

Assessing the alternative livelihood options for climate change vulnerable coastal fishing villages in kerala, India.

ABSTRACT

Fisheries and allied sectors provide means of livelihood to millions of people around the world. In India more than 14.5 million individuals depend on fisheries for their livelihood, with Gujarat, Tamil Nadu and Kerala being the main three marine fish producing states of the country. The social and economic contribution of fisheries as a sector cannot be ignored or go unnoticed. Similarly the impact of climate change on fisheries and its resultant impact on the livelihood of fisheries dependent communities cannot be ignored. To address these pertinent issues, we first need to understand the impact of climate change on fisheries and the need of alternative livelihood options from the perspective of the direct stakeholders i.e. fishermen. This study is an endeavour to look at the need of Alternative livelihood options (ALOs) because of climate change among the coastal communities in Poonthura and Elamkunnappuzha villages of Thiruvananthapuram and Ernakulum respectively. Among the 222 marine fishing villages of Kerala, Poonthura and Elamkunnappuzha are the major fishing villages from the South West hotspot locales of India. The examination investigated different socioeconomic aspects, for example, fishing activity, basic household data, economic as well as historic and cultural dependence on fishing, employment and occupational structure, income distribution and assets, physical capital, financial capital, social capital, and exposure and awareness of the fishermen families to climate change by interviewing 1259 fishermen from Poonthura and Elamkunnappuzha. The study conducted in the most climate change vulnerable marine hotspots of Kerala (Elamkunnappuzha and Poonthura) explains the problems and prospects of the inhabitants in the sector and the importance of Alternative Livelihood Options (ALOs) in climate change adaptation.

Keywords: climate change, vulnerability, fishermen, Alternative Livelihood Options (ALOs), adaptive capacity.

1 .INTRODUCTION

Indian fisheries sector is a sunrise sector with varied resources and potential, engaging over 14.50 million people at the primary level and many more along the value chain. The marine resources of the country comprise an Exclusive Economic Zone (EEZ) of 2.02 million sq. km, a continental shelf area of 5,30,000 sq. km and a coastline of 8,118 km. The marine fishery potential in the Indian waters have been estimated at 4.41 MMT constituting more than 47% demersal, 48% pelagic and 5% oceanic groups. India had annual marine fish landings of 3.63 million tonnes in 2016. Around 29.2 per cent of the total fish production of the India is from the southwest region of the west coast of the country comprising Kerala, Karnataka and Goa, of which 49 per cent contribution is from Kerala. A state-wise analysis of the estimates indicates that the maritime states of West Bengal, Kerala, Karnataka, Maharashtra, Gujarat and the U.T. of Daman & Diu registered increase in landings whereas the other coastal states Odisha, Andhra Pradesh, Tamil Nadu, Puducherry and Goa recorded a decline. Gujarat retained the top position among the states with 7.74 lakh t landings followed by Tamil Nadu which landed 7.07 lakh t. For the first time Karnataka attained the third position pushing down Kerala into 4th position with 5.30 and 5.23 lakh t respectively. In Kerala the marine fish landings during 2016 was 5.22 lakh t showing an increase of 7%; pelagics contributed 61%, demersals 25%, crustaceans and molluscs 7% each. Kerala, Karnataka and Goa together produced 11.13 lakh t which accounted for 31% of the total landings in the country. In spite of a continuing decline in oil sardine landings, Kerala attained 8% increase in the total landings in 2016 (CMFRI Annual Report, 2016-17; CMFRI Marine Fisheries Census, 2010).

With a coastline of over 590 Km, and an exclusive economic zone (EEZ) of 218536 Sq Km, Kerala has a significant marine fisheries sector that has long been an important source of occupation and livelihood for the coastal population of the state. The fishermen population is around 3.1 per cent of

53 the state population, residing in 222 marine fishing villages and 113 inland fishing villages of the state.
54 Out of this, 7.88 lakh fishermen belong to Marine sector while 2.36 lakh fishermen belong to Inland
55 sector. Alappuzha (1.90 lakh) is the district with largest fishermen population, followed by
56 Thiruvananthapuram (1.70 lakh) and Ernakulam (1.36 lakh) (Economic Review, 2016).

57 It is a fact that, the socio-economic condition of the fisher folk in the State is pitiable, when compared
58 to the general section of the population. Backwardness is the hall mark of fishermen. They are in the
59 grip of subsistence economy and indebtedness in the normal aspects of their life. Many reasons could
60 be accounted for this state of affairs. Among social, economic and educational and such other
61 reasons, the depletion of fishery wealth is a major cause (Dept of Fisheries, Govt of Kerala).

62
63 In a state like Kerala where unemployment is the crucial problem, fisheries sector plays a vital role in
64 providing jobs to thousands. Fisheries sector contributes directly and indirectly to the generation of
65 employment in the State, and such sectors must be given due importance to tackle the unemployment
66 problem in the State (Alavy Kutty P.M, 2004).

67
68 In relevance to Kerala's fishing scenario, there is an urgency to carry out sea-friendly fishery practices
69 to be adopted soon considering the global decline in the marine fisheries production. However while
70 doing the same, there should be proper checks and balances, as a large number of populations have
71 been dependent on fishing historically and therefore, livelihood concerns of poor fishermen should be
72 kept in mind (Natasha Kuldeep,2015).

73
74 Even though the state of Kerala is rated among the top three maritime states of the country, still there
75 are illiterate/semiliterate and indigent fishermen who lack the knowledge of latest fishery technologies
76 and proper attitude towards fishery development (Chakrabarthy et al., 2005).

77
78 Furthermore Shyam *et al.* (2014) reported low level of awareness on climate change among fisher folk
79 of Kerala owing to the fact that climate change issues are entangled with other developmental issues;
80 thereby community could not decipher climate change issues in particular. According to the reports of
81 Ridgway (2007a);Cai *et al.* (2005); Cai (2006); the impacts of climate change is expected to be
82 observed in the southern part of India. The impacts of climate change are expected to be different
83 within and between regions and nations, and thus it is important to investigate where climate change
84 impacts on fisheries have greatest social and economic significance (Allison et al.2009).

85
86 According to the study conducted by Shyam *et al.* (2014), Thiruvananthapuram and Ernakulam
87 districts are the highest vulnerable villages in Kerala based on the vulnerability index table formulated
88 by using the Patnaik and Narayin method. With respect to the Vulnerability index table, the highest
89 vulnerable villages of Thiruvananthapuram and Ernakulam District i.e. Elamkunnappuzha and
90 Poonthura Villages were selected as the units of study. (Shyam et al.,2014). The vulnerability of
91 Poonthura (2.85) was found to be higher than Elankunnappuzha (2.80). The results revealed that
92 majority of the fisher households in both the villages were highly vulnerable to climate change which
93 is a major cause of concern.

94
95 Under the above pretext, a study directed in the selected coastal regions of Poonthura and
96 Elamkunnappuzha fishing villages to get an understanding about the level of awareness of fishers
97 about climate change and the importance of alternative livelihood options is relevant. It draws
98 consideration as it is directed at two of the marine hotspots in the nation which encounters high
99 vulnerability to climate related shocks and stress along with a higher vulnerability index as the
100 communities are located near the coastline. Hence, a study regarding the socioeconomic profile of
101 such fishing villages is worth enough to be used as a basis to develop proper adaptation mitigation
102 strategies for the fisher folks to climate change through alternative livelihood options.

103
104 As the ability to sustain fisheries will rest on a mechanistic understanding of interactions between
105 global change events and localised disturbances, it is important to recognize the regional responses
106 to climate change. It is also important to recognize the importance of the changes in these parameters
107 as drivers of change in marine organisms including fish. Initiating a commitment on long- term
108 environmental and ecological monitoring programmes is important as such data cannot be collected
109 retrospectively. Projections on climate change impact on fish populations need to be developed as the
110 first step for future analytical and empirical models and for planning better management adaptations.
111 Effort is also required in- respect of raising awareness of the impact, vulnerability, adaptation and

112 mitigation related to climate change among the decision makers, managers, fishermen and other
113 stakeholders in the fishing sector (E. Vivekanandan, 2010).
114 Climate change and its impact was a debated topic for a long time, but now we know that it is a
115 reality. It has changed in past, is changing in present and will change in future. So it is high time that
116 we focus on the adaptation and mitigation plans at national and regional levels. The term mitigation
117 refers to efforts to cut or prevent the emission of greenhouse gases - limiting the magnitude of future
118 warming. It may also encompass attempts to remove greenhouse gases from the atmosphere.
119 Mitigation may require us to use new technologies, clean energy sources, change people's behaviour,
120 or make older technology more energy efficient. Mitigation differs from climate change adaptation,
121 which refers to the actions taken to manage the unavoidable impacts of climate change.
122

123 The study undertaken will help in understanding the level of awareness about climate change among
124 the fishermen community, problems faced by coastal communities due to climate change and the
125 methods followed by them to overcome it, ALOs available etc. Besides this, it will also help us in
126 finding out the preferred climate change adaptation and mitigation plans among the fishermen
127 community and thus help in preparing a robust strategy to overcome the problems due to climate
128 change. Understanding the impacts of climate change on fisheries is crucial as fisheries is important
129 for food security, livelihood, and generation of employment and foreign exchange for national
130 government.
131

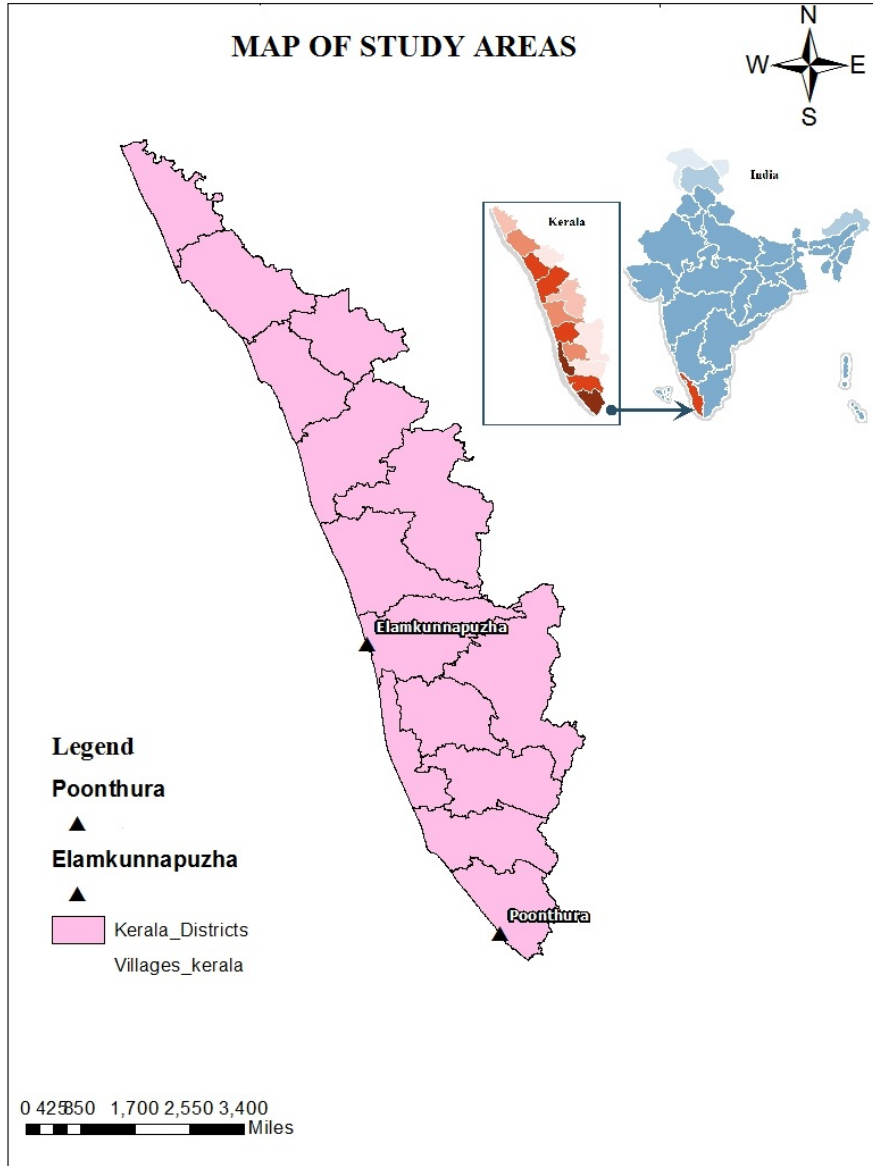
132 **2. MATERIALS AND METHODS**

133 **2.1 Location**

134 The study was conducted in the coastal villages of Poonthura and Elamkunnappuzha situated in
135 Thiruvananthapuram and Ernakulam respectively.

136 Thiruvananthapuram, the capital of Kerala, has the maximum number of fishing villages (42nos) in
137 Kerala constituting around 19 per cent of the state total (CMFRI Marine Fisheries Census, 2010).
138 Coastal village of Poonthura is inhabited by around four per cent of the total fishermen families and
139 six per cent of the total fisher folk population of Thiruvananthapuram (CMFRI Marine Fisheries
140 Census, 2010). It is one of the major fishing villages from the south west hotspot regions of India lying
141 between 10° 00' N and 76° 15 E.

142 Ernakulam with a coastal length of 46 Km has a fishermen population of 1543 per Km length is one of
143 the major fishing district of Kerala. Elamkunnappuzha village in Ernakulam district has a total
144 population of 51,197 and an area of 11.52 sq km. It has a distinct ecosystem that includes capture
145 and culture fisheries, a variety of agricultural crops, and animal husbandry. Elamkunnappuzha village is
146 one of the other major south west hotspot regions of India lying between 10° 1'0"N 76° 13'0"E. Figure 1
147 clearly marks the study area.



148 |
 149 Figure 1. Study Area
 150

151 **2.2 Data collection**

152 A pre-tested interview schedule was used for the collection of information directly from the fishermen
 153 families through personal discussions and interviews regarding the various aspects of the socio-
 154 economic conditions. A total sample of 1259 respondents was selected from the coastal villages of
 155 Poonthura and Elamkunnappuzha through random sampling method. Information gathering was done
 156 to collect data on socio economic and demographic view of the respondents, level of awareness of
 157 fisher folk about climate change, fisher's perception on the impacts of climate change on resources
 158 and resource users, sources of information on climate change, Alternative livelihood options available
 159 and preferred, climate change adaptation actions and the need of more training etc.

160
 161 **3. RESULTS AND DISCUSSION**

162 The result of the particular study undertaken is discussed below under the headings socio-economic
 163 profile, climate change impacts on their livelihood and Alternative Livelihood Options (ALOs).
 164
 165
 166

167
168
169
170
171
172
173
174
175
176
177

3.1 Socio-economic profile

3.1.1 General profile

Out of the total 1259 respondents, 588 were from Elamkunnapuzha and 671 were from Poonthura. The male female ratio was slightly skewed towards the male side in both study areas. Majority (59%) of the respondents from Elamkunnapuzha belonged to Hindu community, whereas in Poonthura 90 per cent of them belonged to the Christian community. Majority (34%) of the respondents from Elamkunnapuzha belonged to the age category 46-55 and 33 per cent from Poonthura belonged to the category 35-45. (Given in Table 1)

Table 1 .General Profile of the respondents

| Sl No | Socio-economic parameters | | Elamkunnapuzha | Poonthura |
|-------|---------------------------|-----------|----------------|-----------|
| 1 | Total | | 588 | 671 |
| 2 | Gender | Male | 327 | 393 |
| | | Female | 261 | 278 |
| 3 | Religious Orientation | Hindu | 345 | 16 |
| | | Christian | 183 | 603 |
| | | Muslim | 56 | 52 |
| | | Others | 4 | 0 |
| 4 | Age | < 35 | 47 | 117 |
| | | 35-45 | 127 | 220 |
| | | 46-55 | 199 | 199 |
| | | 56-65 | 144 | 106 |
| | | > 65 | 71 | 29 |

178
179
180
181
182

3.1.2 Family members

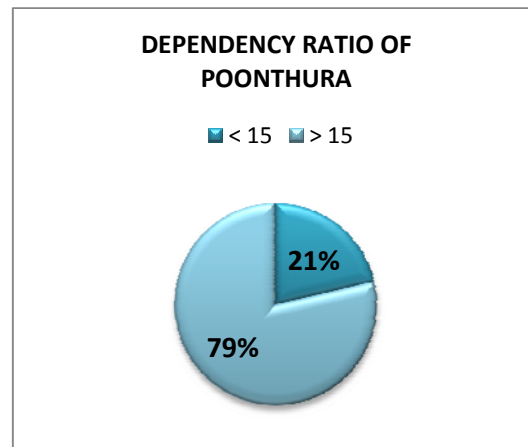
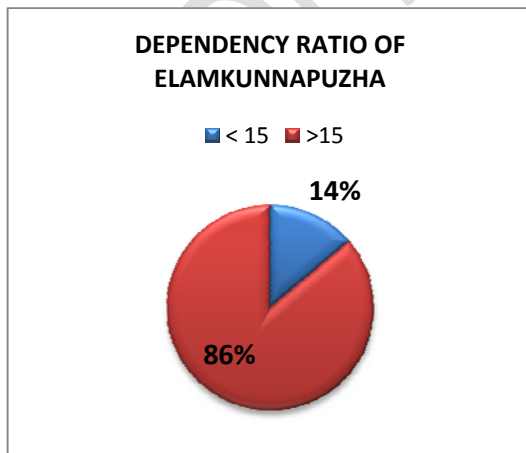
Family members in Elamkunnapuzha village comprised mainly adults (86%) and children constituted only a minor 14 per cent of the total family members. In Poonthura 79 per cent were adults and 21 per cent were children as shown in Table 2. The dependency ratio of both the villages is given in Figure 2.

183

Table 2. Dependency ratio

| Family members | ELN | POON |
|---------------------|------|------|
| Children (< 15 yrs) | 302 | 517 |
| Adults(>15 yrs) | 1892 | 1905 |

184



185

186

Figure 2; Dependency ratio of Elankunnapuzha and Poonthura village

187

188 **3.1.3 Main occupation**

189 According to the response, about 44 per cent of the respondents of Elamkunnapuzha village
 190 considered fishing as their main occupation, while others see it as a part time occupation. In
 191 Poonthura 90 per cent of the respondents consider fishing as their main occupation as given in Table
 192 3.

193 **Table 3. Main occupation of the respondents**

| Main Occupation | ELN | POON | 194 195 196 197 198 199 200 |
|-----------------|-----|------|-----------------------------------------------|
| Fishing | 260 | 602 | |
| Others | 328 | 69 | |

201

202 **3.1.4 Experience in fishing (Years)**

203 Majority (73 percent) of the fishermen in Elamkunnapuzha village has more than 25 years of
 204 experience in fishing whereas in Poonthura it was 51 per cent as shown in Table 4. The results of the
 205 t test validates the fact that respondents of Elankunnapuzha village are more interested in fishing and
 206 got dominant experience than Poonthura village. The results also point out prevalence of the people
 207 of the Poonthura village on livelihood activities other than fishing.

208 **Table 4. Experience in fishing**

| Experience in Fishing (Years) | ELN | POON |
|-------------------------------|----------|-----------|
| < 10 | 23 | 57 |
| 10 to 25 | 46 | 238 |
| > 25 | 191 | 307 |
| t-Test | | |
| Mean | 86.66667 | 200.66667 |
| Variance | 8296.333 | 16670.333 |
| Pearson Correlation | 0.796017 | |
| df | 2 | |
| t Stat | -2.49881 | |
| P(T<=t) one-tail | 0.064856 | |
| t Critical one-tail | 2.919986 | |
| P(T<=t) two-tail | 0.129712 | |
| t Critical two-tail | 4.302653 | |

209

210

211 **3.1.5 Fishing trips per week**

212 The study revealed that 32 per cent of the fishermen respondents in Elamkunnapuzha village make 4
 213 to 5 fishing trips in a week whereas about 45 per cent of the fishermen respondents in Poonthura
 214 make more than 5 fishing trips per week. An infinitesimally small per cent of the fishers in
 215 Elamkunnapuzha have less than three fishing trips a week. While probing the details about the
 216 duration of a fishing trip it is found out that about 46 per cent of the respondents from
 217 Elamkunnapuzha and 11 percent from Poonthura did not have any response to the question (Given in
 218 Table 5).

219 **Table 5. Fishing trips per week**

| Fishing Trips Per Week | ELN | POON |
|------------------------|-----|------|
| < 4 | 4 | 47 |
| 4 TO 5 | 82 | 210 |
| > 5 | 54 | 276 |

220

221 **3.1.6 Average period of fishing trips (hr/day)**

222 On an average 1 to 12 hours per day was the length of fishing trips taken by 55 percent of the
 223 fishermen respondents from Elamkunnapuzha village whereas 80 per cent in Poonthura were found
 224 to be doing the same (Shown in Table 6).

225 **Table 6. Average period of fishing trips (hr/day)**

| Average period of fishing trips (hr/day) | ELN | POON |
|------------------------------------------|-----|------|
| 1 to12 | 143 | 481 |
| 13 to 24 | 21 | 33 |
| >24 | 2 | 5 |

226

227 **3.1.7 Percentage of income derived from fishing**

228 Thirty three per cent of the fishermen respondents from Elamkunnapuzha and Poonthura have 26 to
 229 50 per cent of their income derived from fishing. Twenty seven per cent of fishermen respondents
 230 from Elamkunnapuzha and 34 per cent from Poonthura have more than 75 per cent of their income
 231 derived from fishing (Given in Table 7)

232

233 **Table 7. Percentage of income derived from fishing**

234

| Percentage of income derived from fishing | ELN | POON |
|-------------------------------------------|-----|------|
| Upto 25 | 19 | 22 |
| 26-50 | 87 | 197 |
| 51-75 | 16 | 71 |
| >75 | 71 | 205 |

235

236 **3.1.8 Income and indebtedness**

237 Majority of the fishermen from Poonthura (68%) and Elamkunnapuzha (97%) responded that their
 238 income reduced due to low fishing income. In Poonthura and Elamkunnapuzha 63 and 51 percent
 239 respectively had taken loan and 59 and 61 per cent respectively had repaid their loan as shown in
 240 Table 8.

241

242 **Table 8 Income and indebtedness**

| Income and indebtedness | POON | | ELN | |
|--------------------------------------------|------|-----|-----|-----|
| | Yes | No | Yes | No |
| Income decreased due to low fishing income | 174 | 82 | 517 | 16 |
| Possess any loan | 344 | 201 | 330 | 318 |
| Loan repaid | 174 | 120 | 149 | 96 |

243

244 **3.1.9 Loan amount**

245 Forty two per cent of the respondents from Elamkunnapuzha and 32 per cent from Poonthura were
 246 having a debt amounting to the range Rs. 100000-2000000.This was followed by 20 per cent from
 247 Elamkunnapuzha and 17 per cent from Poonthura found to have taken a loan amounting to less than
 248 Rs.100000 as reported in Table 9.

249 **Table 9. Loan Amount of the respondents**

| Loan amount | ELN | POON |
|----------------|-----|------|
| < 100000 | 115 | 113 |
| 100000-2000000 | 245 | 214 |
| >2000000 | 3 | 0 |

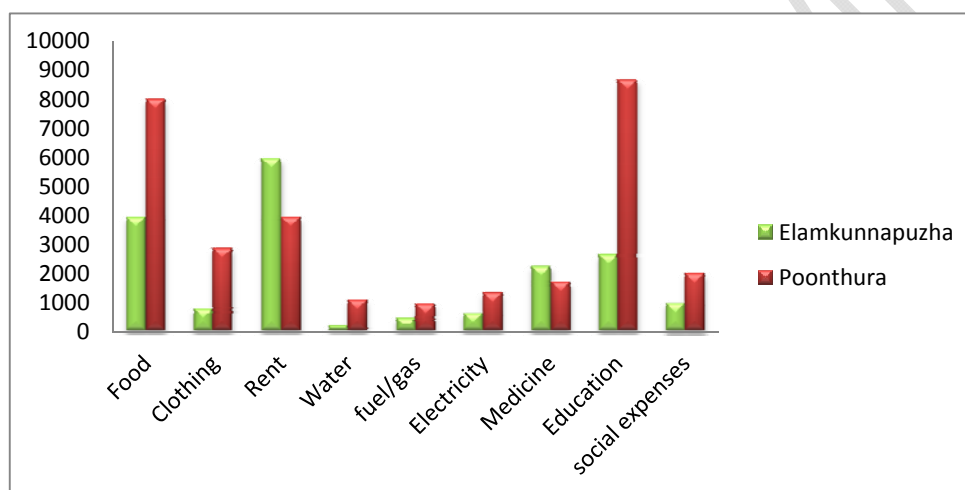
250

251 **3.1.10 Percentage of debt increased due to reduced family income**
 252 According to the survey 8 per cent of the respondents from Elamkunnapuzha responded that their
 253 debt increased in the range 26-50 % due to reduced family income. In Poonthura 16 per cent of the
 254 respondents found their debt increased upto 25% due to reduced family income (Given in Table 10).

255 **Table 10 .Percentage of debt**

| Percentage of debt increased due to reduced family income | ELN | POON |
|-----------------------------------------------------------|-----|------|
| Upto 25 | 24 | 103 |
| 26-50 | 47 | 58 |
| 51-75 | 25 | 52 |
| >75 | 32 | 80 |

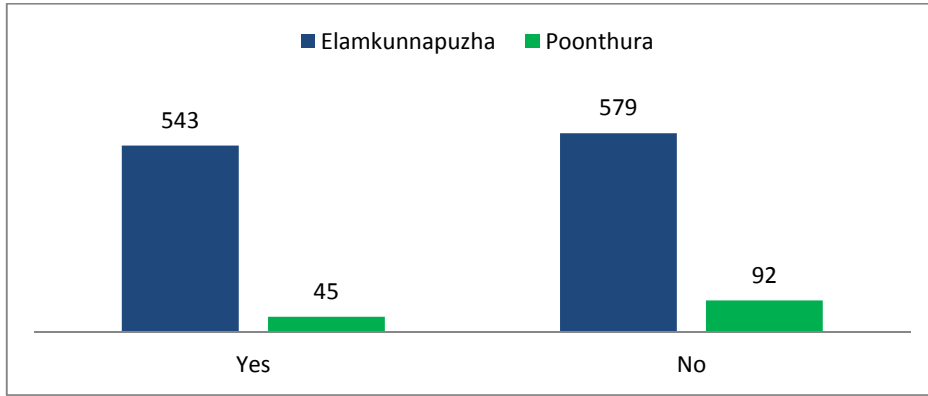
256
 257 **3.1.11 Average expenditure pattern**
 258 Rent, food, medicine and education were the main expenditure drivers in case of both
 259 Elamkunnapuzha and Poonthura. As depicted in figure 3.



260
 261 **Figure 3. Expenditure pattern**

262
 263 **3.2 Climate change impacts on their livelihood**
 264 Fisheries' being heavily dependent on weather and climate is substantially affected by the changes in
 265 climate and environment. These changes can thus directly or indirectly create repercussions in the life
 266 of the fishermen dependent on it for their livelihood.

267
 268 **3.2.1 Climate change impact awareness**
 269 Majority (92 %) of the respondents from Elamkunnapuzha and 86 per cent from Poonthura have
 270 heard about climate change impacts from different sources such as friends ,family members, media,
 271 newspapers, social websites, community groups etc (Figure 4).



272

273

274

Figure 4. Climate change impact awareness level

275

276

3.2.2 Source of information

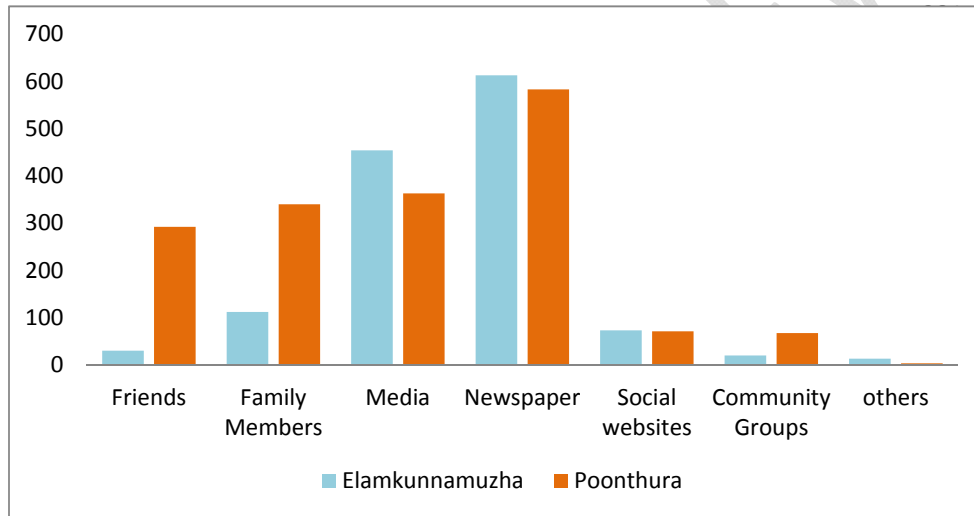
277

Major sources of information related to climate change impacts in Elamkunnapuzha were newspaper and media. In case of Poonthura, newspaper, media, family members and friends were the major sources of information (Figure 5)

278

279

280



290

291

Figure 5. Source of information

292

293

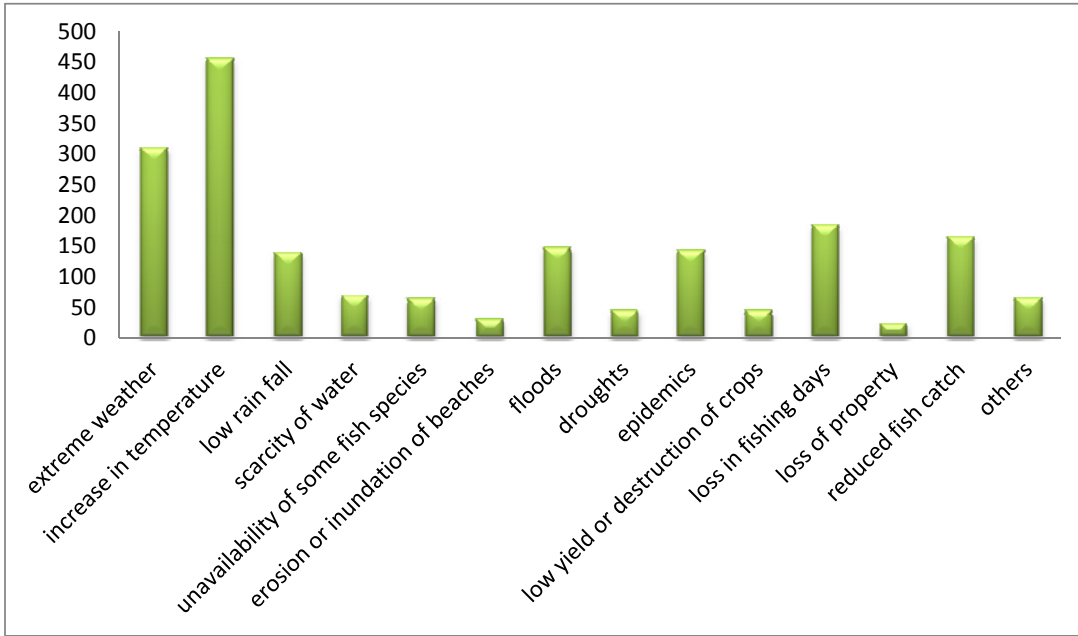
3.2.3 Climate change impacts experienced in day to day life

294

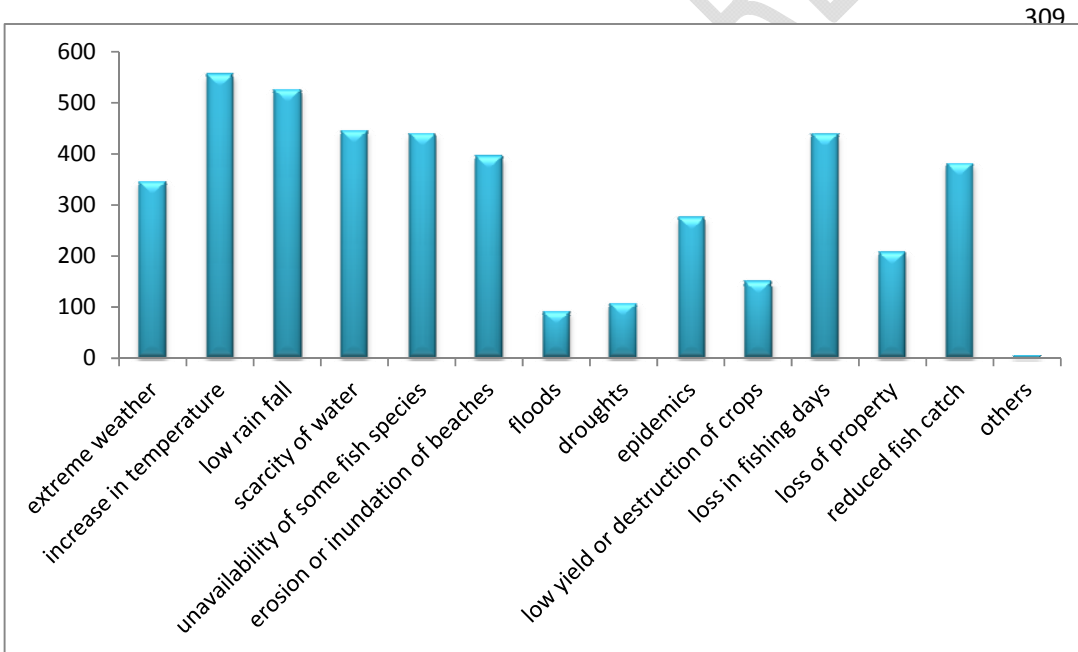
Figure 6 and 7 give details of climate change impacts experienced in day to day life by the inhabitants of Elamkunnapuzha and Poonthura villages.

295

296



308 **Figure 6. Climate change impacts of the inhabitants of Elankunnapuzha**



320 **Figure 7. Climate change impacts of the inhabitants of Poonthura**

321

322 **3.2.4 Willingness to know more about climate change**

323 Sixty three per cent of the respondents from Elankunnapuzha and 76 per cent from Poonthura are
 324 willing to know more about climate change. This shows the interest among the fishermen community
 325 to know more about climate change and contribute more towards the adaptation and mitigation plans
 326 (Given in Table 11).

327

328 **Table 11. Willingness to know more about climate change**

| Village | Willing to know more about climate change |
|---------|-------------------------------------------|
|---------|-------------------------------------------|

| | Yes | No |
|------|-----|-----|
| ELN | 373 | 215 |
| POON | 511 | 160 |

329

330

3.2.5 Willing to participate in any climate change adaptation activities

331

Majority (60%) of the respondents from Elamkunnappuzha and 72% from Poonthura are willing to participate in any climate change adaptation activities. From this we can conclude that a vast majority of the fishermen community are willing to be a part of the climate change adaptation and mitigation strategies (Table 12).

332

333

334

335

336

Table 12. Willing to participate in any climate change adaptation activities

| Village | Willing to participate in any climate change adaptation activities | |
|---------|--------------------------------------------------------------------|-----|
| | Yes | No |
| ELN | 350 | 175 |
| POON | 480 | 83 |

337

338

3.2.6 Type of climate change adaptation activities willing to participate

339

Majority (61%) of the respondents from Elamkunnappuzha would like to take part in individual climate change adaptation activities followed by household (37%), social (21%), institutional (10%) and communal (6%). In case of Poonthura majority (50%) of the respondents favoured social activities followed by communal (27%), household (14%), individual (13%), institutional (7%) and political (2%) (Table 13).

340

341

342

343

344

Table 13. Climate change adaptation activities willing to participate

| Type of climate change adaptation activities willing to participate | ELN | POON |
|---------------------------------------------------------------------|-----|------|
| Individual | 360 | 89 |
| Social | 126 | 333 |
| Institutional | 60 | 48 |
| Household | 220 | 92 |
| Communal | 36 | 179 |
| Political | 0 | 13 |
| Others | 0 | 3 |

345

346

3.2.7 Climate change displacement

347

In Elamkunnappuzha only a small percentage (3%) reported to be displaced due to climate change whereas in Poonthura 13 percent were displaced due to climate change as shown in Table 14. A vast majority of respondents from both the villages responded that they were not displaced due to climate change.

348

349

350

351

Table 14. Climate change displacement

| Village | Displaced due to climate change | |
|---------|---------------------------------|-----|
| | Yes | No |
| ELN | 21 | 524 |
| POON | 89 | 506 |

352

353

3.2.8 Fear of displacement in future due to climate change

354

In Elamkunnappuzha and Poonthura 10 per cent and 20 per cent respondents respectively has fear of displacement due to climate change in future. Fifty one per cent of the respondents from Elamkunnappuzha and 74 % from Poonthura have no fear of displacement due to climate change in future (Table 15).

355

356

357

358

Table 15. Displacement in future

| Village | Fear of displacement in future due to climate change |
|---------|------------------------------------------------------|
|---------|------------------------------------------------------|

| | Yes | No |
|------|-----|-----|
| ELN | 59 | 438 |
| POON | 137 | 342 |

359

360

3.2.9 Climate change adaptation measures practiced

361

Using transportation alternatives, Organic Farming, increasing energy efficiency, reducing food waste, avoiding products with lot of packaging and rain water harvesting are the popular climate change adaptation activities being practiced among the coastal communities of Elamkunnappuzha and Poonthura fishing villages. The details of climate change adaptation measures practiced by inhabitants of both villages are given in Table 16 and 17.

362

363

364

365

366

Table 16. Adaptation Measures-Poonthura

| Sl.No | Poonthura | Score | Rank |
|-------|--------------------------------------|-------|------|
| 1 | Organic Farming | 50.32 | IV |
| 2 | Increase energy efficiency | 61.45 | III |
| 3 | reduce food waste | 66.13 | II |
| 4 | rain water harvesting | 27.1 | VIII |
| 5 | transportation alternatives | 49.16 | V |
| 6 | avoid products with lot of packaging | 73.39 | I |
| 7 | use paper judiciously | 37.58 | VI |
| 8 | limit the use of fossil fuels | 18.65 | IX |
| 9 | pricing carbon | 30.81 | VII |
| 10 | Others | 17.42 | X |

367

368

Table 17- Adaptation Measures-Elankunnappuzha

| Sl.No | Elamkunnappuzha | Score | Rank |
|-------|--------------------------------------|-------|------|
| 1 | Organic Farming | 45.62 | V |
| 2 | Increase energy efficiency | 62.35 | II |
| 3 | Reduce food waste | 60.52 | III |
| 4 | Rain water harvesting | 50.12 | IV |
| 5 | Transportation alternatives | 37.33 | VI |
| 6 | Avoid products with lot of packaging | 70.56 | I |
| 7 | Use paper judiciously | 30.56 | VII |
| 8 | Limit the use of fossil fuels | 19.54 | IX |
| 9 | Pricing carbon | 27.23 | VIII |
| 10 | Others | 16.52 | X |

369

370

3.3 Alternative Livelihood Options (ALOs)

371

3.3.1 Alternative livelihood options

372

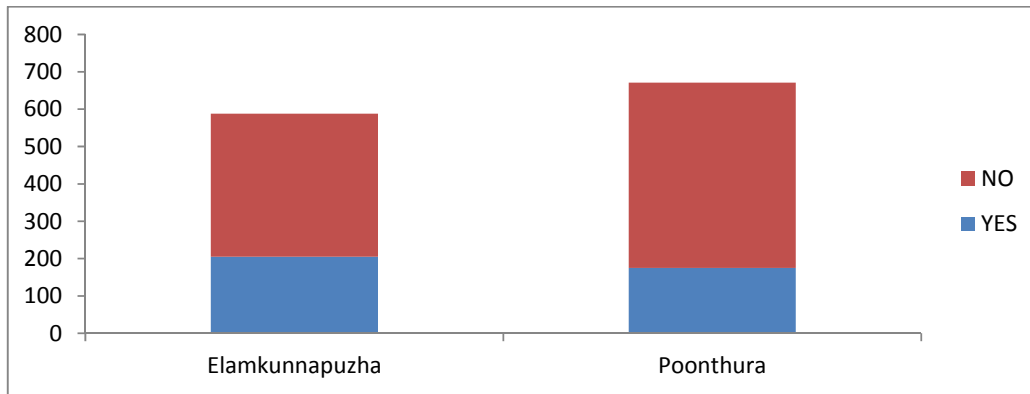
Thirty two per cent from Elamkunnappuzha and 19 per cent from Poonthura have Alternative Livelihood options whereas 61 per cent from Elamkunnappuzha and 67 percent from Poonthura have no Alternative Livelihood options other than fishing. From this we can conclude that majority of the respondents are completely dependent on fisheries and has no other means to survive, if left without it (Figure 8).

373

374

375

376



377

378 **Figure 8. Alternative livelihood options**

379

3.3.2 Preferred Alternative Livelihood Options (ALOs)

380

381

382

383

384

Daily wage labour, SHG, Small scale industry, Service Industry and Masonry/carpentry are the top five ALOs preferred by fishermen in Poonthura and Elamkunnapuzha fishing villages. The order of preference is given in the table 18 and 19.

385

Table 18 Alternative Livelihood Options-Poonthura

| Sl. No | Poonthura | Score | Rank |
|--------|----------------------|-------|------|
| 1 | Tourism | 19.54 | X |
| 2 | Aquaculture/cage | 35.66 | VIII |
| 3 | SHG | 58.65 | IV |
| 4 | Service Industry | 62.53 | II |
| 5 | Agriculture | 47.56 | VII |
| 6 | Daily wage labour | 70.56 | I |
| 7 | Masonry/carpentry | 52.44 | V |
| 8 | Animal Husbandry | 27.25 | IX |
| 9 | Small scale industry | 61.35 | III |
| 10 | Others | 50.12 | VI |

386

387

Table 19 Alternative Livelihood Options-Elamkunnapuzha

| Sl. No | Elamkunnapuzha | Score | Rank |
|--------|----------------------|-------|------|
| 1 | Tourism | 28.34 | VIII |
| 2 | Aquaculture/cage | 39.55 | VII |
| 3 | SHG | 61.15 | II |
| 4 | Service Industry | 45.62 | V |
| 5 | Agriculture | 36.89 | VI |
| 6 | Daily wage labour | 72.35 | I |
| 7 | Masonry/carpentry | 51.35 | IV |
| 8 | Animal Husbandry | 20.56 | IX |
| 9 | Small scale industry | 60.25 | III |
| 10 | Others | 19.23 | X |

388

389

390 **4. CONCLUSION**

391 Climate change is something that can affect the coastal community at multidimensional levels, the
392 most important being their livelihood. Right to livelihood being a fundamental right, is something that
393 is guaranteed to every citizen of India. So it is important that the researchers and policy makers work
394 hand in hand to make this changing situation a boon. According to our study, thirty two per cent from
395 Elamkunnapuzha and 19 per cent from Poonthura have Alternative Livelihood Options whereas 61
396 per cent from Elamkunnapuzha and 67 percent from Poonthura have no Alternative Livelihood
397 Options other than fishing. From this we can conclude that majority of the respondents are completely
398 dependent on fisheries and has no other means to survive, if left without it. Daily wage labour, SHG,
399 Small Scale Industry, Service Industry and Masonry/carpentry are the top five ALOs preferred by
400 fishermen in Poonthura and Elamkunnapuzha fishing villages. Climate change has already been
401 experienced in many parts of India with several seasons of intense storms, droughts, floods, fires etc.
402 Any further delay in addressing the issue would put at risk many more lives, livelihoods and
403 investments for decades to come.

404
405 **5. REFERENCES**

- 406
407 1.CMFRI. Annual Report 2016-17.Central Marine Fisheries Research Institute, Kochi, 2017.
408
409 2.Ministry of Agriculture and CMFRI 2010. Marine Fisheries Census 2010. Kerala. CMFRI, Kochi.
410 State Planning Board, Thiruvananthapuram, Kerala, India March 2017 Economic Review, 2016. Dept
411 of Fisheries, Govt of Kerala. Retrieved from <http://www.fisheries.kerala.gov.in/Alavy> Kutty P.M,
412 2004.Socio-economic problems of fishermen in Kerala with special reference to malabar region
413 Thesis. Department of Commerce and Management Studies, University of Calicut.
414 Natasha Kuldeep, 2015. Impact, adaptation and vulnerability of marine fisheries to climate change: A
415 case study of Kerala.
416
417 3.Chakraborty, C., Dutta, S., and Katiha, P., 2005. Fishery co-operatives in West Bengal:A socio
418 economic appraisal. *Environ. Ecol.*, 23: 50-57.
419
420 4.Shyam S Salim, Kripa V, Zachariah PU, Nivedita Shridhar, Ambrose TV.,2014. Climate change
421 awareness, preparedness, adaptation and mitigation strategies, fisher folks perception in coastal
422 Kerala. *Journal of Aquatic Biology and Fisheries*, Vol. 2/2014. pp 670-681.
423
424 5.Ridgway KR., 2007a. Long-term trend and decadal variability of the southward penetration of the
425 East Australian Current. *Geophys. Res. Lett.* 34: L13613,doi:10.1029/2007GL0303.
426 Cai W., 2006. Antarctic ozone depletion causes an intensification of the Southern Ocean super-gyre
427 circulation. *Geophys. Res. Lett.*33: L03712, doi:10.1029/2005GL02491.
428
429 6.Cai W, Shi G, Cowan T, Bi D, Ribbe J., 2005. The response of the Southern Annular Mode, the East
430 Australian Current, and the southern mid-latitude ocean circulation to global warming.
431
432 7.Allison, E.H. et al. (2009), Vulnerability of national economies to the impacts of climate change on
433 fisheries, *Fish and Fisheries*, Vol. 10, pp. 173–196.
434
435 8.Allison, E. (2011), Aquaculture, fisheries, poverty and food security, Working Paper 2011-65, The
436 World Fish Center, Penang, Malaysia.
437
438 9.FAO (2012), The state of the world fisheries and aquaculture (SOFIA) 2012. Rome: FAO.
439
440 10.E. Vivekanandan, 2010.Impact of Climate Change on Indian Marine Fisheries and Options for
441 Adaptation.
442
443
444
445
446
447
448
449

450
451
452
453
454
455
456
457
458
459
460
461
462
463
464

465

466

467

UNDER PEER REVIEW