureaus of the United Nations system that performs a role in fishermen's safety at sea. IMO is the agency vested with the obligation for enhancing maritime safety and restricting pollution from ships. ILO formulates international labor standards in the form of conventions and recommendations, setting minimum standards of basic labor claims. It also encourages the development of independent employers, workers, and organizations and provides training and advisory services to those organizations (FAO, 1999).

4.4.4 Fishing as a dangerous occupation

The ILO considers fishing a potentially hazardous occupation(ILO 2007), because it is physically demanding work often carried out for long working hours in precarious conditions. Some of the injuries and health impacts in fisheries include: hypothermia, wounds, swelling, pain, amputation, sprains, fractures,

burns, chemical exposure and poisoning, and smoke inhalation. International labor standards specifically covering young workers in fishing include:

- ILO Work in Fishing Convention No. 188 (2007)
- ILO Work in Fishing Recommendation No. 199 (2007)
- ILO Vocational Training (Fishermen) Recommendation No. 126 (1966)

4.4.5 Hazardous work (ILO, 2019)

Certain sectors and occupations are more dangerous than others, priority is given to the workers in the most hazardous sectors and occupations such as agriculture, construction, mining, or ship-breaking, or where working conditions create particular risk such as exposure to hazardous chemical substances or radiation, or in the informal economy.

In this context, ILO is making the use of its extensive experiences in promoting the standards, codes of practice, technical guides, training materials and also developing the practical action for the protection of workers in hazardous conditions. It has developed a series of International Hazard Datasheets on Occupations (HDO) in collaboration with the Israel Institute for Occupational Safety and Hygiene and other Occupational Safety and Health Information Centers throughout the world. Special attention needs to be paid to the area of hazardous work for children and young workers.

The discussion above reveals that for marine fishers there are schemes in state and central Government. However, with the present growth of aquaculture, the industry should devote greater attention to the prevention of work-related injuries. The state of Odisha, with a total fisher folk population of 14,80,704, is an important state with reference to fisheries (Odisha Fisheries Policy, 2015). Enhanced occupational safety and health programs for this industry could help to reduce injuries and illnesses, as well as the cost. Employers and Government should focus on interventions to protect workers from physical hazards in the workplace.

5. SUMMARY & CONCLUSION

Fishing is recognized as one of the most dangerous occupations with a high chance of accidental risks (ILO, 2007). It has reported that 24,000 fishermen die every year in the world during fishing. The Blue Growth Initiative of the Food and Agriculture Organization of the United Nations (FAO, 2018) identified that decent work in fisheries and aquaculture will help in sustainable management of inland and marine sector. In 2007, the ILO Work in Fishing Convention No. 188 entered into force, which was designed to ensure improved occupational safety and health for workers in the fishing sector. For improving livelihoods of fishers and food security in the country, it is important to address issues of occupational safety and health of people associated in the sector (ICSF, 2014).

Occupational hazards in marine fisheries have been addressed in many countries. In India also there are some studies done in the state of Kerala and Odisha. However, studies on occupational safety of fish farmers/workers/fishers in inland sector are very few. FAO (2018) reports 19.3 million people are engaged in aquaculture sector in world wide. The proportion of employment in capture fisheries has decreased from 83% in 1990 to 68% in 2016, while proportion of those employed in aquaculture correspondingly increased from 17-32%.Aquaculture, is a fast growing sector but it has unaddressed occupational safety and health issues. India is ranked 2nd in aquaculture, but there are no comprehensive studies reporting about occupational hazards faced by fish farmers and workers. Sharma (2018).

Thus a study entitled ‘Occupational Hazards in Fisheries Sector in the State of Odisha’ was undertaken with objectives of to identify occupational hazards in fisheries sector, to study the strategies adopted by fish farmers/fishers to mitigate occupational hazard and to locate the context of occupational safety in state fisheries department.

The rationale for selecting Odisha, lies in the fact that the state is one of the important maritime as well as inland states of India having excellent scope for fisheries development. The state has 6.83 lakh ha. of freshwater resources, 4.18 lakh ha of Brackish water resources and 480 kms. of coastline for fisheries

development.The fisheries potential of Odisha is 5,13,667MT. About 4 percent population (16.96 lakh) depends upon fisheries for their livelihood. Of them, 8.90 lakh depend on inland fisheries and 8.06 lakh on marine fisheries (Draft of Odisha Fisheries Policy, 2014). The total fish production of the State during 2017-18 is 6.08 lakh MTs and export generation is around Rs.2204.78 crores. The annual per capita fish consumption is 13.49 Kg.(Annual activity report 2017-18 (F&ARD Department, Odisha)

The state comprises of thirty districts out of which seven are coastal and remaining are inland districts. Out of these seven coastal districts, Balasore district has the highest coastal length of 80 kms and continental shelf of 5380 sq.kms (Coastal Odisha Development Council, 2015). Among inland districts majority of the ponds, rivers and reservoirs, aquaculture farms and fishermen population is in Angul district. So for the study area Balasore district was selected for marine sector and Angul district for inland sector.

Profile of fishers/fish farmers included information on about fishing, age, education, caste, religion, farming area/ fishing length, Income, life insurance, farming/fishing experience and fishing trip.

To find the occupational hazards faced by fishers/farmers in inland sector, a list of possible hazards and possible injuries was prepared. These hazards could be classified as Physical, Chemical, Biological, Ergonomic, Psychosocial, and Natural. An interview schedule was prepared and pilot tested in shrimp workers in Andhra Pradesh and necessary changes were made after field testing to improvise the schedule. Kruskal-wallis test was done in order to know the significance difference of hazards faced by fish farmers/fishers. Consequences of reported occupational hazards were calculated based on the degree of severity of the reported occupational injuries on the affected fishers/farmers and medical expenditure and financial losses were recorded.

For marine fisheries occupational hazards were reviewed from previous studies and few modifications were done in the interview schedule of Sethulakshmi and sharma (2017). Interview schedule included general and fishing profile of fishers like age, education, fishing experience, residential status, religion, caste, fishing trips, and personal insurance. To find the occupational

hazards faced by fishers, hazards were categorized in to vessel hazards and personal hazards. The vessel hazards include capsizing, sinking, grounding and collision, while personal hazards include mishaps, man overboard and injuries. The occurrence of vessels hazards and personal hazards were presented by percentage analysis and to get the significance difference of the reported hazards among mechanized, motorized and traditional vessels kruskal- wallis test was done. The number fishers affected by these hazards were measured. The type medical care provided to injured fishers is like first aid and hospital treatment were quantified.

To study the strategies adopted by fishers and fish farmers to mitigate occupational hazards, NIOSH (2012) defined and accepted method, Hierarchy of Hazard Control (HOHC) was used. Based on the effectiveness of the hazard control strategies, these were coded as elimination (5), substitution (4), engineering control (3), administrative controls (2) and personal protective equipment (1). Then the strategies adopted by fish farmers/fishers to mitigate the occupational hazards were scored then the obtained hazard control scores were normalized. The averages of this normalized scores were taken to calculate hazards control score (HSC) for a specific hazard. These Hazard Control scores were categorized based on their effectiveness like least (<0.33), medium (0.34-0.66) and most effective strategies. In this procedure the hazard control score and effectiveness of control strategies for every hazard were determined for both inland and marine fish farmers/fishers.

To locate the context of occupational safety in state fisheries department, information was collected from Department of Fisheries Officials through personal and telephonic contacts about the various schemes which are available at state Fisheries & Animal Resources Development Department. Same was also reviewed from the state official websites. Addition to this legislation and constitutional provision working in India for safety of workers were reviewed. This was further supplemented by reviewing websites of various international and national organizations working in the areas of occupational safety in fisheries. Qualitative assessment of the collected information was done.

Results indicated that the fishers/farmers' age ranged from 35 to 50 years and average age of pond farmers was found to be more (47 years) in comparison to river (43 years) and reservoir fishers (46 years).More numbers of pond farmers (50%) were graduates whereas; river and reservoir fishers had nil, primary, secondary and intermediary level of education. River and reservoir fishers have more fishing experience than fish farming experience of pond farmers. The average fish farming experience of pond farmers' was found to be 18 years where as fishing experience of river fishers was 21 years and for reservoir it was 25 years. More numbers of fish farmers are from OBC caste category (57%). Among river fishers all are from SC category and among reservoir fishers more are from SC (77%) compared to OBC (23%). All pond farmers are married where as in river and reservoir fishers there are both married and unmarried. Among pond farmers equal numbers are from joint and nuclear family whereas, among river (60%) and reservoir (56%) fishers more are from joint family. More numbers of pond farmers (53%) have personal life insurance than river (23%) and reservoir(40%) fishers. Average fish farming area in case of pond farmers' is was 1.01 ha. However the average fishing length of river and reservoir fishers was 1.34Nms and 1.61Nms respectively.

Among the marine fishers from mechanized, motorized and traditional vessel, majority are of middle (35-50) age group. Most of the fishers are from Schedule Caste and joint family from three vessels. In mechanized vessel more numbers of fishers have life insurance in comparison to motorized and traditional vessel as it is mandatory for fishers from mechanized vessel to take insurance.

The study revealed that, 57% of fish farmers/fishers in the inland sector have been affected by some or the other occupational hazards. Among the six different types of hazards, majority i.e., 95% of them were affected by physical hazards followed by ergonomics hazard which were 77%. A total of 61% faced biological hazards followed by psychosocial hazards which were 52%. Natural hazards faced were 37%, and Percentage affected by chemical hazard was 19%.Fall is most common injury in physical hazard, followed by ergonomic in which shoulder pain is prominent. Among biological hazard, leech bite is very

common. Stress is the most reported psychosocial hazards. Due to natural hazards, crop/habitat loss was reported.

There was statistically significant difference found in physical, chemical, and ergonomic hazards among pond/river/reservoir, which indicates that fishers/farmers were differently affected in these three water bodies. However, there is no significant difference found in case of biological, psychosocial and natural hazards. From the reported occupational injuries 71% were minor, 17% of them were serious and 10% were insignificant where as 2% were critical injuries. There were also some reports of deaths in case of reservoir fishers due to natural hazards like cyclone in their fishing trips. Physical hazard causes serious injuries like fracture of limbs and eye injury. Chemical eye infection is the serious injury due to chemical hazard. Biological hazard causes most serious injuries snake bite and injuries by fish fin rays. Sprain is the most serious injury due to ergonomic hazard.

There was significant difference among the fish farmers/fishers from three different water bodies in terms of medical expenditure/financial loss occurred for physical, chemical, ergonomic and natural hazards. It seems that the median value of physical, chemical, ergonomic and natural hazards are not equal.

In marine fisheries sector, it was found that among vessel hazards, more number of vessels has experienced capsizing (39%) followed by grounding (31%), collision (27%), sinking (24%) and burning (4%). Among personal hazards the dominant occupational hazards was by injuries (39%) followed mishaps (37%) and man overboard (32%). The main reasons behind vessel capsizing were poor stability due to rough sea, storm, heavy rain and loads. Among the personal hazards the reasons for injuries were slipping off deck, stings and bites, cuts, injuries from fishing equipment. It was found that more number of mechanized (33%) vessels/fishers were affected in occupational hazards followed by traditional (32%) and motorized (26%) fishing vessels/fishers. Among vessel hazards capsizing were mainly affecting to traditional vessels (50%) compared to motorized (47%) and mechanized vessels (20%). A total of 30% of traditional, 27% of motorized and 17% mechanized fishing vessels experienced vessel sinking hazard. Grounding was experienced by 43% of traditional, 27%

mechanized and 23% motorized vessels. Burning was reported in mechanized vessels (13%). Similarly due to collision mechanized (53%), motorized (20%) and traditional (30%) vessels were affected. Among personal hazards 60% of fishers from mechanized, 43% from motorized and 37% from traditional vessels faced mishaps during fishing trips. In man overboard 40% of fishers from mechanized, 43% from motorized and 37% from traditional boats were affected. More number of fishers from mechanized boat (60%) faced occupational injuries in comparison to motorized (17%) and traditional (40%) fishers. Most of the personal hazards were reported by fishers of mechanized boats because they are involved in many fishing related activities like handing and repairing of fish catching equipments, maintaining the deck machinery in good working condition, keeping the vessel clean, storing ice in fish hold, sorting the caught fish, sometimes going inside the water when net entangling is happening, unloading the fish in landing centre, cooking the food for crew members during fishing trips etc. Kruskal-wallis test revealed that there was no significant difference in vessels and personal hazards except for capsizing, burning and injuries.

Hierarchy of Hazard control (HOHC) method showed that in case of pond fish farmers, there is some control measures carried out for physical, chemical, biological and ergonomic hazards where as there is no control strategies for psychosocial and natural hazards. In case of river and reservoir fishers there are no hazard control strategies for biological, ergonomic, and psychosocial hazards except physical hazard. However for natural hazard early warning message are given through phone contacts by state government.

The HCS for physical hazard was (0.14) which, implies the least effective strategies were adopted by farmers. For chemical hazard, HCS(0.03), indicated in least effective strategies were followed to control the hazards. The HCS for biological hazard was (0.11), which implies least effective control strategies were adopted. Among the HCS of various hazards, for ergonomic hazards HCS was more (0.51), which implies there is medium effectiveness of hazard control strategies followed.

Both river and reservoir fishers are not following any hazard control strategies for biological, ergonomic, and psychosocial hazards except physical

hazard. Where as in case of natural hazard early warning message are given through phone contacts by state government. These fishers are controlling physical hazard by applying PPE methods.

In marine sector the hazard control strategies for mechanized vessel lies in medium level of effectiveness for most of the hazards except in personal injury where the least effective controlling strategies were followed. In motorized fishing vessels there is least effective hazard control strategies are followed for grounding, collision, mishaps and man overboard, medium effective strategies are followed for capsizing and sinking where as no control strategies are following for personal injuries. In traditional vessel there is no hazard controlling strategies are following except for vessel capsizing, sinking and collision.

In mechanized vessel, for vessel burning the HCS(0.62) is more compared to other hazards, the strategies followed are elimination, administrative control and PPE. For vessel capsizing, the HCS is (0.54), which implies medium level of effectiveness. For vessel sinking the HCS is 0.5, which implies medium effective hazard control strategy. The HCS for collision is 0.45, where administrative control is followed by 20% by managing their vessel speed and PPE and elimination are followed by 40%.

In motorized vessel, there is least effective hazard control strategies are followed for grounding, collision, mishaps and man overboard and medium effective strategies are followed for capsizing and sinking where as no control strategies are following for personal injuries. For vessel capsizing the HCS is 0.44, indicates medium level effectiveness where elimination and PPE adopted by 44% each and 12% are following administrative control.

In traditional vessel, there is no hazard controlling strategies are following except for vessel capsizing, sinking and collision. The HCS for these hazards are least effective. PPE method and elimination are the main hazard controlling strategy which have adopted by fishers of traditional vessel.

To locate occupational safety in state fisheries framework, it was noticed that some state schemes and centrally sponsored plan schemes have considered the safety of fishermen at sea.

Among the various state schemes for fisheries development, Netrajyoti scheme for fishermen (State scheme) and Financial assistance to fishermen for fatal diseases (State scheme) consider the occupational safety of fishermen at sea, rivers and reservoirs. Among centrally sponsored schemes, Group Accident Insurance for Active Fishermen and Safety of fishermen at sea have the provision of occupational safety for marine fishermen.

In India there are presently 16 laws and 2 acts containing the main provisions for legal measures for the protection of health and safety of workers; these are like Factories Act (1948) and the Mines Act (1952).In India, occupational health is under two ministries, 1) Labour, 2) Health and Family welfare ministry. The Ministry of Labour and the labour departments of the states and union territories are mainly responsible for health and safety of workers. The Ministry of Health and Family Welfare is responsible for providing health and medical care to workers through its facilities. The DGMS (Directorate General of Mines Safety) and the DGFASLI (Directorate General – Factory Advisory Services and Labour Institutes) assist the Ministry in technical aspects of occupational health and safety in mines, ports and factories respectively (Nagpal, 2017).The Directorate General of Factory Advice Service & Labor Institutes (DGFASLI) serves as the technical arm of the Ministry of Labour, in the formulation of national policies and strategies relating to occupational safety and health (OSH). It coordinates with the State Factory Inspectorates / Directorates for the enforcement of the provisions under the Factories Act, 1948. However, it is the enforcing agency to implement the provisions under the Dock Workers (Safety, Health & Welfare) Act, 1986. The DGFASLI organization comprises of the head quarters and Central Labour Institute at Mumbai and Regional Labour Institute at Kanpur, Kolkata, Chennai and Faridabad. Docks Safety act of DGFSLI provides a common comprehensive law on safety and health of dock workers titled the Dock Workers (Safety, Health and Welfare) Act,1986. It was brought into force with effect from 18th March 1990 and thereby repealing the earlier Regulations and Scheme. The new Act and Regulations are in line with the ILO Convention-152 concerning safety and health in dock work. There are three articles for ensuring workers' safety and health (Sudhakar, 2017). These are like1) Article 24: Prohibits employment of children under the age of 14 years. 2) Article 39: (e and f) States that the health of men, women and children should be

protected, and children should be given opportunity and facility for healthy development and should be protected against exploitation. 3) Article 42: States those human conditions at work and maternity relief should be provided.

There are some institutes in India are working for occupational safety in the country like, The National Institute of Occupational Health (NIOH) works closely with the Ministries of Labour, Health and Family Welfare, Environment and Forests, Agriculture etc. Among its various thrust Areas of Research Agricultural health is one of them. Similarly one other institute named, National Safety Council of India (NSCI) was established to promote safety consciousness among workers. The three main activities of the NSCI are road transportation safety, the safety of health in the construction sector and safety, health, and environment in small to medium-scale enterprises (SMEs).

There are also some international organizations like International Maritime Organization (IMO), the International Labour Organization (ILO) and Food and Agriculture Organization (FAO) are the three specific bureaus of the United Nations system that performs a role in fishermen's safety at sea.

IMO is the agency vested with the obligation for enhancing maritime safety and restricting pollution from ships. ILO formulates international labor standards in the form of conventions and recommendations, setting minimum standards of basic labor claims. FAO encourages the development of independent employers, workers, and organizations and provides training and advisory services to those organizations.

In this context, ILO is making the use of its extensive experiences in promoting the standards, codes of practice, technical guides, training materials and also developing the practical action for the protection of workers in hazardous conditions. It has developed a series of International Hazard Datasheets on Occupations (HDO) in collaboration with the Israel Institute for Occupational Safety and Hygiene and other Occupational Safety and Health Information Centres throughout the world. Special attention needs to be paid to the area of hazardous work for children and young workers.

It is clear form this study that there are various occupational hazards in inland and marine fisheries sector. In inland, physical hazard is the most commonly faced. In marine, vessel capsizing is dominant hazard. Hazard control

strategies were not very effective. In mechanized vessel the hazard control strategies were medium effective where as for motorized and traditional vessel less effective strategies were followed. The state schemes have occupational safety provision special for marine active fishers and in some extent to river and reservoir fishers but these schemes for aquaculture workers is lacking. Fish farmer/workers are exposed to different kinds of occupational hazards for which prevention measures are required. State wise OH studies needs to be done. A separate policy document should be in place as there is New Fisheries Dept and Ministry to promote trainings, educational material, videos, for fishers for effective hazard control strategies.

6. REFERENCES

Akhtar, M.J. and Bouwer Utne, I., 2015. Common patterns in aggregated accident analysis charts from human fatigue-related groundings and collisions at sea. *Maritime Policy & Management*, *42*(2): 186-206.

Ansuya, M. and Serrao, J.M., 2014. Knowledge and Practice on Safety measures among Fishermen of Udupi District. *International Journal of Science and Research*,3(9):1169-1173

Arthur, J.R., Bondad-Reantaso, M.G., Campbell, M.L., Hewitt, C.L., Phillips, M.J. and Subasinghe, R.P., 2009. Understanding and applying risk analysis in aquaculture: a manual for decision-makers. *FAO Fisheries and Aquaculture Technical Paper*, (519/1).

Backus, A. and Davis, M.E., 2011. Occupational safety and compliance in the maine commercial fishing industry: Status report and policy recommendations. *Ann Backus1 and Mary E Davis*, *1*: 4.

Beevi, M.K., Sreekumar, S. and Nazir, H.K., 2012. Ecological Effects and Occupational Health Hazards Due to Coir Retting: A Case Study from West Coast of Kerala, India. *Nature Environment and Pollution Technology*, *11*(4): 585.

Beriha, G.S., Patnaik, B., Mahapatra, S.S. and Padhee, S., 2012. Assessment of safety performance in Indian industries using fuzzy approach. *Expert Systems with Applications*, *39*(3): 3311-3323.

Biswas, N., 2017. Yemaya, No. 55, September 2017, 20 pp.

Blaikie, P., Cannon, T., Davis, I. and Wisner, B., 2014. *At risk: natural hazards, people's vulnerability and disasters*. *Routledge*. 557 pp.

Boyd, C.E. and Massaut, L., 1999. Risks associated with the use of chemicals in pond aquaculture. *Aquacultural Engineering*, *20*(2): 113-132.

Branch, M.A.I., House, C. and Place, C., 2002. Report on the analysis of fishing vessel accident data, 1992 to 2000. *Southampton: Marine Accident Investigation Branch*.

Cavalli, L. and de Brito, K.C.T., 2015. One Health, One Aquaculture–AquacultureunderOne Health Umbrella. *Journal of Marine Biology and Aquaculture*, 1(1):1-2.

Chauvin, C. and Le Bouar, G., 2007. Occupational injury in the French sea fishing industry: a comparative study between the 1980s and today. *Accident Analysis & Prevention*, *39*(1): 79-85.

Christoffersen, T. and Olsen, E.G., 1993. Injury to the cornea due to fish bile. *Scandinavian journal of work, environment & health*, *19*(5): 358-359.

Christoffersen, T. and Olsen, E.G., 1993. Injury to the cornea due to fish bile. *Scandinavian journal of work, environment & health*, *19*(5): 358-359.

Clarke,E.E.K., 2002. Multidisciplinary occupational health services. Afr. Newsletter *Occup. Health Safety*, 14(1): 3

Correa, M., 2017. SSF guidelines: linking up. *Samudra Report*, (75):47-52.

Courtenay, G., Smith, D. R., & Gladstone, W. (2012). Occupational health issues in marine and freshwater research. *Journal of occupational medicine and toxicology (London, England)*, *7*(1): 4.

DADF. 2018. Annual report 2017-18. Department of Animal Husbandry Dairying and Fisheries, Govt. of India. 206 pp.

D'Souza, R.,2017. Occupational health in India. *Health Action,* 30(7): 6.

Dosman, J., Hagel, L., King, N., Koehncke, N., Kirychuk, S., Trask, C., Neudorf, J., Day, L., Voaklander, D., Pickett, W. and Saskatchewan Farm Injury Cohort Study Team, 2015. The hierarchy of control in the epidemic of farm injury. *Journal of agromedicine*, 20(3): 360-369.

Douglas, J.D. and Milne, A.H., 1991. Decompression sickness in fish farm workers: a new occupational hazard. *BMJ: British Medical Journal*, *302*(6787): 1244.

Durborow, R. M. (1997). Aquacultural hazards. Safety and Health in Agriculture, Forestry, and Fisheries, 659-679pp.

Durborow, R.M. and Myers, M.L., 2016. Safety in Aquaculture. *Journal of Extension*, *54*(3): 3.

Erondu, E.S. and Anyanwu, P.E., 2005. Potential hazards and risks associated with the aquaculture industry. *African Journal of Biotechnology*, *4*(13).

Ezekiel, E.N., Abowei, J.F.N. and Ezekiel, E.F., 2011. Hazard and risk analysis in culture fisheries. *Research Journal of Applied Sciences, Engineering and Technology*, *3*(10):1108-1117.

FAO. 2014.The State of World Fisheries and Aquaculture. (2014) FAO – Food and Agriculture Organization of the United Nations. 223 pp.

FAO. 2016 (a). The State of World Fisheries and Aquaculture 2016. Contributing to food security and nutrition for all. Rome. 200 pp.

FAO. 2016 (b). Scoping study on decent work and employment in fisheries and aquaculture: Issues and actions for discussion and programming. FAO Rome, 108 pp.

FAO. 2018. The State of World Fisheries and Aquaculture 2018 - Meeting the sustainable development goals. Rome. 227 pp.

Frantzeskou, E., Kastania, A.N., Riza, E., Jensen, O.C. and Linos, A., 2012. Risk factors for fishermen's health and safety in Greece. *International maritime health*, *63*(3): 155-161.

Guertler, C., Speck, G.M., Mannrich, G., Merino, G.S.A., Merino, E.A.D. and Seiffert, W.Q., 2016. Occupational health and safety management in Oyster culture. *Aquacultural engineering*, *70*: 63-72.

Holmen, I.M. and Thorvaldsen, T., 2018. Occupational health and safety in Norwegian aquaculture-National profile for a FAO report on global aquaculture OHS, 22 pp.

Ibendahl, G.A., Stephens, W.B. and Myers, M.L., 2012. A stochastic analysis of tractor overturn costs on catfish farms. *Journal of agricultural safety and health*, *18*(4): 285-292.

Jacobs, O., 2014. The Simple Truths of Safety at Sea for Alaskan Tender Vessels: Feasible Regulatory Changes to Prevent Vessel Casualties in the 17th Coast Guard District Tender Fleet. CMC Senior Theses.Paper 908, 67 pp.

Jeżewska, M., Grubman-Nowak, M., Leszczyñska, I. and Jaremin, B., 2012. Occupational hazards for fishermen in the workplace in Polish coastal and beach fishinga point of view. *International maritime health*, *63*(1): 40-48.

Johnson, R.W., 2000. Risk management by risk magnitudes-Unwin Company Integrated Risk Manag., Vol: 1-2

Kaplan, I.M. and Kite-Powell, H.L., 2000. Safety at sea and fisheries management:: fishermen's attitudes and the need for co-management. *Marine policy*, *24*(6): 493-497)

Klase, G., Lee, S., Liang, S., Kim, J., Zo, Y.G. and Lee, J., 2019. The microbiome and antibiotic resistance in integrated fishfarm water: Implications of environmental public health. *Science of The Total Environment*, *649*: 1491-1501.

Kruskal, W.H. and Wallis, W.A., 1952. Use of ranks in one-criterion variance analysis. *Journal of the American statistical Association*, *47*(260): 583-621.

Kucera, K.L. and McDonald, M.A., 2010. Occupational stressors identified by small-scale, independent commercial crab pot fishermen. *Safety science*, *48*(5): 672-679.

Kurien, J. and Paul, A., 2001. Social security nets for marine fisheries: the growth and changing composition of social security programmes in the fisheries sector of Kerala State, India.

Lambert, D.M., E.M. Thunberg, R.G. Felthoven, J. M. Lincoln, and W.S. Patrick. 2015. Guidance on Fishing Vessel Risk Assessments and Accounting for

Safety at Sea in Fishery Management design. U.S. Dept. Of Commer., NOAA Technical Memorandum NMFS-OSF-2,56pp.

Lincoln, J.M., Lucas, D.L., McKibbin, R.W., Woodward, C.C. and Bevan, J.E., 2008. Reducing commercial fishing deck hazards with engineering solutions for winch design. *Journal of safety research*, *39*(2): 231-235.

Lucas, D.L., Kincl, L.D., Bovbjerg, V.E., Branscum, A.J. and Lincoln, J.M., 2014. Primary prevention of fishing vessel disasters: Evaluation of a United States Coast Guard policy intervention. *Marine Policy*, *50*: 67-73.

Lund, J. 2014. Human trafficking for forced labour in the fishing sector. INTERPOL. Presented at COFI 2014 event “Working for Blue Growth - Why decent employment in fisheries and aquaculture matters”, 12 June 2014. Rome, FAO.

Mandal, S., Hasan, I., Hawlader, N.H., Sultana, I., Rahman, M.M. and Majumder, M.S.I., 2017. Occupational Health Hazard and Safety Assessment of Fishermen Community in Coastal Zone of Bangladesh. *International Journal of Health Economics and Policy*, *2*(2): 63-71.

Mara, D.D., Cairncross, S. and World Health Organization, 1989. Guidelines for the safe use of wastewater and excreta in agriculture and aquaculture: measures for public health protection, 207 pp.

Martin, A., 2016. Risk Factors Associated with Severe Injuries in Inland Aquaculture Farms.Theses and Dissertations--Public Health (M.P.H. &Dr. P.H.). 109 pp.

Matheson, C., Morrison, S., Murphy, E., Lawrie, T., Ritchie, L. and Bond, C., 2001. The health of fishermen in the catching sector of the fishing industry: a gap analysis. *Occupational Medicine*, *51*(5): 305-311.

McDonald, M.A. and Kucera, K.L., 2007. Understanding non-industrialized workers' approaches to safety: How do commercial fishermen “stay safe”?. *Journal of safety research*, *38*(3): 289-297.

Mert, B. and Ercan, P., 2015. Occupational health and safety in aquaculture industry. In *Safety and Reliability of Complex Engineered Systems*. Taylor & Francis Group London(Eds), 3277-3280.

Moreau, D.T. and Neis, B., 2009. Occupational health and safety hazards in Atlantic Canadian aquaculture: Laying the groundwork for prevention. *Marine Policy*, *33*(2): 401-411.

Moreau, D.T. and Neis, B., 2009. Occupational health and safety hazards in Atlantic Canadian aquaculture: Laying the groundwork for prevention. *Marine Policy*, *33*(2): 401-411.

Myers, M.L. and Cole, H.P., 2009. Simple solutions for reduced fish farm hazards. *Journal of agromedicine*, *14*(2):150-156.

Myers, M. L. (2010). Review of Occupational Hazards Associated with Aquaculture. *Journal of Agromedicine*, 15(4):412-426.

Myers, M.L. and Durborow, R.M., 2012. Aquacultural safety and health. In *Health and environment in aquaculture*. IntechOpen, 385-400.

Nag, P.K. and Nag, A., 2007. Hazards and health complaints associated with fish processing activities in India—Evaluation of a low-cost intervention. *International Journal of Industrial Ergonomics*, *37*(2):125-132.

Nagpal, N., 2017. Incidents of violence against doctors in India.*The National medical journal of India*, *30*(2):97.

Nakahara, F.A. and Beder, D.M., 2018. A context-aware and self-adaptive offloading decision support model for mobile cloud computing system. *Journal of Ambient Intelligence and Humanized Computing*, *9*(5):1561-1572.

Ngajilo, D. and Jeebhay, M.F., 2019. Occupational injuries and diseases in aquaculture–A review of literature. *Aquaculture*, 507: 40-55.

Novaes, A.L.T., de Andrade, G.J.P.O., dos Santos Alonço, A. and Magalhães, A.R.M., 2017. Ergonomics applied to aquaculture: a case study of postural risk analysis in the manual harvesting of cultivated mussels. *Aquacultural Engineering*, *77*:112-124.

Novalbos, J., Nogueroles, P., Soriguer, M. and Piniella, F., 2008. Occupational health in the Andalusian fisheries sector. *Occupational medicine*, *58*(2):141-143.

Sardar, P., Sharma, A., Hossain, K.,Sil,S. and Das,S., 2003. Study of Profile and Constraints of Prawn Processing Industries of West Bengal, *Aquacult,* 4 (1): 89-92.

Prusty, S. and Sharma, A. (2019) Occupational health injuries faced by shrimp farm workers EXT 15. In: World Brackish water Aquaculture Conference (BRAQCON 2019). Book of Abstracts, ICAR-Central Institute of Brackish Aquaculture (CIBA) & Society of coastal Aquaculture and Fisheries (SCAFI), January 23-25, 2019 Chennai pp: 290

Ramos, A., Carlo, G., Grant, K., Bendixsen, C., Fuentes, A. and Gamboa, R., 2018. A preliminary analysis of immigrant cattle feedyard worker perspectives on job-related safety training. *Safety*, *4*(3):37.

Ray, S., 2013. Fishing for living in and around Chilika Lake-A sociological study of survival strategies and alternate livelihood options of fishermen community in Orissa.

Reena, V., Sharma, A., Sharma, R., Singh, R. and Landge, A.T., 2011. Assessment of occupational profile and time utilization pattern of fresh and dry fish retailers and labourers in Dakshina Kannada, Karnataka. *Indian Fisheries Association*, *38*: 87-96.

Roberts, S.E. and Williams, J.C., 2005. Update of mortality for workers in the UK merchant shipping and fishing sectors. *Risk*, *1976*: 58.

Robertson, M.H., Clarke, I., Coghlan, J. and Gill, O.N., 1981. Leptospirosis in trout farmers. *The Lancet*, *318*(8247): 626-627.

Saha, R.K., 2018. Occupational Health in India. *Annals of Global Health*, 84(3): 330–333.

Sethulakshmi, C.S. and Sharma, A.,2017. Usage of Sea Safety Devices by Fishers of Kerala (2017) in the abstract book of 11th Indian Fisheries and Aquaculture Forum (11 IFAF), 24-27 November, 2017 at Cochin, Kerala, pp: 447-448 pp.

Srinath, K. and Rajeev, P., 1995. The use of sea safety measures by fishermen. *Marine Fisheries Information Service*, Technical and Extension Series, 139: 8-9.

Subasinghe, R.P. and Chief, F.F., 2016. Putting fish back on the menu. *FAO Aquaculture Newsletter*, (54):2.

Sudhakar, PJ., 2017. Improving safety and health of workforce. *Health Action*. 30(7): 12.

Tiligadas, I., Moutopoulos, D.K., Chatziefstathiou, M., Tsoumani, M., Nathanailides, C. and Anastasiou, S., 2014. A Review of Health and Safety Issues in Mariculture Industry in Greece. *Journal of Scientific Research & Reports*, *3*(9):1153-1161.

Turner, K., Rabinowitz, P., Anderson, N., Cohen, M. and Pappaioanou, M., 2018. Occupational injuries of aquaculture workers: Washington state. *Journal of agromedicine*, *23*(4): 336-346.

Velvizhi, S. and Gopalakrishnan, A., 2017. Occupational health hazards among Irular tribal fisherwomen fishing in Pichavaram Mangrove Water. *J Fish Life Sci*, *2*: 20-25.

Watterson, A., 2018. Aquaculture/occupational safety: towards healthy work. *Samudra Report*,7-11 pp.

Watterson, A., Little, D., Young, J., Boyd, K., Azim, E. and Murray, F., 2008. Towards integration of environmental and health impact assessments for wild capture fishing and farmed fish with particular reference to public health and occupational health dimensions. *International Journal of Environmental Research and Public Health*, *5*(4): 258-277.

Watterson, A., Little, D., Young, J.A., Murray, F., Doi, L., Boyd, K.A. and Azim, E., 2012. Scoping a public health impact assessment of aquaculture with particular reference to Tilapia in the UK. *ISRN Public Health*, *2012*. 19 pp.

Weeratunge, N., Béné, C., Siriwardane, R., Charles, A., Johnson, D., Allison, E.H., Nayak, P.K. and Badjeck, M.C., 2014. Small-scale fisheries through the wellbeing lens. *Fish and Fisheries*, *15*(2): 255-279

Online references

ENVIS Centre of Odisha's State of Environment, 2015. *District wise Climate Sensitivity of Odisha State* available at http://orienvis.nic.in/index1.aspx?lid=24&mid=1&langid=1&linkid=22 (accessed on 31.05.2018)

CDA, 2005. *Achievement report 2005*. Bhubaneswar: Chilika Development Authority. (accessed on 24.05.2018)

ENVIS Centre of Odisha's State of Environment, 2015. *District wise Climate Sensitivity of Odisha State* available at http://orienvis.nic.in/index1.aspx?lid=24&mid=1&langid=1&linkid=22 (accessed on 22.06.2018)

Sustainable fisheries and responsible aquaculture: A Guide for USAID Staff and Partners, 2013. Available at https://www.crc.uri.edu/download/FishAquaGuide14Jun13Final.pdf (accessed on 18.07.2018)

Odisha fisheries policy available at 2015https://investodisha.gov.in/download/Odisha_Fisheries_Policy_2015.pdf (accessed on 16.12.2018)

ILO. 2007b. Work in Fishing Recommendation, 2007 (No. 199) available at http://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:12100:0::NO::P12100_INSTRUMENT_ ID:312536). (accessed on 18.03.2019)

WHO Definition of Health. *World Health Organization*. Archived from the original on 2016-07-07. Available at http://www.who.int/about/definition/en/print.html (accessed on 22.04.2019)

ILO, 2007, Occupational Safety and Health related ILO Convention available at https://www.ilo.org/ipec/areas/Agriculture/WCMS_172419/lang--en/index.htm.. (accessed on 12.05.2019)

Topology of Odisha, 2010 "topology". Orissa.gov.in. Archived from the original on 9 December 2010. available at https://web.archive.org/web/20150204220248/http://www.archive.india.gov.in/knowindia/state_uts.php?id=81 (accessed on 16.05.2019)

Annual activity report (F&ARD Department, Odisha (2017-18) available athttp://www.fardodisha.gov.in/sites/default/files/pdfs/Annual%20Activity%20Report%20of%20ARD%20Sector%202017-18.pdf(accessed on 17.05.2019)

Odisha Economic Survey 2017-18. Planning and Convergence Department Directorate of Economics and Statistics Government of Odisha available at

https://pc.odisha.gov.in/Download/Economic_Survey_2017-18.pdf (accessed on 24.05.2018)

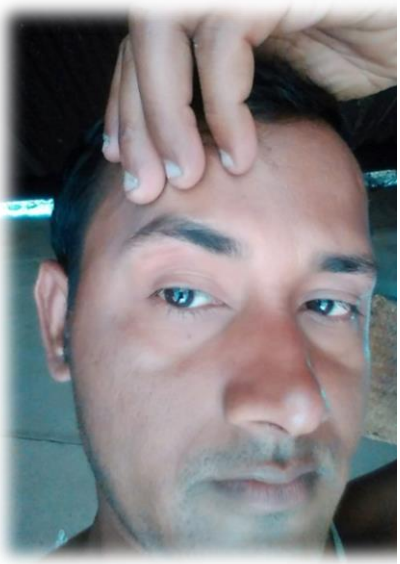
Draft Odisha Fisheries Policy 2014 April 2014 Revised Draft http://www.indiaenvironmentportal.org.in/files/file/comprehansiverevised%20draft%20Odisha%20fisheries%20policy%202014.pdf (accessed on 27.05.2019)

Coastal Odisha Development Council, 2015 available at http://www.cidcindia.com/coastal-odisha.pdf\\ (accessed on 27.05.2019)

Health and Safety Authority pdf. NIOSH. 2012 available at https://en.wikipedia.org/wiki/Hierarchy_of_hazard_controls (accessed on 28.05.2019)

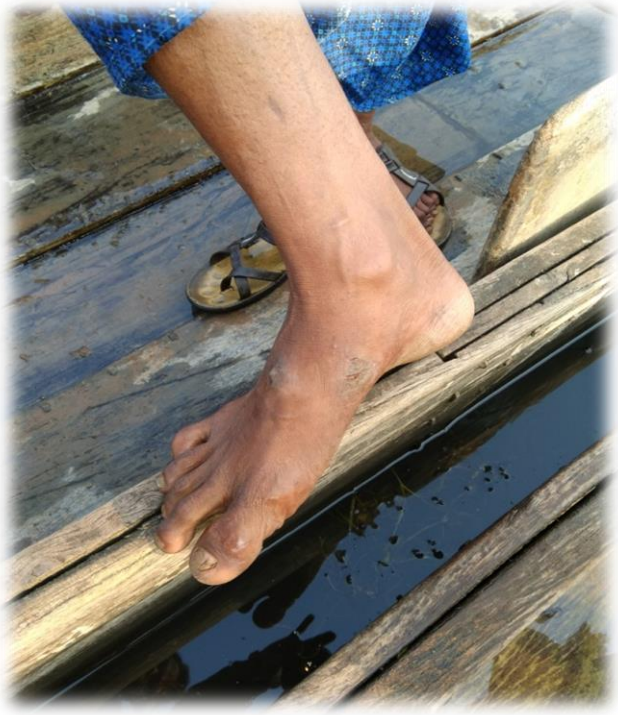
7. PLATES





1. Sustained eye injuries


2. Sustained fractures



3. **Feet infection**

4. **Snake bite**

5. **Leech bite**




6. Interaction with fishers

7. **Hand gloves**

8. **Gum shoes**

9. **Torches and lights**

10. **Farm shelter**

11. Fisheries activities

Annexure-i

Date: **Sl. No:**

APPENDICES

CENTRAL INSTITUTE OF FISHERIES EDUCATION
(University Established Under Section 3 of UGC Act 1956)
Indian council of Agricultural Research
Panch Marg, Off Yari Road, Versova, Andheri (W), Mumbai – 400 061
Web: http://www.cife.edu.in/ ; Email: suchismita.fexma705@cife.edu.in
Ph: 022 2636 1446, 022-2636 0657/ Fax- 022-2636 1537

Title: Occupational Hazards in fisheries sector in the state of Odisha

Inland Sector

Interview Schedule

General information of pond fish farmer

Name :	
Village:-	
Block:-	
District	
Age:	
Education:	
Religion:	
Caste:	
Marital Status:	
Resident Status:	
Family Type	

Farm related questions

Farming Area	
Registration of farm	
Registered under	
Farm insurance	Yes/No
Farming type	Extensive/semi- intensive/Intensive
Type of culture	Nursery/Rearing/Stocking/Breeding
Type of gear used	
Species cultured	
No. of Pond	
Stocking density	
Annual production	
No. of crop	
Selling size	
Selling price	
Selling market	Local/export

Farmer questions

Farming Experience	
Ownership type	Own/ ledge
Personal Insurance	
Member of society	Co-operative/ SHG? Any other
Number of workers hired	yes,/No, if yes how often- Some times/ Repeatedly

	• Permanent • Temporary
Daily time(hour) given for farm work	
Income from fishery	
Other source of income	Agriculture/ poultry/ horticulture/ any other service
Amount of income from other source	
Distance from Home- farm	
Distance from Farm- Hospital	
Monthly Income of family	
Monthly expense on health	
Farm Activities	Ploughing, manuring, Stocking, liming Etc.

General information of river and reservoir fishers

Name :	
Village:-	
Block:-	
District	
Age:-	
Education:-	
Religion	
Caste	
Marital Status	

Resident Status	
Family Type	

Fishing related questions

Fishing from River	Major/Medium/small
Fishing from reservoir	Small/ medium/ Large
Name of the river/reservoir	
Length of area covered during fishing	
Type of boat used	
Registration of boat	
Registered under	
Boat insurance	Yes/No
Type of gear used	
Species catching	
Daily catch	
Time given for fishing daily	
Ban Season	
Selling size	
Selling price	
Selling market	Local/export

Fishing related questions

Fishing Experience	
Boat Ownership type	Own/ ledge
Personal Insurance	
Member of society	Co-operative/ SHG? Any other
Income from fishing	
Other source of income	Agriculture/ poultry/ horticulture/ any other service
Amount of income from other source	
Distance from Home- fishing area	
Distance from Farm- Hospital	
Monthly Income of family	
Monthly expense on health	
Fishing activities daily	Net fixing…….. Other activities please describe

Occupational Hazards faced by fish farmers/ fishers in inland sector and controlling strategies adopted to mitigate the hazard

Consequences

Catastrophic= lethal/Death, Critical= severe injury/ Occupational disease, Serious= injuries or disease require medical care but not critical or catastrophic, Minor = minor injury or disease, Insignificant = property damage only

HOHC controlling strategy

Elimination: completely remove the hazard, **Substitution:** Replacing a hazardous substance or work practice with a less hazardous one, **Engineering controls:** The provision of mechanical aids, barriers, machine guarding, ventilation or insulation to isolate a hazard from workplace, **Administrative Control:** Establishing policies, procedures and work practices designed to reduce a worker's exposure to a risk, **Personal Protective Equipment:** Covering and protecting a worker's body from hazards.

Physical Hazard

Injuries	**During the activity of**	**Consequences** Insignificant-**I** Minor-**M** Serious-**S** Critical-**C** Catastrophic-**R**	**Medical expenditure**	**Hazard**	**Controlling strategy of faced hazard** Elimination (E), Substitution (S), Engineering control (N), Administrative control (A), Personal protective equipment (P)				
Eye Injuries					**E**	**S**	**N**	**A**	**P**
Injury around eyes									

Eye irritation									
Any other									
Mechanical Injuries									
Fall									
Cut									
Fracture									
Any other									
Power line and water contact									
Electric shock									
Deep Water									
Drowning									
High temp working									
Dehydration									
Head ach									
Sweating									
Sun burn									

Any other									
Working in Water area									
Swelling of lower feet skin									
Any other									

Chemical Hazard

Injuries	**During the activity of**	**Consequences** Insignificant-**I** Minor-**M** Serious-**S** Critical-**C** Catastrophic-**R**	**Financial loss**	**Hazard**	**Controlling strategy of faced hazard** Elimination (E), Substitution (S), Engineering control (N), Administrative control (A), Personal protective equipment (P)				
					E	**S**	**N**	**A**	**P**
Burnt skin									
Skin Irritation									
Skin infection									

Inhalation issues									
Eye infection									

Biological Hazard

Injuries	**During the activity of**	**Consequences** Insignificant-**I** Minor-**M** Serious-**S** Critical-**C** Catastrophic-**R**	**Medical expenditure**	**Hazard**	**Controlling strategy of faced hazard** Elimination (E), Substitution (S), Engineering control (N), Administrative control (A), Personal protective equipment (P)				
					E	**S**	**N**	**A**	**P**
Snake bite									
Injuries due to fish fin rays Species bite:-									
Leech bite									

Mosquitoes									
Irritation in feet due to fouling organisms under water(snail)									
Fungal infection in skin									
Any other									

Ergonomic Hazard

Injuries	**During the activity of**	**Consequences** Insignificant-**I** Minor-**M** Serious-**S** Critical-**C** Catastrophic-**R**	**Medical Expenditure**	**Hazard**	**Controlling strategy of faced hazard** Elimination (E), Substitution (S), Engineering control (N), Administrative control (A), Personal protective equipment (P)				
					E	**S**	**N**	**A**	**P**
Neck pain									

Back pain									
Shoulder									
Upper back pain									
Elbow pain									
Wrist Pain									
Lower back pain									
Hips/Thigh									
Knees									
Ankle/feet pain									
Sprain of body parts									

Psychosocial Hazard

Injuries	**During the activity of**	**Consequences** Insignificant-**I** Minor-**M** Serious-**S** Critical-**C** Catastrophic-**R**	**Medical expenditure**	**Hazard**	**Controlling strategy of faced hazard** Elimination (E), Substitution (S), Engineering control (N), Administrative control (A), Personal protective equipment (P)				
					E	**S**	**N**	**A**	**P**
Work stress									
Anxiety									
Imbalance in blood pressure									
Any other									

Natural Hazard

Injuries	During the activity of	**Consequences** Insignificant-**I** Minor-**M** Serious-**S** Critical-**C** Catastrophic-**R**	**Financial loss**	**Hazard**	**Controlling strategy of faced hazard** Elimination (E), Substitution (S), Engineering control (N), Administrative control (A), Personal protective equipment (P)				
					E	**S**	**N**	**A**	**P**
Crop loss									
Work load									
Any other									

Safety equipments used while working: - Torch / First Aid Box/Mosquito Net/Gloves/ shoes/ Safety Glass/ Mask/ Any other**----------**

Annexure-II

Date: **Sl. No:**

APPENDICES

CENTRAL INSTITUTE OF FISHERIES EDUCATION
(University Established Under Section 3 of UGC Act 1956)
Indian council of Agricultural Research
Panch Marg, Off Yari Road, Versova, Andheri (W), Mumbai – 400 061
Web: http://www.cife.edu.in/ ; Email: suchismita.fexma705@cife.edu.in
Ph: 022 2636 1446, 022-2636 0657/ Fax- 022-2636 1537

Title: Occupational Hazards in fisheries sector in the state of odisha

Marine Sector

Interview Schedule

General information of fishers from mechanized, motorized and traditional vessel

1. Name of the respondent: ……. (Mob No. ……)

2. Sex: M/F
3. Farm owner/Employee/Worker/Daily Wage Worker
3. Age: …….
4. Marital status: Single/married/Divorced
5. Religion: ……
6. Caste/Category: …….
7. Residence Type: Local/ Migrant
8. Working experience (fishing): …….years
9. Address: ……
10. Education: ……
11. Family type: Joint/Nuclear
12. No. of Family members: ……

a. Adult: ……. Male: …….. Female: ……..

b. Children: …….. Male: …… Female: ……

13. Respondent's monthly income: ……

a) Income from fisheries: ……

b) Other sources of income: ……..

c) Family monthly income: …….

d) Credit: ……..

e) Saving: ……..

f) Assets House: ……

g) Fisheries Assets: ……..

FISHING PROFILE

14. Type of vessel: …… Traditional: Motorized: Mechanized: Any other:

15. Ownership in the name of: ……..…….(Man/Woman)

16. Size of Vessel: a) <10m b)10-15m c)15-20 m d)20-25m e)>25 m

17. Nature of ownership of boats: a)Owned b)Rented c)Lease

18. Whether the vessel is registered: Yes/No 16. Registered under: …….

17. Whether the vessel is insured: Yes/No (If yes fill the table below)

Sl. No	Insured by	Amount	For what purpose

18. Type of gear used: a)Gill net b)Seine net c)Purse seine d)Trawl net e) others……

19. Species caught: ……..……

20. Duration of fishing: a)single day b)2-7 days c)>7days

21. Working days/month: ……..

22. Catch / month (in kg): ……

23. Ban season duration: ……

24. Place of selling: House/ Market/ Harbours/ Processing plants

25. Details about trawlers

a) Type of trawler: beam/mid-water/Bottom/Any other

b) Size of trawler(m): Small/medium/large

c) Fishermen per trip: ……..

d) Days of fishing/month: …….per year: ……..

e) Fishing hours/day:

f) Travelling distance from shore: …… g) Travelling time: ……

h) Type of engine : …….. Whether the engine is secondary or primary:

i) Engine Capacity (HP): ……

j) Price of engine: ……..

k) Fuel usage/ day (L): …….. l) Fuel Price/ litre (Rs/l): ……..

m) Working hours of engine per day: ……(ON/OFF cycle)

I. Travelling time: ……
II. Net shooting time: ……..
III. Net towing time: ……
IV. Net hauling time: …….
V. Retrieving the fish net: ……..
VI. Resting time: ……..
VII. Return travel time: ……

n) Amount of ice carried per trip (kg/tones): ……..

o) Annual maintenance cost (servicing, colouring, repair): ……

p) Amount of additional weight the boat can bear:

q) Expenses per trip per person: ……..

r) Expenses on nets and ropes per trip: …….

s) Seasonal activities: ……..??(What are these and what are their units? Include under one heading)

OCCUPATIONAL HAZARDS OF MARINE FISHING

Controlling strategy of faced hazard

Elimination: completely remove the hazard, **Substitution:** Replacing a hazardous substance or work practice with a less hazardous one, **Engineering controls:** The provision of mechanical aids, barriers, machine guarding, ventilation or insulation to isolate a hazard from workplace, **Administrative Control:** Establishing policies, procedures and work practices designed to reduce a worker's exposure to a risk, **Personal Protective Equipment:** Covering and protecting a worker's body from hazards.

Hazards	**Faced or not**	**No. of fishers affected in the vessel**	**Type of medical care availed** Nothing (N) First-aid (F) Hospital care (H)	**Controlling strategy of faced hazard** Elimination (E), Substitution (S), Engineering control (N), Administrative control (A), Personal protective equipment (P)				
				E	**S**	**N**	**A**	**P**
Capsizing								
Sinking								
Grounding								
Burning								
Collision								
Personal hazards								
Mishaps								
Man-overboard								
Injuries								