

**AWARENESS AND PERCEPTION ABOUT
CLIMATE CHANGE AMONG ESTUARINE
FISHERS OF RATNAGIRI, MAHARASHTRA**

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December, 2019

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THESIS

Submitted to the

Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli

in partial fulfillment of the requirements for the degree of

MASTER IN FISHERIES SCIENCE

IN

FISHERIES EXTENSION

BY

Sadhana Balaji Telang

B. F. Sc

Under the guidance of

Dr. K. J. CHAUDHARI

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Department of Fisheries Resources,

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With regard to the thesis entitled “**Awareness and perception about climate change among estuarine fishers of Ratnagiri, Maharashtra**” submitted by **Miss. Sadhana Balaji Telang** for the degree of university.

I certify that:

1. She has carried out the research work under my direct supervision and guidance in academic year 2018-2019 and that the manuscript of the dissertation has been scrutinized by me.
2. The entire thesis comprises the candidate’s own work and it is her own work and it is her own achievement. It has not previously formed the basis for the award of any degree, diploma, associateship, fellowship or other similar title of the recognition.
3. The thesis does not contain any conjoint research work with me or anyone else.
4. She has completed her research work to my entire satisfaction.
5. The final typed copy of the thesis, which is being submitted to the University office, has been carefully read by me for its material and languages and it is to my entire satisfaction.

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Date:

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सारांश

रत्नागिरी तालुक्यातील खाड्यामध्ये मासेमारी करणा-या मच्छीमारांमध्ये हवामान बदला विषयी जागरूकता व धारणा जाणून घेण्याच्या उद्देशाने हा अभ्यास केला गेला. यादृच्छिक नमुना पद्धतीद्वारे निवडलेल्या ७३ खाडीतील मच्छीमारांकडून माहिती प्राप्त करण्यात आली. माहिती मिळवण्यासाठी मुलाखतीचे वेळापत्रक वापरले होते. जास्तीत जास्त (२७.४०%) खाडीतील मच्छीमार हे ३१-४० वयोगटातील होते. बहुतेक मच्छीमारांनी (७८.०८%) माध्यमिक स्तरापर्यंतचे शिक्षण घेतलेले होते. सर्वाधिक मच्छीमार (८४.९३%) मुस्लिम धर्माचे होते आणि फारच कमी हिंदू होते. सुमारे २.७४% मच्छीमारांकडे पिवळी शिधापत्रिका आणि ९७.२६% केशरी शिधापत्रिका होती. सुमारे ७१.२३% मच्छीमारांनी हवामान बदलाविषयी ऐकले होते, २८.७७% मच्छीमारांनी हवामान बदलाविषयी ऐकले नाही. सुमारे ९२.३०% मच्छीमारांचा स्वतःचा अनुभव हाच हवामान बदलावरील माहितीचा मुख्य स्रोत होता. खाडीतील मच्छीमारांनी तापमान वाढ, पाऊस कमी होणे, अनियमित हंगामी संक्रमण, मासेमारीचे कमी दिवस आणि प्रजातीची संख्या कमी इत्यादी हवामान बदलाचे परिणाम अनुभवल्याचे सांगितले. हवामान बदल रोखण्यासाठी मच्छीमारांनी सर्वात जास्त प्राधान्य प्रदूषण टाळण्याला दिले असल्याचे सांगितले. सुमारे ४६.५८% मच्छीमारांना स्थानिक हवामान बदलाविषयी मध्यम आणि २४.६६% मच्छीमारांना उत्कृष्ट माहिती असल्याचे सांगितले . सरासरी तापमान, पावसाचे प्रमाण बदलणे, पूर, चक्रीवादळ, भूस्खलन यासारख्या घटनांची वाढ, माशांचे साठे, मासेमारीचे स्थान, माश्यांचे स्थलांतर, प्रजातींची उपलब्धता बदलणे, उत्पन्नातील घट, मासेमारीवरील खर्चात वाढ, रहिवास हानी आणि पावसातील चढ-उतार इत्यादींवर हवामान बदलाचा परिणाम होत असल्याचे सांगितले. खाड्यामध्ये मासेमारी करणाऱ्या सुमारे ७१.२३% मच्छीमारांना मध्यम प्रमाणात हवामान बदलाविषयी जागरूकता होती.

ABSTRACT

The present study was carried out with objectives to study the awareness and perception about climate change among the estuarine fishers of Ratnagiri. Data was obtained from 73 estuarine fishers selected through random sampling method. An interview schedule was used for data collection. Maximum percentage (27.40%) of estuarine fishers were in the 31-40 age group. Majority of the estuarine fishers (78.08%) were educated up to secondary level education. Most of the estuarine fishers belonged to Muslim (84.93%) religion and very few were Hindu. About 2.74% of the fishers had yellow ration card and 97.26% orange ration card. About 71.23% of the estuarine fishers have heard about climate change, 28.77% of fishers did not hear about climate change. The main source of information on climate change was through own experience (92.30%). The estuarine fishers experienced extreme changes in weather, temperature has increased, decreased rainfall, irregular seasonal transition, decreased fishing days, decreased number of species caught and deposition of the beach. 'Avoiding pollution, was found the most important practice for prevention of climate change. About 46.58% of the estuarine fishers have moderate knowledge about climate change and 24.66% of fishers have excellent knowledge about climate change. The estuarine fishers perceived that average temperature, changing rainfall pattern, frequency of extreme climatic events like floods, cyclones, landslides has increased, fish stock, fishing point, migration of fishes, change in species availability, reduction in income, increased cost of fishing, habitat destruction, monsoonal fluctuation and seawater inundation has impacts of climate change. Estuarine fishers have medium level of awareness (71.23%) about climate change.

Keywords: Awareness, perception, climate change, estuarine fishers, impact.

1.0 INTRODUCTION

Climate change occurs when changes in the Earth's climate system result in new weather patterns that last from at least a few decades and may extend up to millions of years. Earth's energy moves through its climate system thereby creating its weather. The long-term averages of weather are called climate. Changes in the long term average is called climate change that may persist over multiple decades or longer. Climate change encompasses both increases and decreases in temperature as well as shift in precipitation, changing risk of certain types of severe weather events and changes to other features of climate change.

Climate change is a global challenge today, with its impacts felt worldwide. The coastal regions around the globe are more prone to the impacts of climate change than the inland regions. Fishing being one of the primary occupations of the coastal belts, the fisher communities form one of the most vulnerable groups to be affected by the changing climate. One of the prominent effects of climate change is a rise in the sea level, which means that coastal fishing communities are more vulnerable to and are in the front line of the deleterious effects of climate change. In addition, changing seawater temperature and current flow patterns also are likely to cause shifts in the distribution of marine fish stocks all of which are the by-product of global climate change. Mostly such changes impact the nature and value of commercial fisheries.

The marine ecosystem is constituted by a complex set of relationships among environment, resources and resource users. Climate change not only affects the environment and resources directly, but also affects the resource users. Changes in temperature are related to alterations in oceanic circulation patterns that are affected by changes in the direction and speed of the winds that drive ocean currents and mix surface waters with deeper nutrient rich waters (Kennedy *et al.* 2002). These processes in turn

affect the distribution and abundance of plankton, which are food for small fish. Estuarine and coastal regions are extremely productive because they receive inputs from several primary production sources and detrital food webs.

Climate change poses a great threat to resource users, in particular, the fisher communities who are emotionally attached to their living environment as their livelihood is heavily dependent on sea and estuaries. The impacts of climate change on resource users include displacement of family members, migration of fisher folk, loss in income level, increased fishing cost and reduction of fishing days. Increased frequency of storms or weather and sea conditions are unsuitable to fishing as well as communities on shore through flooding, erosion and storm damage.

Awareness is the state or ability to know or perceive things or statements. While, perception is the process by which we receive information or stimuli from our environment and transform it into physiological awareness. According to van den Ban and Hawkins (1996), Perceptions are either relative, selective, organized or directional. Perceptions are selective because at any moment our senses are receiving a variable flood of stimuli from the environment around us. Despite its capacity to process vast amount of information, our nervous system cannot make sense of all the stimuli available. Hence an individual pays attention only to a selection of these stimuli. Several physical and psychological factors, including attitudes influence what he or she selects or pays attention to. Perceptions are organized because people tend to structure their sensory experiences in ways that make sense to them. Finally, perceptions are directional because individuals perceive what they expect or are set to perceive and individual mental sets influence what people select, how they organize and interpret it.

Maharashtra is one of the major maritime states along the west coast of India, having 720 km of coastline. Marine fish production of Maharashtra was 4.75 lakh tonnes

during the year 2017-18 and inland fish production was 1.31 lakh tonnes. Total traditional fisher families of Maharashtra were 80,906. Ratnagiri is the coastal district of Konkan region of Maharashtra having 167 km coastline and the Ratnagiri tahsil has 67 km coastline. Ratnagiri district has five coastal blocks namely Mandangad, Dapoli, Guhagar, Ratnagiri and Rajapur. Total marine fish production of Ratnagiri district was 80,340 tonnes during 2017-18 (Anon, 2018). Forty-six landing centres and one minor fishing harbour *viz.* Mirkarwada are located in the Ratnagiri block. The artisanal fishers' data is not available. In present study seven estuaries along Ratnagiri were selected *viz.* Bhatye, Karla, Rajiwada, Shirgaon, Mayekarwadi, Sakhartar and Kalbadevi.

Estuaries are one of the most productive kinds of ecosystem on earth. The estuarine communities are more prone to the impacts of climate change. Many researchers Aphunnu & Nwabeze (2012), Bah *et. al.* (2018), Geetha *et al* (2015), and Hasan (2015) have studied the awareness and perception about climate change of fishers all over the world. None of the researcher has reported the awareness and perception about climate change of estuarine fishers. Therefore, the present study was undertaken in Ratnagiri to study awareness and perception among estuarine fishers about climate change with following objectives:

1. To study awareness among the estuarine fishers about climate change.
2. To study perception among the estuarine fishers about climate change.

2.0 REVIEW OF LITERATURE

2.1 AWARENESS ABOUT CLIMATE CHANGE

Ishaya and Abaje (2008) studied indigenous people's perception on climate change and adaptation strategies. A total 225 face-to-face interviews were conducted with the help of questionnaire. Descriptive analysis was used for data analysis. About 54% of respondents have very weak awareness about climate change, 33% of respondents don't know about climate change and 13% of the respondents agreed they have awareness on climate change.

Hoque and Banna (2010) studied awareness of Bangladeshi urban people on climate change and its impact on food security. Data collected using questionnaire. Total 71 respondents were selected using snowballing method and analysis by using SPSS (Statistical Packages for Social Science) program. Result showed rise in temperature (88.73%) was the first thing that came to respondents mind followed by increase in cyclone/hurricane (80.69%) and increase in drought (71.83%) respectively.

Mandleni and Anim (2010) studied climate change awareness and decision on adaptation measures by livestock farmers in South Africa. Data collected from 250 household. The results revealed that 57% of the farmers were aware of climate change and 43% were not aware about climate change. It suggested that government awareness programmes about climate change should focus more on livestock farmers. It further suggested the need information on climate change to improve livestock production appeared to play a significant role in the selection of adaptation measures.

Sarkar and Padaria (2010) studied farmers' awareness and risk perception about climate change in coastal ecosystem of West Bengal. Data were collected with the help of random sampling and 120 farmers were interviewed. The Study reported that 38% of the farmers had heard about climate change. The farmers aware of increase in

temperature (70%), increased drought and flood (53.3%), increased variability in rainfall (43.3%), increase in sea level and reduction in fresh water availability (43.3%). The study concluded that most of the farmers were fully aware of climate change but most of them lacked in detail information about climate change.

Tologbonse *et al.* (2010) studied farmers' perception of effects of climate change and coping strategies in three agro-ecological zones of Nigeria. Methodology used for data collection was random sampling technique. Total 150 farmers were interviewed using structured interview schedule. Data were analysed by descriptive statistics involving frequency counts, mean and percentage. The inferential statistics and Likert scale were used to analyse data. The results showed that the main source of information on climate change was from personal experience (37.6%), followed by radio (32.2%), extension agents (19.5%), television (6.7%) and fellow farmers (4%). About 45.8% of the farmers experienced effect of climate change.

Adebayo *et al.* (2012) studied farmers' awareness, vulnerability and adaptation to climate change in Adamawa State, Nigeria. The information was collected from 340 farmers. A multistage sampling technique was used in the selection of the farmers. The data was analysed with descriptive statistics. The results indicated that majority of the farmers (96%) were aware of climate change, while only about 4% not to be aware of climate change. Majority of the respondents (87%) stated temperature is increasing. Only about 8% of the respondents stated that temperature trend in the state has been decreasing, while about 4% claimed to have noticed no change.

Assessment of poor resource of farmers' level of awareness on climate change and adaptation/mitigation strategies in Oyo State, Southwest, Nigeria was studied by Adetayo (2012). The methodology used for data collection was multi-stage sampling

technique. Total 240 respondents were interviewed using well-structured questionnaire. The data were analysed using frequency and percentage. The results showed that the majority of the respondents (87.5%) heard about the climate change. About 40% of the respondent said that there was change in the weather condition and 17.5% of the respondents said that climate change was just a weather condition. The result showed that 53.4% of the respondents experienced rainfall increasing while, 36.7% experienced reduction in rainfall, 4.1% reported there was no change in rainfall and 5.8% claimed that they were not aware of any such changes. About 54.2% of the respondents experienced that temperature had increased.

Aphunu and Nwabeze (2012) studied fish farmers' perception of climate change impact on fish production in Delta State, Nigeria. The methodology used for data collection was multi stage random sampling technique. Data were collected through the semi structured interview schedule. The results showed that 75% of the respondents were aware about impact of climate change. It was found that 47.5 % of the respondents had little knowledge about climate change while 31.3% of the respondents stated that they do not have any knowledge about climate change. About 11.3% of the respondents stated that they know about climate change to a reasonable extent while 10% of the respondent claimed to be very knowledgeable about climate change. The sources of information on climate change were through personal experience (33.8%), followed by radio/ television (21.3%), friends/ neighbours' (18.8%), internet (7.5%) and extension agent (1.3%).

Idrisa *et al.* (2012) studied analysis of awareness and adaptation to climate change among farmers in Sahel Savannah agro ecological zone of Borno State, Nigeria. Data were collecting using multi- stage random sampling. The information was collected using interview schedule. The results showed that 82.22% of the respondents were aware about climate change. The sources of information about climate change result showed

that 39.11% of the respondent got information from extension agent, 26.67% from friends and neighbours, 11.11% through media and 5.33% from non-governmental agency.

Oduniyi (2013) studied climate change awareness: a case study of small scale maize farmers in Mpumalanga, South Africa. The methodology used for data collection was stratified random sampling. Total 251 samples were selected from six towns. Data were collected through structured questionnaire and secondary data were collected using published books, publications, journals and internet. For data analysis, SPSS was used in by descriptive and logistic regression models. The results showed that 82.9 % of the respondents were not aware about climate change and 17.1% of the respondents were aware about climate change. Only 36.7% of the respondents did not receive any information on climate change and 63.3% of the respondents received information on climate change through different sources. About 36.7% of the respondents received climate change information from radio, 27.5% from both radio and television and 35.8% of the respondents had no sources of information. It was found that 98.8% of the respondents observed an increase in temperature and rainfall.

Abegaz and wims (2014) studied extension agents' awareness of climate change in Ethiopia. For data collection systematic sampling method were used. Semi structured interview schedule were used for data collection. The results showed that 71.7% of the respondents said climate is changing, 18.3% of the respondents said they did not know and 10% of the respondents said climate is not changing. The sources of information about climate change was mass media which contributed 29 respondents followed by training, workshops and seminars 23 respondent, scientific reports and experts 16 respondents and internet 13 respondents.

Salim *et al.* (2014) studied climate change awareness, preparedness, adaptation

and mitigation strategies of fisher folk's in coastal Kerala. Total 971 fishing households were selected for sampling. The result showed that 75.1% of the respondents heard about climate change. About 24.1% of the respondents aware about climate change. It was found that the major source of information was the media, contributing to 44%, the fishers received information through audio- visual media as well as print media. Friends and relatives were also considered to be sources of information contributing to (41 %). State government organizations contributed to 21.5% as information sources.

Buloshi and Ramadan (2015) studied climate change awareness and perception amongst the inhabitants of Muscat Governorate, Oman. Methodology used for data collection involved a survey with questionnaire. Total 350 respondent were interviewed for data collection. The questions concentrate on knowledge and awareness about climate change, causes and impacts of the phenomenon as well as respondents responses. Majority of the respondents (77.3%) confirmed their awareness of a global campaign for climate change impact adaptation and mitigation. The result showed that the main source of information on climate change is television, out of which 48% of the respondent were dependent on international channel and 36% of the respondents were dependent on local for source of information. About 24% of the respondents were got information through internet and online.

Hasan (2015) studied artisan fishers' perception of and adaptations to climate change in the southeast coast of Bangladesh. Data was collected with the help of structured interview schedule. Data collected from direct field study, face to face interview and group discussion. Data was analysed using statistical package for the social science. The result revealed that major source of information through government agencies (87.2%), followed by friends and family (78.6%), media (70.4%) and Red Crescent society (59.1%).

Hoque (2015) conducted study on climate change awareness and risk perception of the coastal people in Bangladesh. About 240 respondents were interviewed with duly constructed schedule of questions by using multistage random sampling method. Awareness of the respondents were measured with their responses on three point continuum 'fully aware', 'somewhat aware' and 'not aware at all' with corresponding weightage of '3', '2' and '1' respectively. Perception of the respondents were measured with 5 point Likert scale was used for analysing consequence of climate change and data was analysed by using SPSS (Statistical Packages for Social Science) program. The result revealed that about 63.33% were fully aware of rise in temperature, followed by 52.08% of the respondents fully aware about increased drought and flood, 40.83% respondents were fully aware about rise in sea level and reduction in the availability of fresh water, 40.83% were fully aware of increased variability in rainfall and 38.33% of the respondents fully aware about reduction in number of species of forest tree, animal and fish.

Kibue *et al.* (2015) conducted study farmers knowledge, attitudes and perceptions. The methodology used for data collection was field survey. The data collected were analysed using statistical package for the social science. Total 293 samples were interviewed. The data were collected through structured interview schedule. The result revealed that 91% of the respondents heard about climate change. The main source of information about climate change from fellow farmers (73%), friends and family (73%), mass media (66%), extension officers (48%) and traditional knowledge (30%).

Orowole *et al.* (2015) studied analysis of level of awareness and adaptation strategies to climate change among crop farmers in Lagos State, Nigeria. Total 73 farmers selected through random sampling technique. The data were collected through

well- structured questionnaire. Descriptive statistics was used in analysing the data. The results revealed that 87.67% of the farmers were aware about climate change. The result showed that 92.12% of the farmers got information about climate change from extension agent, followed by friends and fellow farmers (79.69%) whereas lectures/ workshops (85.94%).

Shukla *et al.* (2015) studied perception of 300 Lepcha people in Kanchandzonga Biosphere Reserve by using personal structured questionnaire. Primary and secondary sources used for data collection. Respondents above 30 years age interviewed because they would have enough years of experience. Result showed that 85% of respondents were aware of climate change while 12 % of them were totally ignorant and only 3% respondents did not believe that temperature has increased.

Derso *et al.* (2016) examined the analysing farmer's awareness to climate change and trends of climate change in Bale Zone of Oromia National Regional State, Ethiopia. Data from selected area were collected through structured questionnaire. Total 396 wheat and barley producer households were selected through stratified simple random sampling. The result revealed that majority of the respondent 86.55% had awareness about climate change. The main sources of information for climate change were extension agents which accounts more than 95%. The other sources that have been used as source of information were friends (87.67%), farmers' cooperatives (59.78%) and different media (97.73%).

Din *et al.* (2016) studied local perception of climate change and adaptation in mangrove areas of the Cameroon coast. Data was collected with the help of semi structured interview. Total 425 respondents were selected for this study. The result revealed that 55% of the respondents have heard about climate change and 45% of respondents do not hear climate change. The main source of information of climate

change was from radio (20%), followed by television (17.7%) and newspapers (15%). About 78% of the respondents experienced rise of the temperature and rise of precipitation (67%).

Maiti *et al.* (2016) studied climate change awareness among the livestock rearers of east coast of India. Data collected with the help of random sampling. Total 480 livestock rearers were interviewed for data collection. There are 4 states in eastern coastal region of India namely West Bengal, Odisha, Andhra Pradesh and Tamil Nadu. Among these 4 states, two states i.e. Odisha and West Bengal were selected randomly. In overall Odisha, 40.271 % of livestock rearers were having higher level of awareness followed by 38.462 and 21.267 % were having lower and medium level of awareness, respectively. In West Bengal, 37.188 % of livestock rearers were having higher level of awareness followed by 31.973 and 30.839 % were having lower and medium level of awareness.

Salami *et al.* (2016) studied perception and awareness of climate change in Osogbo Metropolis, Nigeria. Data collected from both primary and secondary sources. While primary source of data were questionnaire and the secondary data were gathered from already existing and published works such a textbook, government reports, journals, news, magazines, internet and website. The results revealed that majority (87.1%) of the respondents were aware of climate change. The major sources of information on climate change was through radio/television (73.1%) followed by newspaper (54.4%), internet (43.1%), conferences/seminars/workshop (35.4%), friends (24.2%), researchers (23.6%), politicians (12.1%) and entrepreneurship centers (7.7%).

Salim *et al.* (2016b) conducted study myths and realities in the perception of climate change among the fishers in Kerala. Data was collected with the help of semi structured questionnaire from traditional fisher folk households of selected coastal villages. The results reported that 89.5% of the fishers have heard about climate change.

The main source of the information about climate change through electronic media (68.33%) followed by family members, friends and neighbours (58.33%), print media (57.00%), NGOs, organization and educational institutions (43.33%), local self-government (21.00%) and metrological services (3.67%).

Vani and Kumar (2016) studied awareness levels and adaptation strategies for climate variability among farmers. Data was collected with the help of structured interview schedule and 200 farmers were selected for study. Data was analysed by using computer software Statistical Package for Social Sciences (SPSS). The results showed that majority of the respondents (66.7%) were aware of climate change and 33.3% of respondents were not aware about climate change. The main source of information on climate change was through media (60%), and University extension (25%). The awareness of the respondents as to the causes of climate change shows that nearly 35.8% of the respondents don't know the reasons for climate change.

Elum *et al.* (2017) conducted study on farmers' perception of climate change and responsive strategies in three selected provinces of South Africa. The methodology used for data collection was simple random sampling technique. Total 150 farmers were selected for collection. About 75 cabbage farmers and 75 potato farmers were interviewed. Data was collected with the help of structured questionnaire. The results revealed that 94.67% of the cabbage farmers were aware about climate whereas 90.67% of the potato farmers were aware about climate change. About 53.33% of the cabbage farmers got information on climate change through news media followed by 34.67% through public extension agents and 32% through own observation and experiences. Whereas, 74.67% of the potato farmers got information through news media followed by 38.67% through own observation or experience and 32% through public extension agents.

Fishers' perception of climate change on freshwater fisheries and the role of systems in their adaptation strategy in central river region of the Gambia was studied by Bah *et al.* (2018). Primary and secondary data were used for information collection. Primary data was collected using focus group discussions and key informant interviews. The data were collected through semi- structured questionnaire. Total 77 respondents were selected using random sampling technique out of 70 samples useful. The secondary data included data on climate variables. The result revealed that about 95.7% of the respondents were aware or heard about climate change. The result showed that 70% of the respondents got main source of information on climate change from radio/mass, followed by 44.3% from fisher folk to fisher folk, 17.1% from extension services, 14.3% from personal experience, 7.1% from neighbour farmers and 4.3% from farmers association. The result also revealed that 1.4% of the respondent got least source of information through market places, rumours, workshops, researchers and project/NGO/program. About 90% of the fishermen experienced increase in temperature is the main effect of climate change. About 44% of the respondents said that the drought is also an effect of climate change. Increased winds (60%), decreased rainfall (35.7%) and flood (21.4%) respectively were effects of climate change experienced by fishermen.

Agesa *et al.* (2019) studied climate change effects on crop production in Yatta sub- County. Data were collected with the help of using a semi- structured questionnaire. A stratified random sampling procedures was used for sampling. The results showed that about 98.3% of the respondents had knowledge about climate change. It was found that the main source of information on climate change for farmers were extension officers contributing to a 72% and friends (21%). Radio, own knowledge, newspaper and seminars were also considered to be sources of information contributing 14%, 12% and 2% respectively.

2.2 Perception

Ishaya and Abaje (2008) studied indigenous people's perception on climate change and adaptation strategies. A total 225 face-to-face interviews were conducted with the help of questionnaire. Descriptive analysis was used for data analysis. The results revealed that about 73% of respondents perceived rising temperature, followed by decreased rainfall (83.5%), flood and drought (81%) over the past few decades. The study concluded that the change in climate pattern leads to unpredictable and erratic rainfall pattern, warmer temperature, increased deforestation and frequency of drought.

Hoque and Banna (2010) studied perception and awareness of Bangladeshi urban people on climate change and its impact on food security. Total 71 respondents were selected using snowballing method and self-administered questionnaire was used. SPSS (Statistical Packages for Social Science) program was used for data analysis. Result showed increase in temperature (78.87%) was the highest adverse effect of climate change as perceived by respondents followed by 'pollution (38.03%) and disaster (29.58%) respectively. Adequate training programme and promotional campaign on climate change awareness should be conducted for creating general awareness.

Sarkar and Padaria (2010) studied farmers' awareness and risk perception about climate change in coastal ecosystem of West Bengal. Random sampling was conducted in six villages and 120 farmers were interviewed. Study revealed that respondents perceived consequences of climate change as heavy inundation of cultivable land (80%), migration of people and animals from Sundarbans (68%), increase in frequency of flood (64%), increase of sea water will lower the availability of drinking water (76%), impact on biodiversity and coastal ecosystem of Sundarbans (56%), reduction in number of fish species (32%). The study suggested need for appropriate adaptation and mitigation strategy at state level and community level by involving the local people for dealing with

climate change.

Tologbonse *et al.* (2010) studied farmers' perception of effects of climate change and coping strategies in three agro-ecological zones of Nigeria. Methodology used for data collection was random sampling technique. Total 150 farmers were interviewed using structured interview schedule. Data analysed by descriptive statistics involved frequency counts, mean and percentage. The inferential statistics and Likert scale were used to analyse data. The results showed that 67% of the farmers strongly agree that temperature had increased, 55% strongly agreed that there is reduce yields of crops. About 61% of the respondents strongly agree that the increases poverty rate of farmers.

Deressa *et al.* (2011) studied perception of and adaptation to climate change by farmers in the Ethiopia. Total of 1000 farmers are selected for collecting information. The results revealed that 0.51 farmers' perceived temperature is increasing and 0.53 farmers' perceived decreasing rainfall over the past 20 years. About 0.14 respondents said temperature stayed same, 0.02 farmers claimed decreased temperature, 0.12 claimed precipitation stayed same and 0.10 said precipitation is increased past few years.

Maharajan *et al.* (2011) studied *Tharu* community's perception on climate changes. Primary information was collected with the help of using focus group discussions with farmers, members of Biodiversity Conservation and Development Committee. One day focus group discussion was carried out in each village with 50 participants. About 90% of the respondents perceived increased risks and uncertainty of the climate. Drought ranked first as major climatic risk and storm ranked second as climatic risk and flood ranked third climatic risk as perceived by respondents in Gadariya village. Flood ranked first as major climatic risk and river bank erosion ranked second as climatic risk and heavy fog ranked third climatic risk as perceived by respondents in Shankarapur village.

Aphunu and Nwabeze (2012) studied fish farmers' perception of climate change impact on fish production in Delta State, Nigeria. The methodology used for data collection was multi stage random sampling technique. Data was collected through the semi structured interview schedule. Data were analysed using mean score. The results revealed that the fish farmers on their perception of climate change impacts were destruction of property due to heavy rainfall with 3.06, followed by caused drastic change in weather condition with 3.04, increased incidence of flooding with 2.86, high temperatures and heat waves with 2.64, poor harvest of fish with 2.54, increased incidence of draft with 2.29 and increased cost of fish production with 2.34.

Roy (2012) studied economic analysis of producers' perceptions about impact of climate change on fisheries in West Bengal. Simple random sampling was used to select 80 respondents purposively from 12 villages of four blocks. A structured questionnaire was prepared for data collection. Secondary sources of information were also recorded to substantiate the primary data. Descriptive as well as tabular analyses were followed for analysis. The findings shows that 47.5 per cent of the respondents had low level of awareness about climate change. Only 22 per cent of the respondents showed a positive perception.

Ghimire and Aryal (2013) studied perception and adaptation to climate change of farmers in Nepal. Altogether 151 farmers were selected with the help of using random sampling methods. Data were collected through structured questionnaire. The chi-square test was used for analysis of perception of farmers about climate change. Result showed that 65.7% of farmers perceived climate is changing and 34.3% of respondents does not perceived climate is changing. About 51.5% respondents perceived change in temperature however 48.5% of respondents' perceived change in rainfall. The study concluded that a monsoon precipitation is slightly increasing and erratic rainfall and

winter rain is decreasing.

Geetha *et al.* (2015) studied indigenous technical knowledge of coastal fisherfolk on climate change. A structured questionnaire was used to collect the primary data. Garrett ranking technique was used to rank the fishermen's perception on different climatic parameters as well as their importance & major problems. The results revealed that all the fishermen's were opinion that major changes in climatic parameters occurred in last 10 years particularly wind direction, speed, current & coastal upwelling perceived by the fishermen to predict fishing ground & other fishing activities. Whereas major problems facing fisheries, fishermen ranked first overfishing as main problem, juvenile exploitation as a second rank followed by habitat destruction & climate change.

Hasan (2015) studied artisan fishers' perception of and adaptations to climate change in the Southeast coast of Bangladesh. Data was collected with the help of structured interview schedule. Data collected from direct field study, face to face interview and group discussion. Data was analysed using statistical package for the social science. The results revealed that one third of the respondents over 40 years had a good knowledge on local environment and little more than half the respondents in each age group had a moderate knowledge about climate change. Majority of the fishers agreed about frequency of extreme climatic events has increased, the fishers in Chakaria who live 10 to 15 km inside the coastline, were more concerned about sea level rise, about 80% of fishers from Chakaria and 60% of fishers from Chittagong agreed that rainfall pattern was changing and vast number of fishers from Chakaria and Chittagong agreed that average temperature was increasing.

Hoque (2015) conducted study on climate change awareness and risk perception of the coastal people in Bangladesh. To study about 240 respondents were interviewed with duly constructed schedule of questions by using multistage random sampling

method. Perception of the respondents were measured with 5 point Likert scale was used for analysing consequence of climate change and data was analysed by using SPSS (Statistical Packages for Social Science) program. Result showed that, majority (24.17%) of the respondents perceived change in climate is as a result of God's plan, (23.3%) of the respondents perceived cause of climate change due to fire to bushes before farming, followed by deforestation (20%), industrial waste (15%) and farming alongside river bodies been 6.7%. Migration of people and animal from coastal areas become the top most perceived imminent threat to the respondents with mean score 4.46.

Kibue *et al.* (2015) conducted study on farmers' knowledge, attitudes and perceptions. The methodology used for data collection was field survey. The data collected were analysed using statistical package for the social science. Total 293 samples were interviewed. The data were collected through structured interview schedule. The results showed that 66% of the respondents agreed that adverse effects on agriculture, 58% severe hunger and malnutrition, severe droughts and floods (55%), decrease in water quantity and quality (59%), change in vegetation composition (60%), increased incidences of human diseases (73%) and conflicts among communities (54%) will result from climate change. Many farmers (48%) agreed that land degradation will occur due to climate change, (37%) were not sure if climate change will result in livestock and crop diseases and only 38% of the farmers agreed that climate change will cause rise in poverty levels.

Nkuwsi *et al.* (2015) studied climate change farmer's awareness, perceptions & responses in Lagos state. Data was collected from a direct field study, interviews & questionnaires. A 4 Point Likert scale were used to measure perception of farmers about climate change. The results showed that about 93.33% of the respondents confirmed that the average daily temperature was increased and 4.79 % of the respondents confirmed

that there was no increase in temperature. About 79.04% of the respondent believed that there is a reduction in rainfall pattern over the past 10 years. Almost 20.06% of the respondents do not believe that there is reduction in rainfall pattern.

Salim *et al.* (2015) studied assessment of fishers' perception in developing climate change adaptation and mitigation plans. Total 300 respondents were selected randomly for collection of data. The semi structured interview schedule was used for collecting information. For analysis of respondents' age, gender and education was prepared for percentage analysis. The results revealed that 88.32% of the respondents perceived that fish catch reduction is the most important impact of climate change on resources. Fishing efforts has increased were perceived as the impact of climate change by 50.61% of the respondents. About 48% of the respondents were of the opinion that fishing efforts has increased and 64% of the respondents were opinion that income level of fishers has decreased. Change in the employment pattern were perceived as the impact of climate change by 46% of the respondents. About 51% of the respondents reported that the seasonality of the employment was considered as impact of climate change.

Shukla *et al.* (2015) studied farmer's perception & awareness of climate change. Data was collected from primary and secondary sources. Pre- structured questionnaires survey was used for primary data collection for perception studies. Majority of the respondents 85% was believed or aware about experienced temperature increase. While, 12% of the respondents totally ignore the temperature increase only 3% of the respondents did not believe that temperature was increased. About 76% of the respondents believed that rainfall is unpredictable or changing pattern. About 59% of the respondent believed that seasons were changing.

Swe *et al.* (2015) studied farmers' perception of and adaptation to climate-change impacts in the dry zone of Myanmar. Total 106 farmers were selected. Household survey

and key-informant interviews were used to collect information. The Study revealed that majority (90%) of the respondents perceived the changing climatic patterns in environment. The respondents perceived increasing temperature (36%), followed by uneven rainfall distribution (21%), increasing rainfall (8%) and decreasing rainfalls (20%). About 70% of the respondents' perceived deforestation was major cause of climate change.

Menon *et al.* (2016) studied fishermen's perception of climate change in Andhra Pradesh. The contingency tables were created to study the effect of age, experience, area of residence and fishing sector on the rankings. All 301 fishermen interviewed believed that climate had changed during the last 20 years. The highest percentage of respondents (age-based and area-based) categorized wind as the climatic feature that has changed the most in the last 20 years, followed by temperature and rain. The most important climatic factor that was perceived by the fishermen to change the most was wind speed and direction followed by temperature and rain. Coastal protection structures and safe exit from fishing villages in the event of a weather hazard were perceived to be the best adaptation strategies by the fishermen.

Niles and Mueller (2016) studied farmer perceptions of climate change. Data collected with help of using stratified random sampling technique. Data collection through interview schedule. Total 490 farmers were interviewed. The results revealed that the 45% of the farmers believed that summer temperature had decreased, 42% believed that temperature stayed same over time and only 13% of farmers believed that temperature had decreased. For winter temperature, 42% of the respondent believed that temperature had stayed same, 39% believed temperature increased and 19% of respondent believed that temperature decreased. For rainfall, 51% of the respondent

believed that they increased, 42% of believed rainfall stayed same and 7% believed rainfall had increased.

Salami *et al.* (2016) studied perception and awareness of climate change in Osogbo Metropolis, Nigeria. Data collected from both primary and secondary sources. While primary source of data were questionnaire and the secondary data were gathered from already existing and published works such a textbook, government reports, journals, news, magazines, internet and website. The results revealed that 49.2% of the respondents has a knowledge of climate change to a reasonable extent, followed by 28.3% of respondents have little knowledge, 18.1% has great extent and very few of the respondents do not any knowledge about climate change. About 64% of the respondents perceived high temperature, 56.9% of respondents understand irregular rainfall, 30.2% of respondents' perceived high winds and heat waves, and 27.7% of respondents said that increased incidence of drought.

Salim *et al.* (2016b) conducted a study on myths and realities in the perception of climate change among the fishers in Kerala. Data was collected with the help of semi structured questionnaire from traditional fisher folk households of selected coastal villages. Findings of the study showed that 97% of the respondent were of the opinion that the temperature rise, 65% of changes in wind pattern, 40% of sea water intrusion, and 20% of erratic weather. It was reported that substantial reduction in income was most prominent impact of climate change perceived by the respondent with 94.44%, seasonality of employment with 61.11%, change in employment pattern with 50%, and change in employment pattern with 46%.

Alam *et al.* (2017) studied climate change perceptions and local adaptation strategies of hazard –prone rural households in Bangladesh. Data collected from riverbank erosion-prone areas in Bangladesh using a multistage sampling technique.

Data were collected using face to face interviews. Perception of climate change in various climatic variables for last 10 years were collected using a 4-point Likert scale (increase, decrease, no change, don't know). The result shows that, 91% of the respondents believed that the temperature increased & 89% believed that rainfall had decreased. About 83% and 81% of the respondents suggested that the frequency of flood and cyclone respectively had increased.

Elum *et al.* (2017) conducted study on farmers' perception of climate change and responsive strategies in three selected provinces of South Africa. The methodology used for data collection was simple random sampling technique. Total 150 farmers were selected for collection of information. About 75 cabbage farmers and 75 potato farmers were interviewed. Data was collected with the help of structured questionnaire. The results showed that 77.3% of the potato farmers experienced high temperature & 66.7% of the cabbage farmers experienced high temperature. About 49.33% of potato farmers & 46.67 of cabbage farmers experienced drought.

Geetha *et al.* (2017) studied vulnerability and climate change in Cuddalore district Tamil Nadu. The coastal villages of Cuddalore district was selected for study based on the impact of earlier cyclones and other climatic events. Total 10 villages were selected and 100 respondents from each village were randomly chosen and interviewed. A well-structured interview schedule was used for collection of information. The result reported that about 67.8% of the respondents claimed that sea level rise has highly impacted the environment, followed by, extreme weather events (56.1%), monsoonal fluctuation (54.5%), seawater inundation (46.6%) and habitat destruction (18.4%).

Haque & Hussain (2017) studied perception of the regional political leaders on climate change. Data were collected from both primary & secondary sources. The primary data were collected using questionnaire & interview. The secondary data were

collected through books, journals, research articles, government reports. For this study, questionnaire was used to get specific data to know perception of respondents. Both open ended & close ended questions were used. For analysis of perceptions of respondents weighted mean index was used. The result revealed that the opinion regarding causes of climate change, 98% of the respondents said that emission of smokes from industrial plant is linked with climate change. Whereas, 97% of the respondents have opinion that the deforestation is related to climate change. Almost 97% of the respondents said that the carbon emissions from vehicle is responsible for change of climate. The perception about impacts of climate change result shows that the 95% of the respondent said that unseasonal rainfall increased despite that 86% of the respondent agree with the statement the time of rainy season the no. of rainy days reduced. About 60% of the respondent perceived that sea level is rising. Among 95% respondents said climate change is responsible for the increase of flood occurrence.

Shisanya *et al.* (2017) studied assessing rural farmers' perception & vulnerability to climate change in UMzinyathi district of Kwazulunatal, South Africa. Data collected with the help of focus group discussion & key informant interview. Analysis of community responses to their perceptions on climate change was analysed using SPSS programme. Total 200 respondents were selected for data collection. The results revealed that temperature had increased by 1.5⁰c over 17 years & rainfall had decreased. About 78% of the households indicated that summer temperatures had increased and 62% said that hot periods had also increased. A majority 70% of households indicated that winter temperatures were becoming warmer and 55% indicated that the length of cold season was getting shorter.

Uddin *et al.* (2017) examined farmers' perception of climate change a case study from the coastal region of Bangladesh. Data were collected through structured

questionnaire with open and close ended questions. Face to face interviews were conducted with 100 farmers. Data were analysed by using logistic regression, weighted indexes and descriptive statistics. The result revealed that 88% of the farmers experienced climatic change events. About 100% of the farmers perceived that temperature is increased. 96.6% of farmers said that rainfall has decreased. While, 90.9% of the respondents perceived unpredictable rainfall, 80.7% perceived changes of monsoon season. All farmers perceived occurrence of drought, cyclones, floods and salinity level has increased.

Yusuf (2017) studied an assessment of Crop Farmer Households' Perceptions of Climate Change and Coping Strategies in Kano State, Nigeria. Multistage sampling procedure were used for collecting the sample. Total 407 respondents were selected for data collection. Perception of the respondents on effects of climate change was analysed with the help of Likert scale. The results showed that mean score for decrease in crop production was 5 and it indicates that respondent strongly agree that climate change decrease crop production. The mean score for increase pest and disease infestation was 3.79, decrease soil fertility was 3.86, increase soil erosion was 3.84, increase in cost of food crops was 3.68 and decreases food availability was 4.25. While increase in stunted growth was 3.25 indicated neutral response and it is the least effect perceived by the respondents. The average mean score of farmers perception was 3.93 that indicates that respondent perceived climate change led to decrease crop production.

Pandey *et al.* (2018) conducted study on climate change adaptation in Western Himalaya's household level perspectives on impacts and barriers. For data collection questionnaire was composed of a total 30 questions including open-ended, Likert scale, and close-ended questions. The findings of the study 89% of the respondents agree that climate change is real. The results showed that 85% of the respondents agree with

increased average local temperatures and increased occurrence of extreme temperature.

Somboonsuke *et al.* (2018) studied farmers' perception of impacts of climate variability on agriculture and adaptation strategies in Songkhla lake basin. Data was collected using semi structured interviews from a total sample size 271 farmers. Farmers highly suffered from nine negative impacts of climate variability on rice production. Succession in paddy field with the next generation has reduced, reduced rice traditions, reduced yield, labour movement from paddy field to non-agricultural areas, loss of local wisdom these five most negative impact. The two high negative impacts of climate variability on rice production were reduction in the number of local varieties of rice, change of method of rice planting. The two moderate negative impact of climate variability on rice production were reduction of paddy field area owing to transformation to areas under oil palm and para-rubber plantations, the influx of seawater from storm surges into paddy fields leading to a reduced area of suitable paddy fields.

3.0 MATERIAL AND METHODS

3.1 STUDY AREA

Coastal Ratnagiri block, Ratnagiri district of Maharashtra on the west coast of India, with geographical location ($17^{\circ}18'38.69''$ N and $73^{\circ}11'38.14''$ E) was selected for the present study. Seven villages *viz.* Bhatye, Karla, Rajiwada, Shirgaon, Mayekarwadi, Sakhartar and Kalbadevi were selected from Ratnagiri block for the present study. The villages were selected considering the estuaries in respective villages.

3.1.1 Bhatye

Bhatye ($16^{\circ}97'04.06''$ N latitude and $73^{\circ}30'44.99''$ E longitude) located 4 Km away from Ratnagiri city was selected for study. The geographical location of Bhatye is shown in Map 1 and Photo 1.

3.1.2 Karla

Karla village ($16^{\circ}97'52.70''$ N latitude and $73^{\circ}30'64.73''$ E longitude) is situated near Rajiwada village on Kajali estuary was selected for study. The geographical location of Karla village is shown in Map 1 and Photo 2.

3.1.3 Rajiwada

Rajiwada a small fishing village ($16^{\circ}98'42.73''$ N latitude and $73^{\circ}30'11.79''$ E longitude) is situated on the Kajali estuary south west of Ratnagiri city. The geographical location of the Rajiwada is shown in Map 1 and Photo 3.

3.1.4 Shirgaon

Shirgaon fishing village ($17^{\circ}02'56.67''$ N latitude and $73^{\circ}29'09.87''$ E longitude) is situated near Shirgaon estuary and 6.5 km from Ratnagiri city. The geographical location of Shirgaon is shown in Map 1 and Photo 4.

3.1.5 Mayekarwadi

Mayekarwadi ($17^{\circ}02'56.67''$ N latitude and $73^{\circ}29'09.87''$ E longitude) is situated

MAP 1 Study area

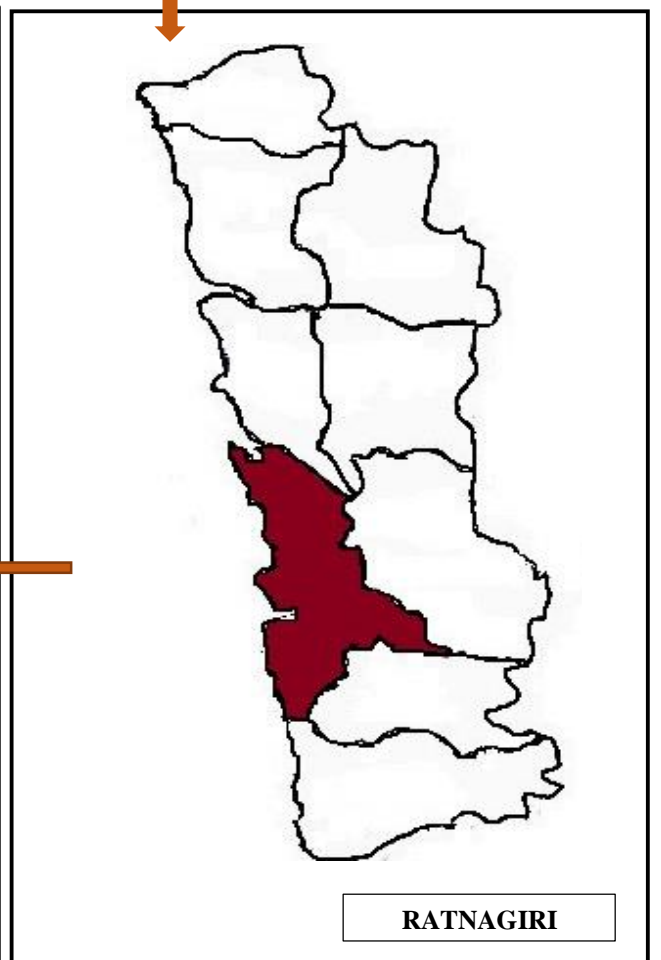
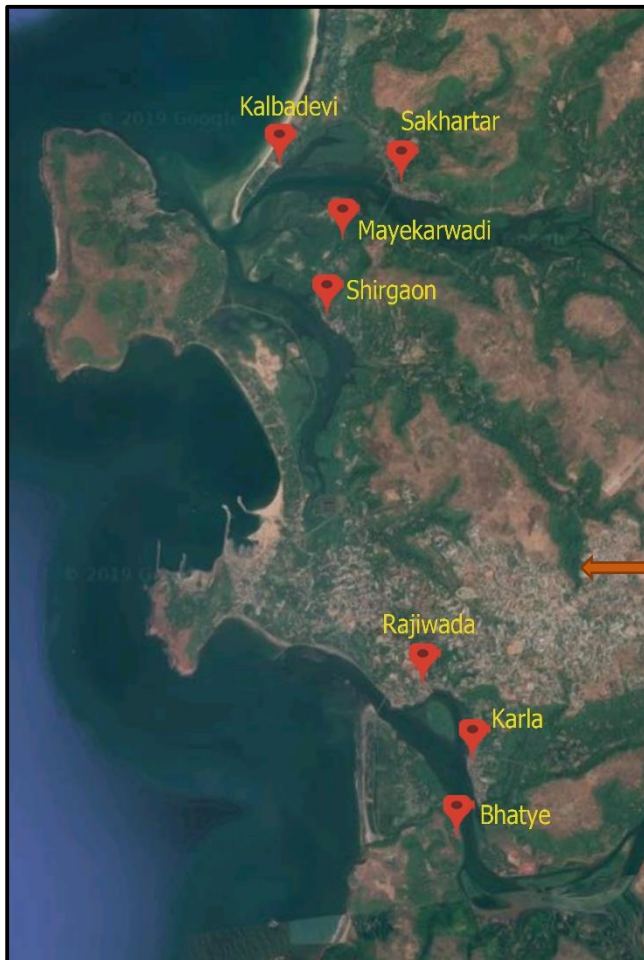
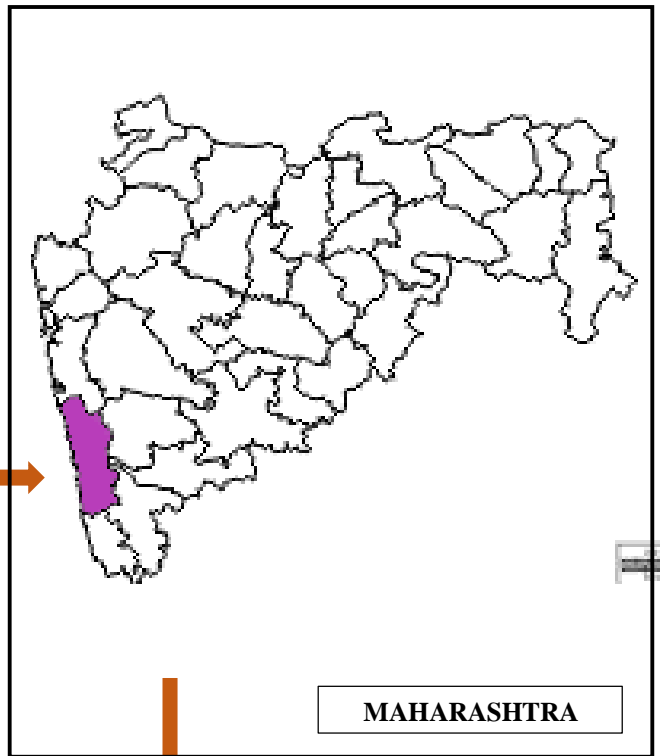
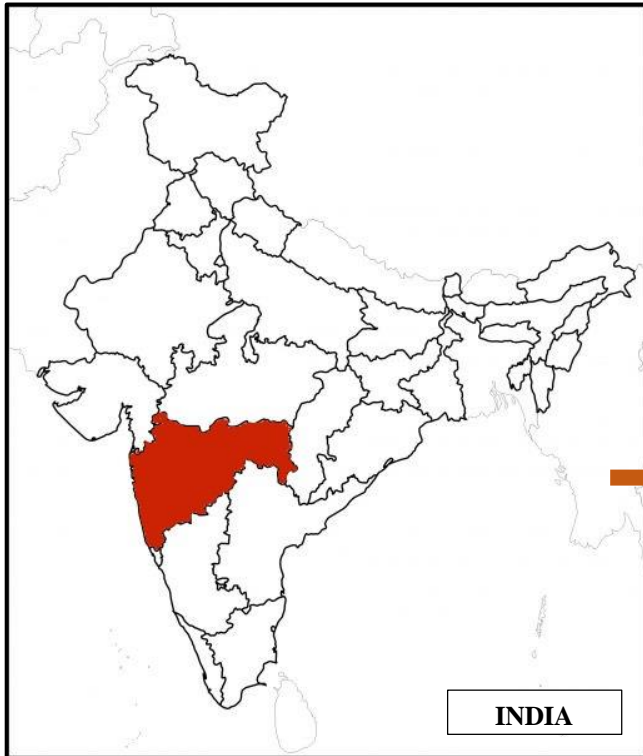




Photo 1 Bhatye village



Photo 2 Karla village



Photo 3 Rajiwada village



Photo 4 Shirgaon village



Photo 5 Mayekarwadi village



Photo 6 Sakhartar village

8 km from Ratnagiri city. The geographical location of Mayekarwadi is shown in Map 1 and Photo 5.

3.1.6 Sakhartar

Sakhartar a small fishing village (17⁰04'23.67''N latitude and 73⁰29'09.87 E longitude) is situated on the bank of Kalbadevi estuary 13 km away from Ratnagiri city was also selected for the present study. The geographical location of Sakhartar is shown in Map 1 and Photo 6.

3.1.7 Kalbadevi

Kalbadevi village is a small fisher village (17⁰04'81.38'' N latitude and 73⁰28'38.16'') was selected for study. It is situated on Kalbadevi estuary. The geographical location of Kalbadevi is shown in Map 1 and Photo 7.

3.2 SAMPLING UNIT

The interview schedule are designed to obtain information on the socio-economic status, awareness about climate change and perception about climate change of estuarine fishers.

3.3 INTERVIEW SCHEDULE

Interview schedule was prepared as per the Hasan (2015), Salim *et al.* (2014), Salim *et al.* (2015), Salim *et al.* (2016b) and Uddin *et al.* (2017). A test run was undertaken to check the correctness of the interview schedule. The interview schedule was divided into three sections. The first section was designed to collect information about social aspects of the estuarine fishers (e.g. Age, education, fishing experience, gender, marital status, ration card etc.). Second section dealt with the estuarine fishers' awareness about climate change and the third section dealt with their perception about climate change. The final interview schedule need in the study is given in Annexure I.



Photo 7 Kalbadevi village

3.4 SAMPLING PROCEDURE

Data were collected from estuarine fishers of each selected villages by using simple random sampling method (Snedecor and Cochran, 1967). Altogether, 73 respondents were interviewed from selected area and the details of the sample size are given in Table 1.

3.5 STATISTICAL ANALYSIS

Test statistics was applied wherever required and tested at 5% level of significance.

3.5.1 SOCIAL ASPECTS

3.5.1.1 Age

Distribution of estuarine fishers were constructed according to age groups. Similarly the family members were also classified according to age groups. Expected frequencies for different age groups were calculated by fitting normal distribution (Biradar, 2002). Significant differences in observed and expected frequencies were tested by goodness of fit Chi-squares test (Snedecor and Cochran, 1967).

3.5.1.2 Education

Estuarine fishers and family members were classified into different classes such as illiterate, primary, secondary, higher secondary, graduate, ITI and diploma according to various age groups. Estuarine fishers were classified into two- way contingency table according to age groups and educational status. Chi-square test of independence was applied to $r \times c$ contingency tables (Panse and Sukhatme, 1985).

Table 1 Village-wise sample size of estuarine fishers

Sr.no	Sampling village	Number of respondents
1	Bhatye	8
2	Karla	29
3	Rajiwada	13
4	Shirgaon	3
5	Mayekarwadi	4
6	Sakhartar	9
7	Kalbadevi	7
Total		73

3.5.1.3 Fishing experience

Estuarine fishers were classified according to numbers of years of fishing experience. Expected frequencies for different numbers of years of fishing experience were calculated by fitting normal distribution (Biradar, 2002). Significant differences in observed and expected frequencies were tested by goodness of fit Chi-squares test (Snedecor and Cochran, 1967).

3.5.1.4 Religion

Religion of estuarine fishers was recorded. Percentages analysis was carried out.

3.5.1.5 Marital status

Estuarine fishers were classified as per their marital status such as married, unmarried and widow or divorcee. The percentages were calculated and data were represented with the help of pie diagram.

3.5.1.6 Family type

Estuarine fishers also classified on the basis of family type such as nuclear and joint family and the percentages according to category were calculated.

3.5.1.7 House type

The nature of house in which estuarine fishers resided were categorised as semi-*pucca* house (tiled with tiled roof), *kachcha* and *pucca* house (concrete). The percentages were calculated.

3.5.2 AWARENESS

3.5.2.1 Fishers heard about climate change

Fishers' responses about climate change were recorded. Fishers' responses about whether they know that the climate is changing or they do not know about climate change. The percentages were calculated and data were depicted by pie diagram.

3.5.2.2 Sources of information

The main sources of information on climate change through friends, family, television, radio, newspaper, internet, government agencies and own experience were recorded. The percentage were calculated and data were presented with help of bar chart.

3.5.2.3 Experienced impact of climate change

A three- point continuum was used to rank the fishers response to change in temperature, change in rainfall pattern, drought, floods, availability of water, fishing days, number of species caught, fish catch. The three- point continuum was increased, decreased and normal. In order to analyse the beach morphology and type of species caught two-point continuum was used. The two-point continuum was erosion/deposition and regular/ different respectively. Wherever necessary percentage and averages were calculated to summarise the data.

3.5.2.4 Climate friendly practices

The Garret ranking technique was used to identify and rank climate friendly practices to prevent climate change. The advantage of this technique over simple frequency distribution is that the practices are arranged based on their importance from the point of view of the respondents. The percent position of each rank was converted into scores referring to the table given by Garret and Woodworth (1969). Garrets formula for converting ranks into percent is given below:

$$\text{Percent Position} = \frac{100 * (R^{ij} - 0.5)}{N_j}$$

Where,

R^{ij} = Rank given for i^{th} factor by j^{th} individual

N = Number of factors ranked by j^{th} individual

For each practice, the scores of the individual respondents were added together and

divided by the total number of respondents who gave scores and based on the mean scores they were given. These mean scores for all the practices were arranged in descending order and the most important factor was ranked first and the least important problem was ranked last.

3.5.3 PERCEPTION

3.5.3.1 Local knowledge about climate change

Estuarine fishers' responses about their traditional local knowledge on climate change were recorded. The data was classified as excellent, moderate and poor. The percentage analysis was used and data were depicted by pie diagram.

3.5.3.2 Level of agreement about climate change

Level of agreement on various statements about climate change among estuarine fishers was recorded. These agreements were classified into 5 Likert scale such as strongly disagree, disagree, ambivalent, agree and strongly agree. Data was analysed with component score. Results were presented with the help of radar chart.

3.5.3.3 Climate change disrupt the elements

In this study fishers were asked to indicate their level of concerned about possible disruptions of climate change on various elements. It was classified as not at all concerned, slightly concerned, moderately concerned, very concerned and extremely concerned. Data was analysed and presented with the help of radar chart.

3.5.3.4 Impact of climate change

Impact of climate change on resource, resource users and environment factors were classified as 5-point Likert scale used to measure the perception of fishers about

climate change. The average maximum score of 292 (4×N i.e.73) for each fishers could be achieved. The score given by each estuarine fishers were summed up to have score of 73 estuarine fishers. The data obtained was normalized and rescaled from 0-1 using the formula;

$$Index\ Si = \frac{Si - S_{min}}{S_{max} - S_{min}}$$

Where,

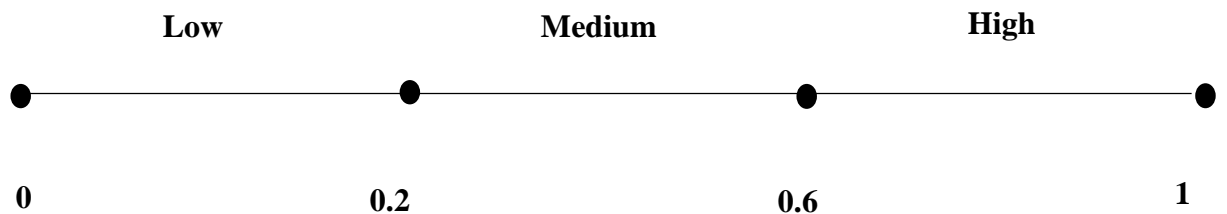
Index Si = Normalized value of an indicator

Si = Actual value of same indicator

S_{min} = Minimum value of same indicator

S_{max} = Maximum value of same indicator

Component score for impact of climate change



4.0 RESULTS

About 73 estuarine fishermen were interviewed from seven coastal villages of Ratnagiri taluka. Data on socio-personal information, awareness about climate change and perception about climate change were collected. The obtained results after data analysis are presented as follows.

4.1 Socio- personal information of estuarine fishermen

The personal information of the estuarine fishermen such as age, education, experience, religion, marital status, ration card, family type were collected during the present study. The analysis of the same is presented here.

4.1.1 Age structure of estuarine fishers

Average age of estuarine fishers was 50.91 ± 1.62 years. Maximum percentage of estuarine fishers were in the 31-40 age group (27.40%), which was followed by 49-58 age groups (19.17%). Minimum percentage of estuarine fishers were in the 22-31 and 76-85 age groups (2.74%). Distribution of age of estuarine fishers was positively skewed. The skewness coefficient recorded was 0.26. Number of estuarine fishers according to age group showed significant differences in 31-40 age group ($P < 0.05$). The observed and expected number of estuarine fishers distributed according to age group and is given in Table 2 and Fig. 1.

4.1.2 Age structure of family members of estuarine fishers

All the estuarine fishers family members sampled from different villages in the Ratnagiri were classified according to age groups is given as Table 3 and Fig. 2 respectively. Average age of the family members of the estuarine fishers was 34.73 ± 1.09 years. Maximum percentage of members were in the 14-26 age group (24.01%), which was followed by 27-39 age group (20.06%). Minimum percentage of family

Table 2 Classification of estuarine fishers according to age groups

Sr. No.	Age group (Years)	Number of fishers	
		Observed	Expected
1	22-31	2 (2.74)	2.86
2	31-40	20* (27.4)	6.88
3	40-49	13 (17.81)	13.82
4	49-58	14 (19.17)	29.10
5	58-67	12 (16.44)	15.27
6	67-76	10 (13.7)	3.86
7	76-85	2 (2.74)	1.21
Total		73	73

(* indicates significant difference $P < 0.05$)
(Figures in parentheses indicate percentages)

Fig. 1 Distribution of estuarine fishers according to age group

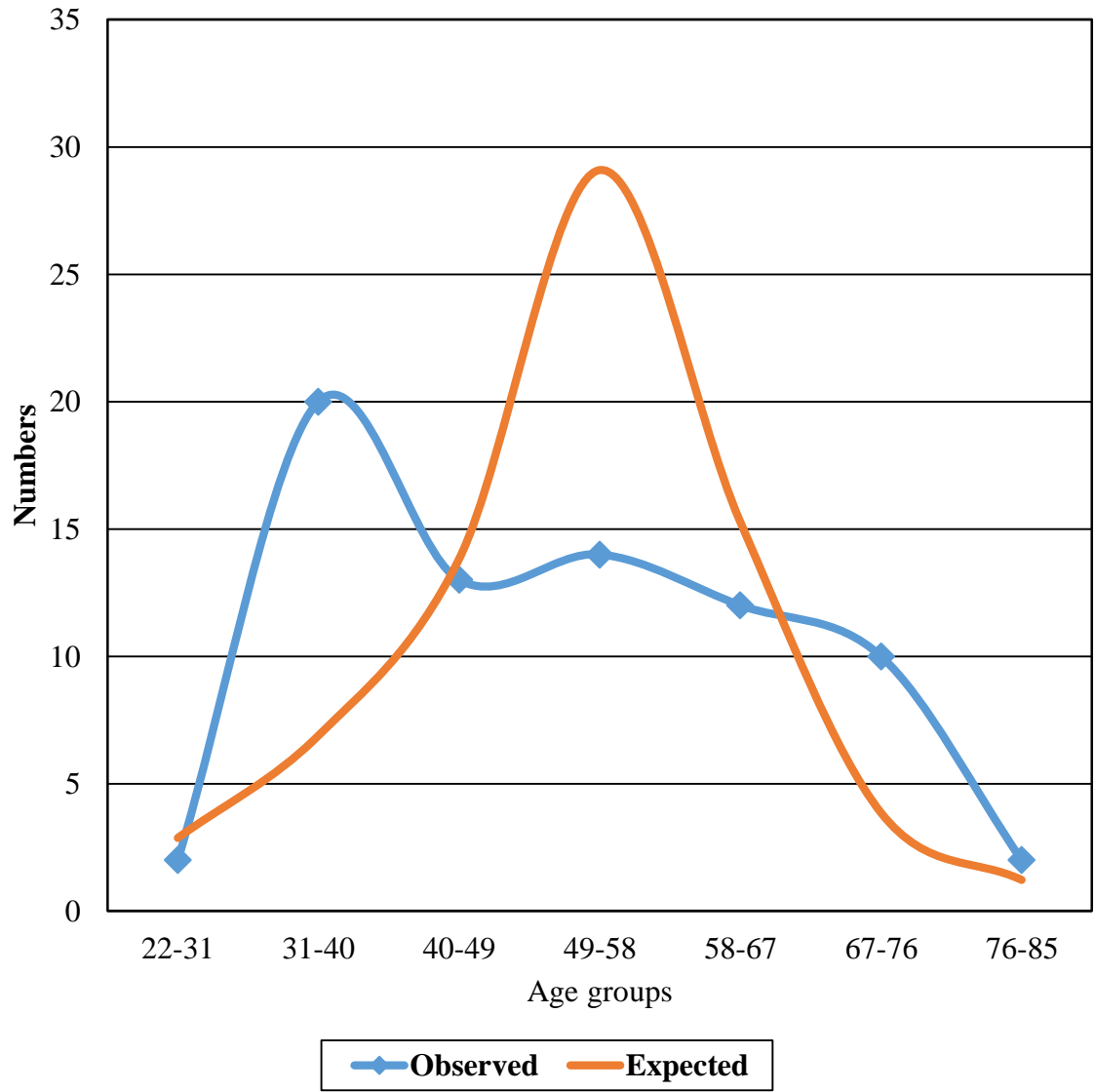
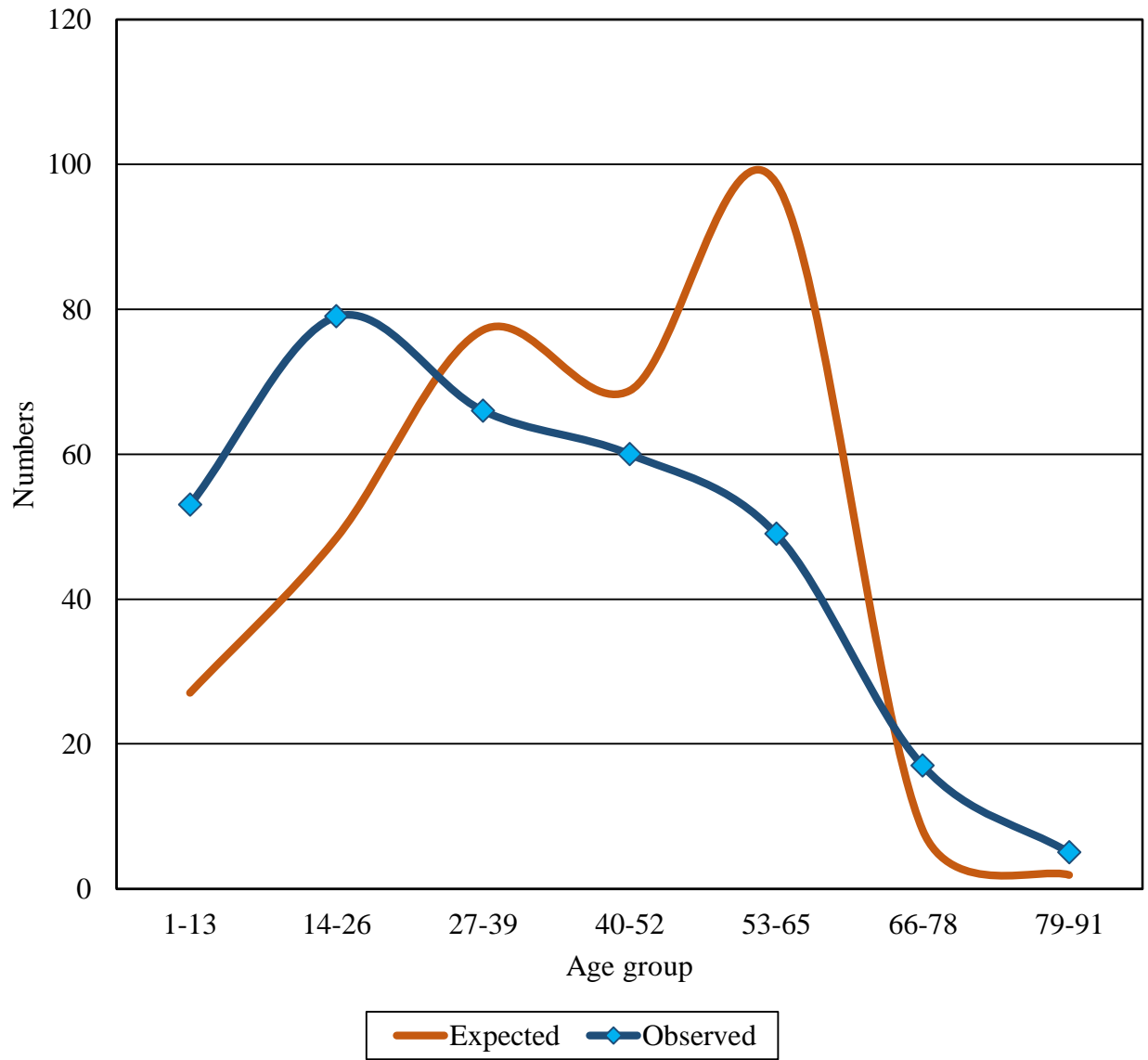


Table 3 Classification of family members of estuarine fishers according to age groups

Sr. No.	Age group (Years)	Observed	Expected
1	1-13	53* (16.11)	27.08
2	14-26	79* (24.01)	48.46
3	27-39	66 (20.06)	77.15
4	40-52	60 (18.24)	68.76
5	53-65	49* (14.89)	97.45
6	66-78	17 (5.17)	8.16
7	79-91	5 (1.52)	1.94
Total		329	329

(* indicates significant difference $P < 0.05$)
(Figures in parentheses indicate percentages)

Fig. 2 Distribution of family members of estaurine fishers according to age group



members were in the 79-91 age group (1.52%). Distribution of age of estuarine fishers' family members were positively skewed. The skewness coefficient recorded was 0.28. Number of family members of estuarine fishers in the age groups of 1-13, 14-26 and 53-65 age groups showed significant differences ($P < 0.05$).

4.1.3 Educational status of fishers

4.1.3.1 Status of education according to age of estuarine fishers

Educational status of estuarine fishers is given in Table 4 and Fig. 3 respectively. Educational categories were illiterate, primary and secondary education level. Most of the estuarine fishers were educated up to secondary level education (78.08%), followed by primary level education (17.81 %). Only 4.11% of the fishers were illiterate. Out of 73 respondents, 57 had completed secondary education level, of which maximum 24.56% were observed in the 30-39 and 40- 49 age groups. In the age group of 80-89, only two respondents were recorded and both of them had primary level education (15.38%). Distribution of estuarine fishers according to educational level in various age groups did not display significant differences for any age group ($P > 0.05$).

4.1.3.2 Status of education according to family members of estuarine fishers

A total of 65.93% of the family members of estuarine fishers were with secondary level education. Only 0.32% of the family members of estuarine fishers were with diploma. About 8.52 % of the family members were illiterate, of which maximum (40%) were observed in the age group of 79-91. In the age group 14- 26, 7.59% of the family members were graduate, ITI holders (2.53%) and 1.27% had completed diploma. Distribution of family members of estuarine fishers according to educational level in age groups showed significant differences in 53-65 age groups ($P < 0.05$). Status of education according to age group of family members is presented in Table 5 and Fig. 4. Members

Table 4 Educational level of estuarine fishers according to age groups

Sr. no.	Age groups	Educational level			Total
		Illiterate	Primary	Secondary	
1	20-29	-	-	2 (3.51)	2
2	30-39	-	2 (15.38)	14 (24.56)	16
3	40-49	-	3 (23.08)	14 (24.56)	17
4	50-59	1 (33.33)	2 (15.38)	11 (19.30)	14
5	60-69	1 (33.33)	3 (23.08)	11 (19.30)	15
6	70-79	1 (33.33)	1 (7.69)	5 (8.77)	7
7	80-89	-	2 (15.38)	-	2
Total		3 (4.11)	13 (17.81)	57 (78.08)	73

(Figures in parentheses indicate percentages)

Fig. 3 Distribution of estuarine fisher according to educational level

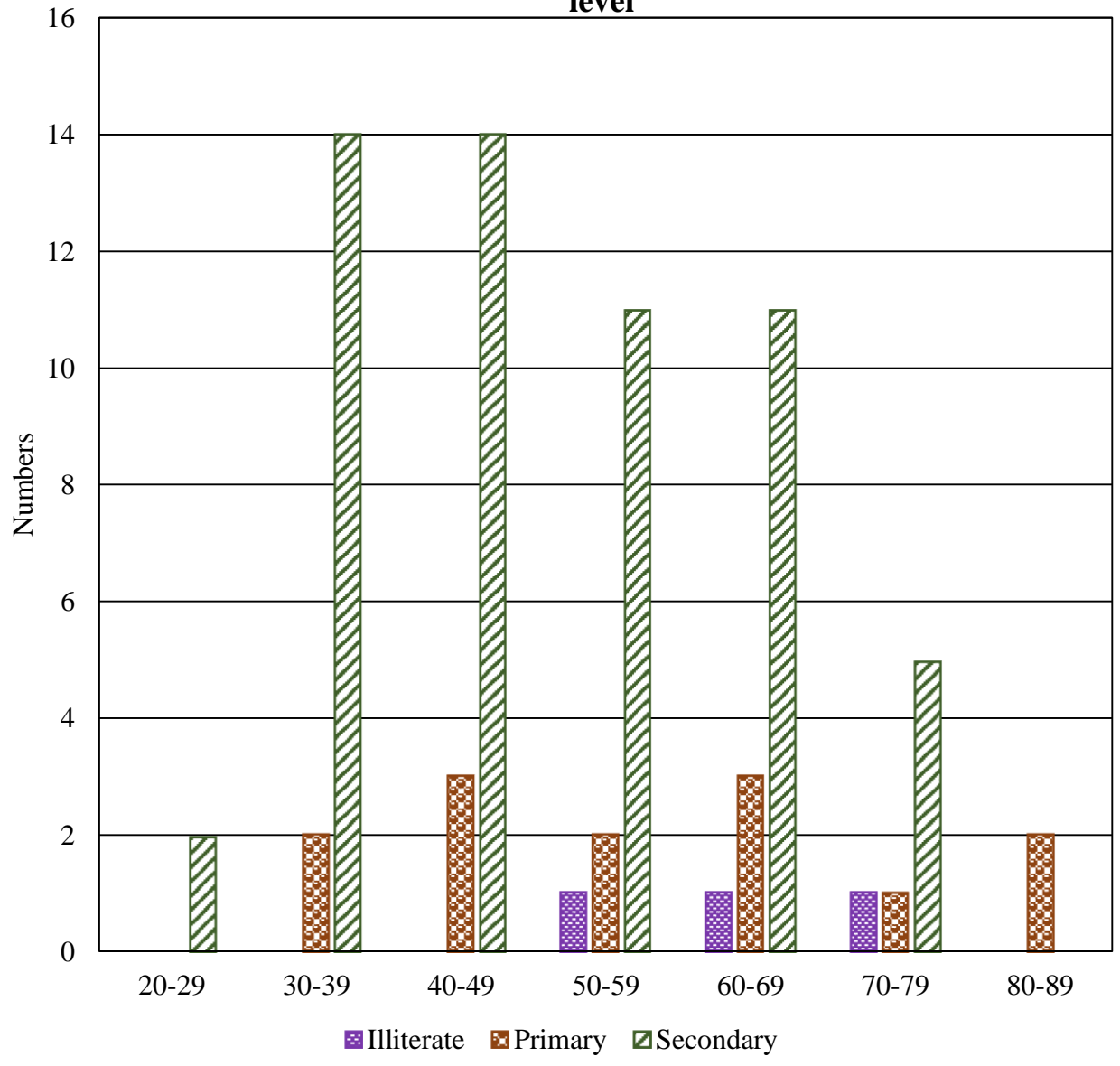
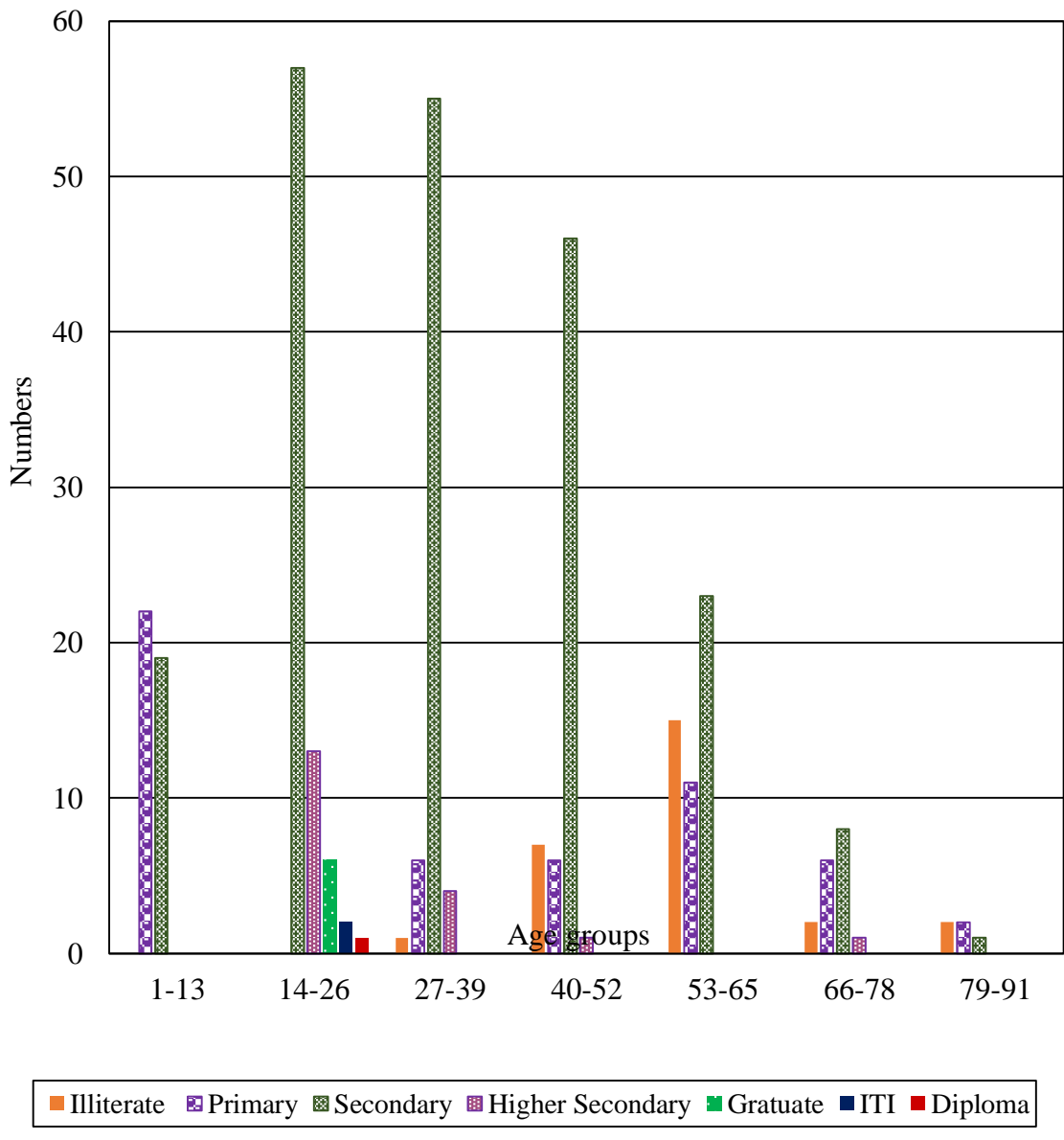


Table 5 Educational level of family members of estuarine fishers according to age groups

Sr. no.	Age groups	Educational level							Total
		Illiterate	Primary	Secondary	Higher secondary	Graduate	ITI	Diploma	
1	1-13	-	22 (53.66)	19 (46.34)	-	-	-	-	41
2	14-26	-	-	57 (72.15)	13 (16.46)	6 (7.59)	2 (2.53)	1 (1.27)	79
3	27-39	1 (1.52)	6 (9.09)	55 (83.33)	4 (6.06)	-	-	-	66
4	40-52	7 (11.67)	6 (10.00)	46 (76.67)	1 (1.67)	-	-	-	60
5	53-65	15 (30.61)	11 (22.45)	23 (46.94)	-	-	-	-	49*
6	66-78	2 (11.76)	6 (35.29)	8 (47.06)	1 (5.88)	-	-	-	17
7	79-91	2 (40.00)	2 (40.00)	1 (20.00)	-	-	-	-	5
Total		27 (8.52)	53 (16.72)	209 (65.93)	19 (5.99)	6 (1.89)	2 (0.63)	1 (0.32)	317

(* indicates significant difference $P < 0.05$)
(Figures in parentheses indicate percentages)

Fig. 4 Distribution of family members of estuarine fisher according to educational level



of fishers families were classified into different categories such as illiterate, primary, secondary, higher secondary, graduate, ITI and diploma.

4.1.4 Fishing experience

Average experience of estuarine fishers in fishing was 35.13 ± 1.73 years. Maximum estuarine fishers were having 20- 30 years of experience in fishing (30.14%), followed by fishers with 40- 50 years of experience (19.18%). About 13.70% of estuarine fishers were having either 10-20, 30-40 or 50-60 years of experience in fishing. Only a few (2.74%) estuarine fishers were having 0-10 years of fishing experience. Distribution of fishing experience was positively skewed with a skewness coefficient of 0.29. The result showed that estuarine fishers were well experienced in fishing. The distribution of estuarine fishers according to years of experience in fishing is given in Table 6 and shown in Fig. 5 respectively.

4.1.5 Gender

Distribution of estuarine fishers according to gender is given Table 7. Numbers of males observed were 94.52% and 5.48% of females. It was concluded that estuarine fishers of Ratnagiri dominated by males.

4.1.6 Religion

Hindu and Muslim were the only two religions involved in estuarine fishing of Ratnagiri (Table 8). All the Hindu families (15.07 %) were of *Kharvi* and *Bhandari*, while 84.93% were Muslim. *Kharvi* belonged to SBC category. *Bhandari* and *Daldi* belonged to OBC category. It was concluded that estuarine fishers in Ratnagiri were dominated by the Muslim community.

4.1.7 Marital status

Marital status of the estuarine fishers was studied. The estuarine fishers were classified based on their marital status is shown in Table 9 and Fig.6. About 90.41% of

Table 6 Classification of estuarine fishers according to fishing experience

Sr. no.	Experience (years)	Observed	Expected
1	0-10	2 (2.74)	6.70
2	10-20	10 (13.70)	6.93
3	20-30	22 (30.14)	10.46
4	30-40	10 (13.70)	24.56
5	40-50	14 (19.18)	10.53
6	50-60	10 (13.70)	7.00
7	60-70	5 (6.85)	6.82
Total		73	73

(Figures in parentheses indicate percentages)

Fig. 5 Distribution of estuarine fishers according to years of experience in fishing

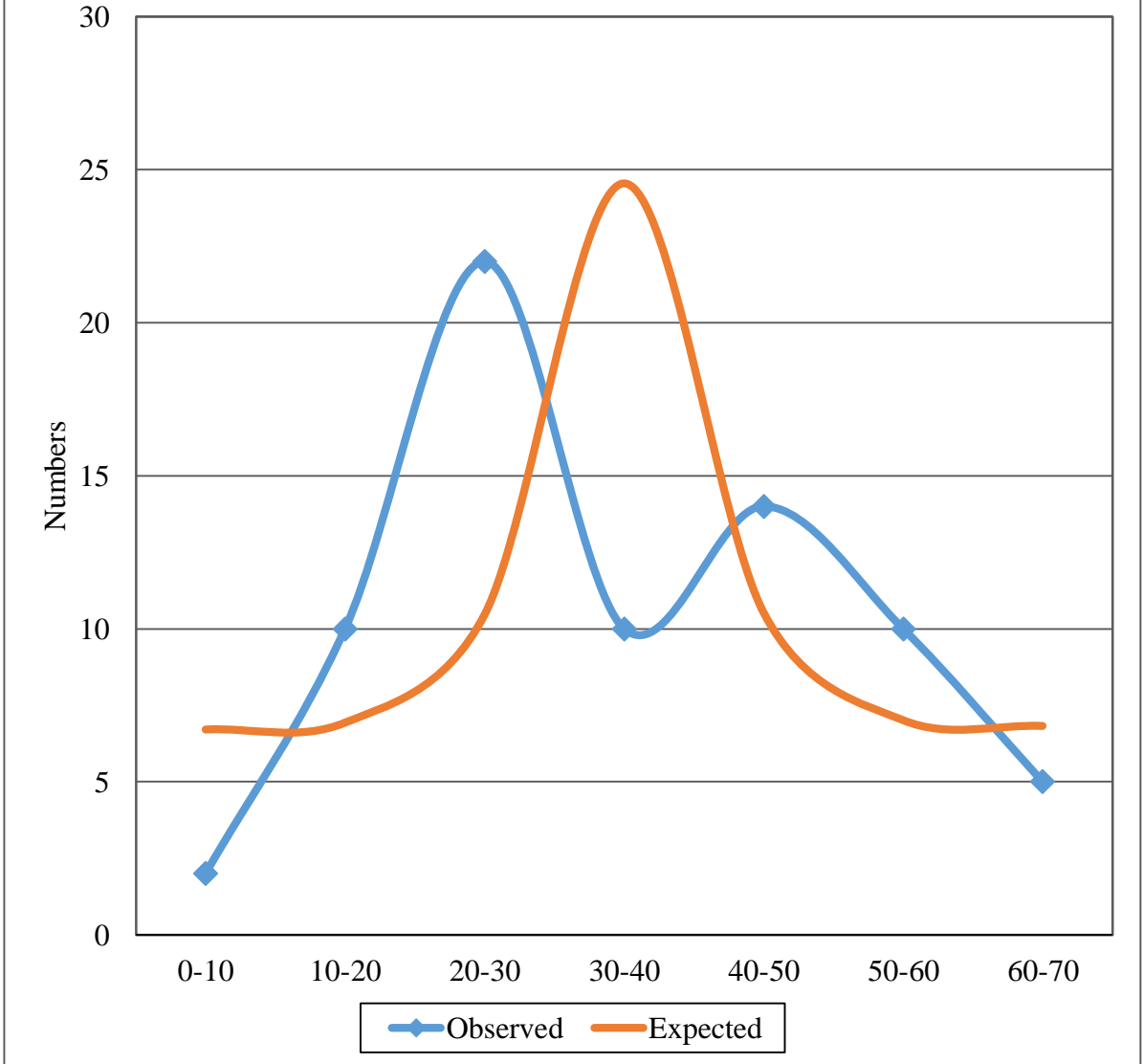


Table 7 Classification of estuarine fishers according to gender

Sr. no.	Gender	Number of fishers
1	Male	69 (94.52)
2	Female	4 (5.48)
Total		73

(Figures in parentheses indicate percentages)

Table 8 Classification of estuarine fishers according to religion

Sr. no.	Religion	Number of fishers
1	Hindu	11 (15.07)
2	Muslim	62 (84.93)
Total		73

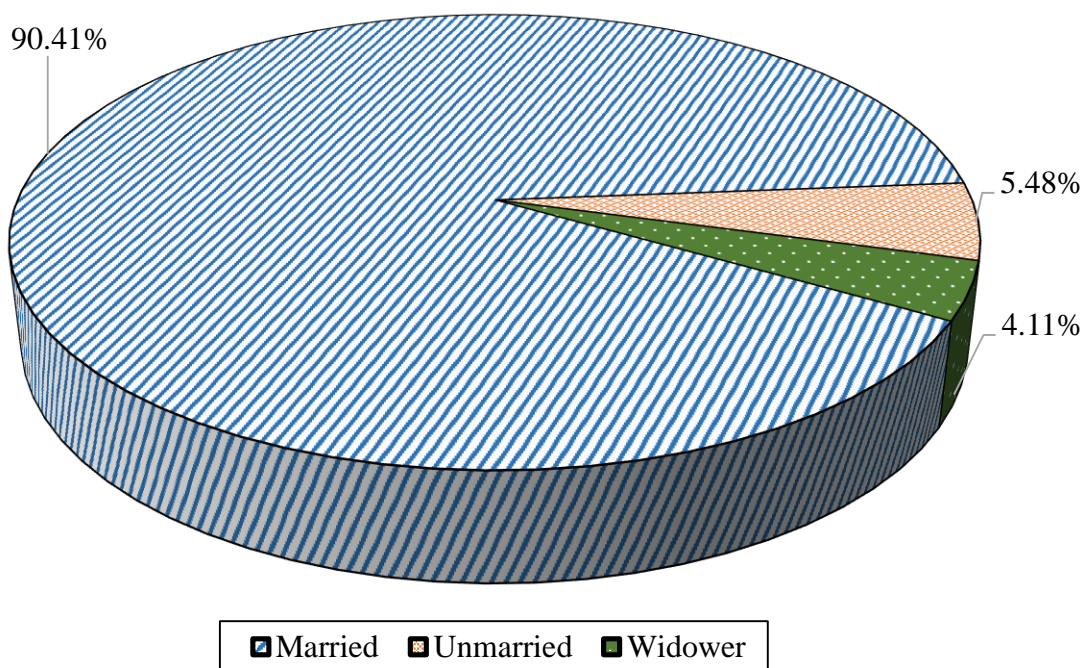
(Figures in parentheses indicate percentages)

Table 9 Classification of estuarine fishers according to marital status

Sr. no.	Marital status	Number of fishers
1	Married	66 (90.41)
2	Unmarried	4 (5.48)
3	Widower	3 (4.11)
Total		73

(Figures in parentheses indicate percentages)

Fig. 6 Distribution of estuarine fishers according to marital Status



the respondents involved in estuarine fishing were married, while, 5.48% of the respondent were unmarried and 4.11% were widower.

4.1.8 Type of ration card

All the fishermen involved in estuarine fishing possessed a ration card. About 2.74% of the fishers had yellow ration card and 97.26% orange ration card (Table 10).

4.1.9 Family type

The families of estuarine fishers were classified into two groups viz. nuclear and joint. Majority of the fisher families (58.9%) were nuclear and the remaining were joint (Table 11).

4.1.10 House type

The house types were categorized as *kachcha*, semi *pucca*, and *pucca* houses (Table 12). Only semi *pucca* and *pucca* houses were recorded in study. Maximum houses were *pucca* (61.64%) and the others were semi *pucca* (38.36%).

4.2. Awareness about climate change among estuarine fishers

4.2.1 Fishers heard about climate change

About 71.23% of the fishers had heard about climate change, 28.77% of fishers did not hear about climate change. (Table 13).

4.2.2 Sources of information on climate change

The information sources on climate change are shown in Table 14 and Fig.7. The main sources of information on climate change were friends, family, television, radio, newspaper, internet, government agencies and own experience. About 92.30% of the fishers got information on climate change through own experience, followed by 36.53% of fishers got information through friends, 34.61% through television, 28.84% through

Table 10 Classification of estuarine fishers according to holding ration card

Sr. no.	Ration card	Number of fishers
1	Orange	71 (97.26)
2	Yellow	2 (2.74)
Total		73

(Figures in parentheses indicate percentages)

Table 11 Classification of estuarine fishers according to family type

Sr. no.	Family type	Number of fishers
1	Nuclear	43 (58.90)
2	Joint	30 (41.10)
Total		73

(Figures in parentheses indicate percentages)

Table 12 Classification of estuarine fishers according to house type

Sr. no.	House type	Number of fishers
1	<i>Semi pucca</i>	28 (38.36)
2	<i>Pucca</i>	45 (61.64)
Total		73

(Figures in parentheses indicate percentages)

Table 13 Estuarine fishers heard about climate change

Sr. no.	Have heard about climate change	Number of fishers
1	Yes	52 (71.23)
2	No	21 (28.77)
Total		73

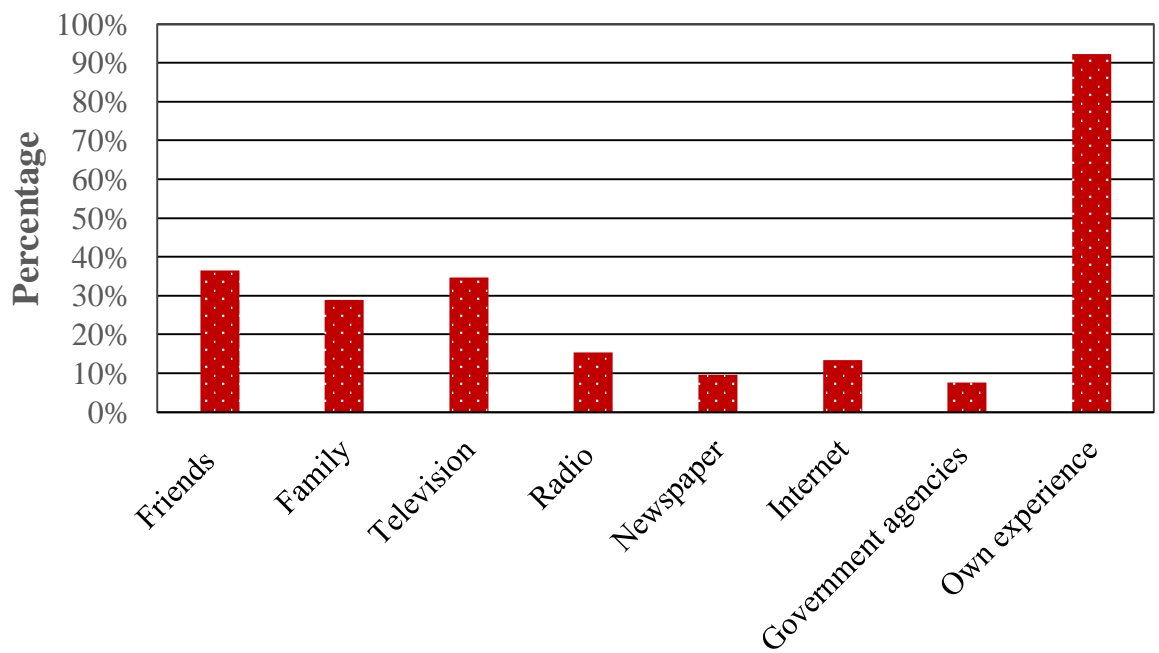
(Figures in parentheses indicate percentages)

Table 14 Estuarine fishers' sources of information on climate change

Sr. no.	Information sources	Number of fishers
1	Friends	19 (36.53)
2	Family	15 (28.84)
3	Television	18 (34.61)
4	Radio	8 (15.38)
5	Newspaper	5 (9.61)
6	Internet	7 (13.46)
7	Government agencies	4 (7.69)
8	Own experience	48 (92.30)

(Figures in parentheses indicate percentages)

Fig. 7 Distribution of estuarine fishers according to sources of information



family, 15.38% through radio and 13.46% through internet. Also fishers got information through newspaper (9.61%) and government agency (7.69%).

4.2.3 Fishers experience on impact of climate change

The estuarine fishers experienced many impacts of climate change such as changes in weather, temperature, rainfall pattern, seasonal transition, number of fishing days, type of species caught. About 65.75% of the fishers experienced weather change in extreme condition, 31.51% experienced slight changes in weather. About 80.82% experienced temperature increase, while, 13.7% experienced the temperature to be normal. About 53.42% experienced decreases in rainfall, 32.88% experienced normal rainfall. About 68.49% of the fishers said that availability of water was normal and 31.51% of experienced decreased availability of water. About 84.93% of respondent experienced that seasonal transition was irregular and 15.07% said that seasonal transition was regular. Almost 78.08% of the fishers experienced deposition on the beach and 21.92% experienced erosion of the beach due to climate change impacts. About 73.97% of estuarine fishers experienced decrease in fish availability whereas 26.03% experienced normal fish availability. About 82.19% of fishers experienced decreasing number of species caught and 17.81% said that there was no changes in number of species caught. Almost 82.19% of fishers said that there is regular species were caught and 17.81% said that different species were caught meaning that there was decrease in the number of fish species caught due to impact of climate change. About 50.68% of the estuarine fishers said that there was decrease in the number of days of fishing because of the strong winds and 49.32% experienced normal days of fishing. Majority of fishers (90.41%) reported a decrease in fish catch, 8.22% fishers replied that fish catch was normal and about 1.37% of fishers experienced increase in fish catch.

4.2.4 Climate friendly practices for preventing climate change

Climate friendly practices for preventing climate change such as energy conservation, fuel conservation, avoiding the use of plastic bags, avoiding pollution, mangrove protection, avoiding venturing in sea, use of alternative transportation and disposal of diesel in sea. Climate friendly practices were studied using Garret ranking technique. Among the climate friendly practices avoiding pollution was found to be the most important practice that the fisher believed to prevent climate change with Garret score 65.18, followed by mangrove protection with score of 64.47 (Table 15 and Fig. 8). Avoiding or reducing use of plastic bag obtained third rank with Garret score 63.01, followed by avoiding disposal of diesel in sea, energy conservation, fuel conservation, avoid venturing in sea and use of alternative transportation.

4.3 Perception of estuarine fishers about climate change

4.3.1 Local knowledge about climate change

The local knowledge of the estuarine fishers about climate change was studied and classified data is shown in Table 16 and Fig.9. About 24.66% of the fishers possessed excellent knowledge about climate change, followed by 46.58% of respondent having moderate knowledge and 28.77% of respondents having poor knowledge about climate change.

4.3.2 Level of agreement about climate change

The estuarine fishers' level of agreement about climate change statements included their responses to questions such as temperature is increasing, sea level is increasing, extreme climatic events have increased, rainfall patterns are changing, fish habitats are destroyed, changes in breeding season of fishes, increasing pollution, fish production increasing, climate change increase risk in fishing and nobody will be able to control climate change (Table 17 and Fig. 10). Among these statements on level of

Table 15 Climate friendly practices for preventing climate change

Sr. No.	Practices	Garett score	Rank
1	Energy conservation	49.04	5
2	Fuel conservation	46.99	6
3	Avoid/ reduce use of plastic bag	63.01	3
4	Avoid pollution	65.18	1
5	Use of alternative transportation	28.38	8
6	Avoid disposal of diesel in sea	49.14	4
7	Mangrove protection	64.47	2
8	Avoid venturing in sea	29.79	7

Fig. 8 Distribution of estuarine fishers according to preferences of climate friendly practices

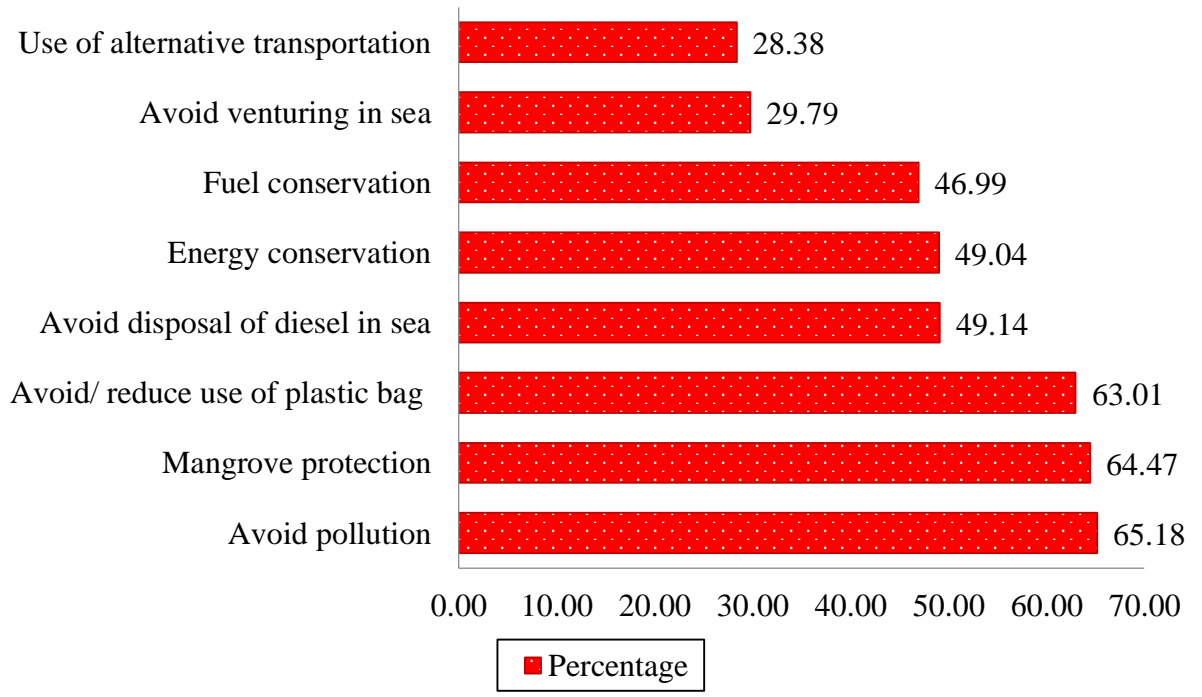


Table 16 Estuarine fishers' knowledge about local climate change

Sr. no.	Knowledge about climate change	Number of fishers
1	Excellent	18 (24.66)
2	Moderate	34 (46.58)
3	Poor	21 (28.77)
Total		73

(Figures in parentheses indicate percentages)

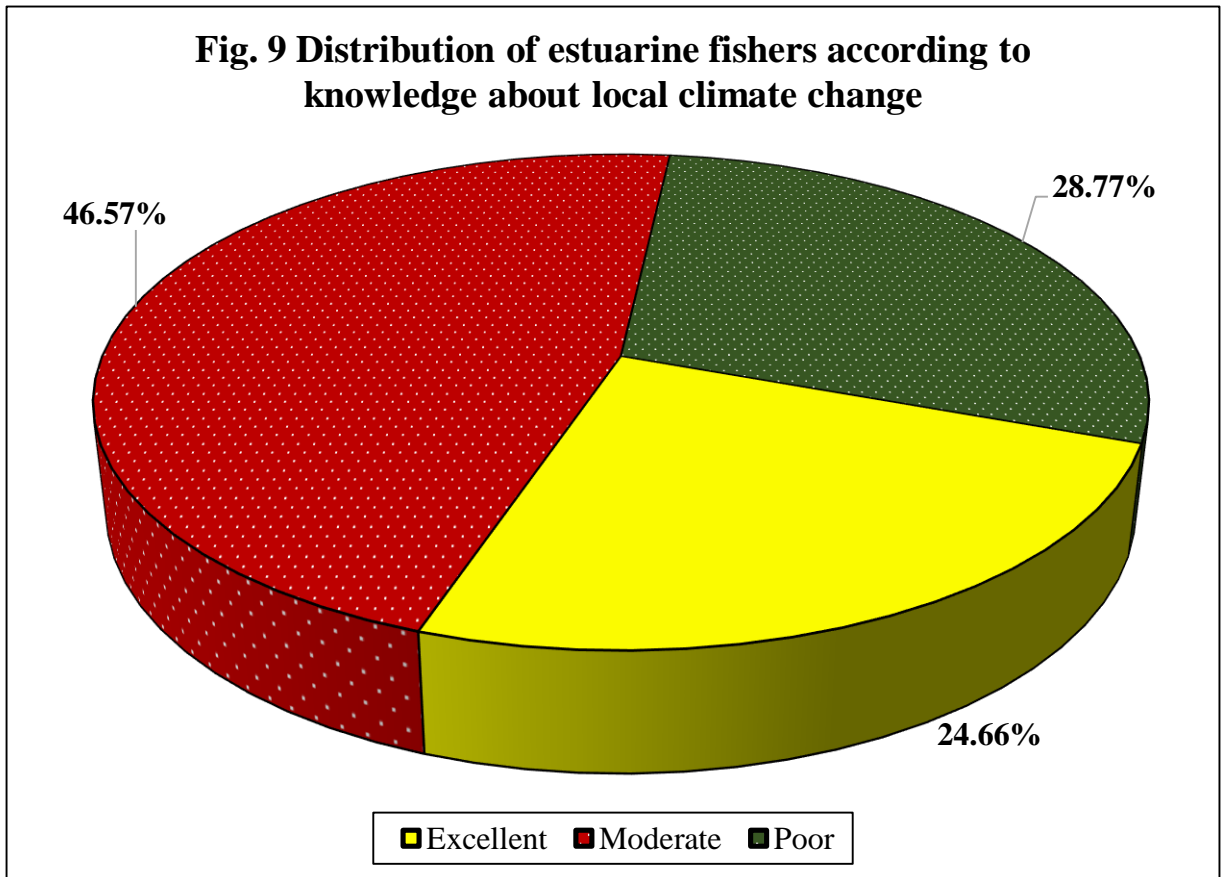
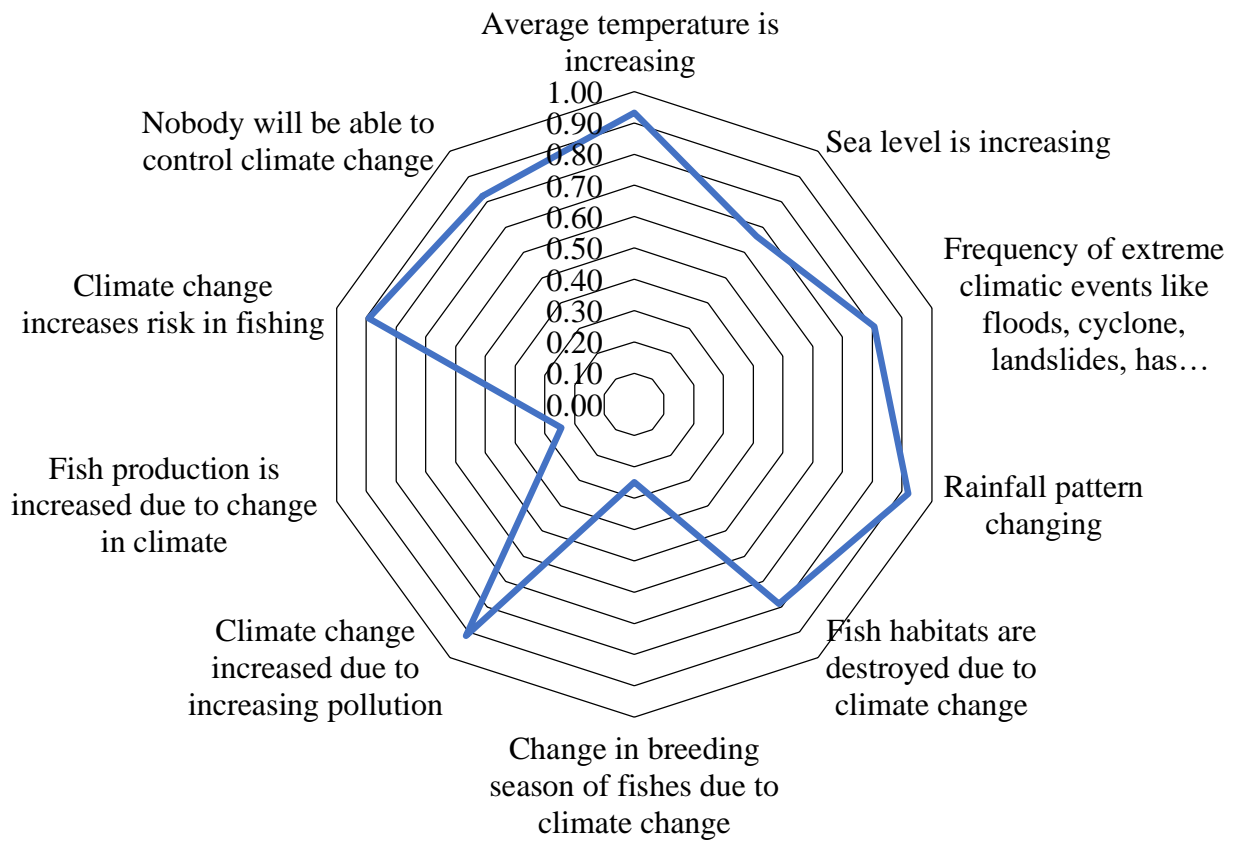


Table 17 Estuarine fishers' level of agreement about climate change

Sr. no.	Level of agreement statements	Component score
1	Average temperature is increasing	0.93
2	Sea level is increasing	0.66
3	Frequency of extreme climatic events like floods, cyclone, landslides has increased	0.81
4	Rainfall pattern changing	0.92
5	Fish habitats are destroyed due to climate change	0.79
6	Change in breeding season of fishes due to climate change	0.25
7	Climate change increased due to increasing pollution	0.92
8	Fish production is increased due to change in climate	0.24
9	Climate change increases risk in fishing	0.89
10	Nobody will be able to control climate change	0.82

Fig. 10 Distribution of estuarine fishers according to Level of agreement on climate change statements



agreement about climate change, increase in average temperature scored (0.93), followed by changing rainfall pattern (0.92), climate change increased due to increasing pollution (0.92), climate change increase risk in fishing (0.89), nobody will be able to control climate change (0.82), frequency of extreme climatic events like floods, cyclones, landslides has increased (0.81) recorded high score for the level of agreement about climate change. Fish habitats were destroyed due to climate change (0.79) and sea level increases (0.66) recorded medium to high score. Fish productivity is increased due to change in climate (0.24) recorded low to medium component score level of agreement about climate change.

4.3.3 Climate change disruption the elements

Climate change disrupt the elements such as fish stock, fishing point, marketing of fish, salinity of water and drinking water (Table 18 and Fig. 11). Fish stock (0.91) and fishing point (0.88) recorded high to very high component score, followed by salinity of water (0.27), marketing of fish (0.25) and drinking water (0.24) recorded low to medium component score.

4.3.4 Impact of climate change on resources

Estuarine fishers' perception on impact of climate change on resources included factors such as shift in spawning season, migration of fishes, alteration in fishing season, and change in species availability (Table 19 and Fig. 12). The component score of migration of fishes was 0.93 and change in species availability was 0.85. Alteration in fishing season recorded medium score (0.50) for impact of climate change. The shift in spawning season (0.28) recorded low to medium component score.

4.3.5 Impact of climate change on resource users

Estuarine fishers' perception on major impacts of climate change on resource users included displacement of family members, increase in food security issues,

Table 18 Climate change disrupt the elements

Sr. no.	Elements	Component score
1	Fish stock	0.91
2	Fishing point	0.88
3	Marketing of fish	0.25
4	Salinity of water	0.27
5	Drinking water	0.24

Fig. 11 Distribution of estuarine fishers according to climate change disrupt the elements

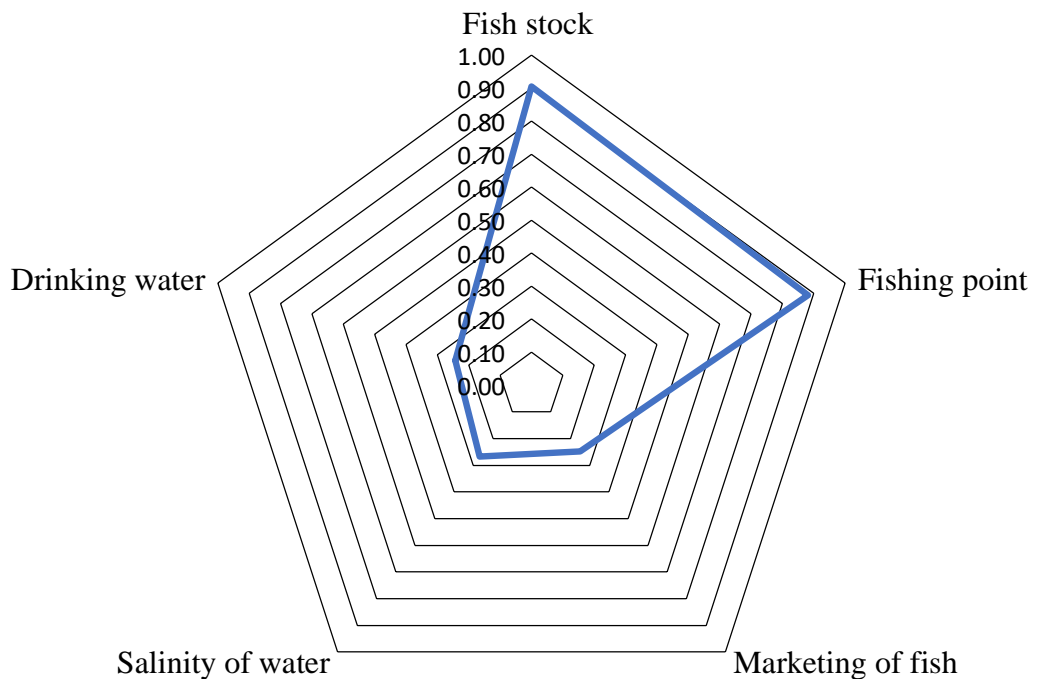
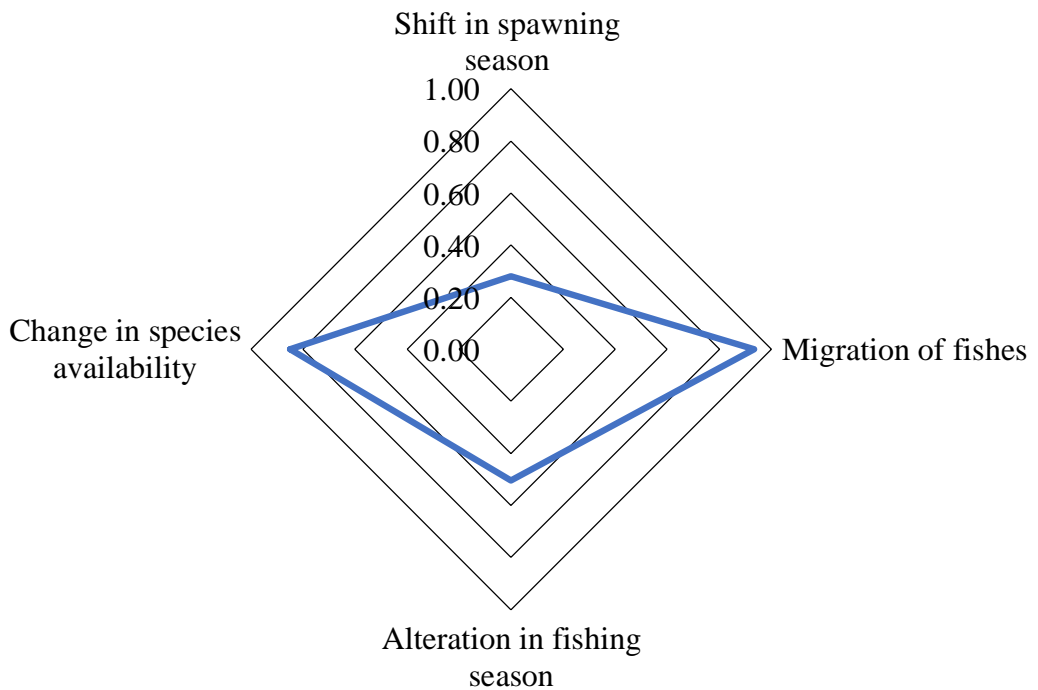


Table 19 Classification of impact of climate change on resources

Sr. no.	Parameters	Component score
1	Shift in spawning season	0.28
2	Migration of fishes	0.93
3	Alteration in fishing season	0.50
4	Change in species availability	0.85

Fig. 12 Impact of climate change on resources



migration of fishers, reduction in income, seasonality in employment, shift in employment pattern and increased cost of fishing (Table 20 and Fig. 13). Among these factors, 'reduction in income' recorded component score was (0.98), followed by increased cost of fishing (0.96), shift in employment pattern and seasonality in employment (0.78) recorded high to very high component score. The component score of displacement of family members and increase in food security issues (0.22) obtained low score on impact of climate change on resource users.

4.3.6 Impact of climate change on environmental factor

Estuarine fishers' perception on major impacts of climate change on environmental factors included sea level rise, extreme weather events, habitat destruction, seawater inundation and monsoonal fluctuation (Table 21 and Fig. 14). The component score of habitat destruction was (0.80), followed by seawater inundation (0.79) and monsoonal fluctuation was (0.72) recorded high to very high score. Extreme weather events (0.62) recorded medium to high component score and sea level rise (0.28) recorded low to medium component score.

Table 20 Classification of impact of climate change on resource users

Sr. no.	Factors	Component score
1	Displacement of family members	0.22
2	Increase in food security issues	0.22
3	Migration of fishers	0.22
4	Reduction in income	0.98
5	Seasonality in employment	0.78
6	Shift in employment pattern	0.78
7	Increased cost of fishing	0.96

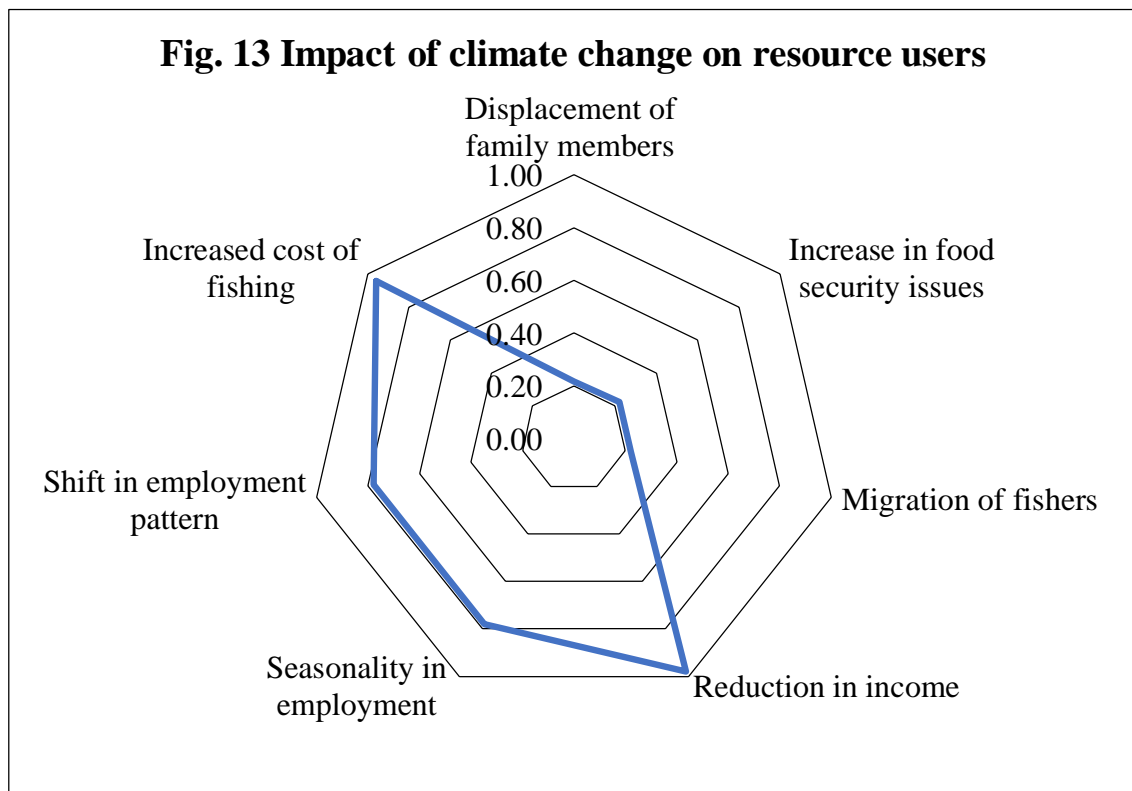
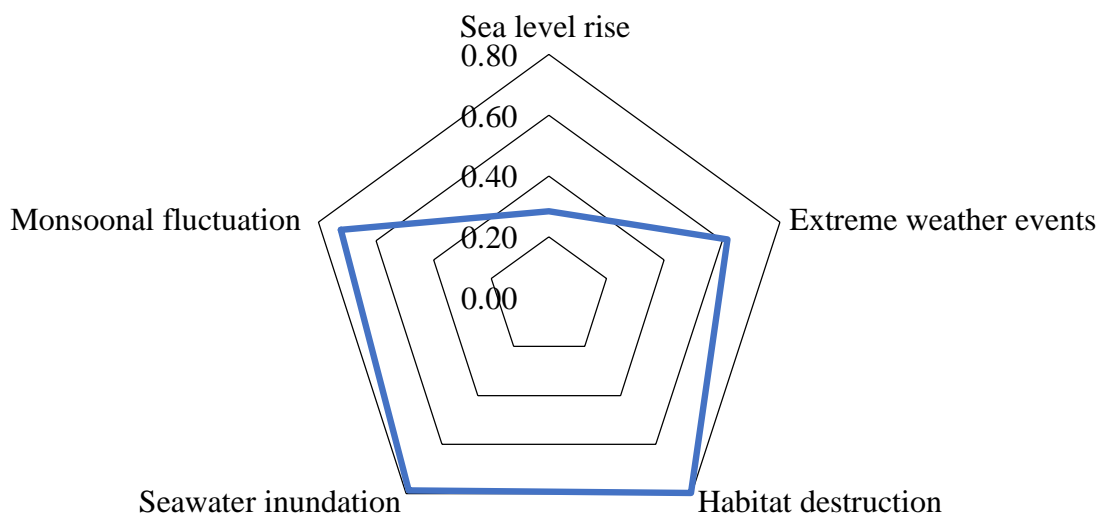


Table 21 Classification of impact of climate change on environmental factor

Sr. no.	Factors	Component score
1	Sea level rise	0.28
2	Extreme weather events	0.62
3	Habitat destruction	0.80
4	Seawater inundation	0.79
5	Monsoonal fluctuation	0.72

Fig. 14 Impact of climate change on environmental factors



5.0 DISCUSSION

Awareness and perception of climate change among estuarine fishers was studied. The findings of study are discussed. This study focused on the fishers who go to estuary.

5.1 SOCIO-PERSONAL INFORMATION

5.1.1 Age

Maximum of estuarine fishers (27.40%) were in the 31-40 years age group and minimum (2.74%) were in 22-31 and 76-85 age group. The average age was 50.91 years. This clearly indicated that the most of fishers involved in estuarine fishing were dominated by middle age group. The result of the present study contradictory with Hasan (2015). They have reported that majority of the artisan fishers of Bangladesh (35.5%) belonged to younger age group (15-30). Salim *et al.* (2014) while studying fishers of Kerala reported that majority (53.50%) of the respondent belonged to age group of 36-55 and 9.40% of respondents belonged to age less than 35 years old. Salim *et al.* (2016b) reported that maximum fishers of Kerala (46.33%) belonged to elder group and 14.67% belonged to 15-35 age group. The results of the present study are similar to the results reported by Bah *et al.* (2018) in the central river region of the Gambia. They have reported that majority of fishers (27.1) were in the age group of (36-45%). Kandhare (2018) reported that most of the fisher women in dry fish enterprise were in 48-58 years followed by 38- 48 (27.06%). Khode (2018) reported that average age of women fresh fish retailers in fresh fish markets of Ratnagiri was 42.8 years. Maximum (35.56%) women fresh fish retailers were in the age group of 34-42 and minimum (2.22%) were in the 66-74 age group. Swami (2019) recorded that the average age of dry fish entrepreneurs of Ratnagiri was 45 years. Maximum of dry fish entrepreneurs (23.36%) were in 34-42 and 42-50 years age group and minimum of dry fish in 66-74 years age

group. Overall result concluded that majority of the fishers are middle aged involved fishing and allied activity in Ratnagiri.

5.1.2 Age of family members

Average age of family members of estuarine fishers of Ratnagiri was 34.73 ± 1.09 years. Maximum (24.01%) of estuarine fishers were in the 14-26 age group, which was followed by 27-39 age groups (20.06%). Distribution of age of family members of estuarine fishers were found positively skewed with value of 0.28. Similarly, Kandhare (2018) reported average age of family members of dry fish retailers was 38.33 ± 3.38 years in Ratnagiri block. The majority of dry fish retailers (20.14) was in the 20-30 age group. Swami (2019) reported that average age of family members of dry fish retailers was 30.92 ± 0.8 years and distribution of age of family members was positively skewed with a value of 0.39. Maximum of the family members of dry fish retailers were in the age group 20-30 and minimum of the respondents (1.26%) were in the age group of 70-80. It was concluded that members of estuarine fishers dominated by younger age group in Ratnagiri.

5.1.3 Educational status

Educational status of the estuarine fishers of Ratnagiri was analysed. Most of the estuarine fishers (78.08%) were educated up to secondary level education, followed by 17.81 % were with primary level education. Kandhare (2018) revealed that majority of the dry fish retailers (55.29%) were illiterate followed by 27.06% of the respondents were educated primary level and 17.65% completed education up to secondary level. The result of the present study contradictory with Kandhare (2018) reported very less of respondents educated upto secondary level. Khode (2018) reported that 27.78% women fresh fish retailers were illiterate. Maximum (50%) of retailers were studied up to secondary education and very few (2.22%) up to higher secondary. Similarly, Salim *et*

al. (2016b) reported that 31.37% of the fishers of Kerala studied upper primary, followed by 29.80% educated up to primary level, only 1.96% of fishers studied Diploma/Degree and 1.57% of the fishers were illiterate,. Overall concluded that result of the present study different than that of Salim *et al.* (2016b) and Khode (2018). In the present study of sample of 73 estuarine fishers, out of them 4.11% were illiterate. In Maharashtra literacy rate was 82.34% and in Ratnagiri district it was 82.18%. It indicates that estuarine fishers had lower rate literacy as compared to national and state literacy rate.

5.1.4 Educational status of family members

Majority of (65.93%) of the family members of estuarine fishers were with secondary level education. Only 0.32% of the family members of estuarine fishers were with diploma. About 8.52 % of the family members were illiterate, of which maximum (40%) were observed in age group of 79-91. In the age group 14- 26, 7.59% of the family members were graduate and 2.53% were ITI holders. Similarly, Swami (2019) reported educational status of dry fish entrepreneur family members of Ratnagiri, most of (30.02%) were with primary, followed by 33.07% of secondary level of education and 0.76 % had completed diploma. Kandhare (2018) reported that educational status of family members of fisher women involved in dry fish enterprise were with primary education (34.13%), followed by secondary (31.50%) and diploma(0.48%). The result of the present study are in agreement with results reported by Swami (2019) and Kandhare (2018). Overall concluded that most of family members of estuarine fishers are educated up to secondary education level.

5.1.5 Fishing experience

Average experience of estuarine fishers in fishing was 35.13 ± 1.73 years. The maximum (30.14%) of the estuarine fishers were having 20- 30 years of experience in fishing, followed by 19.18% of estuarine fishers with 40- 50 years of experience in

fishing. Very less (2.74%) estuarine fishers were having 0-10 years of experience. Waghmare (2018) reported that maximum fishers had more than 30 years (42.17%) of experience in fishing, followed by 15 to 30 years (39.76%) and up to 15 years of fishing experience (18.07%) in Ratnagiri. Salim *et al.* (2014) reported that majority (78%) of the fishers of Kerala were highly experienced more than 20 years, followed by the 17.30 % of respondents with 10-20 years of experience and 4.70% of respondents with less than 10 years of experience in fishing . Menon *et al.* (2016) reported that majority of the (71.8%) fishers of Andhra Pradesh were having less than 20 year of fishing experience and 28.2% having more than 20 years of fishing experience. The result of the present study is almost similar with results reported by Bah *et al.* (2018). They reported that most of the fishermen from Gambia (31.4%) have 21-30 years' experience, followed by 12.9% of fishermen having 31-40 and 41-50 years of fishing experience. Overall result concluded that most of the estuarine fishers in Ratnagiri have 20-30 years' experience in fishing.

5.1.6 Gender

The result of the present study revealed that the numbers of males were 94.52% and 5.48% of females in the estuarine fishing. The result of the present study is accordance with the result reported by Waghmare (2018), that almost 71.08% of males and 28.92 % of females were involved in actual fishing. Salim *et al.* (2016) reported that majority (74.51%) of the respondents were male and 25.49 % of the females. Swami (2019), Kandhare (2018) and Barve (2002) reported that fishers from Ratnagiri male: female ratio as 1:1. The present study concluded that estuarine fishing of Ratnagiri was dominated by male fishers.

5.1.7 Religion

The present study revealed that the maximum number of estuarine fishers were

Muslim (85%) and Hindu (15%) in Ratnagiri. As per 2011 Census, 80.9% of district population was Hindus, followed by Muslims (11.61%) however, the present study showed that estuarine fishing was dominated by Muslims. The result of present study contradictory with Kandhare (2018) reported that, Hindu (62.35%) and Muslim (37.85%) were the only the religions involved in dry fish enterprise of Ratnagiri. Barve (2002) reported that fisher community of Ratnagiri is dominated by Muslim (59.16%), followed by Hindus (40.84%). Khode (2018) reported that most of the women fish retailers of Ratnagiri belong to Muslim religion (56.67%), followed by Hindu (41.11%) and Buddhist (2.22%). Waghmare (2018) studied indigenous traditional knowledge about fishing methods, reported that majority of fishers were Hindu (78.31%), Muslim (18.07%) and Christian (3.61%) in Ratnagiri and Sindhudurg district. Higher percentage of Muslim population in estuarine fishing indicated that the fact that Muslim population looks owned resources for livelihood and therefore dependent on low cost estuarine fishing.

5.1.8 Marital status

The present study results revealed that almost 90.41% of the fishers were married, while, 5.48% of the fishers were unmarried and 4.11% were widow. Khode (2018) reported that majority (72.22%) of women fresh fish retailers were married and 8.89% women were unmarried, 2.22% were divorcee and 16.67% were widow. Kandhare (2018), studying socio-economic status of dry fish retailers of Ratnagiri, reported that 48.24% of women were married, followed by widow (40%), unmarried (9.41%) and 2.35% divorcee. Waghmare (2018) reported that majority (90.36%) of fishers were married and 8.43% of fishers unmarried and 1.20% of fishers were widower in Ratnagiri. Swami (2019) reported that majority of dry fish entrepreneurs were married (77.57%), while 7.48% were unmarried, 14.02% were widow and 0.93% were divorcee in Ratnagiri

block. The result of the present study was similar with Waghmare (2018). It was concluded that the estuarine fishers of Ratnagiri were dominated by married fishers.

5.1.9 Type of ration card

In present study, it was found that 2.74% of the fishers had yellow ration card (total annual income up to ₹ 15,000) and 97.26% of fishers were having orange ration card (total annual income exceeding ₹ 15000 but less than ₹ 1 lakh). Ration cards are an official document entitling the holder to a ration of food, fuel or other goods. Khode (2018) reported that 8.89% of the retailers had yellow card, 90.00% retailers were having orange card and 1.11% were having white card in Ratnagiri. Similarly, Swami (2019) reported that majority (87.85%) of dry fish entrepreneurs had orange ration card and 12.15% of entrepreneurs had yellow ration card. From the present study it was concluded that majority of the estuarine fishers were having orange card and very few of them were having yellow card. The result of present study indicated that the estuarine fishers in Ratnagiri had medium earning.

5.1.10 Family type

The result of the present study showed that the majority (58.90 %) of the estuarine fishers were nuclear as against 41.10% were living in joint families. Almost similar observation were reported by Waghmare (2018) reported, that 55.42% of the fishers were nuclear and 44.58% of the fishers were in joint families in Ratnagiri and Sindhudurg district. Kandhare (2018) reported that 71.76% of dry fish entrepreneurs were nuclear and 28.24% of fisher were joint families in Ratnagiri. Swami (2019) reported that majority (81.31%) of dry fish entrepreneurs' families residing along Ratnagiri block were nuclear and 18.69% were joint families. In present study, majority of estuarine fisher's families were living in nuclear families than joint families. Overall concluded that the most of the fishers' families residing in Ratnagiri were nuclear families.

5.1.11 House details

Most of the estuarine fishers' houses (61.64%) were *pucca* and semi *pucca* (38.36%). Barve (2002) reported that percentages of *pucca* houses, stone houses and *kachcha* houses were 34.75%, 34.12 and 10.45% respectively, whereas 20.04% of houses were of concrete type. Khode (2018) reported that most of the women fresh fish retailers families were residing in *pucca* house (53.33%), followed by semi-*pucca* house (34.45%), *kachcha* house (7.78%) and apartments (4.44%). Kandhare (2018) found that 48.42% of dry fish entrepreneurs families lived in semi-*pucca* house, 43.53% *pucca* house and 8.24% *kachcha* house. As per Ratnagiri district census (2011) 64.35% households were permanent, 34.06% were semi-permanent and 0.95% were temporary. Result of the present study is very close to the district census (2011).

5.2 AWARENESS ABOUT CLIMATE CHANGE

5.2.1 Fishers heard about climate change

In the present study, most of the estuarine fishers (71.23%) heard about climate change, 27.40% of fishers did not hear about climate change and 1.37% of the fishers do not know about climate change. Bah *et al.* (2018) reported that 95.7% of the respondents heard about climate change and 4.3% of the respondents did not hear about climate change. Salim *et al.* (2016b) observed that 98% of the fishers heard about climate change. Salim *et al.* (2014) fishers of Kerala reported that 75.1% have heard about climate change, while 24.1% did not hear about climate change. Result of the present study are in agreement with study done by Salim *et al.* (2014) in Kerala state. Overall concluded that most of estuarine fishers heard about climate change and the results almost similar with Salim *et al.* (2014) while studying, climate change awareness, preparedness, adaptation and mitigation strategies among fisherfolk of Kerala. The result of the present study concluded that majority of the fishers heard about climate change only few fishers

do not hear climate change.

5.2.2 Sources of information on climate change

About 92.30% of the fishers got information on climate change through own experience, followed by 36.53% of fishers got information through friends, 34.61% through television, 28.84% through family, 15.38% through radio and 13.46% through internet. Also fishers got information through newspaper (9.61%) and government agency (7.69%). Bah *et al.* (2018) while studying perception of freshwater fishers, reported that main sources of climate change through 70% of the respondents from radio/mass, followed by fisher folk to fisher folk (44.3%), extension services (17.1%), personal experience (14.3%), neighbour farmers (7.1%) and farmers association (4.3%). Salim *et al.* (2016b) reported that fishers of Kerala have main source of the information about climate change through electronic media (68.33%) followed by family members, friends and neighbours (58.33%), print media (57.00%), NGOs, organization and educational institutions (43.33%), local self-government (21.00%) and metrological services (3.67%). Hasan (2015) studied artisan fishers perception of climate change of Bangladesh, the result revealed that major source of information through government agencies (87.2%), followed by friends and family (78.6%), media (70.4%) and Red Crescent society (59.1%). The result of the present study concluded that estuarine fishers main source of information of climate change was through own experience and friends.

5.2.3 Fishers experience on impact of climate change

The result of the present study revealed that, 65.75% of the fishers experienced weather change in extreme condition, about 80.82% experienced that temperature has increased, about 53.42% experienced rainfall decreased, about 68.49% of the fishers said that availability of water is normal, 84.93% of respondent experienced that seasonal transition is irregular, 78.08% of the fishers experienced deposition on the beach and

21.92% experienced erosion of the beach due to climate change impacts. About 73.97% of estuarine fishers experienced decrease of fish availability. About 82.19% of fishers experienced decreased number of species caught. 82.19% of fishers said that there is regular type of species was caught and 17.81% said that there is different type of fish species was caught means that there is decrease in number of fish species due to impact of climate change. About 50.68% of the estuarine fishers said that there was decrease in days of fishing because of the heavy wind flows, 90.41% of fishers experienced fish catch was decreasing. Bah *et al.* (2018) studying perception of fishers reported that 90% of the fishermen experienced that temperature is increased, 60% of fishermen's experienced increased winds and 35.7% of the fishermen's experienced decreased rainfall as impact of climate change on fishing. Salim *et al.* (2015) revealed that 88.32% of fishers experienced reduction in fish catch, 50% of the respondents said that number of fishing days have reduced. Senapati and Gupta (2015) reported that 45.1% of the fishers in Mumbai experienced high level of rise in temperature and 48.9% experienced very high level of change in rainfall pattern and about 55.5% of the fishers experienced very high level of less availability of fish. Adetayo (2012) reported that 54.2% of the farmers of Nigeria experienced that temperature has increased, 36.3% experienced temperature has reduced, 5% experienced there is no change in temperature; 53.4% of respondents experienced increasing rainfall difference, 35.7 % of the fishermen experienced decreased rainfall and 4.1% of the respondents experienced there is no change in rainfall. Nkwusi *et al.* (2015) observed that 93.3% of the farmers confirmed that temperature has increased, 4.76% experienced temperature has no increased and 1.91% said they not sure about temperature has increased. Downward change in rainfall pattern experienced by 79.04% of the farmers and 20.06% of the farmers did not believe that there is reduction in amount of rainfall. The result of the present study is accordance

with the results of Adetayo (2012), Salim *et al.* (2015), Nkwusi *et al.* (2015) and Bah *et al.* (2018). The present study concluded that majority of the estuarine fishers experienced temperature has increased, rainfall decreased, seasonal transition is irregular, decreased number of species caught and decrease in days of fishing.

5.2.4 Climate friendly practices for preventing climate change

Among the climate friendly practices avoiding pollution was found to be the most important practices to prevent climate change with garret score 65.18, followed by mangrove protection with score 64.47. Avoid or reduce use of plastic bag was given rank III with garret score 63.01, followed by avoid disposal of diesel in sea, energy conservation, fuel conservation, avoid venturing in sea and use of alternative transportation. Salim and Athira (2016a) studied the steps to be taken by the society for preventing climate but none of them recorded that climate friendly practices for preventing climate change therefore, the results of the present study cannot be compared with others study.

5.3 PERCEPTION ABOUT CLIMATE CHANGE

5.3.1 Knowledge about local climate change

About 24.66% of the fishers having excellent knowledge, followed by 46.58% of respondents having moderate knowledge and 28.77 of respondents having poor knowledge about climate change. Hasan (2015) while studying the fishers' perception of climate change of Bangladesh reported that one third of the fishers have good knowledge, half of the fishers have moderate knowledge and little of fishers have less knowledge about local climate change. Aphunu and Nwabeze (2012) while studying fish farmers' perception of climate change on fish production observed that 47.5% of the respondents had little knowledge, followed by 31.2% of the respondents did not have knowledge, 11.03% of the respondents were having reasonable extent knowledge and only 10% of

the respondents having great extent knowledge about climate change. The result of the present study is accordance with the results of Aphunu and Nwabeze (2012) and Hasan (2015). The present study and Hasan (2015) concluded that most of the fishers had moderate knowledge about climate change.

5.3.2 Level of agreement about climate change

The result of the present study showed that, component score of estuarine fishers level of agreement of climate change on ‘average temperature is increasing’ was 0.93 followed by rainfall pattern changing (0.92), climate change increased due to increasing pollution (0.92), climate change increases risk in fishing (0.89), nobody will be able to control climate change (0.82), frequency of extreme climatic events like floods, cyclones, landslides has increased (0.81) recorded high score for the level of agreement about climate change. Fish habitats were destroyed due to climate change (0.79) and sea level increasing (0.66) recorded medium to high score. Fish productivity is increased due to change in climate (0.24) recorded low to medium component score level of agreement about climate change. Salim *et al.* (2016b) reported that, 97% of the fishers of Kerala opined that temperature was increasing, 70% of the respondents believed that climate change was due to the industrialization, urbanization, habitat destruction, pollution and transportation and 33% were concerned about sea level rise. Hasan (2015) reported that above 70% of the fishers from Chakaria and above 60% of fishers from Chittagong agreed about frequency of extreme climatic events has increased, about 55% of the fishers in Chakaria and 20% of fishers from Chittagong were more concerned about sea level rise, about 80% of fishers from Chakaria and 60% of fishers from Chittagong agreed that rainfall pattern was changing and 85% of fishers from Chakaria and 75% of fishers from Chittagong agreed that average temperature was increasing. Senapati and Gupta (2015) while studying climate change and fisheries reported that 42.9% of the

fishers experienced high level of sea level rise and rise in storm heights and frequency. About 39.6% of the fishers perceived loss of fish habitat. Overall result concluded that estuarine fishers are mostly concerned with the average temperature was increased, rainfall pattern changing, climate change increased due to pollution, climate change increases risk of fishing and fishers were not concerned about fish productivity is increased due to change in climate .

5.3.3 Climate change disrupt the elements

Fish stock (0.91) and fishing point (0.88) recorded high to very high component score, followed by salinity of water (0.27), marketing of fish (0.25) and drinking water (0.24) recorded low to medium component score. Hasan (2015) reported that 96% of the artisan fishers of Bangladesh concerned about fish stocks, 50% of respondents were concerned about changes in fishing points, with about 40% of fishers ambivalent and very few respondents not at all concerned about changes in fishing points. About 65% of the fishers which have more than 40 year age were more concerned about salinity of water and about 20% of the respondents concerned about impact of climate change on fish marketing. Only a small percentage of respondents concerned about shortage of drinking water. The present study concluded that estuarine fishers were concerned about fish stock, fishing point changes because of the change in wind direction and temperature and estuarine fishers not concerned about salinity of water, marketing of fish and drinking water.

5.3.4 Impact of climate change on resources

The present study revealed that component score of migration of fishes was 0.93 and change in species availability was 0.85. Alteration in fishing season recorded medium score (0.50) for impact of climate change. The shift in spawning season (0.28) recorded low to medium component score. Salim *et al.* (2016b) reported fishers

perception on impact of climate change on resources, 47.73% of the respondents opined that migration of fishes, 42.24% shift in spawning season, 41.26% alteration in fishing season and 35.96% non-availability of regular species. In the present study perception of estuarine fishers of Ratnagiri concluded that the climate change has resulted into migration of fishes, change in species availability and alteration in the fishing season which was in partial agreement with the results of Salim *et al.* (2016b).

5.3.5 Impact of climate change on resource users

Fishers are the marine living resources users. It was observed that 'reduction in income' recorded component score was (0.98), followed by increased cost of fishing (0.96), shift in employment pattern and seasonality in employment (0.78) recorded high to very high component score. The component score of displacement of family members and increase in food security issues recorded was (0.22) referred as low score on impact of climate change on resource users. Salim *et al.* (2015) observed that 64% of fishers' opinion that income level has decreased, seasonality of employment (51%), change in employment pattern (46%) in Kerala. Salim *et al.* (2016b) reported that perception of respondent on impact of climate change on resource users, about 94.44% of the respondents' examined that income level of fishers has decreased, issue of food security (83.33%), seasonality of employment (61.11%), change in employment pattern (50.00%), increased cost of fishing (38.89%) and displacement of family members (16.67%). The result of present study are in agreement with result of Salim *et al.* (2016b). Aphunu and Nwabeze (2012) fish farmers' perception on impact of climate change reported that increased cost of fish production was 2.34. Overall result concluded that estuarine fishers perceived that reduction in income, increased cost of fishing, shift in employment pattern and seasonality in employment has major impact of climate change on resource users.

5.3.6 Impact of climate change on environmental factor

In the present study it was observed that component score of habitat destruction was (0.80), followed by seawater inundation (0.79) and monsoonal fluctuation was (0.72) recorded high to very high score. Extreme weather events (0.62) recorded medium to high component score and sea level rise (0.28) recorded low to medium component score. Geetha *et al.* (2017) reported that about 67.8 % of the fishers in Tamil Nadu agreed sea level rise, followed by 56.1% of the fishers agreed occurrence of extreme weather events increased, 54.5% of the fishers agreed monsoonal fluctuation, seawater inundation (46.6%) and habitat destruction (18.4%). The result of the present study was contradictory with Geetha *et al.* (2017). Salim *et al.* (2014) reported that sea level rise (63.1%), habitat destruction (50.5%) the impact of climate change. Salim *et al.* (2016) reported that 40% of the respondents opined sea water intrusion. The result of present study are more reflectable than that of Salim *et al.* (2016) and Salim *et al.* (2014), as the component score are higher than that of Salim *et al.* (2016), (2014). Probable reason for more reflectable results may be difference of about 10 years' time period between these two studies, as in last one decade fishers experienced more and significant impacts of climate change. The result concluded that the highly impacted factor was habitat destruction in Ratnagiri.

6.0 SUMMARY

The study of awareness and perception about climate change among estuarine fishers in Ratnagiri was undertaken at seven villages. Total 73 estuarine fishers were studied. The important findings of the present study are summarized below:-

6.1 Age group analysis revealed that maximum percentage (27.40%) of estuarine fishers were in the 31-40 age group. The average age of estuarine fishers was 50.91 years.

6.2 The maximum percentage (24.01%) of family members were in the 14-26 age group. Average age of family members of estuarine fishers were 34.73 years.

6.3 Most of the estuarine fishers were educated up to secondary level education (78.08%), followed by primary level education (17.81 %). Only 4.11% of the estuarine fishers were illiterate.

6.4 The majority (65.93%) of the family members of estuarine fishers were with secondary level education, followed by primary level education (16.72%), illiterate (8.52%) and higher secondary (5.99%). In the age group 14- 26, 7.59% of the family members were graduate, ITI holders (2.53%) and 1.27% had completed diploma.

6.5 Maximum estuarine fishers were having 20- 30 years of experience in fishing (30.14%), followed by fishers with 40- 50 years of experience (19.18%). Only a few (2.74%) estuarine fishers were having 0-10 years of fishing experience. Average experience of estuarine fishers in estuarine fishing was 35.13 years.

6.6 Majority (94.52%) of the estuarine fishers were male and rest were females.

6.7 Majority (84.93%) of the estuarine fishers were Muslim and 15.07% were Hindu by religion practices.

6.8 Almost 90.41% of estuarine fishers were married, while about 5.48% of fishers were unmarried and 4.11% were widower.

6.9 Majority (97.26%) of estuarine fishers had orange ration card, while, about 2.74% yellow ration card (BPL family).

6.10 Majority of the estuarine fisher families (58.9%) were nuclear and 41.10% were joint.

6.11 Maximum houses of fishers were *pucca* (61.64%) and the others were semi *pucca* (38.36%).

6.12 About 71.23% of the fishers had heard about climate change, 28.77% of fishers did not hear about climate change.

6.13 About 92.30% of the fishers got information on climate change through own experience, followed by 36.53% of fishers got information through friends, 34.61% through television, 28.84% through family, 15.38% through radio and 13.46% through internet. Also fishers got information through newspaper (9.61%) and government agency (7.69%).

6.14 About 65.75% of the fishers experienced weather change in extreme condition. About 80.82% experienced temperature increased. About 53.42% experienced decreases in rainfall, 32.88% experienced normal rainfall. Almost 78.08% of the fishers experienced deposition on the beach and 21.92% experienced erosion of the beach due to climate change impacts. About 73.97% of estuarine fishers experienced decrease in fish availability, whereas 26.03% experienced normal fish availability. About 82.19% of fishers experienced decreasing number of species caught and 17.81% said that there was no changes in number of species caught. Majority of fishers (90.41%) reported a decrease in fish catch, 8.22% fishers replied that fish catch was normal.

6.15 Among the climate friendly practices, 'avoiding pollution' was found to be the most important practice that the fisher believed to prevent climate change with Garret score 65.18, followed by 'mangrove protection' with score of 64.47. Avoiding or reducing use

of plastic bag stood third with Garret score of 63.01, followed by 'avoiding disposal of diesel in sea', 'energy conservation', fuel conservation, avoid venturing in sea and use of alternative transportation.

6.16 Almost 46.58% of estuarine fishers were having moderate knowledge, 28.77% of fishers were having poor knowledge and 24.66% of fishers having excellent knowledge about climate change.

6.17 Among the statements on level of agreement about climate change, increase in average temperature scored 0.93, followed by changing rainfall pattern (0.92), climate change increased due to increasing pollution (0.92), climate change increase risk in fishing (0.89), nobody will be able to control climate change (0.82), frequency of extreme climatic events like floods, cyclones, landslides has increased (0.81) recorded high score for the level of agreement about climate change.

6.18 The components score of elements which disrupted by climate change was fish stock (0.91) and fishing point (0.88) recorded high to very high component score, followed by salinity of water (0.27), marketing of fish (0.25) and drinking water (0.24) recorded low to medium component score.

6.19 Estuarine fishers' perception on impact of climate change on resources, the component score of migration of fishes was 0.93 and change in species availability was 0.85. Alteration in fishing season recorded medium score (0.50) for impact of climate change. The shift in spawning season (0.28) recorded low to medium component score.

6.20 Among the factors, 'reduction in income' recorded component score of (0.98), followed by increased cost of fishing (0.96), shift in employment pattern and seasonality in employment (0.78) recorded high to very high component score. The component score of displacement of family members and increase in food security issues (0.22) obtained low score on impact of climate change on resource users.

6.21 The component score of impact of climate change on environmental factors was habitat destruction was 0.80, followed by seawater inundation (0.79) and monsoonal fluctuation was (0.72) recorded high to very high score. Extreme weather events (0.62) recorded medium to high component score and sea level rise (0.28) recorded low to medium component score.

Conclusion: The study of awareness and perception about climate change has shown maximum percentage of the estuarine fishers educated upto secondary level. The estuarine fishers have medium level awareness about climate change. The estuarine fishers indicated relying mostly on own experience rather than on the mass media and government agencies as their sources of information. The study revealed that most of the estuarine fishers experienced, temperature has increased, significant change in rainfall pattern and changes in fish availability. The estuarine fishers perceived that the migration of fish, changes in species availability, reduction in income, increased cost of fishing and habitat destruction has impact of climate change.

Recommendations:

1. Awareness programme such as campaign, training on climate change and its impacts as well as risk and adaptation measures should be conducted.
2. Increase use of mass media for dissemination of information on climate change and natural calamities.
3. Due to climate change, reduction in income and increases the cost of fishing have a negative impact on the socio- economics of the estuarine fisher community. Considering these impacts an effective adaptation policy should be customised and address fisher's needs.

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Annexure I

Interview schedule for study of “Awareness and perception about climate change among estuarine fishers”

1.0 Sampling details

1.1	Sample code	:
1.2	Day of sampling	:
1.3	Sampling date	:
1.4	Sampling time	:
1.5	Location	:

2.0 Personal information

1.	Name of respondent	:	
2.	Relation with family head	:	
3.	Name of family head	:	
4.	Gender	:	
5.	Address	:	
6.	Panchayat	:	
7.	Taluka and District	:	
8.	Mobile number	:	
9.	Landline number	:	
10.	Email ID	:	
11.	Religion	:	
12.	Category	:	
13.	Birth date/ Age	:	
14.	Education	:	
15.	Marital status	:	
16.	Occupation	:	a. Primary b. Secondary
17.	Type of ration card	:	Yellow/ Orange/ White
18.	Aadhar card	:	Yes/No
19.	Family type	:	Nuclear/Joint family
20.	Experience in estuarine fishing	:Years
21.	Have you taken any loan from bank?	:	Yes/No
22.	Distance of house from the estuary	:km
23.	Type of house	:	Kaccha / Semi Pakka /Pakka

Social aspects codes

Q.4 Gender: 1=Male; 2=Female

Q.11 Religion: 1= Hinduism; 2= Islam; 3= Christianity; 4= Other (Specify)

Q.12 Category: 1= Open; 2= SC; 3= ST; 4= OBC; 5= SBC; 6=NT; 7=VJ; 8= DT

Q.14 Education: 1= Illiterate; 2= Primary; 3=Secondary; 4= SSC; 5= HSC; 6=

Graduate; 7=Postgraduate; 8= Doctorate; 9= Diploma; 10= ITI; 11= Certificate course
15 Marital status: 1= Married; 2= Unmarried; 3= Widow/widower; 4= Divorcee; 5= Separated; 6= other (specify)

2.1 Profile of other family members of the family

Sr. No.	Name of family member	Gender	Birth date/ (Age)	Relation	Education	Occupation	Annual income
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							
9.							
10.							

OBJECTIVE: 1.To study the awareness about climate change among estuarine fishers.

1. Have you heard about “climate change”?

- Yes
- No
- Don't know

2. Do you feel the pattern of weather is changing?

- Yes
- No
- Don't know

3. What are the main sources of information on climate change?

- Friends
- Family
- Television
- Radio
- Newspaper
- Internet
- School/ college/ university
- Government agencies/ information
- Other

4. Do you experience any impacts of climate change?

Change in weather	Extreme/slight/normal	Fish availability	Increase/decrease/normal
Change in temperature	Increase/decrease/normal	No. of species caught	Increase/decrease/normal
Change in rainfall pattern	Increase/decrease/normal	Type of species caught	Regular/different
Availability of water	Increase/decrease/normal	Yield	Increase/decrease/normal
Seasonal transition	Regular/ irregular	Fishing days	Increase/decrease/normal
Beach morphology	Erosion/deposition	Fish catch	Increase/decrease/normal
Floods	Increase/decrease/normal		

5. Which climate-friendly practices do you follow for preventing climate change?

Efforts	Rank	Remarks
Energy conservation		
Fuel conservation		
Avoid / reduce use of plastic bag		
Avoid pollution		
Use of alternative Transportation		
Avoid disposal of diesel in sea		
Mangrove protection		
Avoid venturing in sea		

OBJECTIVE: 2. To study the perception about climate change among estuarine fishers.

1. How is your knowledge on local climate change?

- Excellent
- Moderate
- Poor

2. Considering your previous experience, indicate level of agreement with the following statements.

Statements	Strongly agree	Agree	Ambivalent	Disagree	Strongly disagree
Average temperature is increasing					
Sea level is increasing					
Frequency of extreme climatic events like floods, cyclone, landslides has increased					
Rainfall pattern changing					
Fish habitats are destroyed due to climate change					
Change in breeding season of fishes due to climate change					
Climate change increased due to increasing pollution					
Fish production is increased due to change in climate					
Climate change increases risk in fishing					
Nobody will be able to control climate change					
Fishers must be aware of climate change					

3. Climate change disrupt the following elements

Elements	Strongly concerned	Very concerned	Not concerned or concerned	Strongly not concerned	Not concerned	Don't know
Fish stock						
Fishing point						
Marketing of fish						
Salinity of water						
Drinking water						

4. Impact of climate change on resources

Parameters	Strongly agree	Agree	Ambivalent	Disagree	Strongly disagree
Shift in spawning season					
Migration of fishes					
Alteration in fishing season					
Change in species availability					

5. Impact of climate change on resource users

Factors	Strongly agree	Agree	Ambivalent	Disagree	Strongly disagree
Displacement of family members					
Increase in food security issues					
Migration of fishers					
Reduction in income					
Seasonality in employment					
Shift in employment pattern					
Increased cost of fishing					

6. Impact of climate change on environmental factor

Factors	Negligible	Low	Medium	High	Very high
Sea level rise					
Extreme weather events					
Habitat destruction					
Seawater inundation					
Monsoonal fluctuation					