VULNERABILITY AMOUNG FISHING COMMUNITY THROUGH THE CLIMATE CHANGE VARIABILITY IN CHAVAKKAD TALUK

Dissertation

Submitted to the University of Calicut in partial fulfillment of the requirement for the award of the Degree of Master of Arts in Economics

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3.	Name of the supervisor	**Dr. DHANYA K**		
4.	Category	/Master's Thesis		
5.	Department/institution	ECONOMICS, MES ASMABI COLLEGE		
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I, **Dr. DHANYA K,** do hereby certify that this dissertation **"Vulnerability Amoung Fishing Community through the Climate Change Variability in Chavakkad Taluk",** bonafide study and research carried out by **NAFEESATHUL MISRIYA P A,** Department of economics, MES Asmabi College, P.Vemballur.

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I, **Dr. DHANYA K** do hereby certify that this dissertation**, "Vulnerability Amoung Fishing Community through the Climate Change Variability in Chavakkad Taluk",** a record of bonafide study and research carried out by **NAFEESATHUL MISRIYA P A,** under my supervision and guidance. She has not submitted the report for the award of a degree, Diploma, Title or Recognition before.

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DECLARATION

I, **NAFEESATHUL MISRIYA P A,** do hereby declare that the project entitled **"VULNERABILITY AMOUNG FISHING COMMUNITY THROUGH THE CLIMATE CHANGE VARIABILITY IN CHAVAKKAD TALUK",** is an authentic record of work carried out under her guidance of **Dr. DHANYA K**, Assistant Professor, Department of Economics. I further declare that this report has not previously formed the basis for the award of any degree, diploma or similar title at any other university.

Place : P. Vemballur

Date: **NAFEESATHUL MISRIYA P A**

ACKNOWLEDGEMENT

*First and foremost, I praise **God Almighty.** Without his grace nothing would have been possible.*

*I Would like to express my sincere gratitude to **Dr**. **REENA MOHAMED P M**, Principal, M.E.S Asmabicollege and other administrative staff for providing necessary infrastructure facilities and administrative help for the smooth, effective and timely completion of the project.*

*I highly indebted to our supervising teacher **Dr. DHANYA K,*** Head of the Economic Department *of Economics, M. E.S Asmabi College, P. Vemballur for their guidance and constant supervision as well as for providing necessary information regarding the project and also for the support in completing the project.*

Department of economics, and all other faculty members for sharing their valuable opinions, for all the knowledge that they shared during my entire tenure here as a student.

I would like to thank my parents and friends for their help and support for the successful completion of the research work within the limited time.

Nafeesathul Misriya P A

CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

INTRODUCTION

Climate changes affect fisheries in several ways marine ecosystems are affected by rising ocean temperature, ocean acidification and deoxygenating, while fresh water ecosystems are being impacted by changes in water temperature, water flow and destruction of fish habitats. These results vary from fishery to fishery. Climate change is altering fish distribution and the productivity of marine and fish water species. Climate change is expected to cause significant changes in the availability and trade of fish and fish products. The impacts of climate change on marine system have implications for the sustainability of fisheries, the livelihoods of fisheries – dependent communities and the ability of the ocean to capture and store carbon. The effect of sea level rise means that coastal fishing communities are significantly affected by climate change, while rain fall patterns and water use alter in land fresh water fisheries and aquaculture. Climate change impacts on aquaculture include increased risks of flood disease, parasites and harmful algae. Coastal and fishing population and countries dependent on fisheries are particularly vulnerable to climate change. Fishing communities are vulnerable not only to sea level rise but also to flooding and increased cyclones. Fisheries contribute significantly to food security and livelihoods. Climate change effect several parameters of the fishing population such as availability, stability, access, and utilization. Human activities also increase the impact of climate change. Human activity has been linked to Lake nutrient levels, with higher levels associated with increased vulnerability to climate change. Excess nutrients in water bodies, or eutrophication can cause more algae and plant growth, which can be harmful to humans, aquatic communities and even birds. Climate change will have impacts on both recreational and commercial fisheries, as shifts in distribution will result in changes in popular fishing grounds and economic changes in fishing communities.

In India fisheries sector plays an important role in economy. It contributes to national income, exports, food and nutrition security and employment. The fisheries sector plays a main role in sustaining the livelihood of nearly 30 million people in India, especially the marginalized and vulnerable communities. With a record fish production of 175.45 lakh tones in FY 2022-23, India contributing 8% of global production and 1.09% to the gross value added. The sector has immense potential to grow and calls for focus through policy and financial support for sustainable, responsible, inclusive, and equitable growth.

Globally, fishing communities are particularly vulnerable to the effects of climate change. These communities, which are frequently found in rural and coastal regions, mostly depend on marine resources for their traditional ways of life, food security, and way of life. Through a combination of increasing sea levels, more frequent and intense extreme weather events, ocean acidification, and altered marine ecosystems, climate change exacerbates these vulnerabilities.

Many fishing villages face imminent danger due to rising sea levels, which can result in the loss of livable land, more frequent floods, and the entry of saltwater into freshwater systems. Severe weather phenomena, including hurricanes and typhoons, not only demolish houses and infrastructure but also interfere with fishing operations, causing financial losses and raising the risk to fishermen's safety. Fish populations and marine biodiversity are impacted by ocean acidification and warmer seas, which also change migratory patterns and deplete fish stocks. Fish availability is directly impacted by this, and it is essential for both commercial and subsistence fishing.

Furthermore, conflicts over resources, community uprooting, and a loss of traditional knowledge and behaviors might result from these environmental changes. Fishermen's communities confront even more difficulties when socioeconomic issues like poverty, restricted market access, and insufficient government support come together.

Developing adaptive capacity, encouraging sustainable fishing methods, building community resilience, and guaranteeing inclusive policy-making that takes these communities' needs and voices into account are just a few of the comprehensive strategies needed to address the vulnerability of fishing communities to climate change. The livelihoods and cultural legacy of fishing communities will remain gravely endangered in the absence of immediate and concerted action.

OBJECTIVES

- To access the vulnerability level of marine fishing community to impact of climate variability and changes
- To evaluate the infrastructural facilities available for marine fisher folk
- To identify the programs provided by the government for the fishing community for their employment and welfare

SCOPE OF THE STUDY

The study was conducted in Chavakkad taluk, a coastal region of Thrissur district. The area consists of various fishing villages, coastal ecosystem and associated geographical features. The study focuses on various sections of the fishing community in Chavakkad thaluk including fishermen, fish processors and other stake holders involved in fishing activities.

METHODOLOGY

In order to achieve objectives of this study, the study has used both primary and secondary data sources.

PRIMARY DATA

- To study to assess the vulnerability level of marine fishing community to impact of climate change, for this purpose data collected from Chavakkad thaluk.
- 50 samples collected from the fishermen through interview schedule. From the interviews, data was gathered directly from them to evaluate whether they are getting any kind of help from the government
- Using the primary data for satisfy the whole objectives.

SECONDEARY DATA

The secondary data were collected from different authentic sources including the articles, journal, websites, etc.

LIMITATION OF THE STUDY

- The opinion of the sample taken as the opinion of whole.
- Availability of limited time
- Only 50 sample are used for this study.

CHAPTER-2

REVIEW

REVIEW OF LITERATURE

- Climate changes and fish communities: s conceptual framework - William M Tonn Transaction of the American fisheries society 119(2) 337-352,1990.

  Many ecologically effects of temperature on fish are known, and fishery biologist are beginning to impact this knowledge to marine community to educate them about possible effect of climatic warming on fisheries and their habitats and their impacts of fisheries community.

- Resilience and sustainable Development.

  Building adaptive capacity in world of transformation Sep 2002.AMBIO A journal of the Human Environment 31(5).437.40 - Carl talked, Steve Carpenter, Thomas, Lance H Gunderson

  The emerging recognition of two fundamental errors underlying past policies for issues raises awareness of the need for fundamental change in the thinking and practice of environmental management worldwide. The first error is the implicit assumption that ecosystem responses to human use are linear, predictable and controllable. The second assumption is that the capacity better change, development and learn as a frame works for understanding how to sustain and enhance adaptive capacity in complex world of rapid transformation.

- Fishery co- management. A practical Hand book – R.S Premeroy, R. Rivera – guieb, Jan 2006

  Today there has been a shift in the governance and management of fisheries to broader approach that participate fishermen, local stewardship in decision making process. Through this the fishers are empowered to become active participants of management team balancing their rights and responsibilities and working friendly with government. It describes the process of community based co management from it's beginning to its turnover to community. It mainly focuses on small scale fisheries in developing countries and to the management of other coastal resources.

- The impacts of climate change in coastal marine system. Christopher DG Harley, A Randall Hughes, Kristin M Hultgren, Benjamin G Miner – Ecology letter 9(2), 228-241, 2006.

  Global climate changes have profound implications for the marine ecosystem and the economic and social systems. The relation between temperature and individual performance is studied and much climate related research has focused on potential

shifts in distribution and abundance driven by temperature. This study revealed that both biotic and abiotic changes are complex. Changes in ocean chemistry may be more important than changes in temperature for the survival and the performance of many organisms. In the moment of climate change give more importance to the management and conservation of living marine resources by improved predictive framework. Key directions for future research include predicting changes in community level impacts of ecologically dominant species, incorporating population's ability to involve identify the demographic transitions that influence population dynamics and understand the scales over which climate will change and living systems will responds.

- Vulnerability of tropical pacific fisheries and aquaculture to climate change.
  Johann D Bell, Johanna E Johnson, Alistair J Hobday- Pacific community, 2011.
  Now it is clear that global community must do more to reduce global warming. We learn to adapt to the inevitable increases in temperature and acidification of oceans due to the emission of greenhouse gases. Adaptation has been a focus of recent international climate change negotiations and pledges. That have been made to help developing countries respond to climate related changes. Australia is well aware of effect of climate change on yields from agriculture and fisheries and they are deeply committed to help the pacific Island neighbors.
- Nurse, L. A. (2014). "Small islands." In: Climate Change 2014: Impacts, Adaptation, and Vulnerability.
  Because to their reliance on fisheries and small land area SIDS are among the most susceptible. Research conducted in 2014 by Nurse, details the particular difficulties these communities confront, such as rising sea levels and extreme weather.
- Managing fisheries for human and food security. Tim McLuhan, Edward H Allison, Joshua E Cinner. Fish and fisheries 16(1),78-103,2015
  We analyze the current status of global marine fisheries using the key factors of conflict, vulnerability and food security. Today's treads suggest that there is likely to be more food insecurity due to north south divide in investment declining, fishery resource, changing consumption pattern increasing reliance on fishery resources and greater poverty traps due to low productivity. Consequently, managing fisheries is more important in the perspective of food security. In this paper mainly focuses on three key components. Sensitivity exposure and adaptive capacity. It also focused

build the adaptive capacity of fisheries and give recommendations to avoid future conflict. Fewer subsidies, reduced capital investment, precautionary steps to minimize the risk of ecosystem. Conservation of resources, diversified portfolio for production and markets are involved in recommendations.

- Impact of climate change on fisheries and aquaculture. Manicel Barange, Tarub Bahri, Malcolm CM Beveridge, Kevern L Cochrane, Simon Funge Smith, Florance Poulain.

  United Nations Food and Agriculture Organization 12(4),628-635),2015.

- Sea change: Island communities and climate change- Heather Lazrus

  Island Community is first to be adversely affected by the global climate change. Increasing air and sea surface temperature, rising Sea level, changing storm pattern, already effect the resources of that community.

  Anthropologist make more contribution to identify the global cause of vulnerability Island based knowledge. Local perception of risk and adaptive capacity and resilience. A conceptual framework that analyzes both the complexities and the opportunities available to Islanders and understand their approach towards those changes like global change migration pattern. This framework is used to show that Island Community is not merely isolated or impoverished but they are deeply globally connected in ways that reject the simple description and will be essential to just and equitable climate solutions.

- Maryn Monroy and Ojeda (2016) Claimed that employment and food availability in Mexico were correlated with the socioeconomic status of coastal areas. They talked about the socioeconomic and community fisheries scales of fishermen by calculating their poverty and vulnerability statistics.
- Perceptions of GENDER dynamics in small scale fisheries and conservation. A case study in the pursuit province of Tonle Sap Lake, Cambodia. V.K Kwok University of Guelph 2017.

  Women's contribution in small scale fisheries in Tonle Sap Lake is often overbooked. Because of Socio-economic cultural expectations of roles and responsibilities. There was difference between men's and women's perceptions of fishing and no fishing practices, strength and control over fishery resources protected and protected areas in pursat province of Cambodia. Women are believed that they fall distinct challenges in

conservation areas. It describes the ways that men and women perceive their engagement in fisheries and how norms may shape both opportunities that they have actively participate in management.

- Senapati and Gupta (2017) Examine how climate change is affecting society economically and how vulnerable Mumbai's fishing community is. Sea level changes brought about by climate change have already had an influence on fisheries productivity and the quality of life for low-income fishing communities.
- Community values and traditional knowledge for coastal ecosystem service management in the satoumi sea space of Himeshima island, Japan Shamik Chakraborty, Alexandria Gasparatos.

  Ecosystem services 37(2019) 100940

  This study combines both primary and secondary data highlights the history of resources use and ongoing change in a coastal social ecological system in Japan. It focuses on Himeshima Island in Japan, whose local community both depends on coastal ecosystem services and developed over generations resources management practices informed by traditional and local knowledge. By engaging with local community through interviews and surveys we identify 14 ecosystem services.
- KMdetal(2020)Affirmed the socioeconomic standing of the Nijhum Dwip fishing community. The lives and economic conditions of the fishermen at Nijhum Dip are covered in this work. This essay discussed the state of families, housing, power use, level of education, and youngsters quitting fishing.
- Surbin (2022) Describe the socioeconomic situation of the fishermen in the Padma River's Rajshahi district. They talked statistically about the social lives of fishermen.
- Assessing climate change vulnerability in Alaska's fishing communities

  Amber Himes-Cornell, Stephen Kasperski

  Fisheries Research 162, 1-11, 2015

  Alaska's communities are experiencing impacts from unprecedented climate-related changes in the harvests of natural resources. Residents of rural Alaska are reporting heretofore unseen changes in the geographic distribution and abundance of marine resources, increases in the frequency and ferocity of storm surges in the Bering Sea, changes in the distribution and thickness of sea ice, and increases in river and coastal erosion. When combined with ongoing socio-economic change, climate, weather, and

changes in the biophysical system interact in a complex web of feedbacks and interactions that make life in rural Alaska challenging.

Socio-economic vulnerability due to climate change: Deriving indicators for fishing communities in Mumbai

- Sibananda Senapati, Vijaya Gupta

  Marine Policy 76, 90-97, 2017

  This paper assessed the socio-economic implications of climate change and vulnerability of fishing communities known as “Koli” living in Mumbai, India. The vulnerability indicators are derived from sustainable livelihood literature and use of multi-criteria analyses and are validated with expert opinions. A survey of two hundred fishermen from five fishing villages in Mumbai was conducted to collect data. The results demonstrate that vulnerability perpetuates due to physical and financial resource constraints among the fishing community.

- Social indicators of vulnerability for fishing communities in the Northern Gulf of California, Mexico: implications for climate change

  Hem Nalini Morzaria-Luna, Peggy Turk-Boyer, Marcia Moreno-Baez

  Marine policy 45, 182-193, 2014

  Marine fisheries support the livelihoods of millions of people worldwide. These fisheries and the communities that depend on them are highly vulnerable to climate change and other interacting anthropogenic threats. The cumulative and interacting effects of these stressors could potentially produce declines in fish production, which would significantly impact artisanal fishers.

- Social-ecological vulnerability of fishing communities to climate change: A US West Coast case study

  Laura E Koehn, Laura K Nelson, Jameal F Samhouri, Karma C Norman, Michael G Jacox, Alison C Cullen, Jerome Fiechter, Mercedes Pozo Buil, Phillip S Levin

  Plos one 17 (8), e0272120, 2022

  Climate change is already impacting coastal communities, and ongoing and future shifts in fisheries species productivity from climate change have implications for the livelihoods and cultures of coastal communities. Harvested marine species in the California Current Large Marine Ecosystem support U.S. West Coast communities economically, socially, and culturally. Ecological vulnerability assessments exist for

individual species in the California Current but ecological and human vulnerability are linked and vulnerability is expected to vary by community.

- Shifting habitats expose fishing communities to risk under climate change

  Lauren A Rogers, Robert Griffin, Talia Young, Emma Fuller, Kevin St. Martin, Malin L Pinsky

  Nature Climate Change 9 (7), 512-516, 2019

  Climate change is expected to have a profound impact on the distribution, abundance and diversity of marine species globally,. These ecological impacts of climate change will affect human communities dependent on fisheries for livelihoods and well-being. While methods for assessing the vulnerability of species to climate change are rapidly developing and socio-ecological vulnerability assessments for fisheries are becoming available, there has been less work devoted to understanding how impacts differ across fishing communities.

- Vulnerability of fishery-based livelihoods to climate change in coastal communities in central Vietnam

  Phuong TA Huynh, Ngoan D Le, Sen TH Le, Hong X Nguyen

  Coastal Management 49 (3), 275-292, 2021

  In the context of increasing climate change, fishery-based livelihoods as major means of income and well-beings for millions of population in coastal communities around the world are most affected. Yet, available information how fishery-based livelihood system at local level are vulnerable to climate change, especially in developing countries is very limited. Using an indicator-based vulnerability assessment framework, this study examined the household-level vulnerability of fishery-based livelihoods in two coastal communities in Central Vietnam. The results showed that the nature and degree of livelihood vulnerability to climate change among fishing households depend on their own characteristics and conditions as well as accessibility to livelihood diversification opportunities. Developing appropriate adaptation policies and coastal management measures to reduce livelihood vulnerability should enhance positive indicators of household’s adaptive capacity and create a better environment for alternative livelihood opportunities.

- Climate change vulnerability and responses of fisherfolk communities in the South-Eastern coast of Bangladesh

  Prabal Barua, Syed Hafizur Rahman, Suman Barua, Ismail MM Rahman

Water Conservation and Management 4 (1), 20-31, 2020

Worldwide, nearly half a billion people derive their income from fisheries and fisheries products provide about 15% of the animal protein and support the livelihoods of 10-12% of the world's population. Most people who depend on fisheries live in developing countries where incomes are low, food resources limited, and residents have few opportunities to substitute occupations and diets. In both cases large-scale environmental change can pose a serious threat to the lives and livelihoods of people who depend on marine resources (Islam et al., 2014).

- Socio-economic vulnerability due to climate change: Deriving indicators for fishing communities in Mumbai

  Sibananda Senapati, Vijaya Gupta

  Marine Policy 76, 90-97, 2017

  This paper assessed the socio-economic implications of climate change and vulnerability of fishing communities known as "Koli" living in Mumbai, India. The vulnerability indicators are derived from sustainable livelihood literature and use of multi-criteria analyses and are validated with expert opinions. A survey of two hundred fishermen from five fishing villages in Mumbai was conducted to collect data. The results demonstrate that vulnerability perpetuates due to physical and financial resource constraints among the fishing community. Fishermen from Madh and Worli villages are observed to be more vulnerable and less adaptive due to their inability to use efficient mechanized boats and advanced fishing implements, such as fish finders and GPS (Global Positioning System). The divergence in the vulnerability scores among fishing villages is attributed to the coping strategies, resource availability, knowledge and the benefit derived from the local government. Fishermen have been observing the negative impacts of climate change on their fishing livelihoods. Adaptation strategies to maximize fish catch are observed in such practices as targeting different species and fishing intensively for several days. However, these practices are leading to an imbalance in the common resource pool and biased resource sharing among different groups of fishermen.

- Social indicators of vulnerability for fishing communities in the Northern Gulf of California, Mexico: implications for climate change

  Hem Nalini Morzaria-Luna, Peggy Turk-Boyer, Marcia Moreno-Baez

  Marine policy 45, 182-193, 2014

  Marine fisheries support the livelihoods of millions of people worldwide. These fisheries and the communities that depend on them are highly vulnerable to climate change and other interacting anthropogenic threats. The cumulative and interacting effects of these stressors could potentially produce declines in fish production, which would significantly impact artisanal fishers. Assessing relative vulnerability of fishing communities to anthropogenic stressors is an important first step to identifying mitigation or adaptation strategies. This study assessed the vulnerability of 12 coastal communities in the Northern Gulf of California to disruptions in fishing activities from anthropogenic stressors, including climate change. The Northern Gulf is a megadiverse area and a major source of fishery resources. Quantitative indicator indices based on secondary and primary data were developed to assess the three aspects of vulnerability: sensitivity, exposure, and adaptive capacity. The key components of vulnerability varied amongst communities. Vulnerability was higher in communities with higher fishing dependence and lower socioeconomic diversification. The approach presented here provides important insights into the type of policy actions that might be needed in different communities for adaptation and mitigation.

- Assessing climate change vulnerability in Alaska's fishing communities

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  Alaska's communities are experiencing impacts from unprecedented climate-related changes in the harvests of natural resources. Residents of rural Alaska are reporting heretofore unseen changes in the geographic distribution and abundance of marine resources, increases in the frequency and ferocity of storm surges in the Bering Sea, changes in the distribution and thickness of sea ice, and increases in river and coastal erosion. When combined with ongoing socio-economic change, climate, weather, and changes in the biophysical system interact in a complex web of feedbacks and interactions that make life in rural Alaska challenging.

RESEARCH GAP

Policy and Governance Gap: Research on how well-suited the current governance structures and policies are to mitigating the climate change vulnerabilities of fishing communities is required. By highlighting best practices and pointing out areas where policies are not being implemented properly, evaluative research helps create more resilient and flexible governance structures. Localized research can offer comprehensive understandings of the vulnerabilities and adaptive abilities unique to a community, resulting in more specialized and successful intervention approaches**.**

CHAPTER-3

OVER VIEW

CLIMATE

The long-term average of the weather is called the climate. This can apply to temperature, precipitation, snowfall, or any other aspect of the weather. Typically, we take 30 years to characterize the climate of a region.

There are numerous parts to the Earth's climate system. It encompasses all elements that have the power to influence the weather, including the atmosphere, clouds, seas, land surface, and vegetation.

Because of glaciers, sea ice, and land-based ice sheets, ice also has an impact on our climate. A further effect of volcanic eruptions is the modification of our atmosphere. Large-scale human activity has the potential to impact local weather patterns as well as the climate. In the end, the Sun provides the majority of the energy that powers our climate system.

Earth's climates are divided into roughly five major categories by climate experts. They are as follows:

- Humid: The average annual temperature in this hot, humid region is above 64°F (18°C), and it receives more than 59 inches of precipitation annually.
- Arid: Because there is very little precipitation and moisture evaporating from the air quickly, these climatic zones are extremely dry.
- Moderate: This zone usually experiences mild winters and steamy, muggy summers with thunderstorms.
- Airborne: These areas get extremely frigid winters and warm to cool summers. This zone can have snowstorms, high winds, and extremely low temperatures during the winter—sometimes as low as -22°F (-30°C)
- Polar: The polar climate zones have bitterly frigid temperatures. Here, summertime temperatures never rise over 50°F (10°C)

Climate change has a variety of effects on fisheries. For example, rising ocean temperatures, ocean acidification, and ocean de oxygenation influences marine aquatic ecosystems, while changes in water temperature, water flow, and fish habitat loss affect freshwater ecosystems.

WOLRD SCENARIO

10% of the world's population makes their living from fishing, according to the United Nations Food and Agriculture Organization (UN FAO), while 50% of the seafood imported into the world comes from developing countries. Fish provides at least 20% of the animal protein consumed daily by 3.3 billion people (Sustainable Fishing and Communities.). Statistics show that in 2022, the combined production of fisheries and aquaculture reached a record 184 million tonnes. The record for 2021 was set by 182 million tonnes. A 2 percent reduction in capture fisheries as a result of lower catches for social and climatic causes is the primary cause of the restricted growth (Global Fish Production by Fishing and Aquaculture, 2023).

The many effects of climate change are making fishing communities more vulnerable all across the world. These communities, which are frequently found in rural and coastal areas, are strongly dependent on marine resources for their traditional ways of life, food security, and means of subsistence. The fact that different places have varied vulnerabilities and their ramifications emphasizes how worldwide the problem is. An outline of the situations in different regions of the world is provided below:

1. Southeast and South Asia

Affected nations include Bangladesh, India, Indonesia, the Philippines, and Vietnam.

Rising Sea Levels: More erosion and floods are occurring in low-lying coastal areas and tiny islands, which is causing habitat loss and community dislocation.

Extreme Weather Events: More frequent and powerful storms and cyclones interrupt fisheries, cause infrastructure damage, and endanger public safety.

A change in fish availability can be attributed to the alteration of fish migration patterns and breeding areas caused by warming waters and shifting ocean currents.

2. Affected East African Nations: Kenya, Tanzania, Mozambique, Madagascar

Coral Bleaching: As sea temperatures rise, vital marine ecosystems that sustain regional fisheries are harmed by coral bleaching.

Drought and Freshwater Scarcity: As a result of decreased freshwater availability, inland fisheries are negatively impacted, and competition for available water resources is intensified.

Sea Level Rise: Agricultural land and coastal habitats are at risk from saltwater intrusion and coastal erosion.

3. Islands in the Pacific

Fiji, Solomon Islands, Kiribati, and Vanuatu are the affected countries.

Sea Level Rise: The loss of land and human dislocation caused by rising sea levels disproportionately affects small island states.

Ocean acidification: This has an impact on coral reefs and shellfish, which are essential to the survival of fish populations and marine biodiversity.

Storm surges and cyclones: Frequent and powerful cyclones damage infrastructure and interfere with fishing operations.

4. Regions of the Arctic and Sub-Arctic

Russia, Greenland, Canada, and Alaska (USA) are the affected nations.

Warming Waters: Both commercial and indigenous fisheries are being impacted by the alteration of fish habitats and migration patterns caused by melting ice and rising sea temperatures.

Thawing Permafrost: Infrastructure and traditional fishing grounds are impacted by coastal erosion brought on by thawing permafrost.

Ecosystem Changes: Current fishing methods are disrupted by new species entering Arctic seas and shifts in predator-prey ratios.

5. The Americas: South America and the Caribbean

Affected nations include the Caribbean Islands, Brazil, Peru, and Chile.

Hurricanes and Severe Weather: Increasing storm frequency and intensity destroy coastal infrastructure and communities.

Coastal Erosion: Sea level rise and erosion pose a threat to coastal ecosystems and tourists, which frequently supports fishing revenue.

Climate change is a complicated and pressing issue that calls for inclusive, coordinated initiatives at the local, national, and international levels to address the vulnerability of fishing communities across the world.

INDIAN SCENARIO

India is the third largest producer of fish in the world and the second largest aquaculture country after China, India's blue revolution has demonstrated the importance of fisheries and aquaculture sector. The region is considered a sunrise region and is poised to play a major role in the Indian economy in the near future. In recent times Indian fisheries have witnessed a paradigm shift from marine dominated to inland fisheries with the latter emerging as a major contributor to fish production from 36% to 70% in the mid-1980s. In inland fisheries the shift from capture to culture-based fisheries has paved the way for a sustainable blue economy. Although inland fisheries and aquaculture have fully grown, development in terms of potential is yet to be realized. 191024 km of rivers and canals, 2.36 million hectares of ponds and tanks, 3.54 vast and vareed untapped resources.

The effects of climate change are making fishing villages In India more vulnerable. These communities are especially vulnerable to environmental changes because they are mostly located along the long coastline and depend on both inland and marine fisheries. In the Indian context, the particular vulnerabilities and their ramifications are complex.

- Rising sea levels and coastal erosion are affecting the following regions: West Bengal, Odisha, Andhra Pradesh, Tamil Nadu, Kerala, and Gujarat.

Impact: The habitability of coastal settlements is threatened by rising sea levels and increased coastal erosion, which results in infrastructure destruction and village displacement. Low-lying areas are particularly vulnerable in states like West Bengal and Odisha, where regular flooding damages houses and fishing spots.

- Areas Affected by Extreme Weather Events: coasts of the Arabian Sea (Maharashtra, Gujarat, Kerala), and the Bay of Bengal (West Bengal, Odisha, and Andhra Pradesh)

Affected: Boats, nets, and other fishing equipment are destroyed as a result of storms, cyclones, and severe rainfall events occurring more frequently and intensely. For instance, coastal populations in West Bengal and Odisha suffered severe damage from Cyclones Fani in 2019 and Amphan in 2020, which disrupted livelihoods and resulted in financial losses.

Monsoon Pattern Variations Affected Regions: Impact Across the Nation: Monsoon patterns are erratic and changeable, which throws off fishing seasons and mating cycles. Rainfall and water supply fluctuations have a special impact on inland fisheries and aquaculture, as they depend on consistent freshwater supplies.

Socio-Economic Vulnerabilities: Affected regions include the entire country, with an emphasis on artisanal and small-scale fishing populations.

Effect: Communities that depend on fishing frequently have limited access to capital, technology, and other forms of income. Climate change-related economic losses increase poverty and make it harder to fund adaptation strategies. In addition, as communities are compelled to adjust to evolving circumstances, social structures and conventional knowledge systems are upset.

KERALA SCENARIO

Kerala occupies over 38863 square kilometers, or 1.27% of the Indian Territory, and is located on the southwest coast of the Indian subcontinent. The Arabian Sea lies to the west while the western Ghats to the east divide the state from the rest of India. Kerala makes up 10% of India's total coastline with its 589.5 kilometers of shoreline. Kerala boasts a substantial marine fishing industry that has traditionally been a major source of employment and income for the coastal population of the state. The state has an exclusive economic zone (EEZ) covering 218536 square kilometers and more than 590 kilometers of coastline. In the 222 fishing villages scattered around the state's coastline, an estimated 8 lakh people make their living from capture and related activities in marine fisheries. Kerala's coastline stretched across nine districts. Thiruvananthapuram, Kollam, Alappuzha, Ernakulum, Trissur, Malappuram, Kozhikode, Kannur, and Kasaragod are Kerala's marine districts. Additionally,

the state is endowed with a wealth of inland production resources, including 44 rivers, 49 reservoirs, 9 freshwater lakes, over 65000 hectares of brackish water, over 46000 hectares of backwaters, and numerous ponds, irrigation tanks, streams, etc.

The state earns about three percent of its revenue from the export of fish products, which are valued at about 5008.54 crores. About 13% of the nation's marine fish are produced in Kerala

Kerala is one of the world's top fish producers and consumers thanks to its abundant marine life, which includes a wide variety of fish, and its highly competent fishing community. The Kerala coast is particularly fish-rich due to the abundant rainfall and numerous rivers. The mud banks, or chakara in Malayalam, are one of the coast's specialties in Kerala. The reason for a successful fish catch is the buildup of clay and organic materials along the shore following the monsoon, when the sea stays quiet.

Fishing communities around the world especially in coastal areas like Kerala are increasingly vulnerable to the impacts of climate change. These communities rely heavily on marine resources for their livelihoods, making them exceptionally vulnerable to environmental changes. Coastal erosion, fish migration, extreme cyclones and storms are the challenges faced by the fisherman communities. Climate change can affect the health of coastal regions through increased decease like water borne decease.

The state' s capacity in marine fisheries is about 5.7 Lack tonnes. Fishermen in Kerala contribute 3 percent to the economy. Moreover, they help the state in earning huge amount of foreign exchange and goodwill. The fisheries here is very famous all over the world and hence exported to many foreign counties. At present 6 Lack tonnes of fish are produced annually.

CHAVAKKAD

Chavakkad thaluk located in Thrissur district of Kerala, is known for its significant coastline along the Arabian sea. The area is critical to the fishing industry, contributing Significantly to local livelihoods and the district's economy. Chavakkad taluk is situated on the west coastal of Kerala. The coastline is characterized by sandy beaches, mangrove forest that support a reverse marine ecosystems system. This beach is a prominent beach known for natural beauty and tourist attraction

Many fishing villages like Blangad, Munakkal, Edakkazhiyur, are integral part of the local fishing industry. The climate is subtropical and monsoon rains influence the coastal environment. The area is rich in biodiversity including various species of fish, shellfish and marine plants. Estuaries and backwaters contribute to a wide variety of marine life, support fisheries and culture.

Fishing is an important occupation, using both traditional and mechanized methods. Traditional methods include small Boats and nets. Aquaculture and fish farming are also practiced, especially in brackish water areas. Fishing is cornerstone of the local economy, providing employment and livelihood to significant portion of the population.

PROFILE OF THE STUDY AREA

Location and geography:

Chavakkad taluk is on the south west coastal of India on the western border of Arabian sea.

Climate:

Tropical monsoon climate with heavy rain falls during monsoon,that is June to September and dry from December to March.

District: Thrissur

State: Kerala

Major towns: Guruvayoor, Chavakkad, Kottappadi

Panchayats: 23 Panchayats

Chavakkad is the well famous taluk in Thrissur district of Kerala. In India, a taluk is a district subdivision that oversees the management and tax collection of a specific area inside the district. It is a vital component of the local government system and is essential to the growth and management of the neighborhood.

As to the data from the 2011 census, Chavakkad Block's (CD) sub-district code is 05653. Chavakkad Taluk has a total area of 235 km², of which 162.06 km² is urban and 72.67 km² is rural. There are 4,70,898 people living in Chavakkad Taluk, 3,46,922 of them live in urban areas and 1,23,976 in rural ones. The population density of the Chavakkad taluk is 2006 people per square kilometer. The sub district has roughly 1,08,151 homes total, of which 29,562 are rural and 78,589 are urban.

In terms of literacy, 84.44% of men and 84.46% of women in Chavakkad Taluk are literate, making up the 84.45% of the population. There are roughly 27 villages in Chavakkad Taluk.

Agriculture: Rice, coconut, Banana are the main agricultural crops in this place.

Fisheries: Coastal areas are engaged in fisheries which contribute Significantly to the local economy.

Tourism: Guruvayoor is the major pilgrimage center famous for its Guruvayoor temple. Chavakkad beach is also a favorite destination for tourists.

Education: This Taluk has Several educational institution s ranges from primary school to Higher secondary school and colleges. MES Engineering College and Sree Krishna College are notable.

CHAPTER 4

DATA ANALYSIS AND INTERPRETATION

TABLE 4.1

GENDER OF RESPONDENTS

Option	Number of respondents	Percentage
Male	50	100
Female	0	0

The table shows that most of the respondents are male.

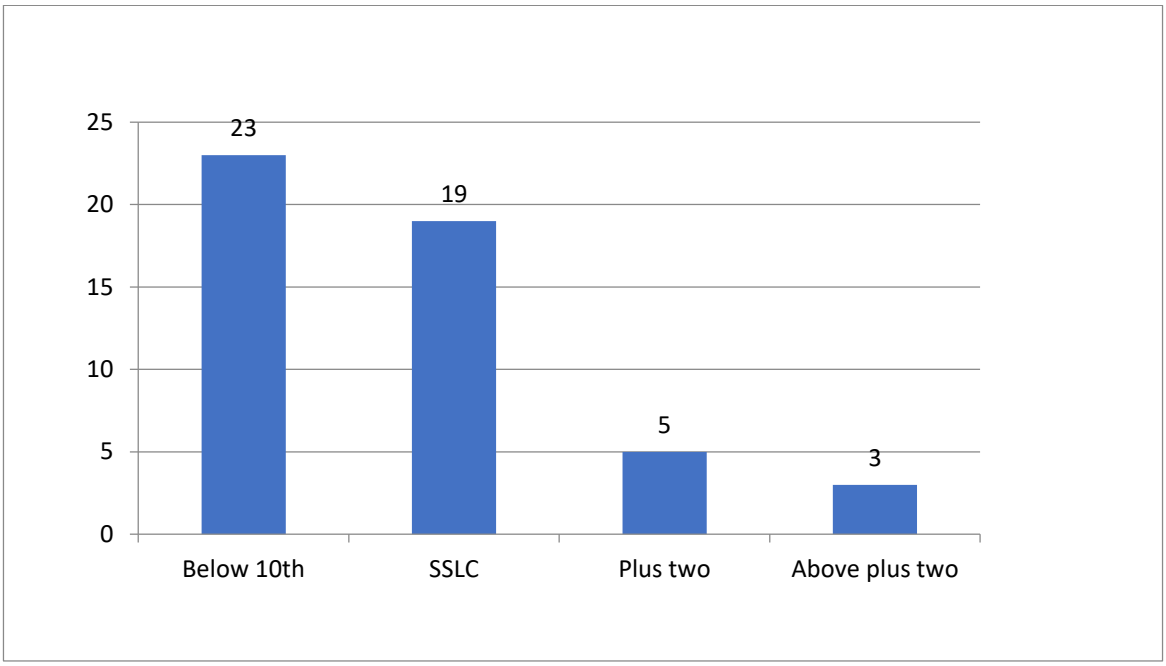

FIGURE 4.1

EDUCATION LEVEL

On analyzing the above table, reveals the fact that on 46% of respondents' educational level is below 10^{th}. 38% of respondents are belongs the category of SSLC. Only 10% of respondents are completed plus two and remaining 6% are above plus two.

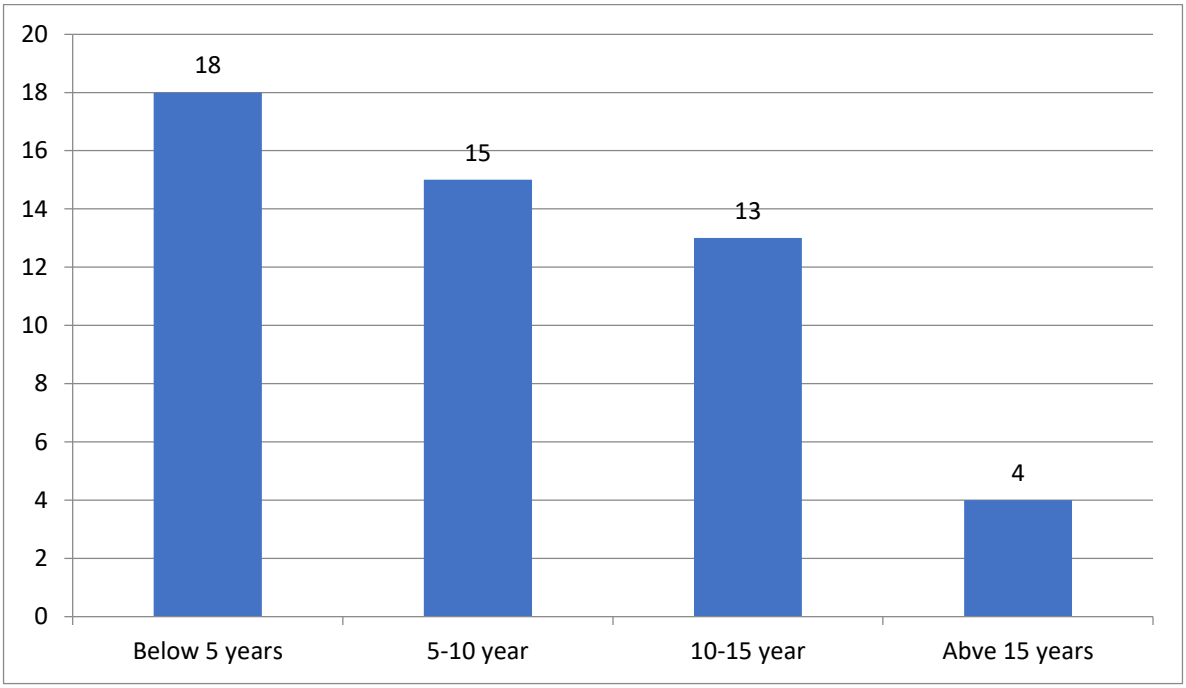

FIGURE 4.2

YEAR OF EXPERIENCE IN FISHIG

The table shows that most of the respondents (66%) experiencing less than 10 years in fishing. And the remaining (34%) them are above 10 years. Most of the workers who participated in my survey had less than 10 years of experience. The workers in the area have years of experience and those with less experience. However, all the fishermen there have a good knowledge of the fishing, its conditions and climate.

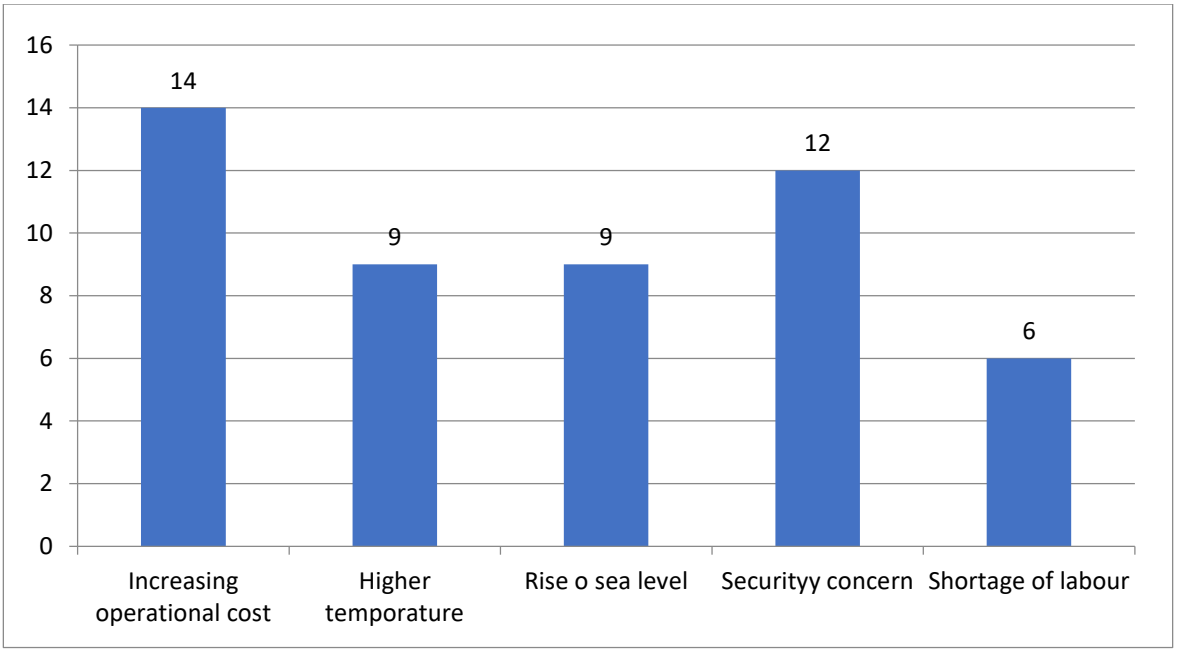

FIGURE 4.3

CHALLENGES FACED BY FISHERMEN

Table shows the main challenges that are faced by the fishermen. Most of the respondents are opines that Increasing operational cost (28%) is the main problem of fishing. It is main reason for this is the change in the migration pattern fish due to climate change. This leads to having o goo elsewhere to catch fish, which increases operational cost. Other challenges are higher temperature (18%), rise of sea level (18%), security concern (24%) and shortage of labor (12%).

The high temperature in the sea causes the migration of fishes. As a result, the availability of fish in each region is greatly reduced. So that fishermen have to go to other places for fishing. Loss of time and other difficulties arise. Changes in water temperature and salinity can cause fish populations to migrate to different areas, making it difficult for workers to find and catch them. Coastal erosion can destroy fishing infrastructure such as docks, processing facilities and processing areas. Strong and intermittent storms can cause damage to boats and other equipment. Changes in habitats can lead to declines in the number of some fish species, reducing the number of fish caught and affecting the income of fishermen. Communities that depend heavily on fishing are struggling to find alternative livelihoods as traditional fishing grounds fall into disuse. Economic uncertainty and fluctuating prices make it challenging for fishermen to plan ahead and invest in sustainable ways. Many small businesses lack insurance, making them vulnerable to theft, accidents, and natural disasters.

TABLE 4.2

EFFECT OF CLIMATE CHANGE IN FISHERMEN'S LIFE

Option	Number of respondents	Percentage
Yes	50	100
No	0	0

The table shows that whole respondents are opined that climate change will adversely affect the fishermen's livelihood in a year. Climate change is causing a lot of difficulties in the lives of fishermen. Climate change is a factor that greatly affects the lives of fishermen. Changing temperatures, rising sea levels, dwindling fish stocks and more are disrupting the lives of fishermen.

TABLE 4.3

CHANGES IN MIGRATION PATTERN OF FISH DUE TO CLIMATE CHANGE

Option	Number of respondents	Percentage
Yes	50	100
No	0	0

From the table clear that due to the climate change migration pattern of the fish will change. It is the main challenge faced by the fishermen. Climate change is causing fish to migrate. Due to climate change, ocean temperature changes, so when they cannot survive there, they migrate to other places. As climate changes, the location of food sources available to fish also varies and fish migrate.

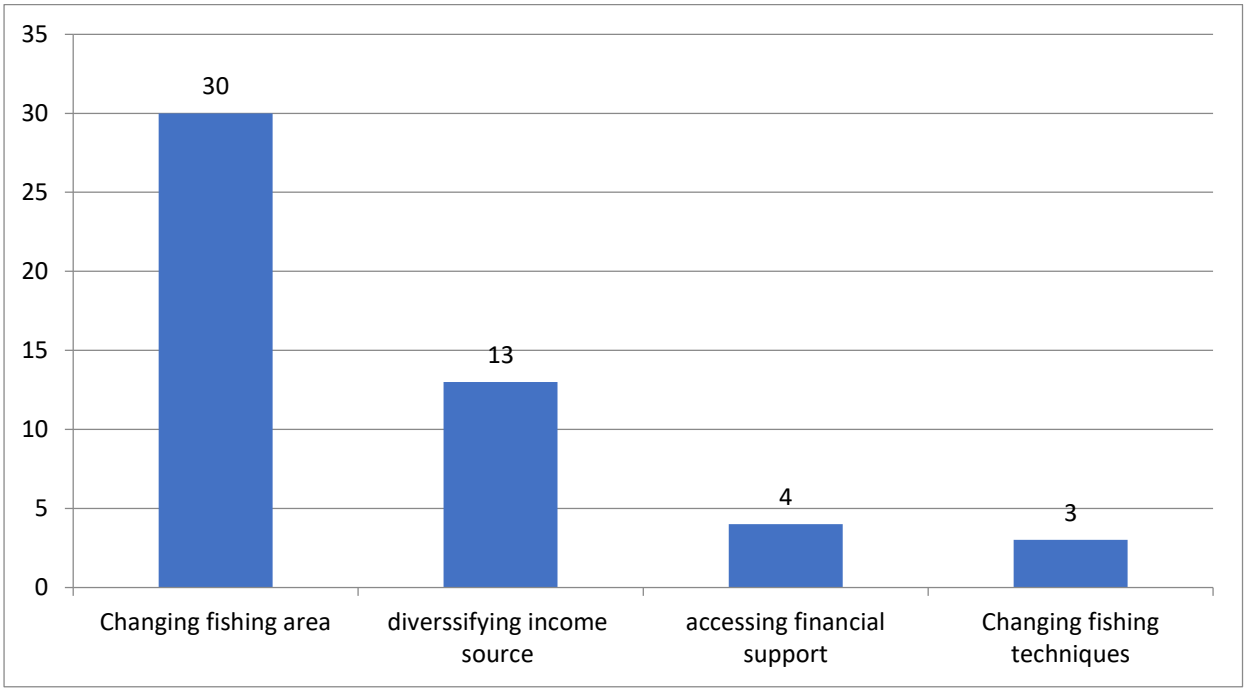

FIGURE 4.4

STRATEGIES USE TO COPE WITH THE IMPACT OF CLIMATE CHANGE VARIABILITY

The table shows that majority of respondents (60%) will opines that changing the fishing area to cope with the impact of climate change variability. Other strategies are diversifying income source (13%), accessing financial support (4%) and change in fishing techniques (3%). Fishermen are using many strategies to combat the effects of climate change. In the situations where fish are migrating, fishermen change their fishing areas to catch fish. During rainy season fish are less available but they shift fishing to other places and continue fishing. In case of non-availability of fish during summers, it affects the income of fishermen and they look for other jobs. Due to this, the fishermen face financial problems and have to take loans and loans from others when there is a change in weather conditions, if there is fishing on one day, there is no fishing on the next day. Due to climate change, the oceans are becoming more and more difficult and traditional fishing techniques cannot be used and they have to look for other techniques.

TABLE 4.4

COST OF OPERATION CHANGED DUE TO CLIMATE CHANGE VARIABILITY

Option	Number of respondents	Percentage
Significantly increased	40	80
Increased	10	20
No change	0	0
Decreased	0	0

When analyzing the table, it is clear that cost of operation changed due to climate change variability. 80% of them are belongs to significantly increased, and remain are opines increased. It explains how climate change is increasing operational costs for fisheries. They have to buy more fishing equipment and their transportation costs increase. Due to different weather conditions, there is loss of fishing gear and all this requires a lot of money to buy new infrastructure as well as to introduce new technology and use new technology. A decrease in catches might result from shifts in fish populations and distribution, which would affect fishermen's livelihood and the stability of the economy. Cost increases are a result of longer trip lengths, more time spent at sea, and the requirement for new or modified equipment to accommodate changing fishing circumstances. Changes in the availability of fish can cause price swings, which can make fishermen's revenue uncertain and their planning more challenging.

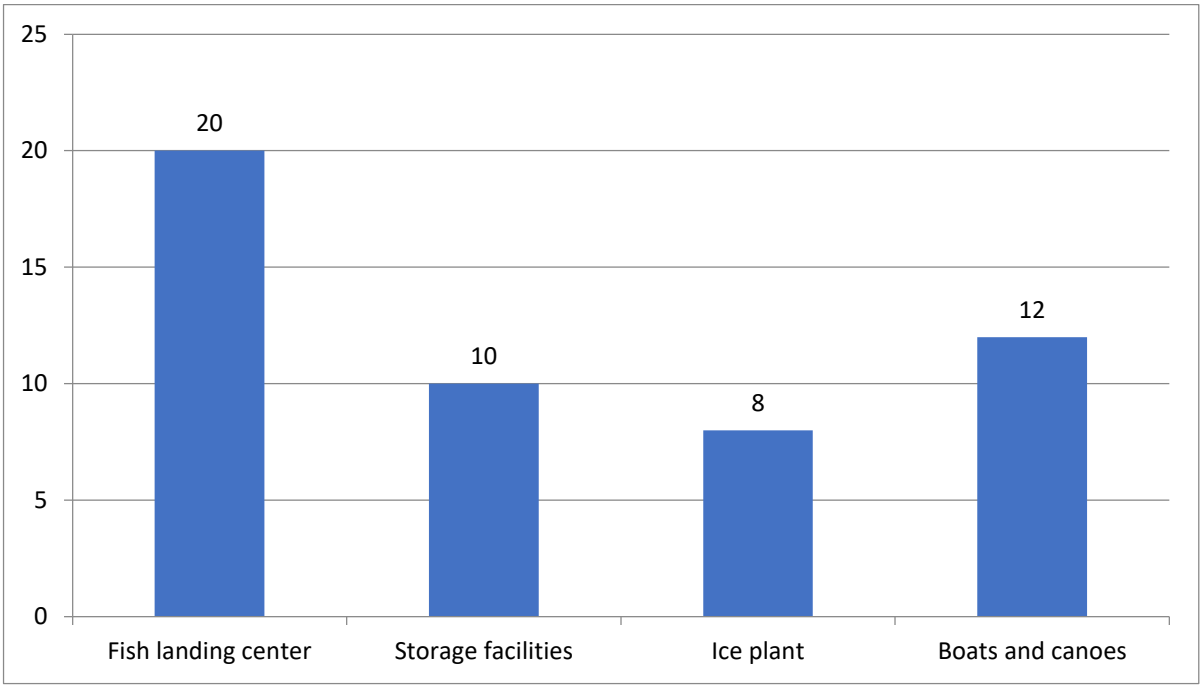

CHART 4.5

AVAILABLE INFRASTRUCTURE

Table shows that 40% of them use fish landing center,20% have storage fecilities,16% use ice plants and remains are use boats and canoes. Fishing infrastructure is available in Chavkad taluk as there are a lot of fishing activities. Most of them are fish landing centers Fish landing centers are available in all the important fishing areas such as Natika, Thalikulam, Engandiyur, Chavakkad, Munakkadav. A storage facility is also available in Chavakkad Munakkadav area which is all rented out by local fishermen. Ice plants are available in some areas which makes it easy for them to keep the fish intact. Boats and other canoes are essentially available in this taluk.

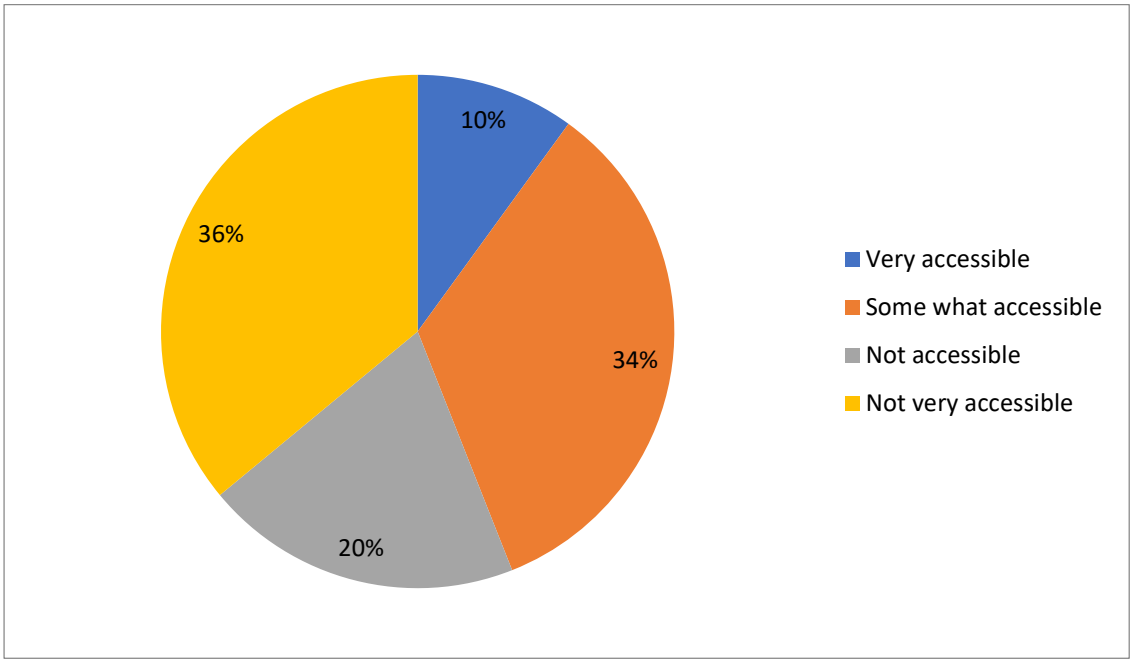

FIGURE 4.6

ACCESSIBILITY OF SUPPORT

The table shows that 44% of respondents are opines that these facilities are accessible to them and 56% are belongs to not accessible. Fish land centers are essentially accessible to workers in all areas. But storage facilities are available only in very few areas. All the storage facilities are bought by the fishermen themselves with their own money. Boats and canoes are available to all, although their numbers are dwindling due to damage to boat docks and other facilities due to high waves.

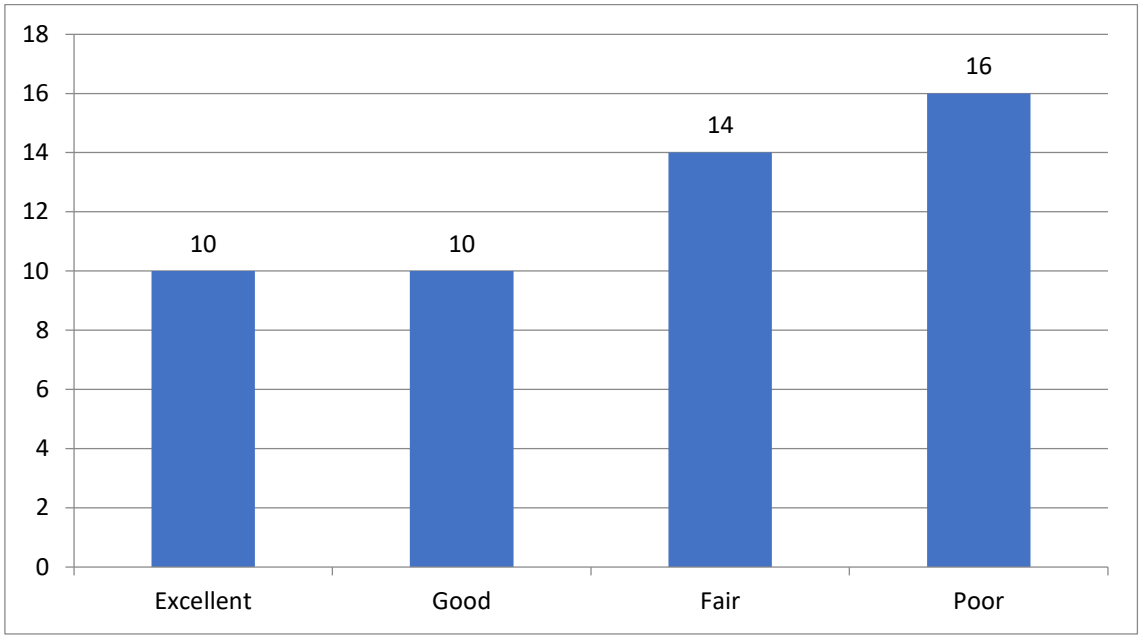

CHART 4.7

RATING OF FISHING INFRASTRUCTURE

We analyze the table, most of them rate the fishing infrastructure poor (32%). And followed by fair (28%). both excellent and good rate is 20% respectively. Chavakkad taluk has basic facilities for fishing, but there are more places without basic facilities when we look at each area. Better infrastructure can be ensured by introducing modernized technologies, expanding cold storage facilities and enhancing fish processing units.

TABLE 4.5

USAGE OF AVAILABLE INFRASTRUCTURE

Option	Number of respondents	Percentage
Daily	34	68
Several time a week	14	28
Occasionally	2	4
Rarely	0	0

This table shows that majority of respondents opines that they use available infrastructure daily basis (68%).28% of them use some time a week, remain 4% them use occasionally. The fishing infrastructures available in each part are also used by its fishermen on a daily basis. They try to use the equipment which is not available in each region by renting it from other region for weekly or special occasions.

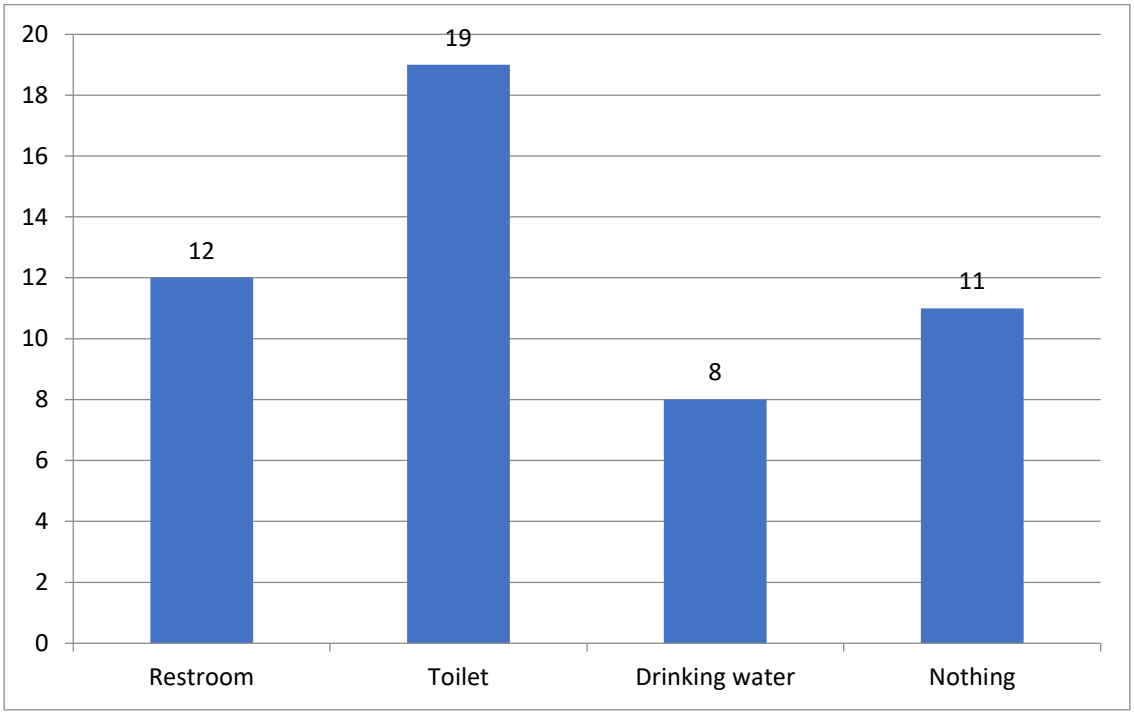

FIGURE 4.8

BASIC AMINITIES

The table analyze basic amenities available to the fishermen. Rest room (24%), toilet (38%), drinking water (16%) are the basic amenities available at fishing sites. All facilities like storage facilities, ice box, drinking water are available in Chavakkad areas but there are no facilities in areas like Thallikulam, Engandiyur.

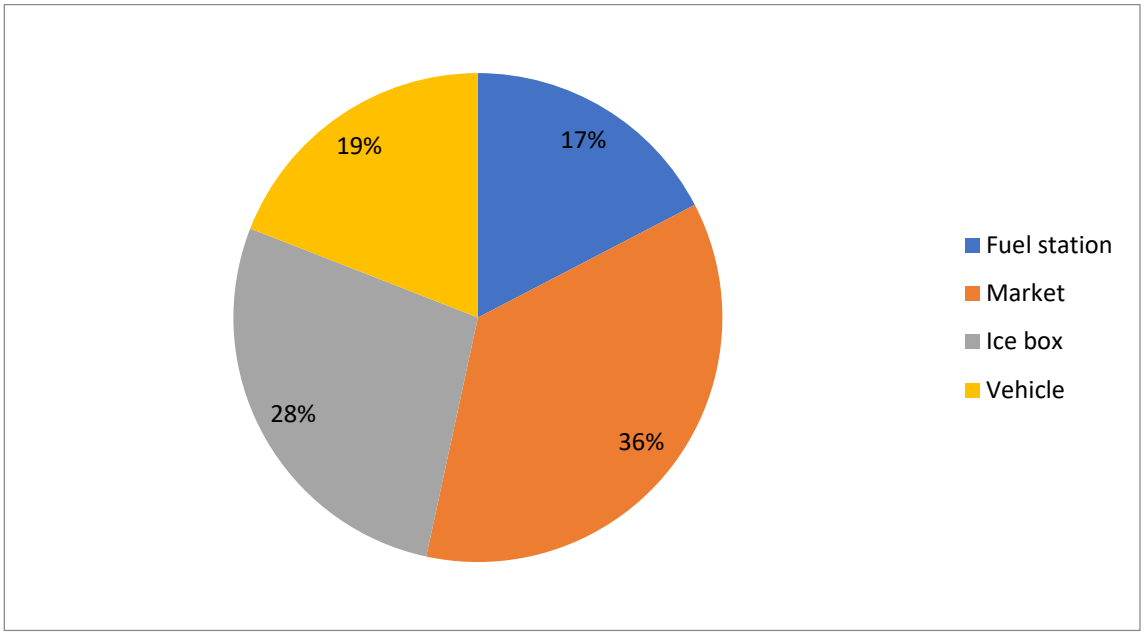

FIGURE 4.9

AVAILABLE SUPPORTS

Most of the fishing facilities are available in the Munakkakadav area. All fishing aids like market, shops, ice boxes, harbor, boats are available there. Markets, shops and ice boxes are only available in certain areas. After that area, the necessary fishing facilities are available in the Chavakkad area. All the rest of the regions have very little support.

TABLE 4.6

ACCESS OF FUEL AND ICE

Option	Number of respondents	Percentage
Very easily	8	16
Easily	14	28
Moderately	19	38
Slowly	9	18
Very slowly	0	0

The importance of ice in protecting fisheries is invaluable. Fishermen often have to approach ice plants and local suppliers to obtain ice. Reliability and efficiency of supply may vary even if facilities are available. During times of more fishing, they are most adversely affecting. Even if the workers have access to the fuel they need, intermittent fuel shortages affect them badly. Even if the workers have access to the fuel they need, intermittent fuel shortages affect them badly.

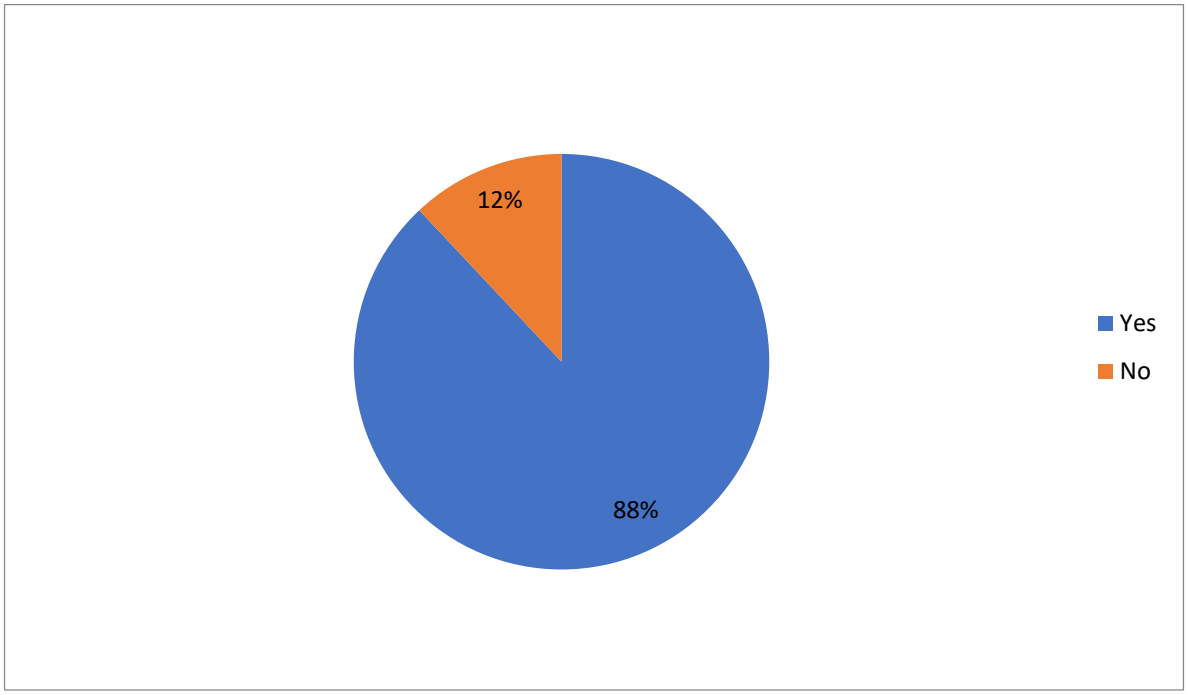

FIGURE 4.10

LEVEL OF AWARENESS ABOUT GOVERNMENT PRGRAMS

Most of the workers are aware of the government programs but they are not aware of all the government programs and they are aware of only a few of the government programs. These programs have not reached more workers. They did not want to know about other government programs or learn about their benefits.

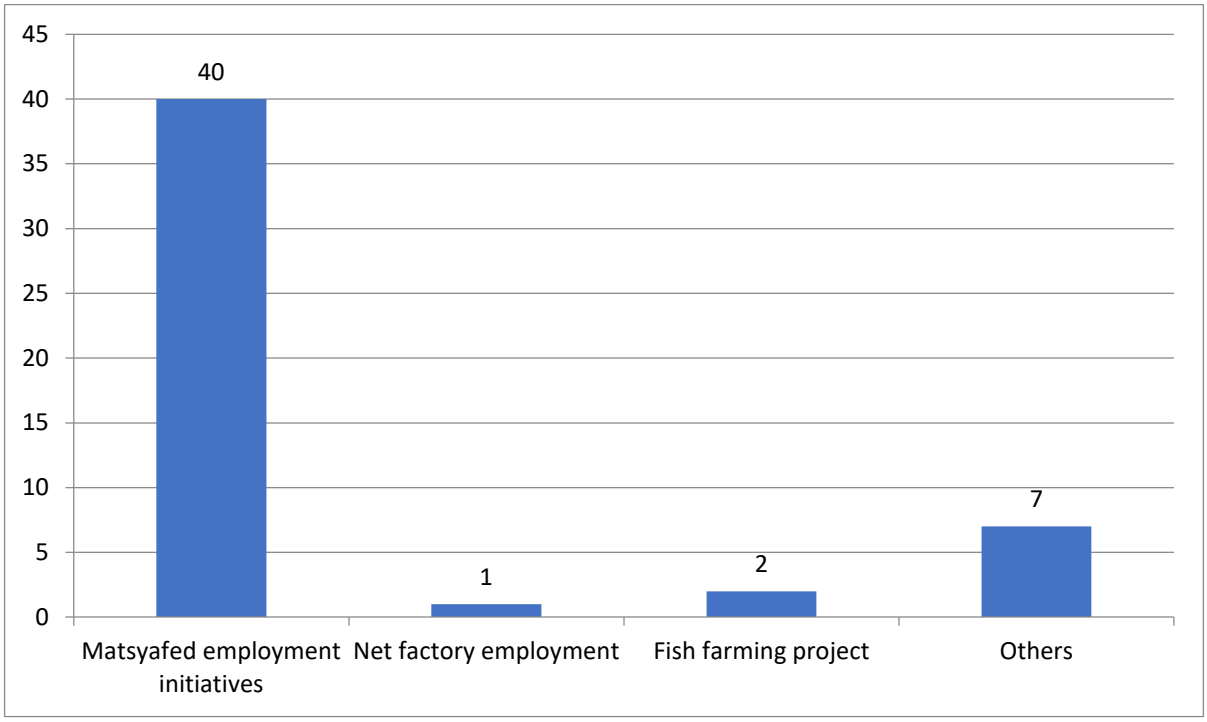

FIGURE 4.11

EMOLYMENT PROGRAMS PROVIDED BY THE GOVERNMENT

This study finds that the fishermen or their families are getting the benefit of at least one of the programs provided by the government. Matsyafed employment program is the most popular government employment program. Most of fishing employees are also included in this program and through this they get things that are beneficial. Joint Liability Group Project, Theeramaithri Seafood Restaurant Project, Ashtamudi Project, Punargeham, Matsya Samrudhi, Kudumbashree Fishermen Empowerment Program, Kerala Fishermen Welfare Fund Board, Matsyakeralam Project, Nava Kerala Mission, many employment programs implemented by the government for the fishermen. These programs have not reached more workers. Most of the workers are not aware about these programs. Most of the workers are not aware about these programs. Such programs have come into being to reduce the unemployment level and improve the quality of life of the fishermen. These programs have not reached more workers.

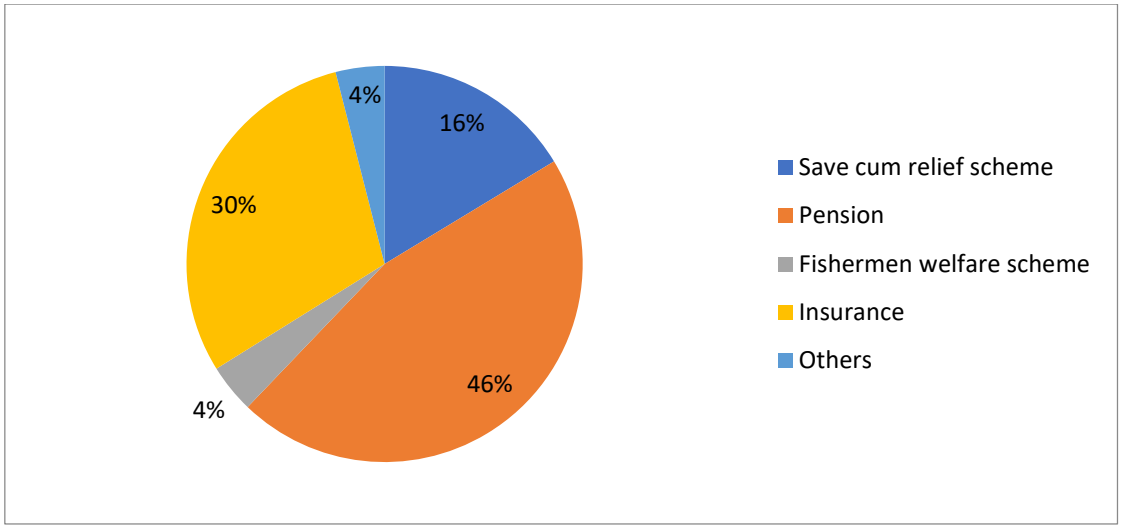

FIGURE 4.12

WELAFARE PROGRAMS AND INITIATIVES

Pension is a welfare program that most of the fishermen in Chavakkad taluk are getting. Old age fishermen are getting this pension. Insurance is provided to workers in the fishing sector, providing a safety net for them and their equipment. By taking insurance, insurance helps to compensate for any kind of damages or other financial losses in the fish industry it helps the workers to some extent. Ensures the social security of fishermen by offering accident insurance coverage. The government supports fisherman through a number of welfare programs and initiatives. These initiatives frequently seek to improve their standard of living, guarantee ethical fishing methods, and offer social and financial security. The government supports fisherman through a number of welfare programs and initiatives. These initiatives frequently seek to improve their standard of living, guarantee ethical fishing methods, and offer social and financial security.

The government has initiated several welfare programs to support the lives of fishermen. Development of Deep-Sea Fishing Vessels, Group Accident Insurance Scheme for Fishermen, Kisan Credit Card (KCC) Scheme, Blue Revolution Scheme, National Scheme on Welfare of Fishermen, Pradhan Mantri Matsya Sampada Yojana (PMMSY) are some of the government initiative programs. All of these initiatives attempt to support fishermen by enhancing their working circumstances, offering financial support, guaranteeing their safety and insurance, and encouraging environmentally friendly fishing methods. Although many programs are available, many of the fisher folk do not have access to these programs. Pension Fund, Insurance and Save Cum relief scheme are the most available program out there.

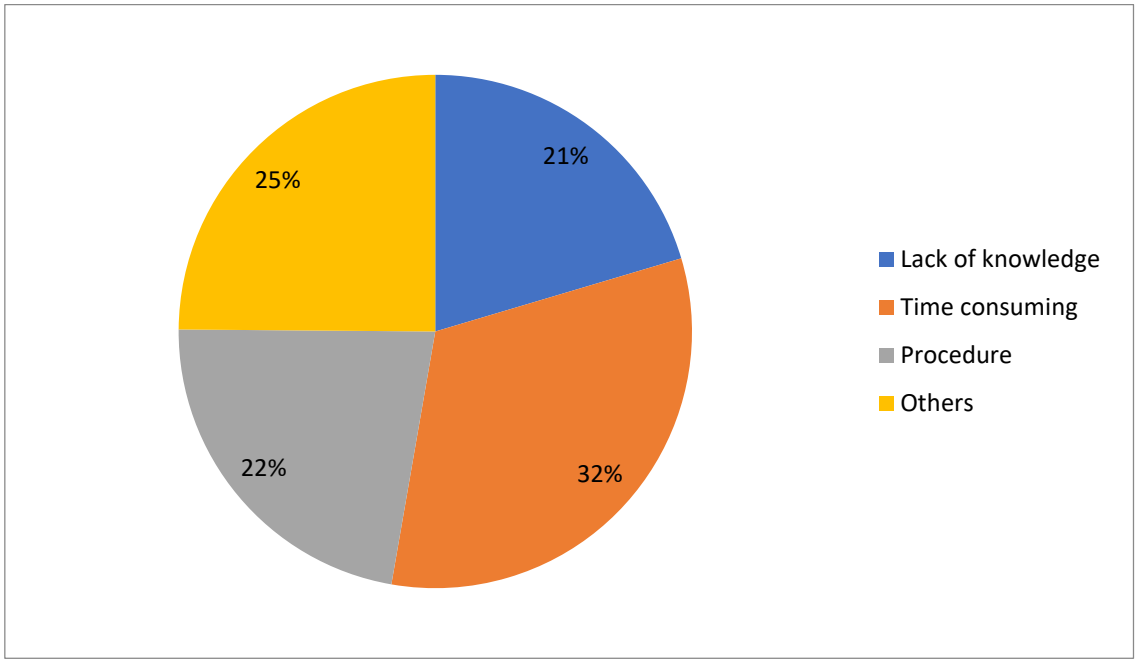

FIGURE 4.13

CHALLENGES WHILE ACCSSESING THE GOVERNMENT PROGRAM

Many fishermen might not be aware of the several government programs that are available to them, or they might not know all the details necessary to apply for these benefits.

The significant paperwork involved in applying for government programs can be time-consuming.

In order to inform and support fishermen in rural or underserved areas, government officials may occasionally fail to perform sufficient field trips or outreach.

Fishermen might not be digitally literate

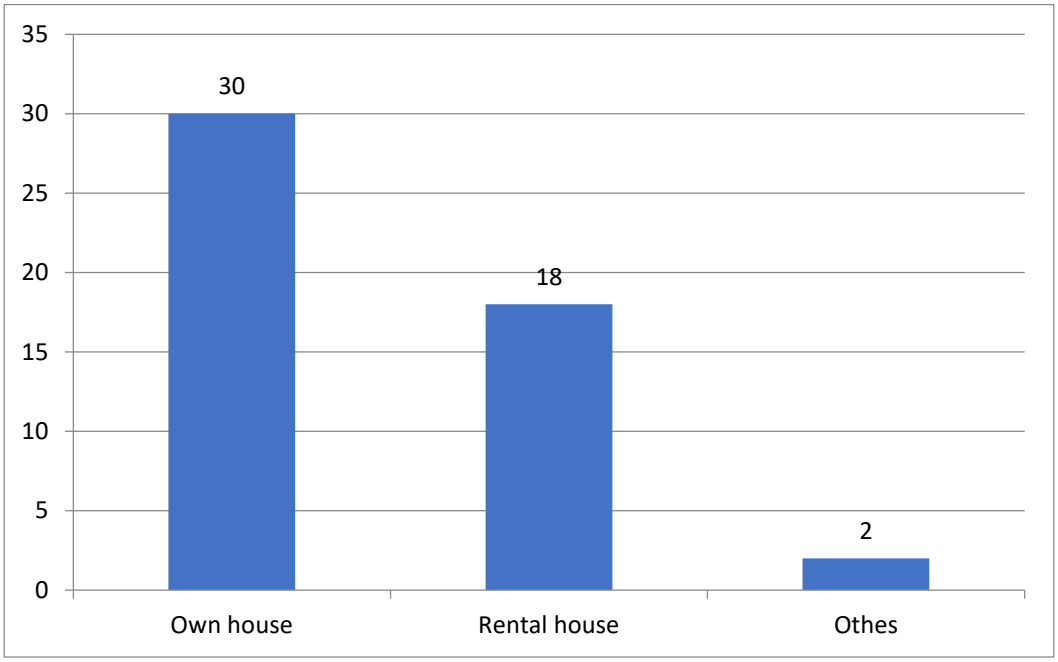

FIGURE 4.14

HOUSING FASILITIES

Most of fishing worker has their own houses. Some of them got government-provided houses not from a scheme specially designed for fishermen, but from the government's Life Mission scheme. A few workers are still living in rented houses. The remaining few are all living in joint families in ancestral houses and in the houses of other relatives. Even if they own their own houses, their houses are in very poor condition. Among those who have their own houses, there are those who are confined to one or two cents of land and live in a very miserable condition.

TABLE 4.7

EFFECTIVENESS OF GOVERNMENT PROGRAMS

Option	Number of respondents	Percentage
Strongly effective	3	6
Effective	8	16
Neutral	12	24
Not effective	18	36
Strongly not effective	9	18

Government provides varieties of government programs to support fisherman's livelihoods. All these programs are not properly delivered to fishermen. Government support to fishermen is a much-needed factor in this era when climate change is affecting the coastal zone very badly. Some areas have government-provided storage facilities, harbors and fish center. In certain coastal areas where more fishing activities are going on, there is a lot of lack of infrastructure and basic amenities. Fish landing center is the only infrastructural facility provided by the government. All other storage room things are rented and used by them.

STATISTICAL APPLICATION

Figure 4.4 challenges are ranked by Garett ranking method.

Garratt ranking was developed by Dr. Garratt. Garratt ranking is the method used to evaluate and rank policy instrument or options based on their potential effectiveness in achieving a specific policy goal or objectiveness.

Challenges faced by fishermen	Percentage	Rank
Increasing operational cost	28	1
Higher temperature	18	3
Rise of sea level	18	3
Security concern	24	2
Shortage of labor	12	4

Increasing operational cost, higher temperature, rise of sea level, security concern and shortage of labor are the main challenges faced by a fisherman due to climate change. The main challenge is increasing operational cost. That is way it was given first rank. The other challenges security concern, higher temperature, rise of sea level and shortage of labor are ranked 2^{nd}, 3^{rd}, 4^{th} and 5^{th} respectively.

CHAPTER 5

FINDING, SUGGESTIONS AND CONCLUSION

FINDINGS

- Most of them are belong to below SSLC 84% and only 16% are in the category of above SSLC.
- Majority of respondents 66% have experience in fishing less than 10 years and others belongs to above 10 years.
- Majority of respondents opines that increasing operational cost 28% is the main the main challenges faced by fishermen followed by security concern18%
- The study reveals that climate change effect the livelihood fishermen (100%)
- Climate change effect the migration pattern of the fish (100%)
- Majority of the respondents opines that changing fishing area 60% and diversity in income source are the main strategy used to cope with the climate change variability.
- Cost of fishing operations changed due to the climate change (100%)
- Fish landing center 40%, ice plant 16% and Boats and canoes 24% are the main fishing infrastructure available in this area
- 44% of the respondents are opines that these facilities are accessible to them and 56% are belongs to not accessible
- Most of them rate the fishing infrastructure is poor 32% and followed by fair 28%
- Majority of respondents opines that they are use available infrastructure daily (68%)
- All the respondents opine that infrastructure issues of challenges
- Rest room24%, toilet 38%, Drinking water 16% are the basic amenities available at fishing sites.
- The study reveals that Market 34% is the most support available at fishing area
- 28% of respondents opines that easily access the ice plant and fuel and 38% of them are belongs to Moderately and slowly.
- Most of them 44% aware of government programs available to fishing community
- 80% of respondents opines that Matsyafed employment initiatives is the main employment generation program provided by the government to fishermen community

- Majority of respondents opines that pension 26% and insurance 30% are the welfare programs and initiatives offered by government for the benefit of fishermen and their family
- 74% of respondents enjoy the benefit of government programs
- Lack of knowledge and time consuming and Procedures are the challenges faced by the fishermen while accessing the government programs
- 22% of respondents are opines that government programs are effective in addressing the employment and welfare needs of fishing community and 27% belongs to not effective.

SUGGESTIONS

- Build levees to resist sea waves.
- Encourage more fishing using mechanized techniques and provide necessary facilities for the type of fishing.
- Provide proper infrastructure for fishing at proper time.
- Make sure basic amenities at all fishing areas.
- Construction of mini harbor.

CONCLUSION

Climate changes effect the fishermen in many ways. Raising sea level, high temperature, acidification of water and migration of fish, etc. are the main challenges faced by the fishermen. The climate changes lead to increase the operational cost of fisheries sector. The main strategy to reduce the impact of climate change variability are changing the fishing areas and diversify income source. Majority of the respondents are aware of the government programs available to fishermen. Fish landing center, ice plants, boats and canoes are the fishing infrastructure available in this area. Majority of the fishermen use the available infrastructure daily basis. Matsyafed is the most familiar employment generation program to fishermen in this area. Most of them enjoy the benefit of welfare and employment generation programs available to fishermen. Ice plant and fuel are easily accessible to fisheries. All the respondents are male in this study. The climate change effect the livelihood of fisheries community.

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QUESTIONNAIRE

- NAME:
- GENDER
  - Male
  - Female
  - Others
- EDUCATION
  - Below 10^{th}
  - SSLC
  - Plus two
  - Above Plus two
- Year of experience in fishing
  - Below 5 years
  - 5-10 year
  - 10-15 year
  - Above 15 years
- Name the challenges faced by fisherman in your area
  - Increasing operational cost
  - Higher temperature
  - Rise of sea level
  - Security concern
  - Shortage of labor
- Does climate change effect the fishermen's livelihood in a year?
  - Yes
  - No
- Have you noticed changes in the migration pattern of fish due to climate changes
  - Yes
  - No
- What strategies do you use to cope with the impacts of climate change variability
  - Changing fishing areas
  - Diversified income source
  - Accessing financial support

- Changing fishing techniques

❖ Have the cost of fishing operations changed due to climate variability
- Significantly increased
- Increased
- No change
- Decreased

❖ What kind of fishing infrastructure available in your area
- Fish landing center
- Storage facilities
- Ice plant
- Boats and canoes

❖ How accessible are these facilities to fishermen
- Very accessible
- Somewhat accessible
- Not very accessible
- Not accessible

❖ How would you rate the fishing infrastructure in your area
- Excellent
- Good
- Fair
- Poor

❖ How often do fishermen in your area use the available infrastructure for their fishing activities
- Daily
- Several times in a week
- Occasionally
- Rarely

❖ Are there infrastructure issues or challenges facing fisher men in your area
- Yes
- No

❖ Name the basic amenities available at fishing infrastructure sites in your area
- Rest room
- Toilet

- Drinking water
- Nothing

❖ Name the support available at your fishing area
- Fuel station
- Market
- Icebox
- Vehicle

❖ How do you access fuel and ice foe your fishing activities
- Very easily
- Easily
- Moderately
- Slowly
- Very slowly

❖ Are you aware of government programs specifically designed for the fishing community
- Yes
- NO

❖ Government provides any employment programs for the fishermen in your community
- Matsyafed employment initiatives
- Net factory employment
- Fish farming project
- Others

❖ Name the welfare programs and initiatives offered by the government for the benefit of fishermen and their family
- Save cum relief scheme
- Pension
- Fishermen welfare scheme
- Insurance
- Others

❖ Have you or your family benefited from any of these government programs
- Yes
- No

- What are the challenges faced by the fisherman while accessing the government programs
  - Lack of knowledge
  - Time consuming
  - Procedures
  - Others
- What type of housing facilities are available in your area
  - Own house
  - Rental house
  - Others
- In your opinion how effective the government programs in addressing the employment and welfare needs of fishing community
  - Strongly effective
  - Effective
  - Neutral
  - Not effective
  - Strongly not effective
- Give suggestions for the development of fishermen’s livelihood