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

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 Elamkunnapuzha villages of Thiruvananthapuram and Ernakulum respectively. Among the 222 marine fishing villages of Kerala, Poonthura and Elamkunnapuzha 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 taking 1259 samples from Poonthura and Elamkunnapuzha. The study conducted in the most climate change vulnerable marine hotspots of Kerala (Elamkunnapuzha 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 the state population, residing in 222 marine fishing villages and 113 inland fishing villages of the state.

Out of this, 7.88 lakh fishermen belong to Marine sector while 2.36 lakh fishermen belong to Inland sector. Alappuzha (1.90 lakh) is the district with largest fishermen population, followed by Thiruvananthapuram (1.70 lakh) and Ernakulam (1.36 lakh) (Economic Review, 2016).
It is a fact that, the socio-economic condition of the fisher folk in the State is pitiable, when compared to the general section of the population. Backwardness is the hall mark of fishermen. They are in the grip of subsistence economy and indebtedness in the normal aspects of their life. Many reasons could be accounted for this state of affairs. Among social, economic and educational and such other reasons, the depletion of fishery wealth is a major cause (Dept of Fisheries, Govt of Kerala).

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

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

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

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

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

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

As the ability to sustain fisheries will rest on a mechanistic understanding of interactions between global change events and localised disturbances, it is important to recognize the regional responses to climate change. It is also important to recognize the importance of the changes in these parameters as drivers of change in marine organisms including fish. Initiating a commitment on long- term environmental and ecological monitoring programmes is important as such data cannot be collected retrospectively. Projections on climate change impact on fish populations need to be developed as the first step for future analytical and empirical models and for planning better management adaptations. Effort is also required in- respect of raising awareness of the impact, vulnerability, adaptation and mitigation related to climate change among the decision makers, managers, fishermen and other stakeholders in the fishing sector. (E. Vivekanandan, 2010).

Climate change and its impact was a debated topic for a long time, but now we know that it is a reality. It has changed in Past, is changing in Present and will change in Future. So it is high time that we focus on the adaptation and mitigation plans at national and regional levels. The term mitigation refers to efforts to cut or prevent the emission of greenhouse gases - limiting the magnitude of future warming. It may also encompass attempts to remove greenhouse gases from the atmosphere. Mitigation may require us to use new technologies, clean energy sources, change people's behaviour, or make older technology more energy efficient. Mitigation differs from climate change adaptation, which refers to the actions taken to manage the unavoidable impacts of climate change.

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

2. MATERIALS AND METHODS

2.1 Location

The study is conducted in the coastal villages of Poonthura and Elamkunnapuzha situated in Thiruvananthapuram and Ernakulam respectively.

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

Ernakulam with a coastal length of 46 Km has a fishermen population of 1543 per Km length is one of the major fishing district of Kerala. Elamkunnapuzha village in Ernakulam district has a total population of 51,197 and an area of 11.52 sq km. It has a distinct ecosystem that includes capture and culture fisheries, a variety of agricultural crops, and animal husbandry. Elamkunnapuzha village is one of the other major south west hotspot regions of India lying between10°1′0″N 76°13′0″E. Figure 1 clearly marks the study area.

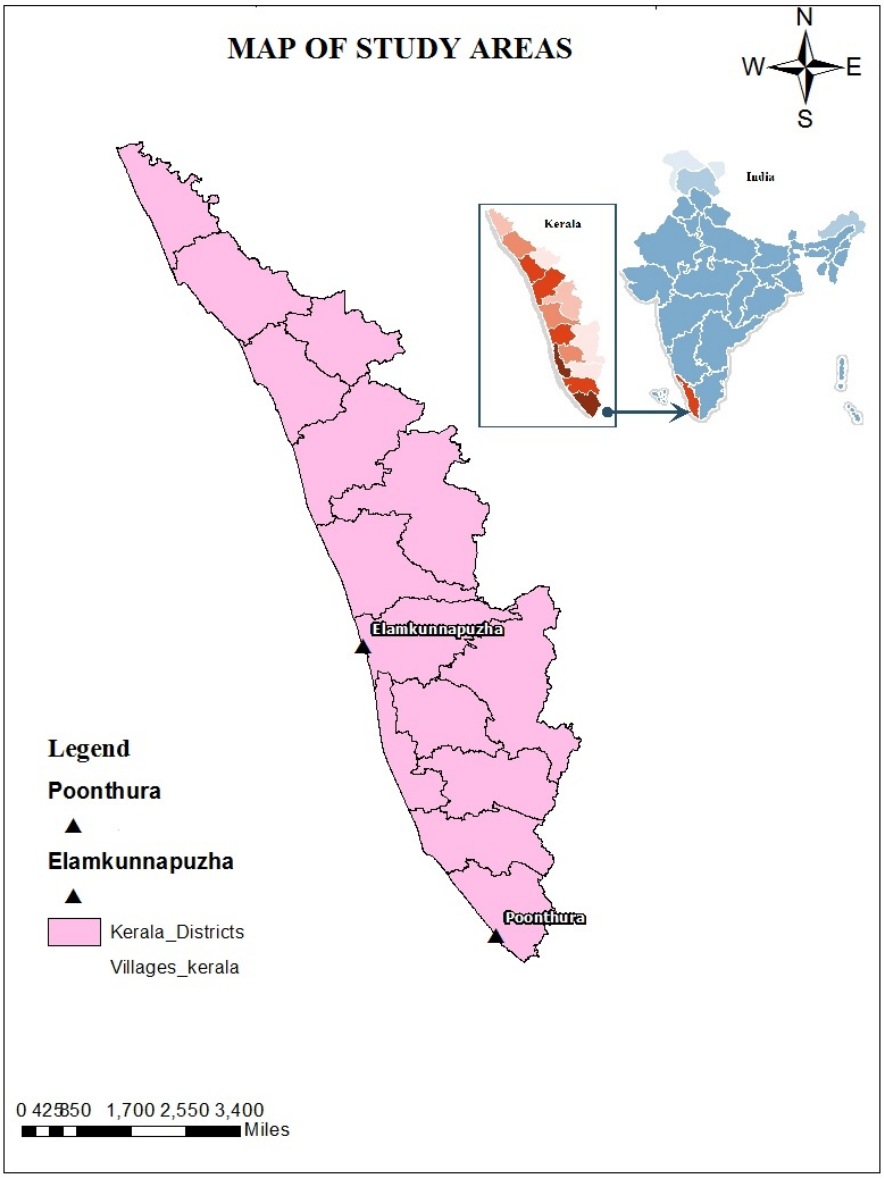

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Figure 1. Study Area

2.2 Data collection

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

3. RESULTS AND DISCUSSION

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

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

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.

Table 2. Dependency ratio

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

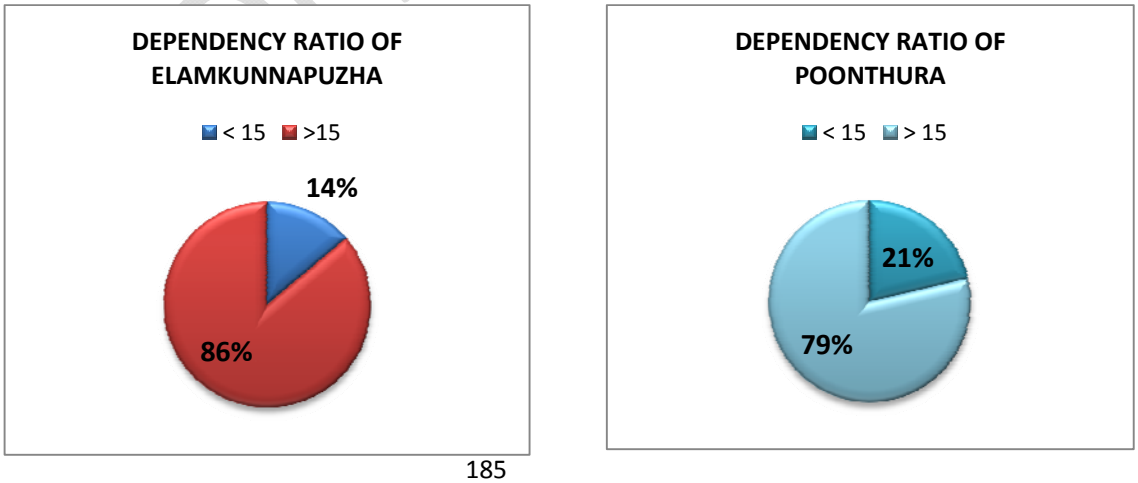


Figure 2; Dependency ratio of Elankunnapuzha and Poonthura village

3.1.3 Main occupation

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

Table 3. Main occupation of the respondents

Main Occupation	ELN	POON
Fishing	260	602
Others	328	69

3.1.4 Experience in fishing (Years)

Majority (73 percent) of the fishermen in Elamkunnapuzha village has more than 25 years of experience in fishing whereas in Poonthura it was 51 per cent as shown in Table 4.

Table 4. Experience in fishing

Experience in Fishing (Years)	ELN	POON
< 10	23	57
10 to 25	46	238
> 25	191	307

3.1.5 Fishing trips per week

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

Table 5. Fishing trips per week

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

3.1.6 Average length of fishing trips (hr/day)

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

Table 6. Average length of fishing trips (hr/day

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

3.1.7 Percentage of income derived from fishing

Thirty three per cent of the fishermen respondents from Elamkunnapuzha and Poonthura have 26 to 50 per cent of their income derived from fishing. Twenty seven per cent of fishermen respondents

from Elamkunnapuzha and 34 per cent from Poonthura have more than 75 per cent of their income derived from fishing (Given in Table 7)

Table 7. Percentage of income derived from fishing

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

3.1.8 Income and indebtedness

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

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

3.1.9 Loan amount

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

Table 9. Loan Amount of the respondents

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

3.1.10 Percentage of debt increased due to reduced family income

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

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

3.1.11 Average expenditure pattern

Rent, food, medicine and education were the main expenditure drivers in case of both Elamkunnapuzha and Poonthura. As depicted in figure 3.

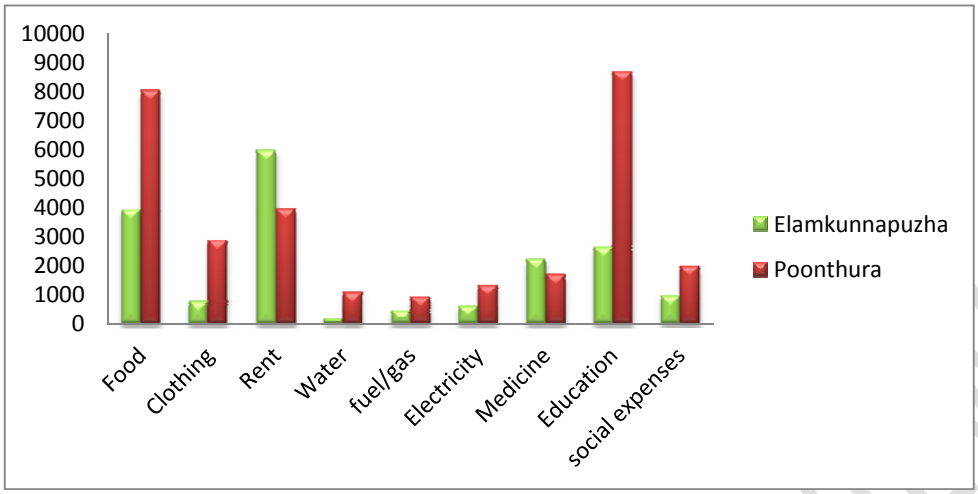


Figure 3. Expenditure pattern

3.2 Climate change impacts on their livelihood

Fisheries' being heavily dependent on weather and climate is going to get substantially affected by the changes in climate and environment. These changes can thus directly or indirectly create repercussions in the life of the fishermen dependent on it for their livelihood.

3.2.1 Climate change impact awareness

Majority (92 %) of the respondents from Elamkunnapuzha and 86 per cent from Poonthura have heard about climate change impacts from different sources such as friends ,family members, media, newspapers, social websites, community groups etc (Figure 4).

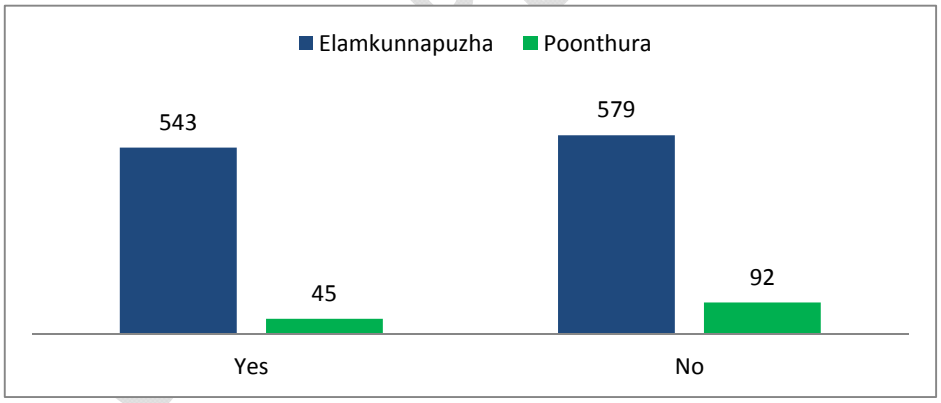
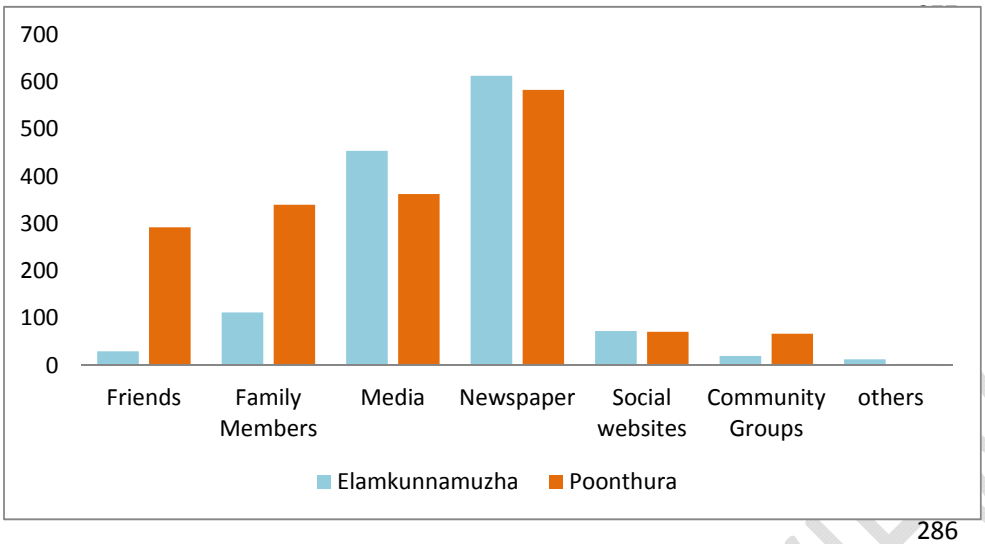


Figure 4. Climate change impact awareness level

3.2.2 Source of information

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)



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287 **Figure 5. Source of information**

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289 **3.2.3 Climate change impacts experienced in day to day life**

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

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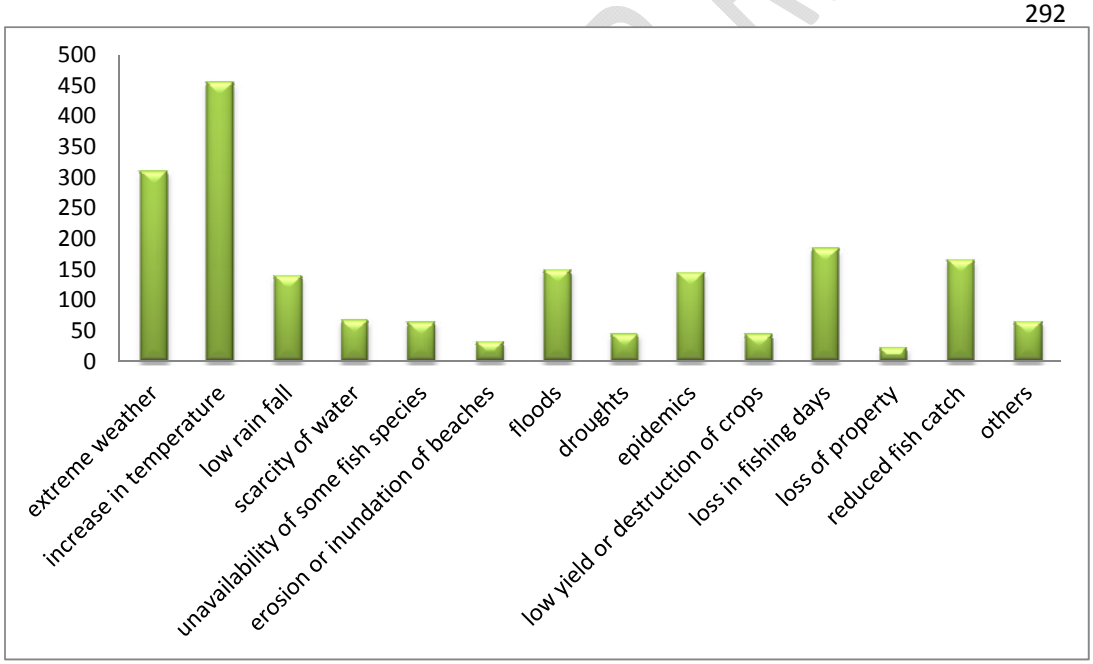

304 **Figure 6. Climate change impacts of the inhabitants of Elankunnapuzha**

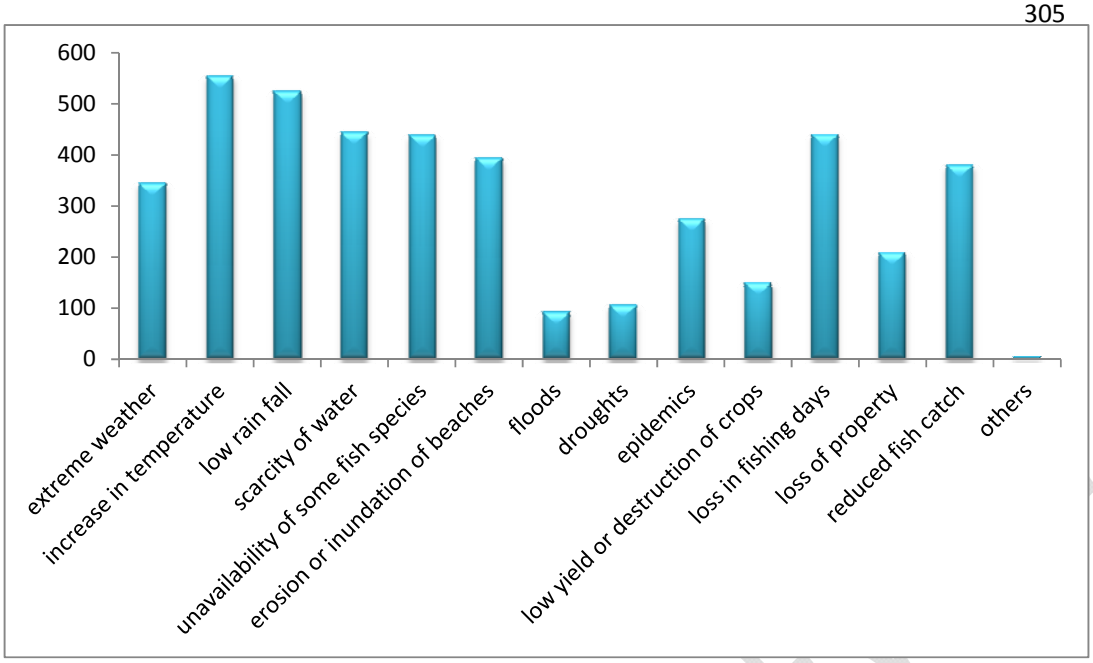

Figure 7. Climate change impacts of the inhabitants of Poonthura

3.2.4 Willingness to know more about climate change

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

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

3.2.5 Willing to participate in any climate change adaptation activities

Majority (60%) of the respondents from Elamkunnapuzha 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).

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

3.2.6 Type of climate change adaptation activities willing to participate

Majority (61%) of the respondents from Elamkunnapuzha 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).

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

3.2.7 Climate change displacement

In Elamkunnapuzha 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.

Table 14. Climate change displacement

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

3.2.8 Fear of displacement in future due to climate change

In Elamkunnapuzha 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 Elamkunnapuzha and 74 % from Poonthura have no fear of displacement due to climate change in future (Table 15).

Table 15.Displacement in future

Village	Fear of displacement in future due to climate change	
	Yes	No
ELN	59	438
POON	137	342

3.2.9 Climate change adaptation measures practiced

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 Elamkunnapuzha and Poonthura fishing villages. The details of climate change adaptation measures practiced by inhabitants of both villages are given in Table 16 and 17.

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

Table 17- **Adaptation Measures-Elankunnapuzha**

Sl.No	Elamkunnapuzha	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

3.3 Alternative Livelihood Options (ALOs)

3.3.1 Alternative livelihood options

Thirty two per cent from Elamkunnapuzha and 19 per cent from Poonthura have Alternative Livelihood options whereas 61 per cent from Elamkunnapuzha 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).

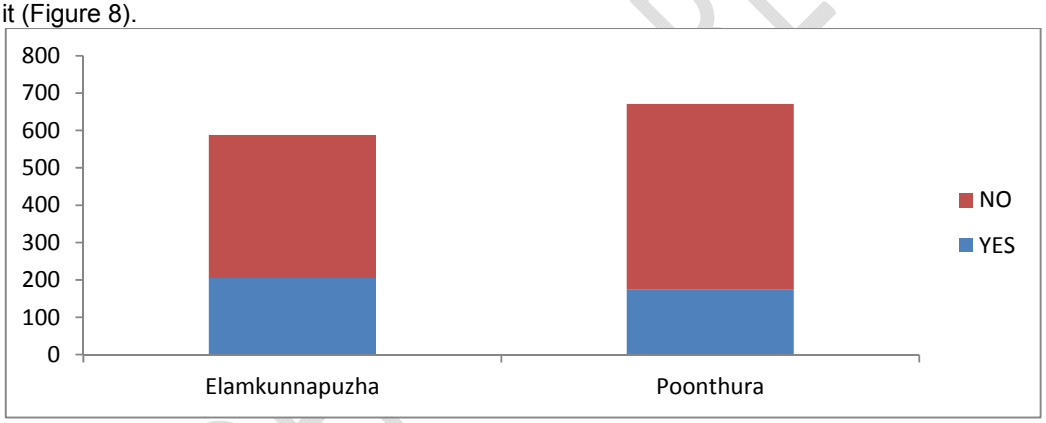

Figure 8. Alternative livelihood options

3.3.2 Preferred Alternative Livelihood Options (ALOs)

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.

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

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

4. CONCLUSION

Climate change is something that can affect the coastal community at multidimensional levels, the most important being their livelihood. Right to livelihood being a fundamental right, is something that is guaranteed to every citizen of India. So it is important that the researchers and policy makers work hand in hand to make this changing situation a boon. According to our study, thirty two per cent from Elamkunnapuzha and 19 per cent from Poonthura have Alternative Livelihood Options whereas 61 per cent from Elamkunnapuzha 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. 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. Climate change has already been experienced in many parts of India with several seasons of intense storms, droughts, floods, fires etc. Any further delay in addressing the issue would put at risk many more lives, livelihoods and investments for decades to come.

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