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Local Knowledge of Coastal Population to Sea Level Rise and Climate Change – A Case Study in Fishermen Community, Kanyakumari District, Tamil Nadu, India

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Abstract: This research synthesises two evaluations of a local level climate change adaptation and planning process in the southernmost coastal region, Kanyakumari, India which was supported through community-based appraisals. First, understanding the public perception of climate change factors is crucial in generating support for climate change response. Second, generating enough grass-root level support from the local population to assess the long-term climate change impacts on decision-making to design the adaptation strategies for sea-level rise. These two results highlight the level of understanding and awareness of climate change's impact by the local population in the coastal region of Kanyakumari. A well-designed questionnaire with structured interviews, to collect data on local knowledge and local perception of climate change and sea-level rise from 100 respondents was distributed each in 44 coastal villages in the study area. The finding showed that 20.7% of the local population have knowledge of climate change and its impacts and 18.4% of the population agreed that the impact of sea-level rise is experienced in the coastal region. This study is to provide insight into the communities' knowledge of the adaptive capacity of the local population to cope with climate change towards the treaty of sea-level rise.

Keywords: Climate change; Sea-level rise; Coastal community; Adaptation; Awareness; Impacts.

Introduction

India has low awareness and poor adaptive capability to the impacts of climate and sea-level changes due to illiteracy or low education, poor lifestyle, political conflicts, etc. (UNDP, 2007). Various climate change studies indicate that climate change is not a priority issue in developing countries like India (GlobeScan, 2006). In the southern part of the Indian coastal system, the coastline of Kanyakumari is more sensitive to the impact of climate change and sea-level rise which is affected by floods, overflowing sewers, and crumbling infrastructure. The major environmental risk along the coastline is high population density (1106 /sq.km.) caused by overcrowding, which has led to the devastation of beach vegetation, and shoreline degradation. In addition, the human settlements, critical infrastructure like Indian Rare Earth Ltd Manavalakurichi, and public institutions like schools are located very close to the shoreline of the study area. The biological and cultural changes along the coastline of Kanyakumari impact the climate and sea-level changes. In the study area,

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if the coastal population responds to the impact of climate change and sea-level changes, then this would be helpful in building an adaptation policy to mitigate the climate change impacts (Batty, 2010). Therefore, at the regional level, the local population plays a key role in the implementation of both mitigation and adaptation strategies in the coastal region of Kanyakumari (Moser & Dilling, 2007).

Public engagement is the best practice for planning, preparedness, and policymaking in the coastal region from the impacts of sea-level rise (Hügel & Davies, 2020). It leads to more informed residents; better actions, impacts, and outcomes; more community buy-in and support; faster implementation, and more trust in local government. The adaptation policies on the local perception of the issues of climate and sea-level changes might not be considered without the local perception (Sakawi, 2017). When the policy and practice responses are implemented without accounting for local understandings, it causes difficulties in its implementation. This study used a qualitative research approach, incorporating one-on-one interviews where participants responded to specific questions as they are known about the impact of climate and sea-level changes in the coastal region of Kanyakumari (Cov & Kain, 2016). In the study area, most of the respondents are directly or indirectly affected by the impact of climate change and sea level rise. Consequently, most of the respondents assumed that the surging waves and high tide waves are powerful and destructive and can cause terrible damage to human settlements and coastal properties in the study areas (Begum et al., 2020). The study identified that they investigated the adaptation strategies to sustain their location rather than displacement by the perceptions of local knowledge on sea level rise. This study is focused to identify the perceptions of local knowledge on the impact of sea level rise on local adaptive capacity and coping with the rising sea level to solve this issue (Nicholls & Mimura, 1998). In addition, an attempt is made to evaluate the adaptive capacity and strategies of the local population in response to sea-level changes in the coastal region. Therefore, it is necessary to have perceptions of local knowledge on the climate and sea-level change issues and investigate the potential adaptation options to solve these silent issues in the coastal regions. The successful adaptation strategies for the sea level rise in the study area is to have a good understanding of the public perceptions of the local people for coastal planners and policymakers (Brechin et al., 2011; Leiserowitz, 2007). Generation of enough local support from the local people is required on the coastline of Kanyakumari to design and implement the adaptation plan and policies on sea-level changes (Hagen, 2013; O'Neill & Hulme, 2009). Since meaningful stakeholders (public, private and local population) engagement efforts require having informed and educated stakeholders and are based on effective communication of critical information, these two areas are closely linked together to develop a successful adaptation policy.

Materials and Methods

Study Area

The study area, the coastline of Kanyakumari (87′ 30″-815″ S, 77′ 27″-735″ E) is located in the southern coastal zone of the Indian subcontinent (Figure 1 and Table 1) which is covered by the Arabian Sea, Bay of Bengal and the Indian Ocean. The coastline of the study area is 71.5 km in length and studded with 44 coastal fishing villages. As of the 2011 census, in the coastal region, the fishermen's population was 11, 48,539 people with males (73,571) and females (69,915) constituting about 26% of the total fishermen of the state of Tamil Nadu. The coastal population mainly comprises climate-sensitive sectors like fisheries and tourism for their livelihood initiatives. The coastal zone is more exposed to degradation and the main drivers of degradation are population pressure, increasing urbanisation, coastal constructions, natural disasters (tsunami- 2004, cyclone ockhi–2017), destruction of wetlands (Manakudy Estuary), tourism (Muttom, Sothavilai, Sanguthurai Beaches), coastal erosion (Kovalam, Manavalakurichi, Mandaikadu, and Thengapattinam), atomic plant (Kudankulam Nuclear Power Plant), marine pollution, coastal sand mining, coastal highways, etc., The coastal region is highly vulnerable to the impacts of sea level rise in the form of flood, erosion of coastal land, overflowing sewers, and crumbling infrastructure. Under the scenario of sea level rise of 0.5 to 1 meter, approximately 13 km^2 of coastal areas of Kanyakumari district will be inundated (Natesan et al., 2010). The marine fisheries, which make up two-thirds of total fish export, are getting affected due to the impact of climate change, hence the economy is getting affected (Fifita, 1991) in the coastal region.

Method

The study focussed on the developed single composite measures to ascertain the risk perceptions of the coastal population of Kanyakumari for the impacts of climate and sea-level changes (Roser et al., 2015;

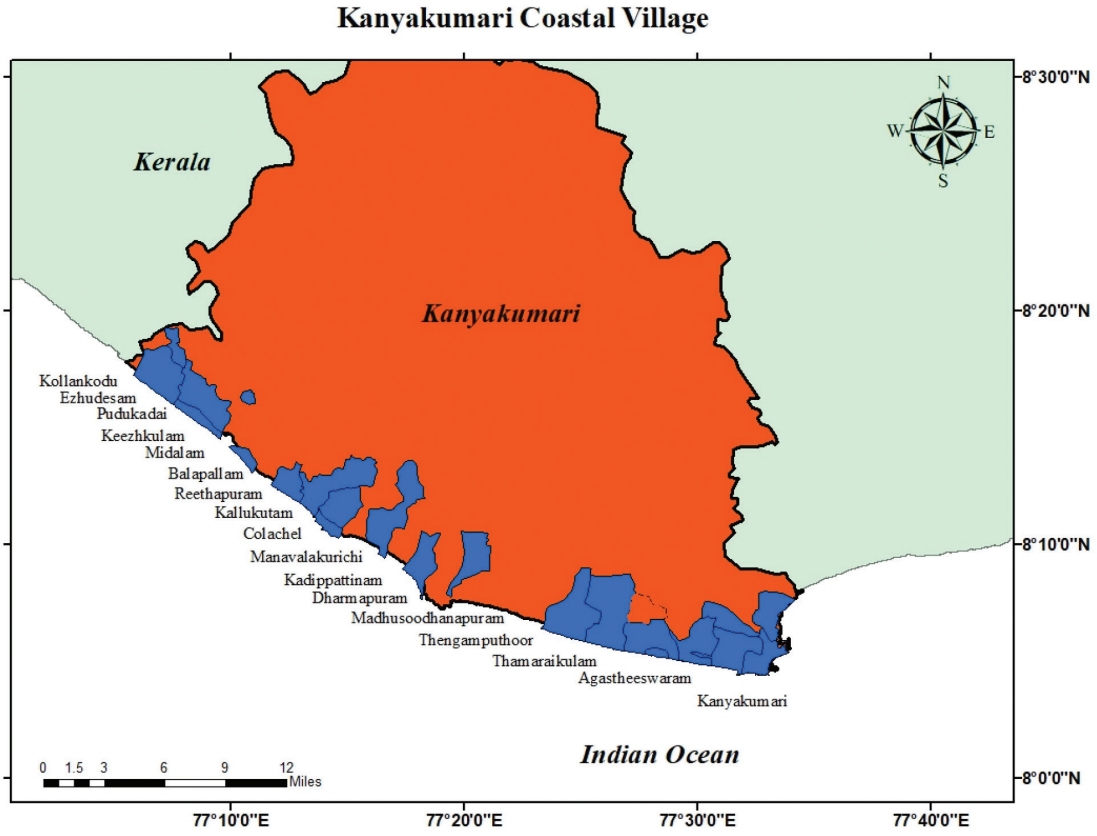

Figure 1: Study area southern tip of India.

Table 1: Study area location with latitude and longitude

S. No	*Place*	*Latitude*	*Longitude*
1	Kollengode	8°17′16.94″N	77° 6′44.90″E
2	Ezhudesam	8°16′17.06″N	77° 9′10.40″E
3	Pudukadai	8°16′28.89″N	77°10′52.06″E
4	Keezhkulam	8°18′55.50″N	77°11′58.65″E
5	Midalam	8°12′21.65″N	77°12′57.68″E
6	Balapallam	8°12′37.87″N	77°14′50.47″E
7	Reethapuram	8°11′27.53″N	77°15′2.06″E
8	Kallukootam	8°11′27.35″N	77°15′5.34″E
9	Colachel	8°10′43.03″N	77°15′21.95″E
10	Manavalakurichi	8° 8′49.73″N	77°18′8.22″E
11	Kadiapattinam	8° 7′55.24″N	77°18′22.83″E
12	Dharmapuram	8° 7′0.23″N	77°24′25.91″E
13	Madhusoodhanapuram	8° 6′28.76″N	77°26′10.87″E
14	Thengamputhoor	8° 6′52.41″N	77°27′26.24″E
15	Thamaraikulam	8° 7′10.23″N	77°29′14.66″E
16	Agasteeswaram	8° 6′3.41″N	77°32′10.21″E
17	Kanyakumari	8° 5′17.90″N	77°32′18.42″E

Leseirowitz, 2006). A well-structured questionnaire constructed using questions from the previous study was used in this survey (Whitmarsh, 2008; Taylor et al., 2014). The primary and secondary data were analysed from the coastal villages of Kanyakumari for the analyses of climate impacts. The primary data were obtained through face-to-face and specific interviews and observation. A total of 4400 sets of questionnaires in the entire coastal villages of the study areas were randomly administered to get comprehensive data on the perception of the coastal population.

The secondary data and information on the study area were collected from various reports and publications from various government institutions and previous research studies (Sakawi, 2017). The data obtained in this study were processed within the statistical package of the SPSS 20.0 software package and the 'descriptive statistical methods' *(frequencies)* were used for statistical analyses. A significant level of at least $p < 0.05$ was used for all statistical survey data. The descriptive statistics were engaged to summarise the characteristics of participants, including age, gender, occupation, and also geographic location. During the survey, the screening of questionnaire was performed to collect demographic information about participants and select participants that lived, worked or attended classes in the geographic area that was the focus of the mapped portion of the alert.

Results and Discussion

This method ensures comprehension by respondents and facilitates obtaining additional responses, personal opinions, and other pertinent insights related to the questions. All respondents were guaranteed anonymity and confidentiality. The sample consisted of the respondents who were older than 18 years of which 43.3% were male and 56.7% were female, which included local fishermen (45.1%), local women (39.8%), students (12.7%) and teachers (1.4%), government administrators (0.7%) and village leaders (0.3%).

Climate Change Perceptions

The strong relationship with self-perceived knowledge is consistent with the growing certainty in the underlying scientific understanding of climate change. The survey indicated that (Figure 2) most of the respondents (20.7%) have experienced the impacts of climate and sea-level changes directly or indirectly. The low awareness of climate change and rising sea levels leads to high vulnerabilities in the low-lying coastal regions

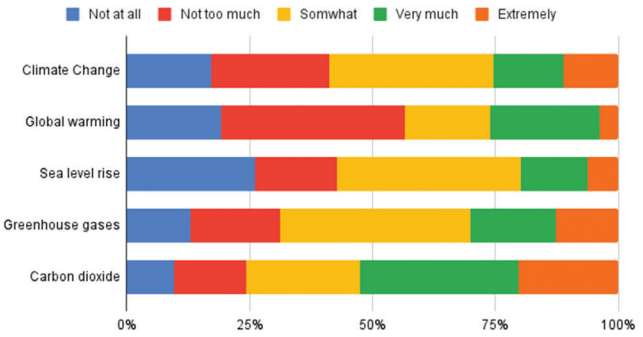

Figure 2: Survey report on local community knowledge of climate change and sea-level rise.

(Pugliese and Ray, 2009). In addition, the highest numbers of the respondents (somewhat: 29.9%, very much: 19.9%, extremely: 10.9%) have awareness of the global effect of climate change. The positive side of the study is that one-seventh of the respondents knew about the scientific terms related to global warming like carbon dioxide, greenhouse gases, climate change, SLR, etc. in their local knowledge. The risk embedded in more densely populated low-lying coastal regions is frequent exposure to extreme weather events in the coastal region (Mahajan et al., 2009).

The media is a powerful tool to create awareness about the impact of anthropogenic climate change and turn people towards positive behavioural changes in mitigation and adaptation to this issue. In the study area, the television (74.06%), social media (45.5%), radio (57.7%) and newspapers (23.4%) have a great impact on covering the news on the issues of climate change in all the categories of the local population (Ahsan et al., 2009). Nowadays, social media has a huge role (87.7%) to share the issues of climate change with the younger respondents in the study area. Television makes a huge impact on all the categories of the population (younger -78.2%, middle-age -74.3%, and elder -69.7%) to reach the silent issues through live news on disasters, various documentaries, etc. The governments (8.4%) also implement some climate change resilience and adaptation plans like National River Conservation Plan, National Afforestation Programme, etc. Educational institutions like local colleges and schools, (17.6%) and civil bodies (14.2%) are unaided to reach these issues to a small portion of the population in all categories. The study found that a small percentage of the family members shared the extreme climate events and the impacts of human and habitat loss on their younger generation (Figure 3).

The respondents accepted that the climate change impact course is a very strong impact (76.3%), in the

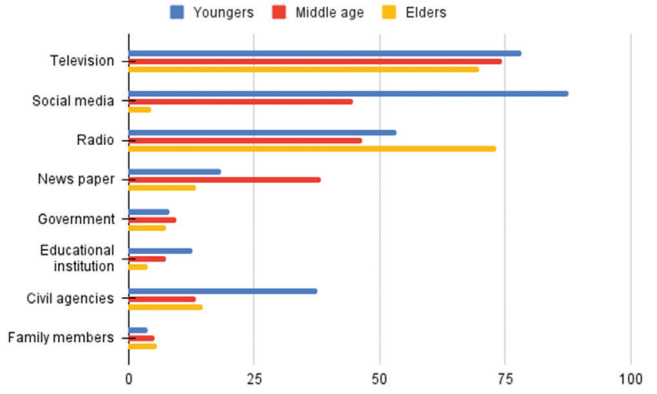

Figure 3: Survey report on source of information for climate change and sea level rise.

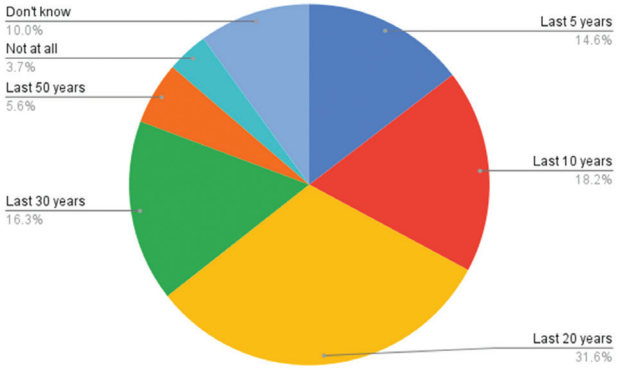

Figure 4: Survey report on climate change impact.

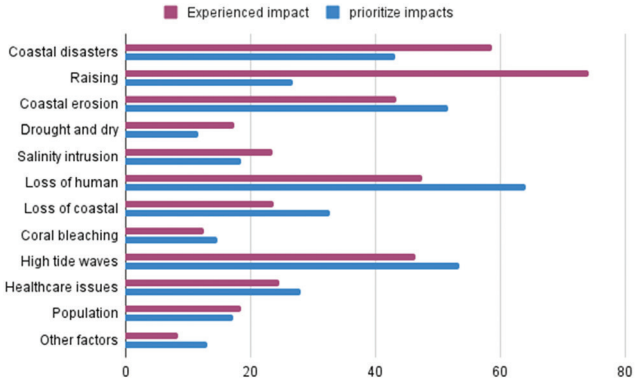

Figure 5: Survey on experienced and prioritised impacts of climate change.

future and also 83.4% of the respondent recognised that the frequency of extreme weather events is an increase in the future (Mirza, 2003). In this study, it was reported that almost half of the total respondents (42.6%) understand that climate change is very harmful to the human population (Hinkel et al., 2014) and 31.2% of respondents argued that somewhat serious issue and 26.2% concluded that it is not so harmful issues to the coastal ecosystem. Almost all the respondents conclude that deforestation (42.3%) and anthropogenic impacts (51.8%) are the main factors that cause climate change in the study areas. The local population understands the effects of climate change after the giant waves (tsunami -2004) triggered the coastal region of the study area (Thomalla & Larsen, 2010). Most of the respondents accepted that the frequency of the climate change impact has been increasing over the last 15 to 20 years (Figure 4).

Climate Change Impacts

Loss and damage are already a significant consequence of inadequate ability to adapt to changes in climate patterns in the study areas. The local population has already experienced meteorological and biophysical events in the coastal region. After the tsunami (2004) devastated the coastal region, the local population slowly understood the silent risk and its local factors (Alhamid et al., 2022). According to the survey, (Figure 5) most of the respondents have complained about the rising temperature (74.2%) as a major concern (Dash et al., 2007) followed by extreme weather events like cyclones, tsunami (58.6%), erosion on the shoreline areas (48.3%), loss of human settlements (47.5%), high tide waves affected the shoreline region (46.5%), which are the secondary concerns as suggested by the respondents of the study regions. The indirect effect of healthcare issues by the climate change (24.6%), loss of coastal vegetation (23.7%) and seawater intrusion (23.6%) are the same ratios as the respondents' drought and dry spells (17.5%) and human displacement (18.6%) in the coastal areas are the other factors by the respondents in the study areas (Lensing & Wise, 2006). The study also attempted to target the respondents by prioritizing the climatic risk in the coastal region of the study areas. On the basis, the prime prioritized hazards are, the loss of human settlements (64%), high tide waves (53.4%), coastal erosion (51.6%), and extreme weather events (43.2%), struck along the coastline, which is directly impacted the local population in the study areas (Hallegatte et al., 2013; Hinkel et al., 2014). The least prioritised climate risk is the healthcare issues (28.1%), rising temperature (26.8%), saltwater intrusion (18.5%) human displacement from the study areas (17.3%) coral bleaching (14.8%) drought, and dry spells (11.7%) other non-climatic issues like community clashes (13.2%) which will indirectly impact the human system.

In the study area, normally the rate of awareness of global warming, climate change, and sea-level rise is somewhat high compared to other coastal regions.

Through the survey, the respondents were directly asked some statements about global warming which directly affected humankind in daily life (Figure 6). Most of the respondents agreed that the temperature is getting hot in recent years (96.3%). In addition, particularly the young respondents have a little basic knowledge about global warming and how it affects the earth's surface. The remaining most of the respondents who disagreed on this are elders and may be lack knowledge of the emerged issue.

The survey (Figure 7) indicated that most of the respondents are directly affected by the impact of climate and sea-level changes by high tides waves (68.4%) in the coastal region which caused shoreline erosion (49.8%), the recants cyclones (43.6%), which caused the loss of life and damage of properties in the study region. In addition, the indirect climate impact of health issues like malaria (36.3%)is a concern by the respondents (Caminade et al., 2014). The respondents agreed that the climate change hazards like a flood (32.6%), tsunamis (23.6%), seawater intrusion (23.7%), and other non-climate issues like community clashes (3.9%) are the concern in the study area.

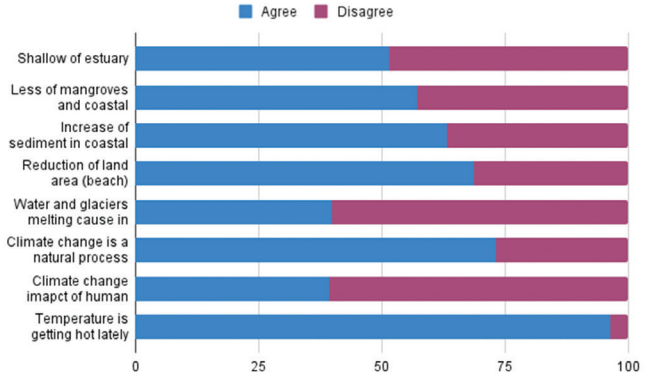

Figure 6: Survey on precipitation of local community on sea-level rise and climate change.

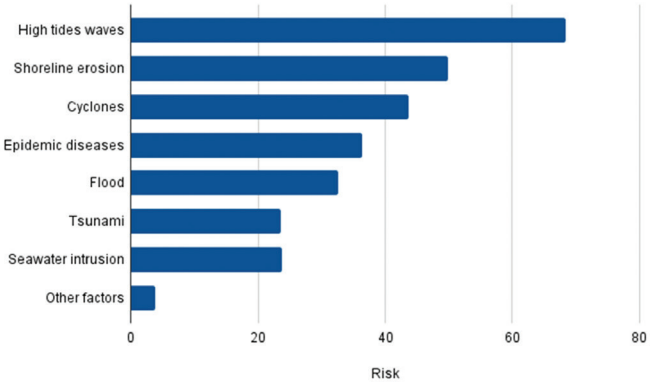

Figure 7: Local survey report on climate change risks.

Climate Change Vulnerability

The vulnerability in the coastal areas to the sea level rise is most suffered by the local population who have very little to do with climate change. Therefore, it is very necessary to understand the local perception of the factors to assess the vulnerability in the coastal region of the study areas (Brechin et al., 2011; Leiserowitz, 2007). Most of the respondents (Figure 8) argued that the prime factors of the coastal vulnerability occurred due to shoreline erosion (33.8%) and high tide waves (34.4%)(Srinivasan, 2012), and the interlinking secondary factors are extreme weather events (19.2%) which caused the vulnerability.

Changes in infectious disease transmission patterns are a likely major consequence of climate change and need to study more about the underlying complex causal relationships (Pidgeon & Butler, 2009). In the study, almost 62.9% of the respondents agreed that epidemic diseases like malaria, dengue are the major concern causing respiratory infections (18.7%) and cardiovascular diseases (12.2%), and other diseases like cancer (6.2%), etc. The rising sea level is causing a major economic impact in the shoreline region in the absence of further climate action (Anthoff et al., 2010). The study finds that (Figure 9) negative economy-wide effects of loss of human settlement (38.5%), damage to coastal infrastructure (43.1%), livelihood income loss (32.4%), expenses on healthcare issues (28.4%), loss of life in the families (13.4%), expenses on the physiological issue (11.4%) and economic loss on non-climate factors (11.4%) like community clashes are threatening the coastal populations.

Seawater intrusion is considered as one of the main processes that degrade water quality by raising salinity to levels exceeding acceptable drinking water standards (Werner and Gallagher, 2006). The result indicated that almost 0.5 to 1.0 km of the coastline has a significant effect on the seawater intrusion in

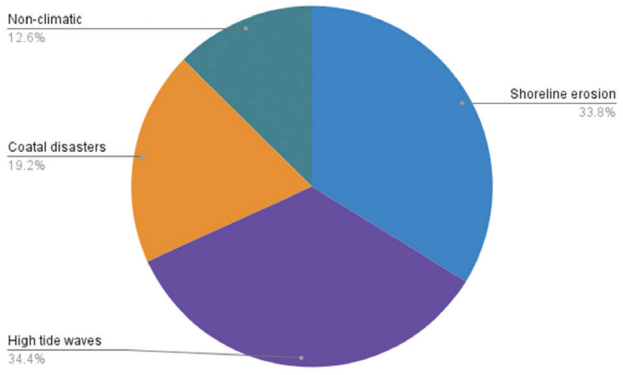

Figure 8: Survey report on coastal vulnerability.

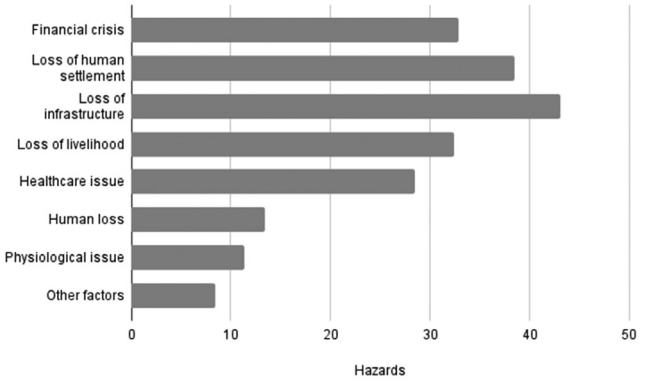

Figure 9: Survey report on the indirect effect of climate-related hazards.

the study area. Almost all the respondents (97.7%) used groundwater for drinking and other purposes. The remaining respondents (2.3%) used desalinated or bottled water for drinking and used groundwater for all other purposes of daily life. On the other hand, rainwater is not used for any purpose and the rainwater harvesting technology is not used by the population in this coastal region.

Degradation of Coastal Ecosystem

In the study area (Tables 2 and 3), the predicted impact of climate and sea-level changes disruption, several months to years which causes human losses, and billions of dollars in damage in the shoreline areas (Mani Murali & Kumar, 2015). The findings from the present study showed that risks to the physical environment were of greater concern than economic risks (Carlton & Jacobson, 2013). Almost all the respondents in this study have accepted the aggregated impact of human and financial losses due to frequent weather extremes like cyclones, flooding, etc.

Sea level rise is a global and inter-governmental issue, but the local communities required knowledge of regional sea-level rise is essestial (Hagen, 2013; O'Neill & Hulme, 2009). The study area had no regional policy perspectives on the technical and institutional aspects of adaptation to minimize the impacts of sea-level rise. The population is vulnerable to estimates based on the scenario projection, and commonly women had the largest absolute increase in exposure for all scenario combinations (Hauer et al., 2015). The study showed that the policy environment for addressing coastal livelihood vulnerability is heavily based on developing adaptive capacity and to certain extent sensitivity without adequately addressing exposure, the initial cause of vulnerability (Ferrol-Schulte et al., 2015).

Table 2: Coastal area destruction in the study

Climate Event	*Year*	*Category/Intensity*	*Human Loss*	*Property Loss*	*Vulnerable Area*
Cyclone "Ockhi"	Nov 2017	(118-221 kmph wind speeds)	218	500 boats	Entire coast
	1992	1,621.21 (Rainfall)	9	19417 houses	Entire coast
Flooding	1993	1,372.03 (Rainfall)	1	634 houses	Entire coast
	2010	2,000.59 (Rainfall)	0	3358 houses	Entire coast
	2015	2,061.13 (Rainfall)	2	1434 houses	Entire coast
Tsunami	Dec 2004	Earthquake at magnitude 9.3 wave height penetration between 300 m to 3000 m inland	799 life 1,187 cattle loss 754 Injured.	17,200 houses & 5000 boats	72 km coastline
Coastal erosion	Every Year – June to September	Coastal erosion rate is 1.13 m/yr ± 0.17 m/yr	No life loss	Every year average 150 houses damaged	70% of the coastline
High Waves	Every Year – June to September	Wave height from 4 m to 12 m	No life loss	Every year average 150 houses damaged	Entire coast

Source: Compilation from various sources

Table 3: Impact of sea-level rise on the human and physical environment in the study area

Sl. No	*Coastal Environment*	*Impacts*
1	Coastal ecosystems	Almost 40% of the coastal villages and higher-value infrastructure are more vulnerable to coastal erosion and 20% of the coastal wetland (*Manakudy estuary*) fishing harbours (*Chinna Muttam, Colachel*), sand beaches (*Kovalam beach*) and recreational places are highly vulnerable to erosion, flooding and extreme weather events.
2	Coastal population	Comparing 2017 and 2050 estimates of the population impacted, there is a 67% increase in the total population exposed to sea-level rise under the fast scenario from approximately 27,200 to 45,300 people, which is similar to previous estimates for the coastal regions (Hardy et al., 2018)
3	Local infrastructure	In the coastal study areas, almost 80% of the shoreline infrastructure is vulnerable to coastal erosion due to climate-induced threats. The residential areas, fishing harbours, and recreational areas are highly vulnerable to erosion, flooding, and inundation in the study areas (Spirandelli et al., 2018).
4	Coastal livelihoods	The problems of the coastal zone square measure are distinctive due to climate change-induced threats of the high density of population, loss of land as a result of coastal erosion, and forceful morphological and bound changes. The coastal population is the sole sector that periodically loses lodging places as a result of erosion. The climate change-induced threats will reduce 20 to 30% of the fishing and allied activities in the study area (Islam et al., 2020)
5	Coping/adaptation appraisal	Need policy initiatives to protect the investments, minimize the loss of coastland in the low-lying coastal regions, conserve wetland ecosystems, control coastal erosion, and protect groundwater resources. The community-based climate change adaptation plan is the best coping appraisal of adaptation strategies in the study areas (Pandey and Okazaki., 2005).
6	Relocation destinations	Resettlement of coastal populations from the disaster-prone shoreline region to reduce their exposure to climate change has been proposed. The layout of the new places/city/center has been designed for the interior place from the coastal region to be more sustainable, energy-efficient, and have better options for cultural activities and socialising.

Climate Change Migration

The Indian coastline has high levels of human mobility and produces and hosts a significant number of climate refugees. The study area has a huge impact on climate and sea-level changes and the population relocated from the coastline mainly due to extreme weather events, loss of coastal lands, development works from coastal areas, etc. (Panda, 2010). The study area chosen is densely populated and most of the coastal population has been evacuated and displaced internally from the coastline temporarily and prohibited from returning there and relocated to safe areas (IPCC, 1990). In this study area, almost 70.2% of the respondents responded that the local population was displaced temporarily to the nearest location during the period of disasters (Figure 10). In addition, 24.3% of the respondents responded that the human mobilisation took place in inter-region for permanent settlement. Almost 5.5% of the respondents argued that the local population migrated to the Gulf and other eastern countries for their income generation initiatives (Wennersten & Robbins, 2017). After the tsunami severely affected the coastal regions of the study area, the rate of human displacement increased from this coastal ecosystem.

Climate Risk Insurance

The Kanyakumari coastal region is under pressure from human settlement and infrastructure, and these coastal regions have more exploration and investment in infrastructure over the coming years (OECD, 2006). The coastal properties in vulnerable areas should be ensured through long-term planning to minimise the risk in coastal settlements (McGuire, 2015). The climate resilience of these human settlements and infrastructure along the coastal areas are adversely impacted by extreme weather events (McBean & Ajibade, 2009).

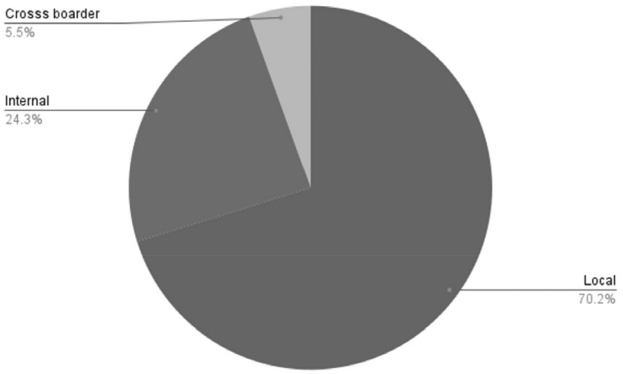

Figure 10: Climate-induced displacements from the study area.

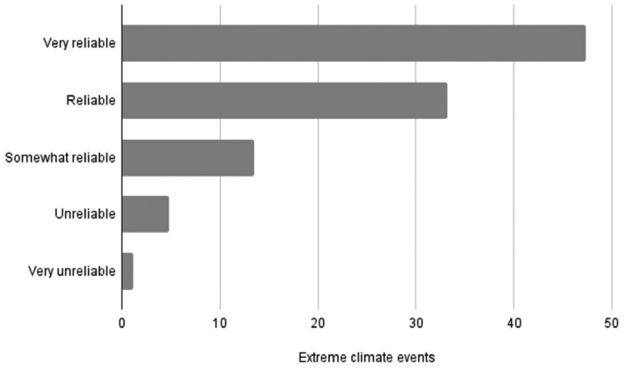

Figure 11: Local weather predictions on extreme climate events.

On the liability side, insurers are helping the clients to focus on risk management related to climate change including avoiding harm to the coastal environment in the study areas. Most of the respondents (88.4%) are not aware of climate-related insurance for their assets in the vulnerable region and only 11.6% of the respondents have little awareness of climate-related insurance (Ahsan et al., 2009). On the negative side, almost 82.5% of the respondents have no insurance policies and 15.3% of respondents have individual or family insurance and only 2.3% of the respondents have health insurance.

Climate Community of Practice

The local people have a critical role to play in androgenic activities, climate policy, and adaptation to minimise the impact of sea-level rise (Revi, 2008). The fundamental changes in climate policy will not occur without the support of the local population. Climate education is the best option for awaring the local population about the future impact of sea-level rise (Ford et al., 2010). Weather and climate disasters have become more frequent and intense in recent years as a result of climate change in this coastal region. The positive response from the survey is that most of the local fishermen are frequently watching the weather broadcast and extreme weather events prediction. Almost 47.3% of the respondents suggested that the local weather prediction is very reliable, and 33.2% of the respondents submitted that the weather prediction for the local area is reliable.

Most of the respondents have low responses to the involvement of climate action to mitigate the impact of climate and sea-level changes in the coastal region (Roser-Renouf et al., 2015). After the cyclone Ockhi (2017), the civil agencies worked with churches and coastal schools to create awareness about coastal disasters. Only a few percent of the respondents (7.2%) of the younger and middle-aged population, particularly students, are actively involved in environmental issues along with taking actions in the community to cope with the climate impacts (Table 4). Latter may account for a general lack of interest in public policy or pressuring the government to do something about greenhouse gases and global warming.

Over the past 15 years, the number of tropical cyclones have gradually increased in this study area. So, most of the respondents (76.3%) strongly agreed that the frequency of tropical cyclones will increase in the future. The study also indicated that most of the respondents are highly aware of cyclones and coastal erosion and that more than one-third of the respondents have their own experience. So, a long-term, well-planned disaster management plan is needed with the participation of the local population in the study area (Lorenzoni et al., 2007). The low catch is another concern for the fishermen's community which affected their income due to the climate change impacts in the coastal study areas. At the same time, the policy of renewable resources in the fisheries sector to solve the economic growth included framing the climate change adaptation for the coastal region (Gopalakrishnan et al., 2017). The local people better understand adaptation techniques to extreme weather events in coastal areas and the importance of respecting regulations for the management of littoral zones. However, the disaster-induced human displacement is not able to mitigate the vulnerability (Fang et al., 2014). It will be very difficult to maintain coastal structures and coastal roads and developing new facilities along the coastal region would be highly vulnerable (Keller, 2002). In this study, almost 23% of the respondents agreed that

Table 4: Local responses for climate change action in the study area

Activities	*Daily*	*Weekly*	*Bimonthly*	*Monthly*	*Biannually*	*Annually*
Environment awareness				ü	ü	ü
Beach clean ups						ü
Erosion monitoring						ü
Ground water quality test					ü	ü
Marine biology stations		ü	ü	ü	ü	ü
Weather stations	ü	ü	ü	ü	ü	ü
Desalinated water quality test						ü
Solid waste management logs				ü	ü	ü
Disaster Management Plan					ü	ü

the residential areas, infrastructures, and recreational facilities along the coastal region were damaged due to high tide waves. Annually, the human settlement, infrastructure, and industries along the coastal region are adversely impacted by erosion, flood, and tropical cyclone (Mani Murali and Kumar, 2015).

Increasing people's awareness on climate change through education is an important measure to persuade them at all levels of the community to play an active role in mitigating and adapting to climate change (McNamara, & Buggy, 2017). The role of scientific communities is to share the latest scientific information on climate impacts, policies, adaptation and mitigation strategies, etc. with the local communities. The policy-makers on the sea-level rise may also encounter resistance to scientific, technological, and financial assistance to reduce the impact on future flooding and coastal erosion in the study area. It is very necessary to implement the adaptation strategies along the coastline of Kanyakumari with public, private, and local people partnership (Agrawal et al., 2008). Facilitating cooperation between states and federal agencies and regional associations regarding the coastal properties and the coastal properties in vulnerable areas should be insured through long-term planning to minimise the risk in coastal settlements. The Community-Based Disaster Management (CBDM) and technical improvement with an early warning system, which included the Climate Change Adaptation Plan (CCAP) which supports mitigating the impact of extreme weather events in the study areas (Pandey and Okazaki, 2005).

Conclusion

Overall, this study examined the local people's perception of the impact of sea-level changes and climate change at the coastal line of the study area. Most of the respondents in the study area have been directly or indirectly victims of climate-sensitive issues like extreme rainfall, tsunami, cyclones, etc., therefore, the majority of the respondents have exhibited a high-level concern about the impacts of sea-level rise and climate change and believe that it is occurring with a human factor contributing to it. On the other hand, the result revealed a huge significant gap between scientific information and local perceptions on the impacts of sea-level changes and climate change in the selected coastal regions. Overall, this study area is one that needs inter-disciplinary information on the impacts to frame the adaptation model. The local population in the study area urgently needs analysis of community-based comprehensive plans to develop a policy for adaptation strategies for the entire coastline of the Kanyakumari district.

Limitation

The study identified the current perceptions of local knowledge on climate change and sea-level impact in the study area to solve this issue. This study of estimation on the local SLR impacts may not be valid for the periods further into the future.

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