Local Adaptation to Climate Change in South India: Challenges and the Future in the Tsunami-hit Coastal Regions

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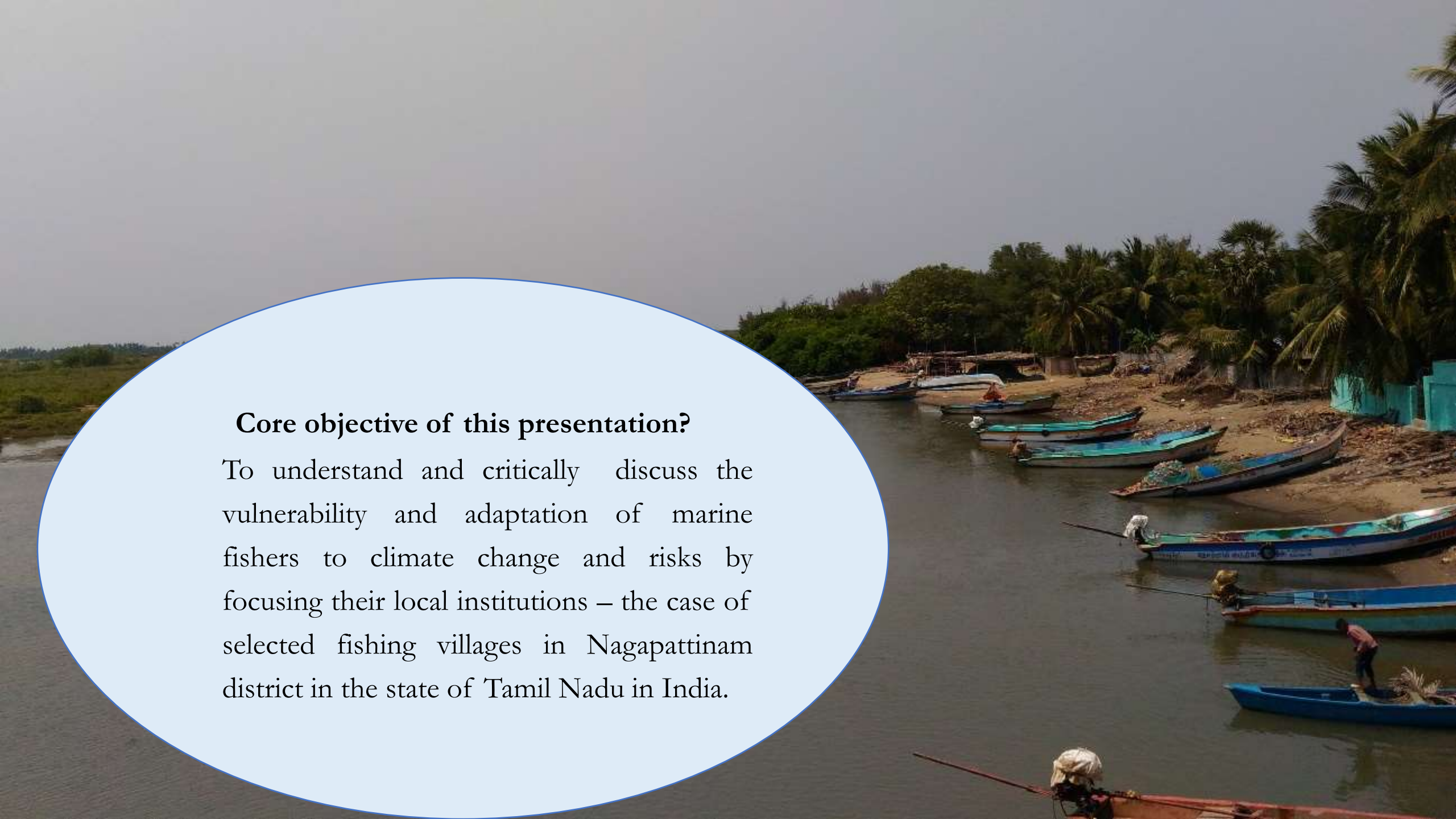


Core objective of this presentation?

To understand and critically discuss the vulnerability and adaptation of marine fishers to climate change and risks by focusing their local institutions – the case of selected fishing villages in Nagapattinam district in the state of Tamil Nadu in India.

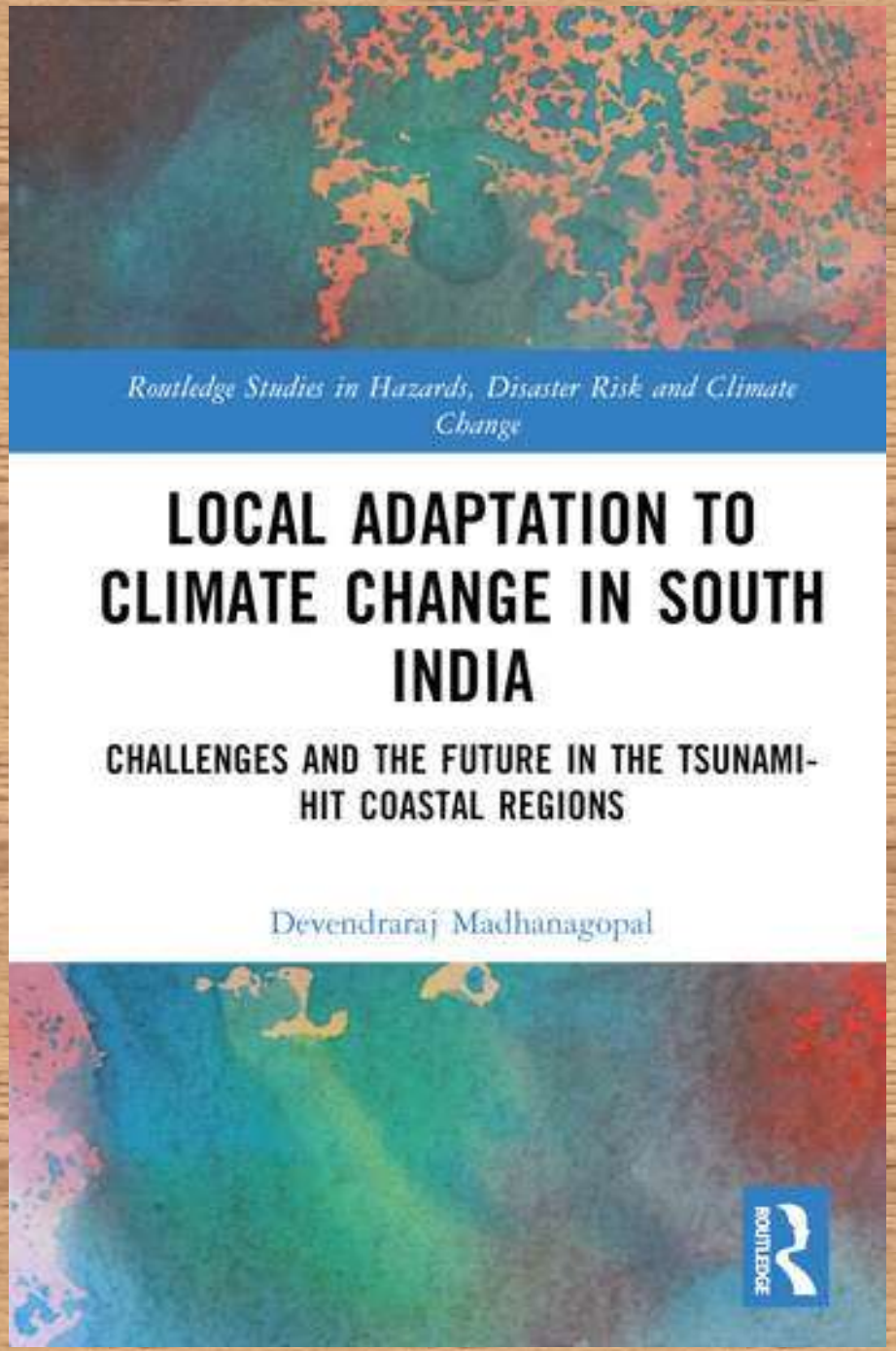
Introducing the research context and focus of this research with conceptual underpinning

Indigenous knowledge systems in confronting climate change

Living with climate change: Vulnerability and adaptation actions

Local institutions: Boon or bane in local adaptation to climate change?

Fisherwomen and their agencies in responding to climate change



Overall approach of this research

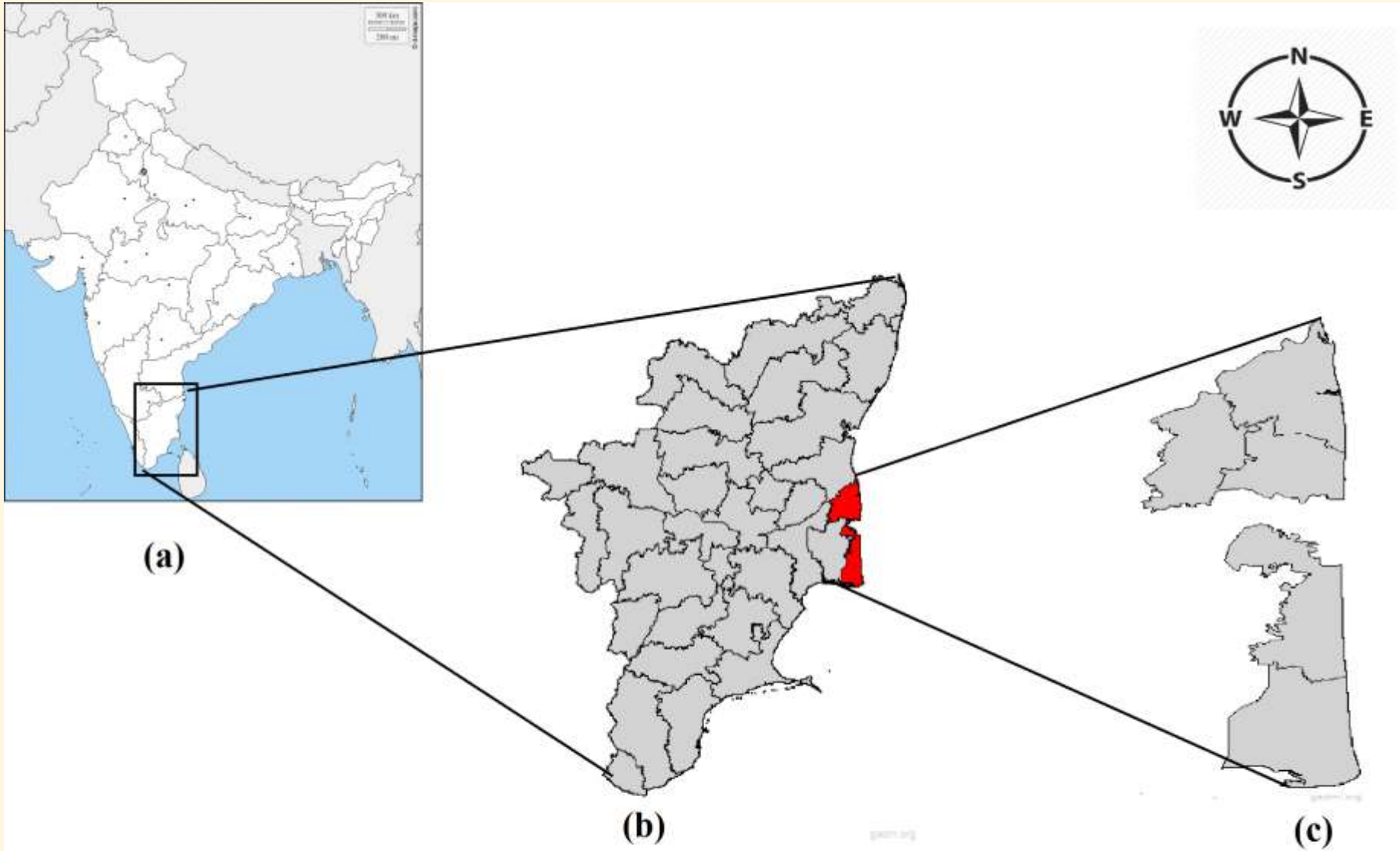
Two prominent approaches of climate change adaptation

Top-down approach – Climate negotiations, energy-based interventions are the major parts of top-down approaches (Dessai & Hulme, 2004, Mitchell & Tanner, 2006).

Bottom-up approaches (Dubash, 2009) - recognizes local institutions, local coping mechanisms and traditional knowledge of the communities in facing the challenges of climate variability.

Adopting "bottom-up" approach to address the aims of this study.

Three major reasons for choosing Nagapattinam district to conduct this research



(a) India (Tamil Nadu state is highlighted) Source: https://d-maps.com
(b) Tamil Nadu (Nagapattinam district is highlighted) Source: https://gadm.org/
(c) Nagapattinam district. Source: https://gadm.org/

Maps only for illustrative purpose. Not to scale.

Climate change – one of the greatest and unprecedented challenges of our time

There is a large and growing consensus that global warming and the resulting local climate variability have had wide-ranging of effects on the environment, coastal zones and the livelihoods of the people (UNFCC, 2006; IPCC, 2014).

> *"We underline that climate change is one of the greatest challenges of our time. We emphasize our strong political will to urgently combat climate change in accordance with the principle of common but differentiated responsibilities and respective capabilities".*
>
> *(UN Climate Change Conference 2009)*

> *"Climate change affects us all; but not equally".*

> *"The effects of climate change are global, intertemporal and highly inequitable"* (Stern review 2007).

- Inequality and marginalization are the two most important determinants that influence the vulnerability to climate change (Ribot 2011).

Social dimensions in climate change research

- IPCC third assessment report is highly dominated by “natural sciences,” especially the “earth sciences.” “Climate change is addressed as a global environmental problem which is detached from its social contexts” (Bjustrom & Polk 2011).

- Contributions of “sociology” and “social sciences” in understanding the adverse the effects of climate change and adaptation (Brulle & Dunlap 2015).

Research context – Vulnerability of coastal India to climate change

- Coastal South Asia are highly vulnerable to climate change due to multiple geographical and social factors. Half of the disaster events in South Asia between 1990 and 2008 were due to climate extremes. Rising sea levels and coastal inundation have further worsened in South Asia (UNEP, 2009; Ahmed & Suphachalasai, 2014).

- With about 20.6 million people at risk to sea-level rise, India ranks top among all the 233 countries for the year 2008 (Wheeler, 2011).

- Around 6% of India’s population lives in the low elevation coastal zone, and they are highly exposed to the impacts of cyclones and floods (McGranahan, Balk & Anderson, 2007; Wong et al., 2014).

- India is one of the top 10 countries that are largely hit by climate change.

[Image Source: World Economic Forum, 2022).

Vulnerability of marine fishers to climate change and coastal disasters – the case of the state of Tamil Nadu in India

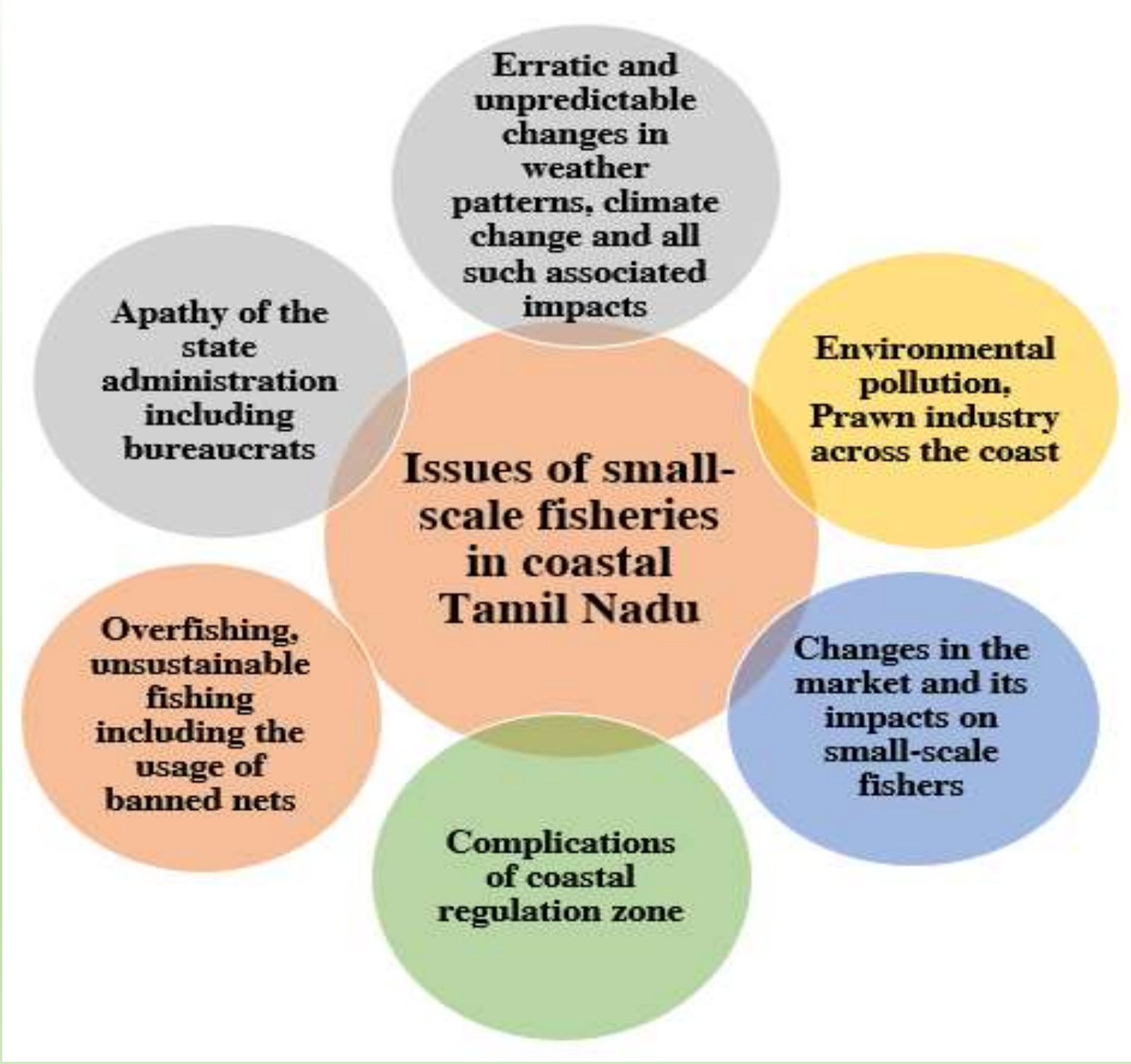
Tamil Nadu, the Southernmost state of India covers the coastline for about 1,076 km.

Out of Tamil Nadu's 72 million people, approximately 600,000 are marine fishers, with about 66% of them living below the poverty line, surpassing the national average of 61%. 96% of the fishing families in Tamil Nadu are traditional fishers. (CMFRI, 2012a; CMFRI, 2012b).

Cyclonic storms/depressions hit it for about 31 times with disastrous effects from 1952 to 2004.

Tamil Nadu, the southernmost state of India regularly experiences coastal flooding and extreme storm surges. The coasts of Tamil Nadu were affected by cyclonic storms about 30 times with disastrous effects from 1900 to 2004. The affected districts including Chennai, Cuddalore, Nagapattinam, Thanjavur, Ramanathapuram, and Kanyakumari (Sundar & Sundaravadivelu, 2005).

Image Source: Wikipedia.


Erratic and unpredictable changes in weather patterns, climate change and all such associated impacts
Apathy of the state administration including bureaucrats
Environmental pollution, Prawn industry across the coast
Issues of small-scale fisheries in coastal Tamil Nadu
Overfishing, unsustainable fishing including the usage of banned nets
Changes in the market and its impacts on small-scale fishers
Complications of coastal regulation zone

Focusing Nagapattinam district of Coromandel Coast of Tamil Nadu –Why this district?

- Marine fisheries are a major income source in this district.
- Most of the east coast north of Nagapattinam is low-lying, making the district prone to seawater intrusion, cyclones, and storms (Mascarenhas, 2004; Byravan, Chellarajan & Rangarajan, 2010; Arivudai Nambi and Bahinipati, 2013).
- Between 1991 and 2015, the district experienced four cyclones, four heavy rainfall events, and the devastating 2004 Indian Ocean Tsunami (Nagapattinam district disaster management guide).
- During the 2004 Indian Ocean Tsunami, the Cuddalore-Nagapattinam coastal stretch faced the most severe impacts, with Nagapattinam district being the worst affected among all thirteen affected districts in Tamil Nadu, resulting in 6065 deaths (Lakshmi, Purvaja, & Ramesh, 2014; ENVIS Centre: Government of Tamil Nadu).
- Fishing communities in the district were particularly hard-hit by the tsunami disaster (http://www.nagapattinam.tn.nic.in/relief.html).

***Pattinavar* –** the dominant fishing caste in Coramandel coast of Tamil Nadu (including Nagapattinam district) and Puducherry.

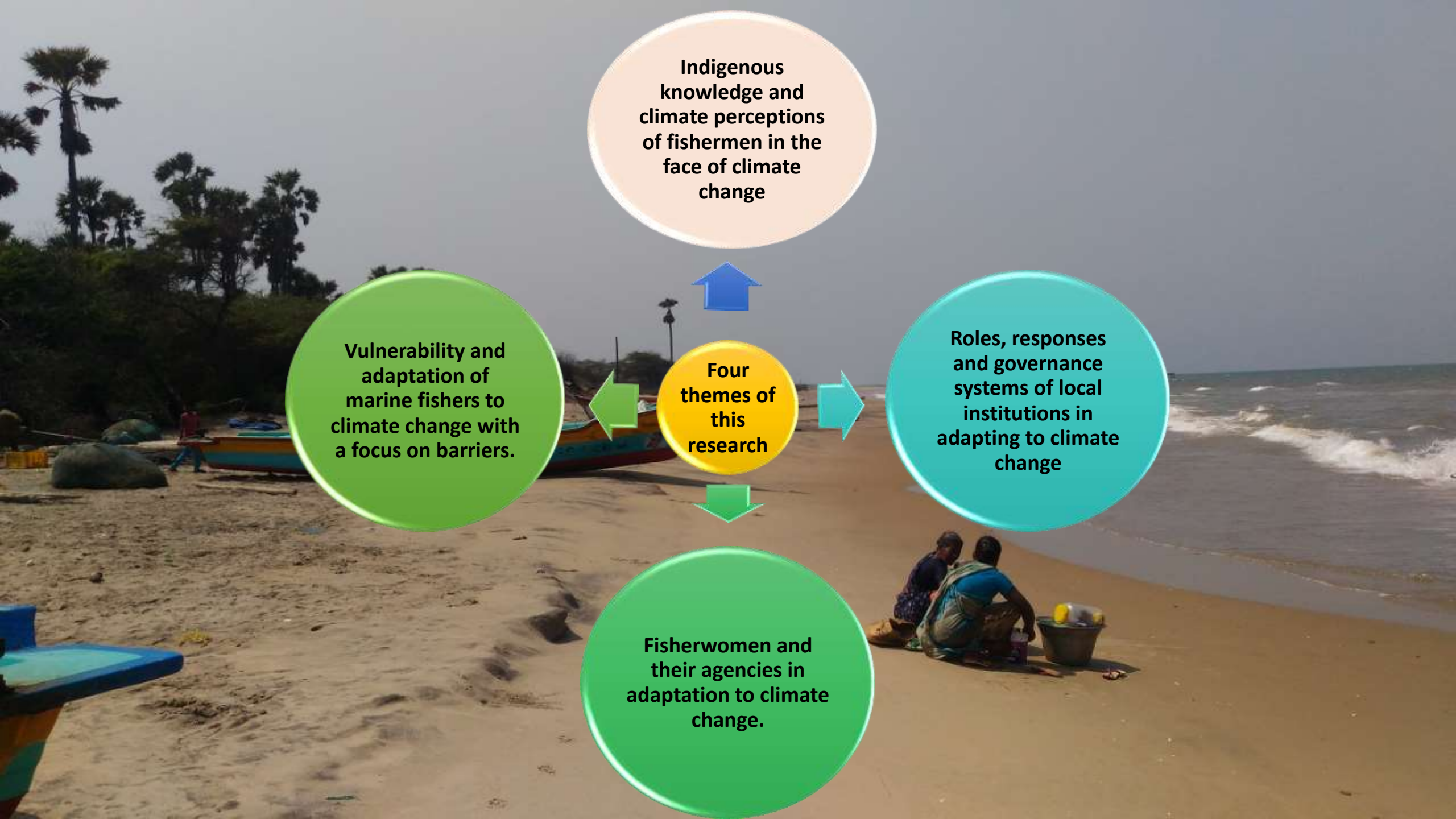
Uniqueness of the local governance systems of *Pattinavar* fishers

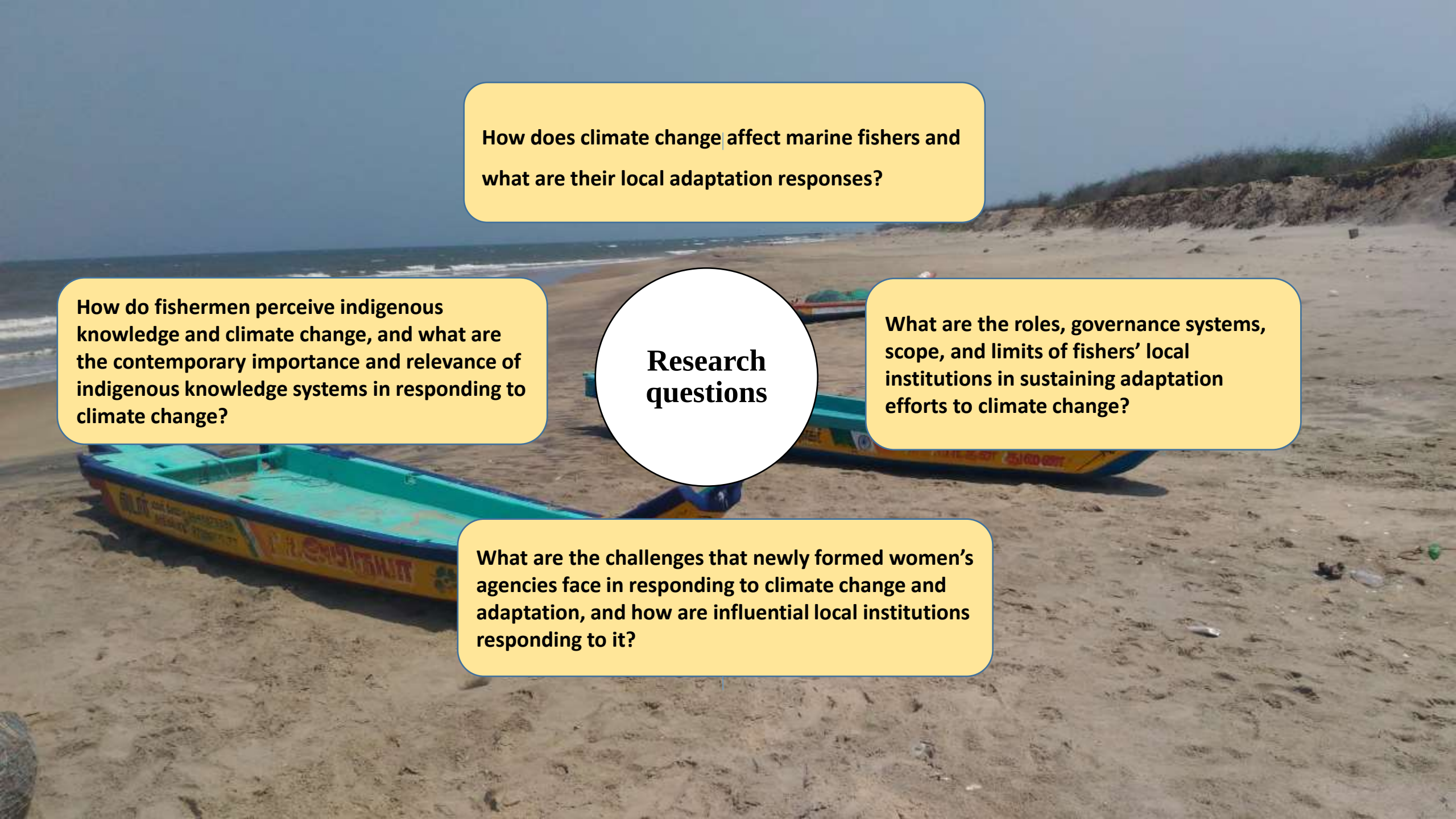
Pattinavars internal governance systems are the part of the old civilization

Pattinavars have historically inherited and developed a set of institutions, rules, and regulations in governing the commons and marine resources (Bavinck, 1996).

Bonding and linking social capital (Aldrich 2011).

Fishermen councils – Possess influential roles in resolving the local issues, maintaining peace and fixing the conflicts among the fishers – Influential roles in marine fisheries management (Bavinck, 1996).


Indigenous knowledge and climate perceptions of fishermen in the face of climate change
Vulnerability and adaptation of marine fishers to climate change with a focus on barriers.
Four themes of this research
Roles, responses and governance systems of local institutions in adapting to climate change
Fisherwomen and their agencies in adaptation to climate change.



How does climate change affect marine fishers and what are their local adaptation responses?

How do fishermen perceive indigenous knowledge and climate change, and what are the contemporary importance and relevance of indigenous knowledge systems in responding to climate change?

Research questions

What are the roles, governance systems, scope, and limits of fishers' local institutions in sustaining adaptation efforts to climate change?

What are the challenges that newly formed women's agencies face in responding to climate change and adaptation, and how are influential local institutions responding to it?

Some selected conceptual underpinnings - Framing the research

Climate variability and climate change: *"Climate variability looks on the changes/variability of the climate at smaller frames (like weeks, months, years and seasons), whereas climate change looks changes that occur over the long period of time - like decades or longer"* (WMO).

"Extreme events comprise a facet of climate variability under stable or changing climate conditions. They are defined as the occurrence of a value of a weather or climate variable above (or below) a threshold value near the upper (or lower) ends ('tails') of the range of observed values of the variable" Lavell et al., (2012).

"Impacts generally refer to effects on lives, livelihoods, health, ecosystems, economies, societies, cultures, services, and infrastructure due to the interaction of climate changes or hazardous climate events occurring within a specific time period and the vulnerability of an exposed society or system. Impacts are also referred to as consequences and outcomes" (IPCC, 2012).


Resilience
Vulnerability
Adaptation
Institutions
Adaptive capacity

Vulnerability to climate change

The three central tenets of vulnerability research (Cutter, Boruff, & Shirley 2003): i. the identification of conditions that make people or places vulnerable to extreme events. ii. the assumption of vulnerability is a social condition. iii. the integration of potential exposures and societal resilience with a specific focus on particular places or regions.

Vulnerability can be defined as *"the potential for loss"* (Cutter, 1996).

"Vulnerability can be termed as the inability to adapt to the extremes. Vulnerability also refers to a situation when certain groups in society are more vulnerable than others to shocks that threaten their livelihood and/or survival" (Parthasarathy, Narayanan & Patnaik, 2007).

***"Vulnerability is the propensity or predisposition to be adversely affected. It encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt"* (IPCC, 2014).**

"The capacity of individuals and social groups to respond to, that is, to cope with, recover from or adapt to, any external stress placed on their livelihoods and well-being" (Kelly & Adger 2000).

Resilience to climate change

Social resilience to environmental change and environment-society relations. *the ability of the communities to withstand external shocks (for, eg, environmental risks) and to adapt them."* (Adger 2000).

The capacity of social, economic, and environmental system sto cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation (IPCC, 2014a).

Three capacities of social resilience. i. coping capacities. ii. adaptive capacities iii. transformative capacities (Keck & Sakdapolrak 2013)

"World Fisheries" by Ommer, Perry, Cochrane, & Cury (2011)

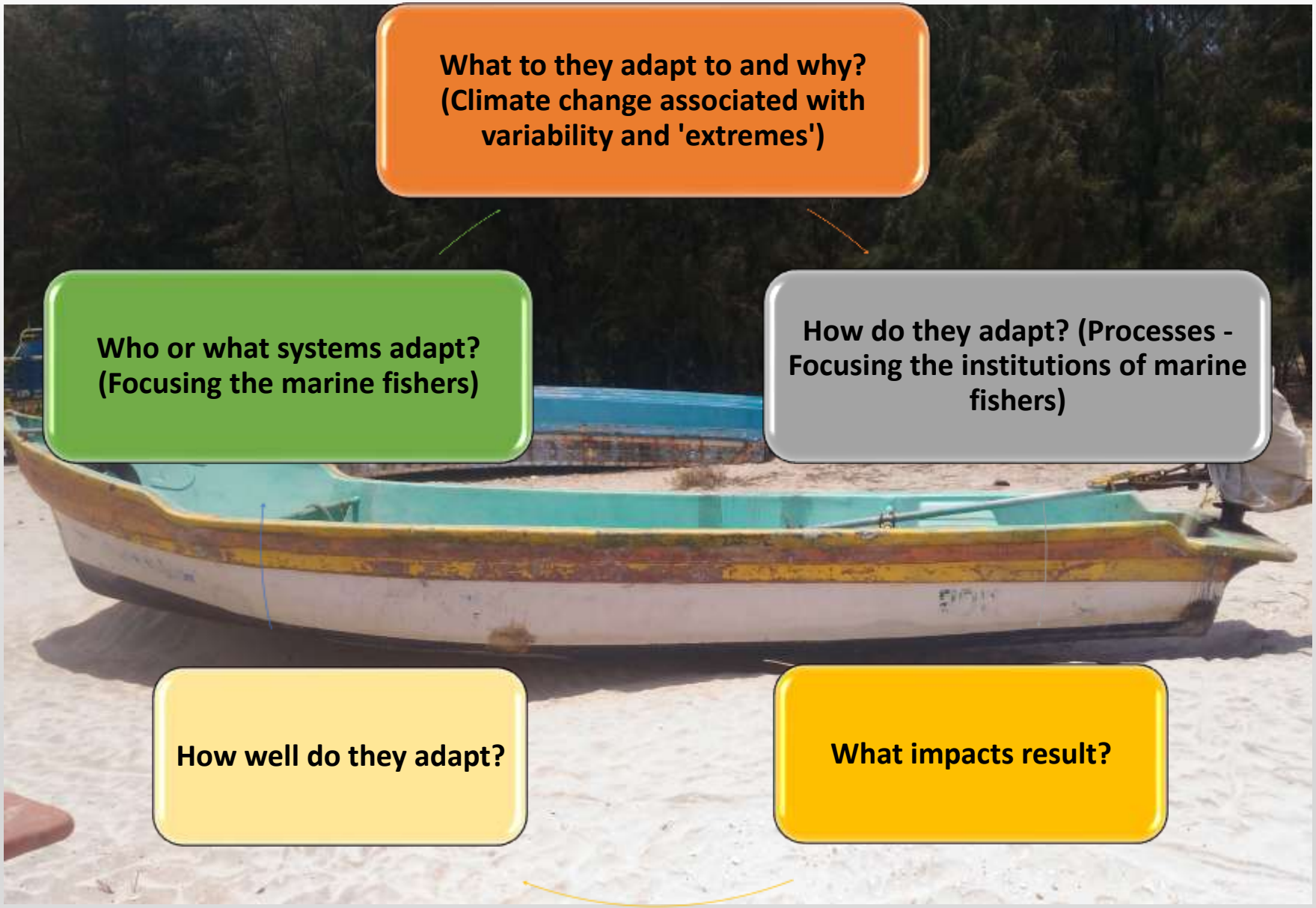
Adaptation to climate change

Societies inevitably need to adapt themselves to respond to environmental change (Nelson, Adger & Brown, 2007).

i. The risks of climate change projections are much evident, and the threats due to the changes in the environment are more apparent and considerably predictable than ever.

ii. Climate change projections and environmental risks may not be quantifiable – at notable instances. However, the impacts of the risks are highly significant. Therefore, transformations in the systems are required. It also requires the collective actions of multiple actors.

Six prime factors for adaptation (Ford & King 2015).



Adaptation cycle (Source adapted from Wheaton & Maciver, 1999)

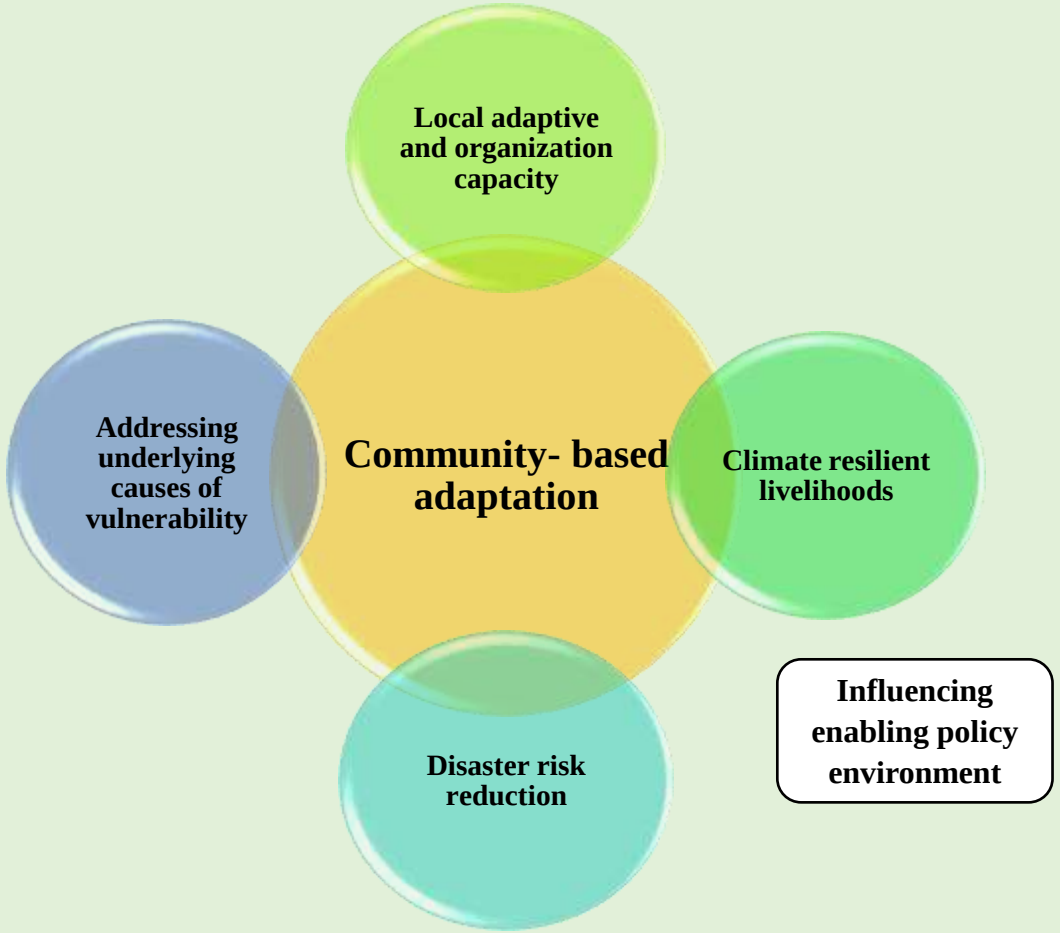
IPCC fifth assessment report definitions on coping and adaptation (IPCC 2014).

Coping: *"the use of available skills, resources, and opportunities to address, manage, and overcome adverse conditions, with the aim of achieving basic functioning of people, institutions, organizations, and systems in short to medium term."*

Adaptation: "*the process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects."*

Power and social relations play the central role in shaping adaptation actions and influencing adaptive capacity of the community (Pelling 2011; Pelling & Manuel-Navarrete 2011).

Community-based adaptation: *"Community-based adaptation to climate change is a community-led process, based on communities' priorities, needs, knowledge, and capacities, which should empower people to plan for and cope with the impacts of climate change."* (Reid et al., 2009).



Community-based adaptation framework (From CARE, 2014).

Adaptive capacity to climate change

Adaptive capacity refers to *"the ability to adapt to shocks and risks. It includes adjustments in both behaviors and resources and technological options. Adaptive capacity is uneven across and within the societies" (*Adger et al., 2007).

Six dimensions of adaptive capacity to climate change (Gupta et al., 2010): i. Variety ii. Learning capacity iii. Space for innovative and autonomous action iv. Good leadership v. availability vi. Access to resources and fair governance of the institutions.

Sustainable livelihoods approach

- Sustainable livelihoods: *"a livelihood comprises the capabilities, assets (stores, resources, and claims) and activities required for a mean of living: a livelihood is sustainable which can cope with and recover from assets and shocks, maintain and enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation; and which contributes net benefits to other livelihoods at the local and global levels and in the short and long-term"* (Chambers & Conway, 1992).

- Five types of assets/capitals to achieve sustainable livelihoods of the community – Natural, Physical, Economic (Financial), Human and Social capitals (Scoones 1998).

- Information capital, cultural capital (Bebbington, 1999; Odero, 2003; Cochrane, 2006).

- The community should have equal access to all 'capitals' are essential in building their resilience and adapting to climate change. Sustainable livelihoods framework unifies the five 'capitals' and provides the holistic view to understand the complexities of livelihoods systems (DFID, 1999; Farrington, Carney, Ashley & Turton, 1999).

Image source: ASRLM

Sustainable livelihoods approach is beneficial in understanding the climate change vulnerability and adaptation of socioecological systems as it analyses both the components and the factors that influence the livelihoods (Scoones, 1998; Reed et al., 2013).

Social capital *'refers to connections among individuals – social networks and the norms of reciprocity and trustworthiness that arise from them'.*

Social capital – that includes bonding, bridging, trustworthy links, reciprocity, social networks interrelate the community and the institutions and facilitate collective actions (Putnam, 2000), and it is particularly relevant in climate adaptation discourses (Adger, 2003; Pelling & High 2005; Aldrich, Page-Tan, & Paul, 2016) and disasters (Aldrich, 2011).

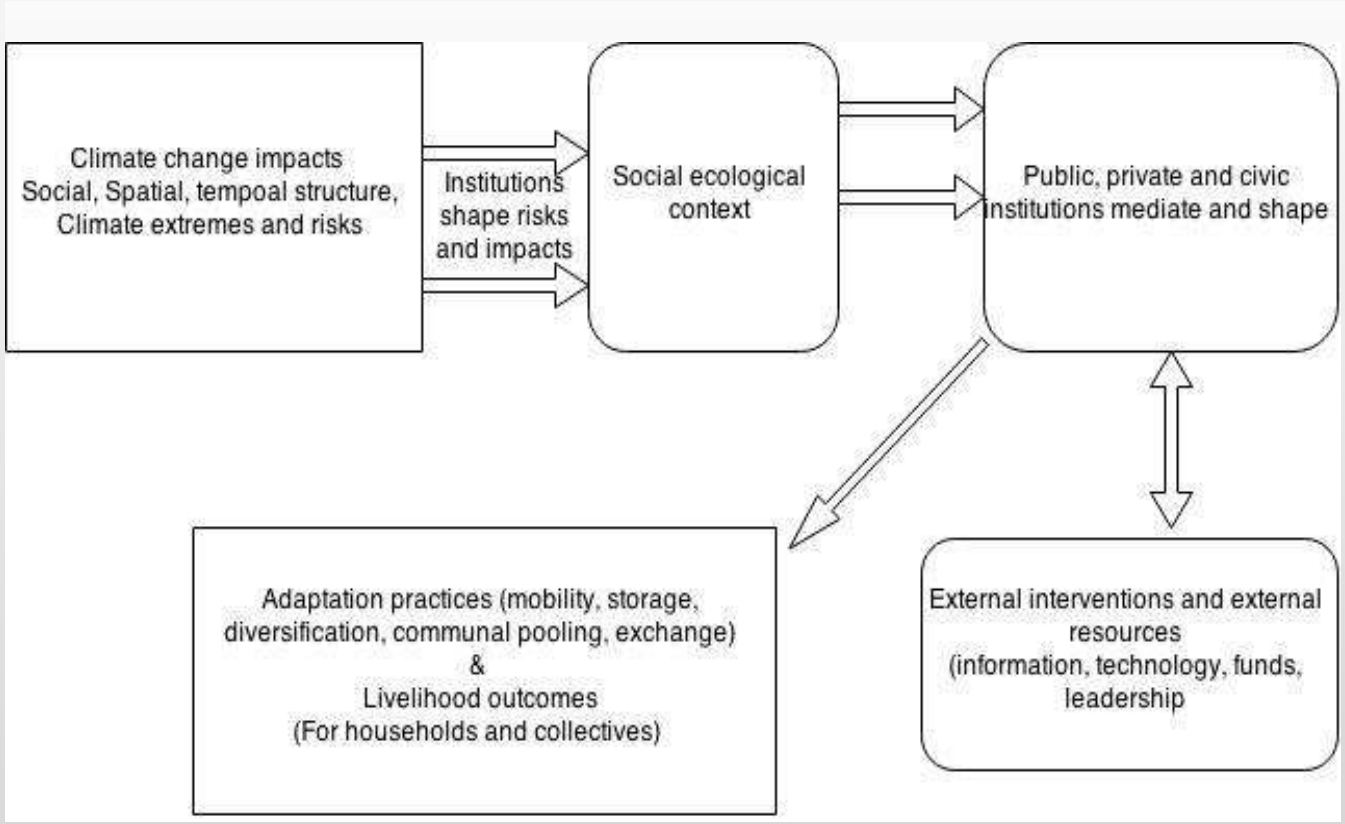
Institutions: *"Institutions are the humanly devised constraints that structure political, economic and social interaction. They consist of both informal constraints and formal rules"* (North 1991).

Scott's (1995) definition on institutions captures the enabling qualities of the institutions. *"Institutions consist of cognitive, normative, and regulative structures and activities that provide stability and meaning to social behaviour"* (Scott, 1995: 33).

"*Institutions reflect formal governmental processes as well as formal and informal social patterns of engagement" (*Gupta et al., 2010).

Three types of local institutions that are relevant to adaptation to climate are of the following: civic, public and private in their formal and informal norms. (Donnelly-Roark, Ouedraogo & Ye, 2001; Agrawal, McSweeney, & Perrin, 2008; Agrawal & Perrin, 2009).

The rules of the formal institutions are openly codified, whereas the informal institutions possess "socially shared rules," usually, they are unwritten, and entirely operated through non-formal channels (Helmke & Levitsky 2003).



Adaptation, institutions and livelihoods framework (Source: Agrawal & Perrin, 2008; Agrawal & Perrin 2009)

Why focusing the "local institutions" are important in responding to climate change impacts? (Bakker et al., 1999; Agarwal, 2008; Agrawal & Perrin 2009; Berman, Quinn & Paavola, 2012; Marschke, Lykhim & Kim, 2014).

i. It regulates and governs human-environment interactions.
ii. It structures the power and rights of the community. It mediates the communities and external resources at multiple levels of governance.
iii. It co-evolve with the changes in the environment.
iv. It mediates the social responses, external agencies into localized contexts and thereby it promotes the adaptation efforts of the community.
v. It structures the distributions of the risks of climate change.
vi. In most cases, local communities and their surrounded institutions have already experienced the differences in their local external environment and its resulting consequences on the lives and livelihoods.
vii. Local institutions and its key leaders influence the climate adaptation efforts at the local level.
viii. Local institutions are firmly rooted in the traditional communities (e.g., traditional marine fishers), and they are already well positioned to deal the environmental threats and environmental related projects.
ix. Local institutions are the fundamental mediating mechanisms to convert the external interventions into adaptation to climate change.

Interlinking ‘social capital’ and ‘local institutions’ in adaptation to climate change – focusing the research context

Social capital interlinks the community, and it plays the central role in building awareness about the emerging risks, and thereby it promotes the adaptive capacity (Woolcock & Narayan, 2000; Ireland & Thomalla, 2011).

Conceptual framework of this study – Interlinking the sustainable livelihoods framework (DFID, 1999) and (AIL) framework (Agrawal & Perrin, 2008), and incorporating “political capital” Divakarannair (2007) to address the objectives of this study.

i. Natural capital – Marine fisheries resources, coastal spaces, water, fisheries resources in the river

ii. Physical capital – It denotes the infrastructure and assets of the fishing communities. For eg. Fishing assets, markets, transport and communications.

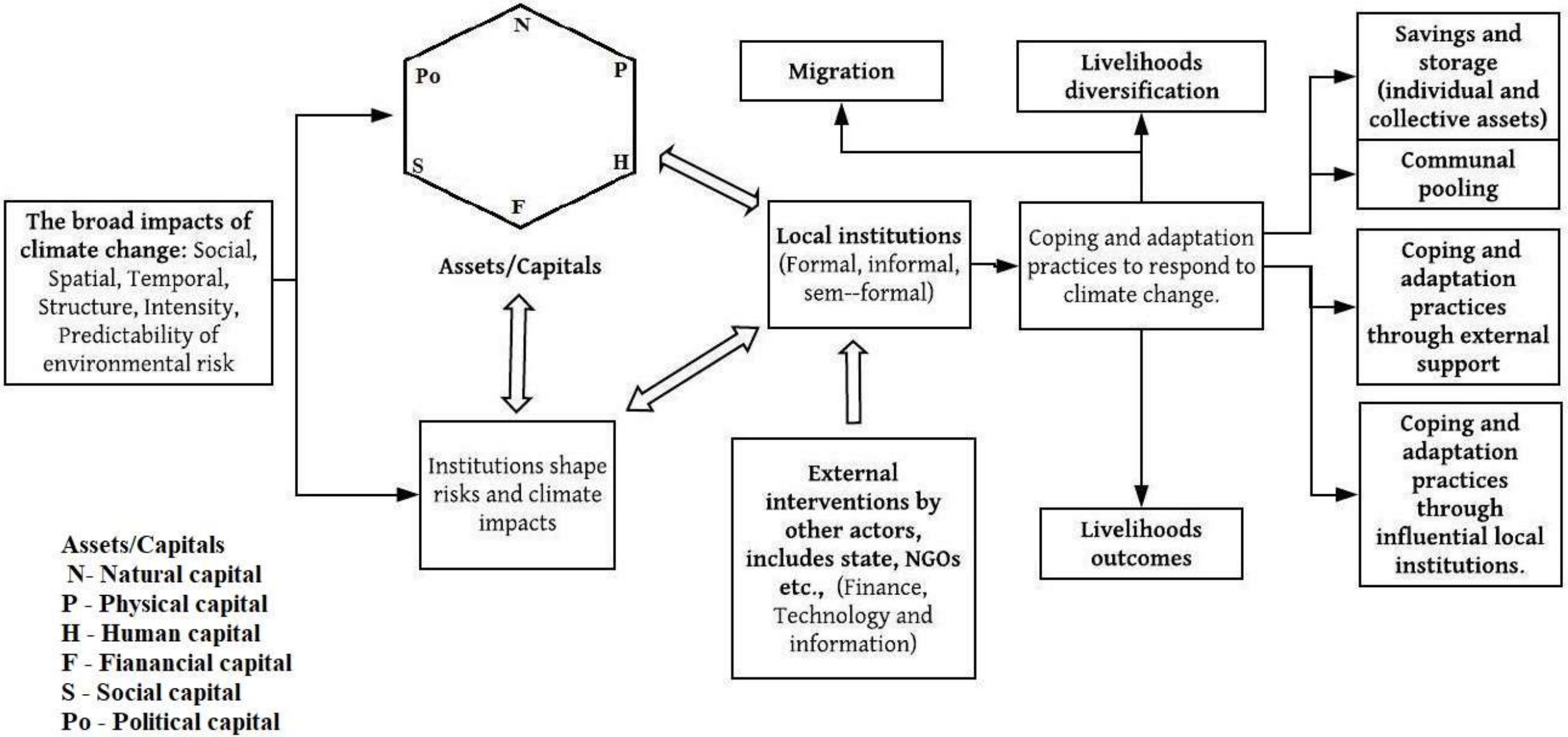
iii. Human capital – It denotes the skills that is acquired by the fishers to actively pursue the livelihoods strategies. It includes fishing skills, technical knowledge, indigenous knowledge, health, education, labor power, ability to fish, and ability to diversification the livelihoods.

iv. Financial capital – It includes cash, savings, jewels, cash remittances from their family members, other external financial sources and immovable property assets.

v. Social capital –It endows support to them when they are in crisis. It includes trust, mutual reciprocity, kinship relations, friendships and informal safety nets.

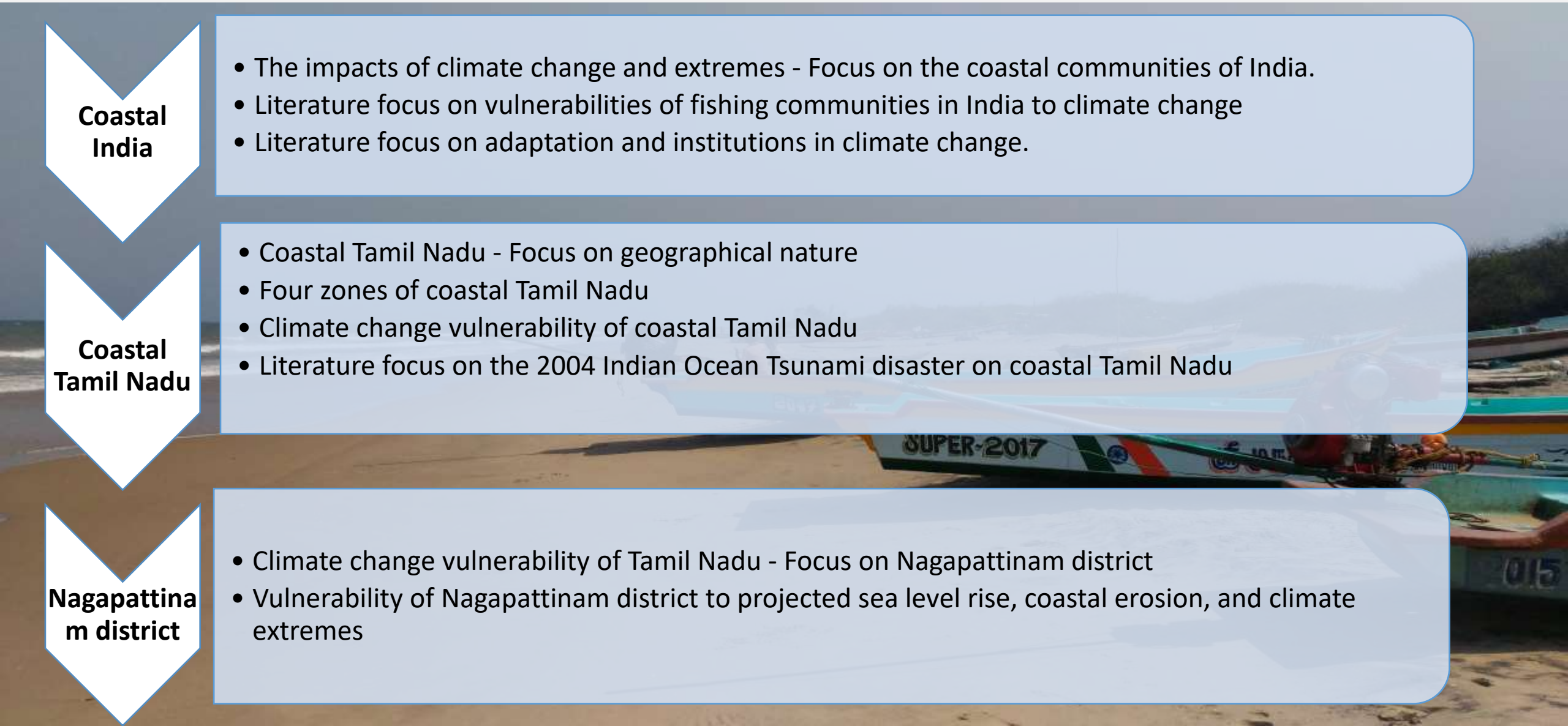
vi. Political capital – This study particularly focuses on local level institutions. Hence, institutions and its underpinning ‘politics’, therefore, an essential asset/capital to include with the five other capitals.

Capitals/Assets of marine fishers – focusing the research setting (Source adapted from Ellis, 2000; Allsion & Ellis, 2001; Divakarannair, 2007; Badjeck, 2008; Monirul Islam, 2013)



"Assets/Capitals" based Adaptation, Institutions, and Livelihoods (AIL) framework (Source adapted from DFID, 1999; Agrawal & Perrin, 2008).

Vulnerability of coasts, coastal areas, and marine fisheries sector to climate change and its impacts – Situating the research site



Coastal India

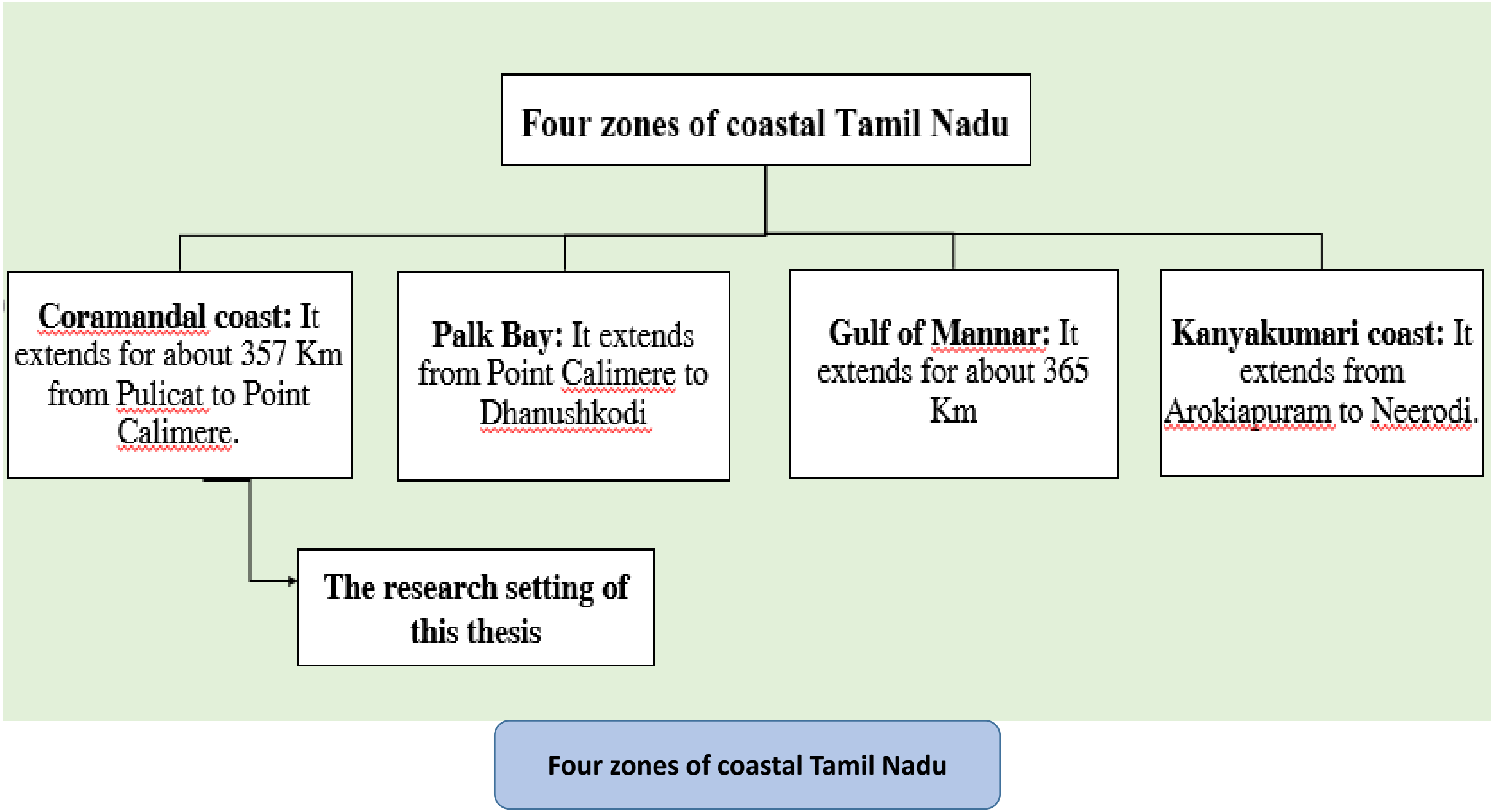
- The impacts of climate change and extremes - Focus on the coastal communities of India.
- Literature focus on vulnerabilities of fishing communities in India to climate change
- Literature focus on adaptation and institutions in climate change.

Coastal Tamil Nadu

- Coastal Tamil Nadu - Focus on geographical nature
- Four zones of coastal Tamil Nadu
- Climate change vulnerability of coastal Tamil Nadu
- Literature focus on the 2004 Indian Ocean Tsunami disaster on coastal Tamil Nadu

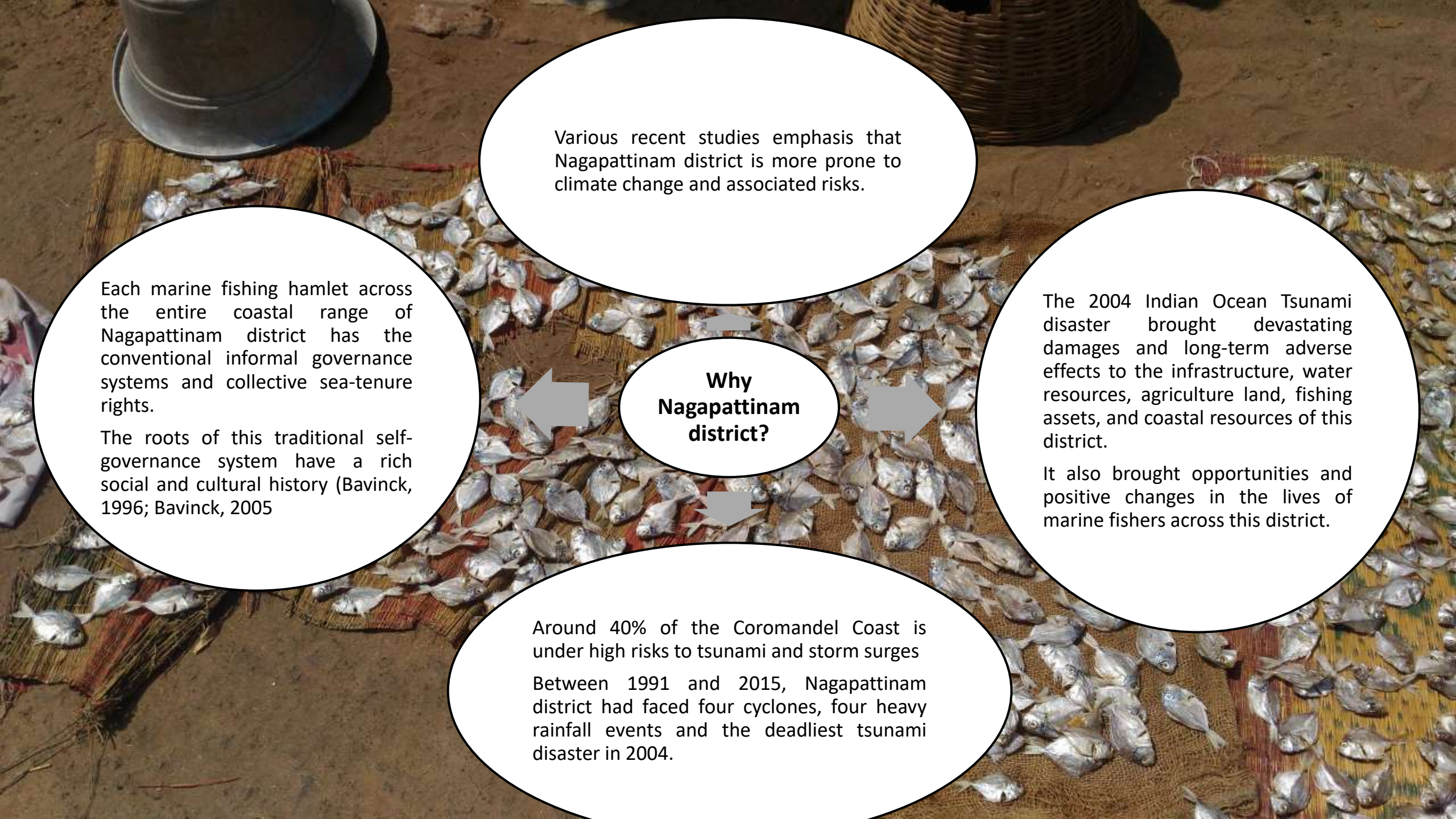
Nagapattinam district

- Climate change vulnerability of Tamil Nadu - Focus on Nagapattinam district
- Vulnerability of Nagapattinam district to projected sea level rise, coastal erosion, and climate extremes



Four zones of coastal Tamil Nadu

Authors	Findings and discussions
Srinivasan & Nagarajan (2005)	The authors have conducted post-tsunami studies along the 305 Km coastline in between Chennai and Nagapattinam of Tamil Nadu, India and points out that the 2004 Indian Ocean Tsunami disaster did extensive damages to Thirumullaivasal – Nagapattinam coast.
Khan, Ramachandran, Usha, Arul Aram & Selvam (2012b)	This study has analyzed the vulnerability of the mangrove-dependent communities in Pichavaram mangrove forest which is in southeastern coastal Tamil Nadu, India to sea-level rise by participatory approach (stakeholder analysis and rapid rural appraisal) and has formulated a methodological framework to create awareness among the coastal communities (Especially fishers and farmers).
Gupta et al., 2014	This study has discussed the needs to integrate climate change adaptation measures and disaster risk reduction measures in central, state and local level.
Sheik Mujabar & Chandrasekar, 2011	The southeastern coastal Tamil Nadu (which includes Nagapattinam district) of India faces severe threat due to rapid changes in geology and geomorphology, sea-level change, tropical cyclones and storm surges.
Khan, Ramachandran, Malini & Palanivelu (2014)	This study has analysed the climate data (which includes, decadal and seasonal analyses of important climate parameters such as temperature, rainfall, relative humidity, wind speed and cyclonic storms) of the study area (Pichavaram mangrove coast of Tamil Nadu coast, India) from the year 1951 to 2010 and found that the climate has changed for over the past decades.
Bal et al., (2016)	This study has analyzed regional climate change projections for Tamil Nadu state by using Met Office Hadley Centre regional climate model and finds that the average temperature of the state is showing an increasing trend for the baseline period (1970 – 2000).
Chakraborty & Joshi (2016).	The authors have assessed the vulnerability of Indian district to natural (earthquakes) and climate-induced disasters (cyclones, floods, droughts, and sea-level rise) by ranking composite indicators. This study has pointed out that, in India, significant parts of coastal Tamil Nadu are one of the highly vulnerable zones to sea-level rise and cyclones and Nagapattinam district is one among them, which is highly susceptible to sea-level rise.



Various recent studies emphasis that Nagapattinam district is more prone to climate change and associated risks.

Why Nagapattinam district?

Each marine fishing hamlet across the entire coastal range of Nagapattinam district has the conventional informal governance systems and collective sea-tenure rights.

The roots of this traditional self-governance system have a rich social and cultural history (Bavinck, 1996; Bavinck, 2005

The 2004 Indian Ocean Tsunami disaster brought devastating damages and long-term adverse effects to the infrastructure, water resources, agriculture land, fishing assets, and coastal resources of this district.

It also brought opportunities and positive changes in the lives of marine fishers across this district.

Around 40% of the Coromandel Coast is under high risks to tsunami and storm surges

Between 1991 and 2015, Nagapattinam district had faced four cyclones, four heavy rainfall events and the deadliest tsunami disaster in 2004.

Navigating to the field sites & methods adopted

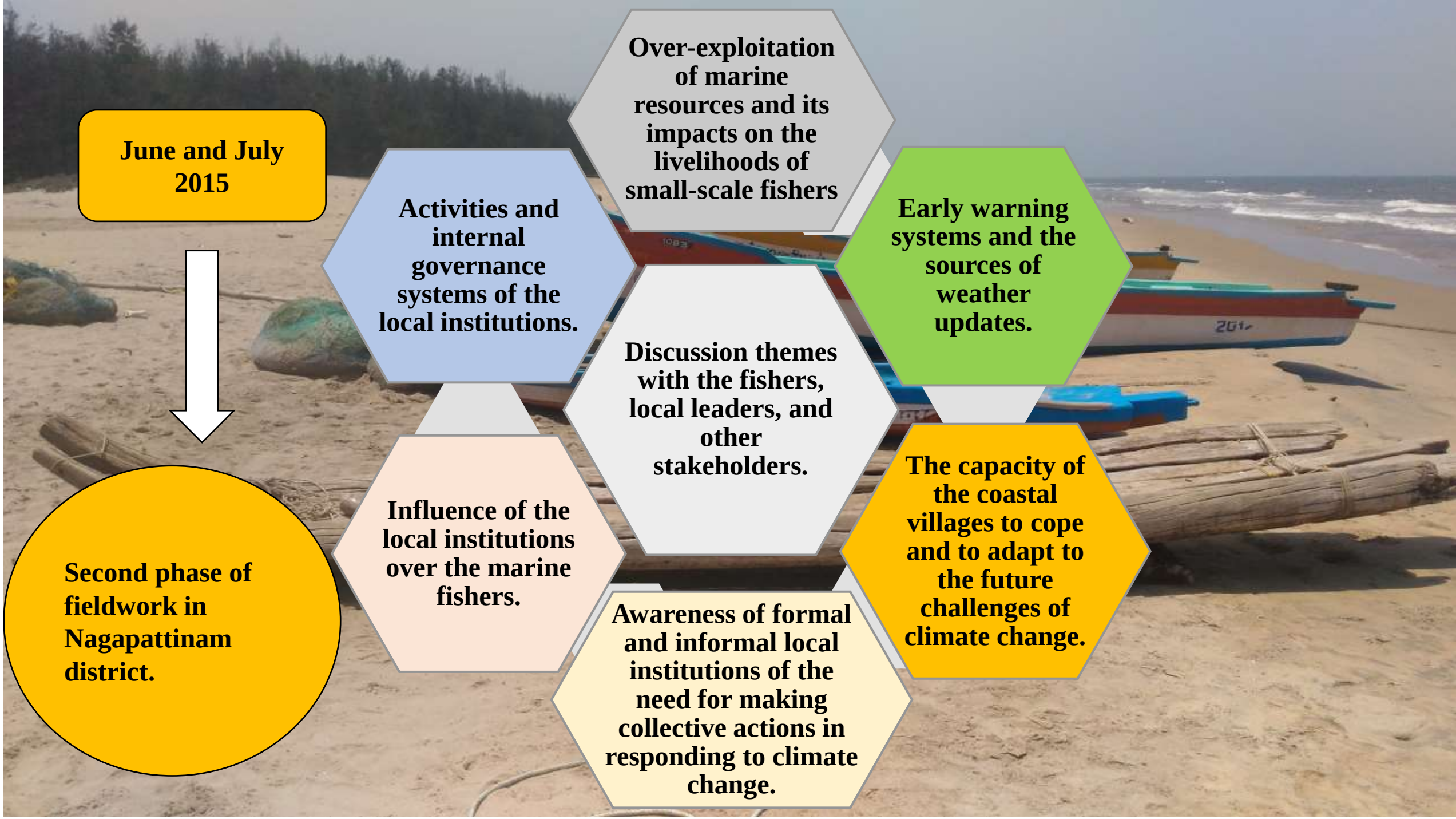
Case study research is the most flexible research design that allows the researcher to investigate complex-real phenomena without losing its holistic and fundamental characteristics (Schell 1992). Qualitative case study research approach (Yin, 2003).

April and May 2014: Pilot surveys in the villages of Nagapattinam district. Aarukkattuthurai, Kodiyakkarai, Kodiyakkadu, Pushpavanam, Vellappallam, Vanavanmadevi and Akkaraipettai (*Thalai Gramam* (in Tamil): Head fishing village across the entire coastal stretch), Kodiyampalayam and Kozhayar.

Social bonding among the local institutions and its influence over the fishers was reasonably significant due to:

i. Less population. ii. Single caste. iii. Less occupational diversity: "if you born as fisher, you must do fishing." iv. The apathy of state government and external agencies.

Review of local documents – hunger project (2008), Panchayat-Level Disaster Preparedness report, CMFRI Census data, disaster management reports of Nagapattinam district and reports of SIFFS, IFAD and MSSRF


June and July 2015
Second phase of fieldwork in Nagapattinam district.
Over-exploitation of marine resources and its impacts on the livelihoods of small-scale fishers
Activities and internal governance systems of the local institutions.
Early warning systems and the sources of weather updates.
Discussion themes with the fishers, local leaders, and other stakeholders.
Influence of the local institutions over the marine fishers.
The capacity of the coastal villages to cope and to adapt to the future challenges of climate change.
Awareness of formal and informal local institutions of the need for making collective actions in responding to climate change.

Locating the study site – Fishing villages

Kodiyampalayam

Madavamedu

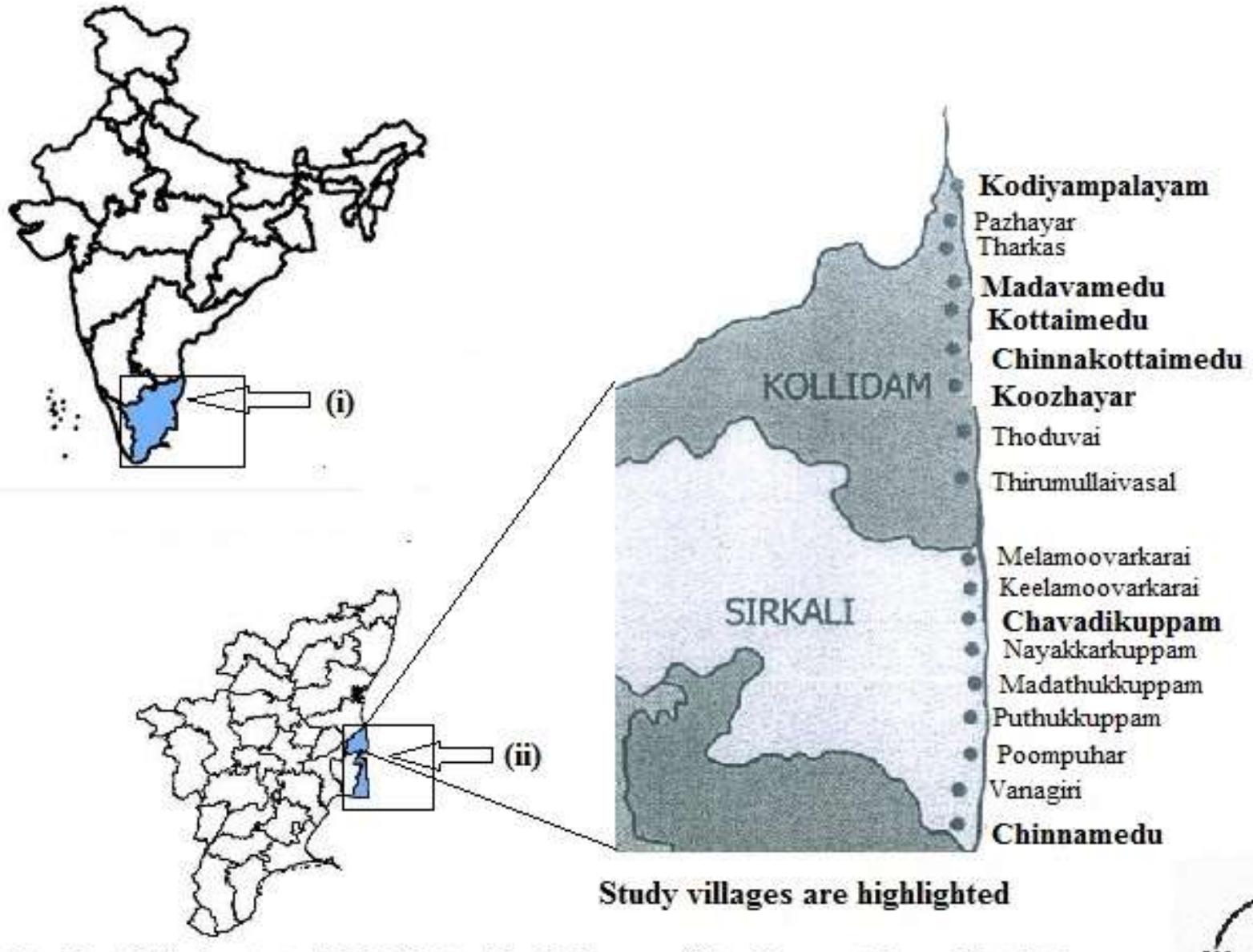
Kottaimedu

Chinnakottaimedu

Koozhayar

Chavadikuppam

Chinnamedu



Study villages are highlighted

(i) - Tamil Nadu state is highlighted in India map (ii) - Nagapattinam district is highlighted in Tamil Nadu map. Source of (i) and (ii): National remote sensing centre, ISRO, Government of India, Hyderabad, India

Kodiyampalayam

Small-scale fishing village

Covered by water in all the four sides. Also called as Kodiyampalayam island

One of the highly vulnerable fishing villages in the district to climate stress and erosion

Local institutions and its tacit influence.

Madavamedu

Less than 1500 reside in the small-fishing village.

Highly vulnerable to climate extremes, erosion, and sea-water intrusion.

Purse-seine fishing

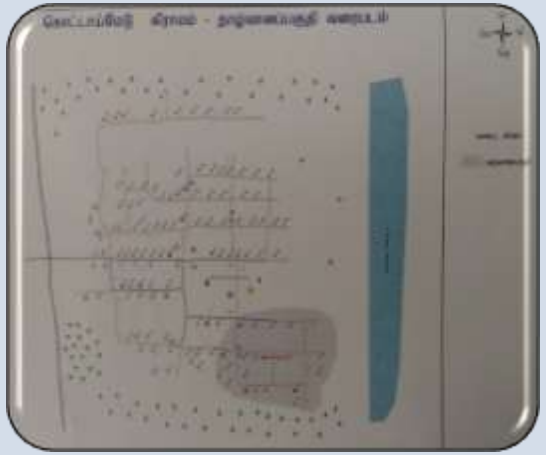
Dominant influence of uur panchayats over the other local institutions.

Chinna kottaimedu

According to the local villagers, as per population size, Chinnakottaimedu/Olakottaimedu is the smallest fishing village in Nagapattinam district.

Faced extensive damages in the tsunami disaster.

Continuous damages due to climate risks for over the past three decades.



Kottaimedu

Purse-seine fishing village.

Total population comes around 1000.

Around 165 fishing families in the village were the beneficiaries of free-tsunami houses scheme.

In total, the fishers of this village own 110 OBM boats, 12 surukku valai boats (Ring seine fishing boats. Fishers locally refer this boat as 'Visai padaku').

The economic status of the fishers of this village are better than the other study villages.

Koozhayar

The primary livelihoods of more than 95% of the households in the village are dependent on marine fishing. Most of them are small-scale fishers.

The population of this village comes around 1500, and a notable portion of them have recently started engaged with purse-seine fishing.

Not a strict homogenous village as compared to the other fishing villages. The residents of this village live in two different areas. The people who live near to the beach are more vulnerable to climate extremes, erosion, and sea-water intrusion than the others.

Chavadikuppam

Small-scale fishing village.

Single caste – Pattinavar village.

Highly affected due to climate stress, coastal hazards, and coastal erosion.

This village was also profoundly affected due to the 2004 Indian Ocean tsunami disaster.

Fifteen villagers (including children) who belong to this village had lost their lives in the tsunami disaster.

Chinnamedu

Less than 1000 people reside in the village

Small-scale fishing village.

The marine fishers of this village are continuously affected to climate stress, coastal hazards, and coastal erosion for over the two decades.

The domination of uur panchayats over the fishers.

Single caste fishing village.

100% access to mass medias and mobile phones.

- Intensive fieldwork of around 6 months during different time intervals (from 2014 to 2018).

- The purpose of qualitative research is to capture more insights and understandings about the case rather than mere “generalizability”

- Sampling strategy: Purposive sampling and snow-ball sampling methods

- Proper schedules and checklist guided in-depth open interviews, focus group discussions, and non-participatory observation with the respondents.

- **Respondents:** Marine fishers, fisherwomen, uur panchayat leaders and leaders of the statutory panchayat, senior fishermen, local political leaders, representatives of women self-help groups and fisheries co-operative society, other fisheries stakeholders, NGO employees, and a few government employees.

- **Data analysis:** Descriptive qualitative analysis method (Creswell, 2014)

Category of fishermen	Number of Respondents (n= 150)	Age group (in years)	Fishing experience (in years)
Senior fishermen	80	45 - 65	25 - 45
Middle-aged fishermen	40	35 – 45	15 – 25
Young fishermen	30	25 – 35	10 – 15

Respondents	Methods of data collection	Numbers of respondents
Active fishermen	In-depth interviews and focus-group discussions	150 (including 40 key informants)
Fisherwomen (majority of them are active in women self-help groups and headloaders)	In-depth interviews and focus-group discussions	40 (including 10 key informants).
Middlemen (fishing)	Informal discussions	10
Fish traders (All are Pattinavars)	Open in-depth interviews and informal discussions	10
Retired fishermen	Open interviews and group-discussions	20
NGO employees (IFAD, MSSRF, ICSF, SIFFS)	Informal discussions (It was mostly done during the pilot study)	Around 10 (Only 4 respondents participated with the discussions. Remaining respondents were helpful in identifying the key informants of the fishing villages)
Local businessmen (other than fishing)	Informal discussions	4
Government employees (brief informal discussions)	Informal discussions	3
Activists and writer	Discussions including e-mail discussions	3
Academicians	Before conducting the pilot surveys and first phase of data collection (Discussions)	3

The relevance of indigenous knowledge of fishers in the face of climate change: Focusing fishermen's climate perceptions

How does the fishermen perceive the relevance of their local traditional knowledge in the face of climate change?

Local knowledge systems transferred from generations to generations and the basis of indigenous knowledge systems lie in culturally specific systems, practices and beliefs (van Kerkhoff & Lebel, 2006; MoSTE, 2015).

FAO on local knowledge

i. local knowledge is dynamic.
ii. it is based on experience of particular communities and tested for a long period of time.
iii. it is adapted to the local culture and environment.
iv. it is embedded in social institutions, rituals and practices of the given community. Local knowledge of communities depends on the claims of connections with the particular place.

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Exploring fishermen's local knowledge and perceptions in the face of climate change: the case of coastal Tamil Nadu, India

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Abstract

Fishers' local knowledge and their perceptions of climate change are increasingly recognized by researchers and international institutions. However, in India, limited regional studies are available to understand the fishers' local knowledge, and a crucial question which largely remained unaddressed has been how fishers perceive the relevance of their local knowledge systems in the face of climate change. Provided this background, this paper aims to explore the fishermen's local knowledge and their climate perceptions in the face of climate change. This paper has employed the data that were obtained by in-depth interviews and focus-group discussions with the small-scale fishermen of three highly vulnerable fishing villages of Nagapattinam district, Tamil Nadu. The marine fishers across this coast were the victims of the 2004 Indian Ocean Tsunami disaster, several major cyclones, and various weather and climate events for over the last four decades. Key results show (1) fishermen perceive multiple aberrations and anomalies in the weather and climate patterns for over the previous three to four decades, particularly after the 2004 Indian Ocean Tsunami disaster. (2) The next finding is contrary to the conventional understandings, in which we have found that the fishermen are increasingly felt and experienced that their local knowledge is no longer adequately relevant in the face of climate change. Thus, for promoting the adaptive capacity of fishers, this paper has suggested that fishermen's perceptions and their expectations should be appropriately recognized and there is a strong need to provide scientific assistance to the fishermen through proper channels to respond to climate change impacts.

Keywords Fishermen · Local knowledge · Climate change · Climate perceptions · Tamil Nadu · India

Indigenous knowledge or local knowledge? Some conceptual understandings

Agrawal (1995) has underlined the weakness in strictly delineating and differentiating between indigenous knowledge and scientific knowledge by its epistemological and practical nature respectively. He questioned the strict differentiation, delineation and dichotomization between scientific and indigenous knowledge and advocates for productive dialogues between the knowledge systems.

Knowing the social, cultural and moral aspects of the society are necessary to understand how they respond to the impacts of climate change at the local level. But the observations of locals and their interpretations of climate change have its own limitations. Nonetheless, it can be helpful to the scientists and the policymakers as an important supplement (Byg & Salick 2009).

Limited knowledge available on indigenous knowledge of marine fishers in the face of marine fishers of South India – discussions that are centered on the previous literature (Swathi Lekshmi et al., 2013; Geetha et al., 2015; Menon et al., 2016; Santha, 2008, Santha, Fraunholz, & Unnithan 2010; Santha, Gahana & Aswin, 2014).

A few selected questions/schedule that guided the data collection

i. Share the community lingo of the currents, wind patterns and seasons and note how the community lingo favors your fishing occupation.

ii. How do you find out the timings, directions and fish shoals when you are in the sea?

iii. What is the significance of wind patterns in detecting the fish shoals and determining the fish caught in the typical fishing day?

iv. How currents influence the fish catch and safely navigating the boats?

v. How do you predict the impending rainfalls, cyclones and floods by local traditional knowledge?

vi. What are the signs and indicators of the heavy rains, storms and floods? Explain.

vii. How the lunar cycle influences the fish catch?

viii. Explain the relationship between the changes in the climate and the fish catch.

ix. What are the climate variables that affect the fish availability and catch? List and rank the variables according to its influence.

x. Explain the effects of the climate events that occurred for over the past three to four decades and point out how it has influenced the fish catching patterns.

xi. Elaborate on the effects of the 2004 Indian Ocean Tsunami disaster.

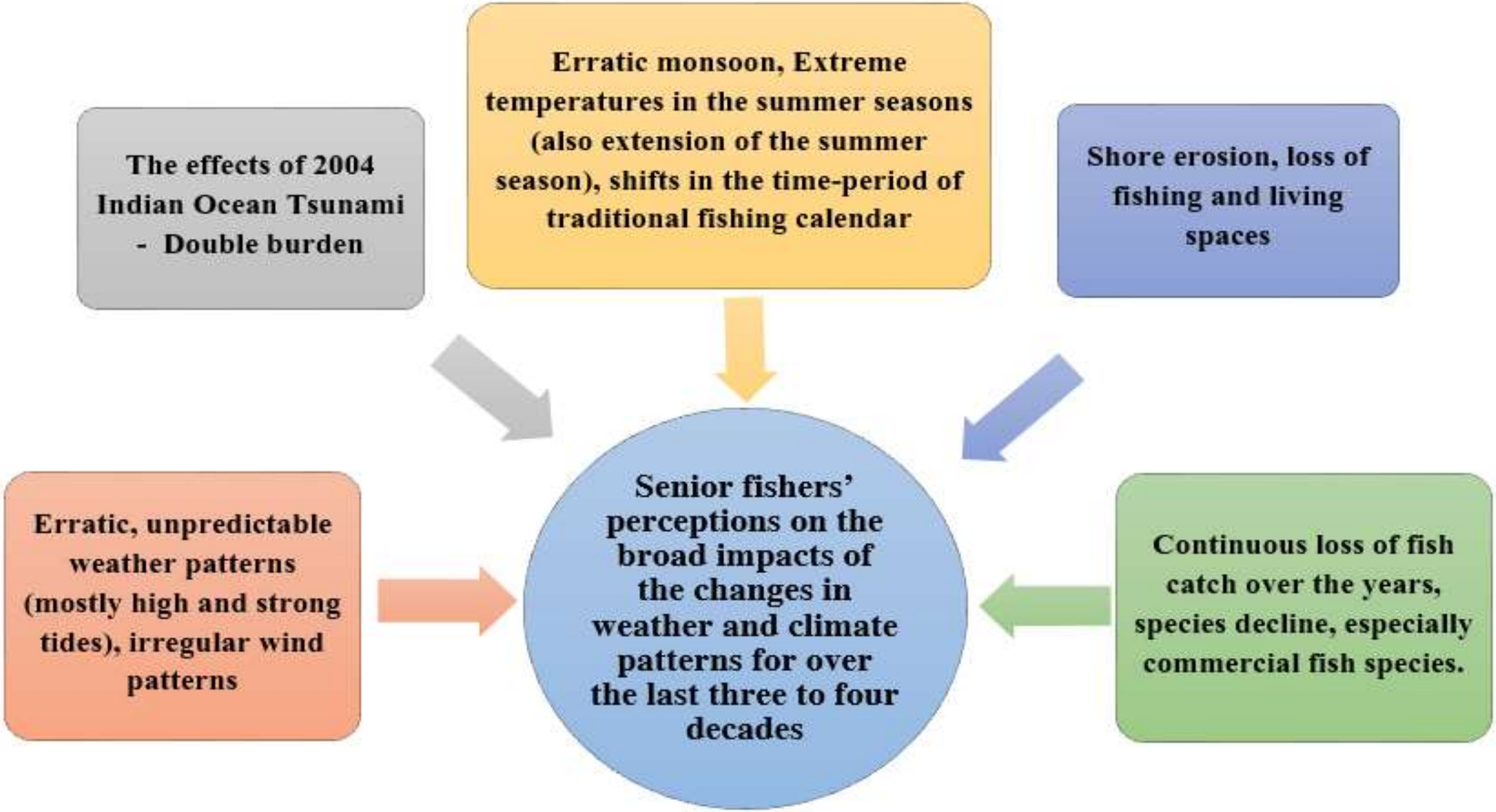
xii. Did tsunami disaster influence the changes in weather and climate patterns? If yes, explain it. What are the differences in fish catch and fish stock patterns aftermath the tsunami disaster?

xiii. Sources of weather-related updates and early disaster warning and its efficiency – Fishermen's opinions and narratives.

xiv. What's your view of the relevance of local traditional knowledge in the face of climate change? Is it helpful to face the weather-related challenges and to earn livelihoods for your family?

- Majority senior fishermen are aware of the fluctuating environmental conditions and its negative impacts on their livelihoods for over the last three to four decades.
- Many relatively younger and middle-aged fishermen (ages 35 – 45 years) have frequently attributed over-fishing is the stressor to their livelihoods.
- Fishermen's local ecological knowledge to identify the fish shoals and to predict the impending rains/cyclones vary according to their age and fishing experience.
- All the senior fishermen have reported that seasonal anomalies and the wild weather patterns were the primary factors that decreased the fishing days but intensified their risks for over the last 15 years.

> *For over the last two to three decades, the decline of some fish species has increasingly been getting high. We consider the fishing day is 'very lucky' if we able to catch these fishing species in the near seashore. In these years, our livelihoods are mostly dependent on sardines, flying fish, Mackerel, and crab. At the rough season, we go fishing in the nearby Kollidam River by using our catamaran boats. There is no certainty in our income."* (A fishermen co-operative society of Chinnamedu)


The effects of 2004 Indian Ocean Tsunami - Double burden
Erratic monsoon, Extreme temperatures in the summer seasons (also extension of the summer season), shifts in the time-period of traditional fishing calendar
Shore erosion, loss of fishing and living spaces
Erratic, unpredictable weather patterns (mostly high and strong tides), irregular wind patterns
Senior fishers' perceptions on the broad impacts of the changes in weather and climate patterns for over the last three to four decades
Continuous loss of fish catch over the years, species decline, especially commercial fish species.

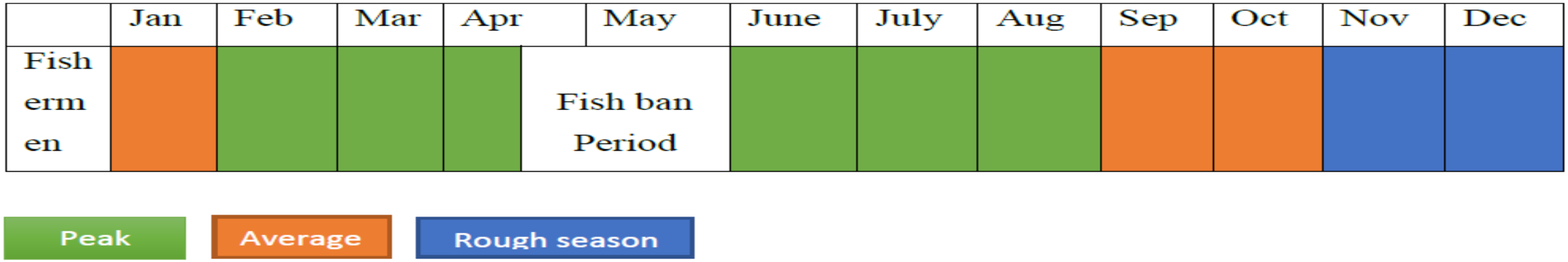
- The local traditional knowledge of fishermen on fish stock, fish population, and climate change have concurred mainly with the early studies (Nirmale, Sontakki, Biradar, & Metar, 2004; Suyasaaradha, 2005; Swathi Lekshmi et al., 2013; Menon et al., 2016).
- There was complete symmetry in the responses of all fishermen that the over-fishing and less fish catch over the past two to three decades. Based on age, the senior fishermen were of the similar opinion that the climate change is a reality and it has had direct impacts on fish catch.
- Fishermen's perceptions of sea-surface temperature and its impacts on fish reproduction and fish migration supported the scientific findings (Kizhakudan et al., 2014).
- The indigenous knowledge of fishermen varies according to the types of gears that they use, family structure and geographical locations (Santha 2008).

Long-term impacts of the 2004 Indian Ocean Tsunami disaster

Depletion of fish stock and less fish catch over the years: Significant senior fishermen have stated that they could not find more than half of the species that they used to catch before 30 – 40 years in their traditional marine fishing grounds.

- Already extinct or endangered: Lady Fish / Indian Whiting (*Sillago indica*), Indian Anchovy (*Stolephorus indicus*), Silver Moony/Silver batfish (*Monodactylu sargenteus*).
- Fishers' livelihoods were mostly dependent Indian oil sardines *(Sardinella longiceps),* Indian mackerel (*Rastrelliger kanagurta*), Seer fish *(Scomberomorus guttatus),* Prawn *(Fenneropenaeus indicus),* Little Tunny *(Euthynnus affinis)* and flying fish *(Cypselurus coromandelensis Hornell).*

Seasonal calendar of fishermen (Source: Field visits of the author, concept adapted from FIMSUL report)



Comparison of climate perceptions (majority) of senior fishermen with the recent scientific findings

Climate variables	Climate perceptions of fishermen	Recent scientific findings	Conformity
Sea-level rise	Fishermen possess limited knowledge.	Five coastal districts of Tamil Nadu, including Nagapattinam district, are highly vulnerable to sea-level rise (Byravan, Chellarajan, & Rangarajan, 2010).	Unknown
Shore erosion	Heavy for over the past three decades.	Shore erosion has widely been observed across the coastal Tamil Nadu. Apart from climate change, various other factors such as rapid urbanisation, industrialisation play important roles for erosion (Natesan, Parthasarathy, Vishnunath, Kumar, & Ferrer, 2015; Bhalla, Ram, & Srinivas, 2008).	Agreement
Temperature	Increasing trend.	Temperature data for the period 1901 - 2005, indicates that Tamil Nadu has experienced more dry days than wet days every year (Guhathakurta, Shreejith, & Menon, 2011).	Agreement
Rainfall	Decreasing trend and increasingly uncertain.	Rainfall projections with the baseline period of 1970 to 2000 show the decreasing trend (CCC&AR & TNSCCC, 2015).	Partial agreement
Climate events	Increasing trend.	Increasing trends of cyclonic disturbances in the Bay of Bengal had been observed during the winter (October – February) and pre-monsoon months (March to May). (TNSAPCC, 2013).	Partial agreement

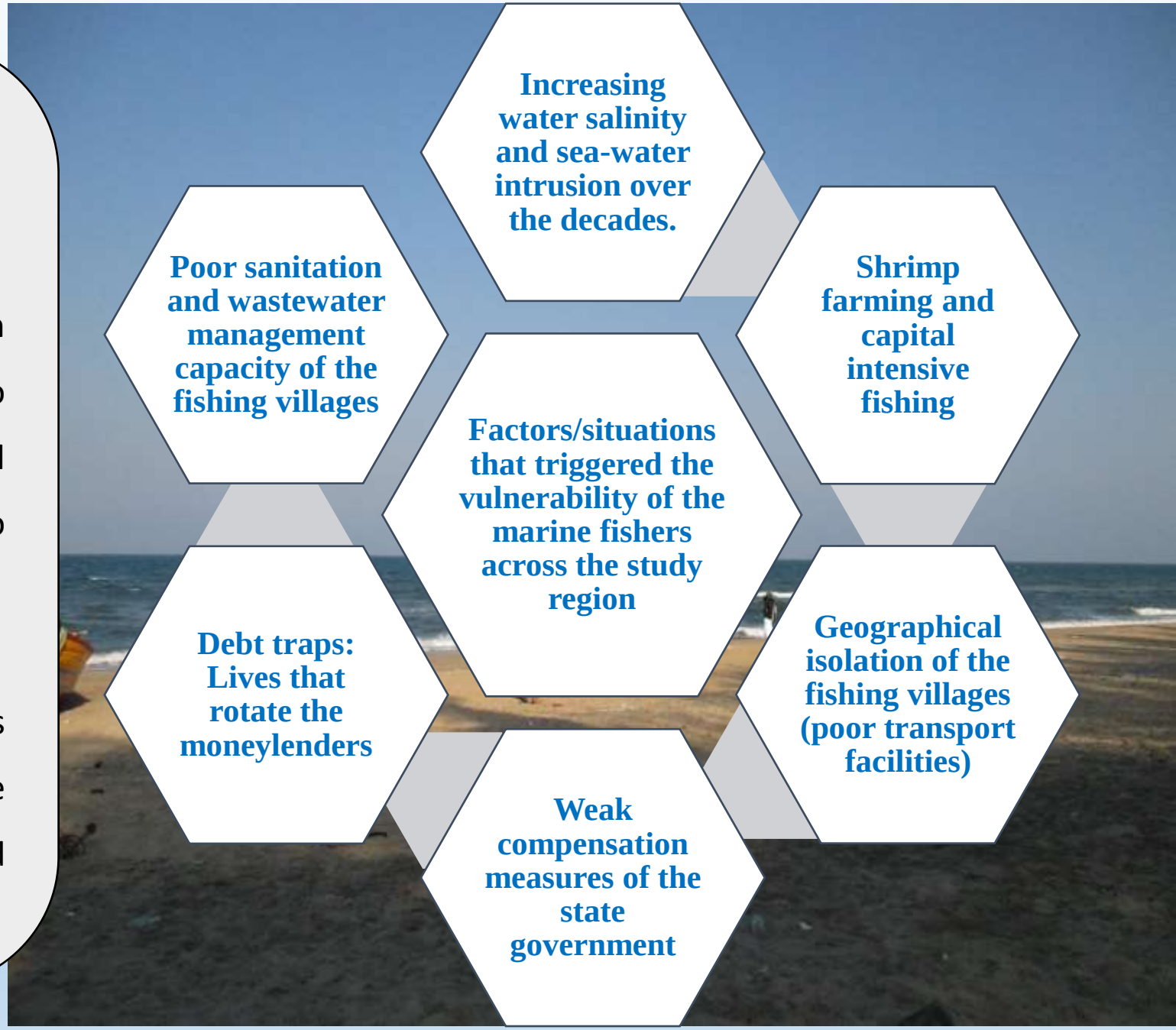
Indigenous knowledge in the face of climate change: analysis of fishermen's perceptions

- Small-scale fishermen increasingly disregard their traditional knowledge due to its perceived inadequacy in addressing unpredictable climate change.
- Instead, most fishermen, regardless of age or literacy, seek assistance from external sources like government bodies and donor agencies to forecast environmental changes and fish movements.
- *'We have been exposed to various climate stresses for over the last 30 years, and the frequencies are rising. Nowadays, we can't entirely depend on our local ecological knowledge to predict environmental precursors, fish distribution, and abundance as we have often realised and experienced that our traditional wisdom is no longer precise and sufficient to understand the coastal systems'.* (Secretary of the fishermen co-operative society of Kodiyampalayam. Date: 25 April 2017).
- However, this study does not de-emphasize the potentials of indigenous knowledge of marine fishermen.
- There is a strong need of providing regular, accurate weather updates to the small-scale fishermen and fish workers and recommended the need of setting up the regional level centers.

Vulnerability and adaptation of marine fishers to climate change

To identify the vulnerability and adaptation actions of marine fishers to respond to climate change and to discuss barriers and limitations of marine fishers in adapting to climate change.

Impoverished and marginalized communities are more prone and vulnerable to the impacts of climate extremes and environmental hazards



- Weak and improper compensation measures of the state government

  “It is a common story. If any storm, flood or heavy rainfall occurs, elected representatives and bureaucrats would visit our villages to evaluate the damage of assets. But as far as I am aware, we never have received timely and fair ‘compensation’ from the state administration. It was exactly the same story for the Thane cyclone. The sole exception was the tsunami disaster. [Recovery] went very well because a lot of NGOs came and provided rehabilitation measure”. (A senior fisherman of Chinnamedu. 25 March 2016).

- During climate extremes, fishers (irrespective of their socioeconomic differences) has chosen to risk their lives to protect their homes and fishing assets.

- Remittances of the family members – the visible and reliable solace to the fishermen

  “My fishing gear was destroyed due to continuous massive rains. If I had visited the coast during heavy rains, I could have saved the gear. But that was extremely risky as both rain and seawater level had increased. I did not take that risk, and I left my gear on the coast. I knew it was going to be hard to get any compensation from the state administration. But the remittances sent by my son from abroad helped me make that decision. (8 April 2016, Chinnamedu village; translated from Tamil)”

- Climate vulnerability of purse-seine fishers?

A few coping and adaptation strategies of the fishers - field insights

Changing the fishing gear

Deep-sea fishing

Diversifying fishery livelihoods (only in a few cases)

Debts and money exchange (through social networks)

Financial assistance (formal credit)

Welfare measures of the state government

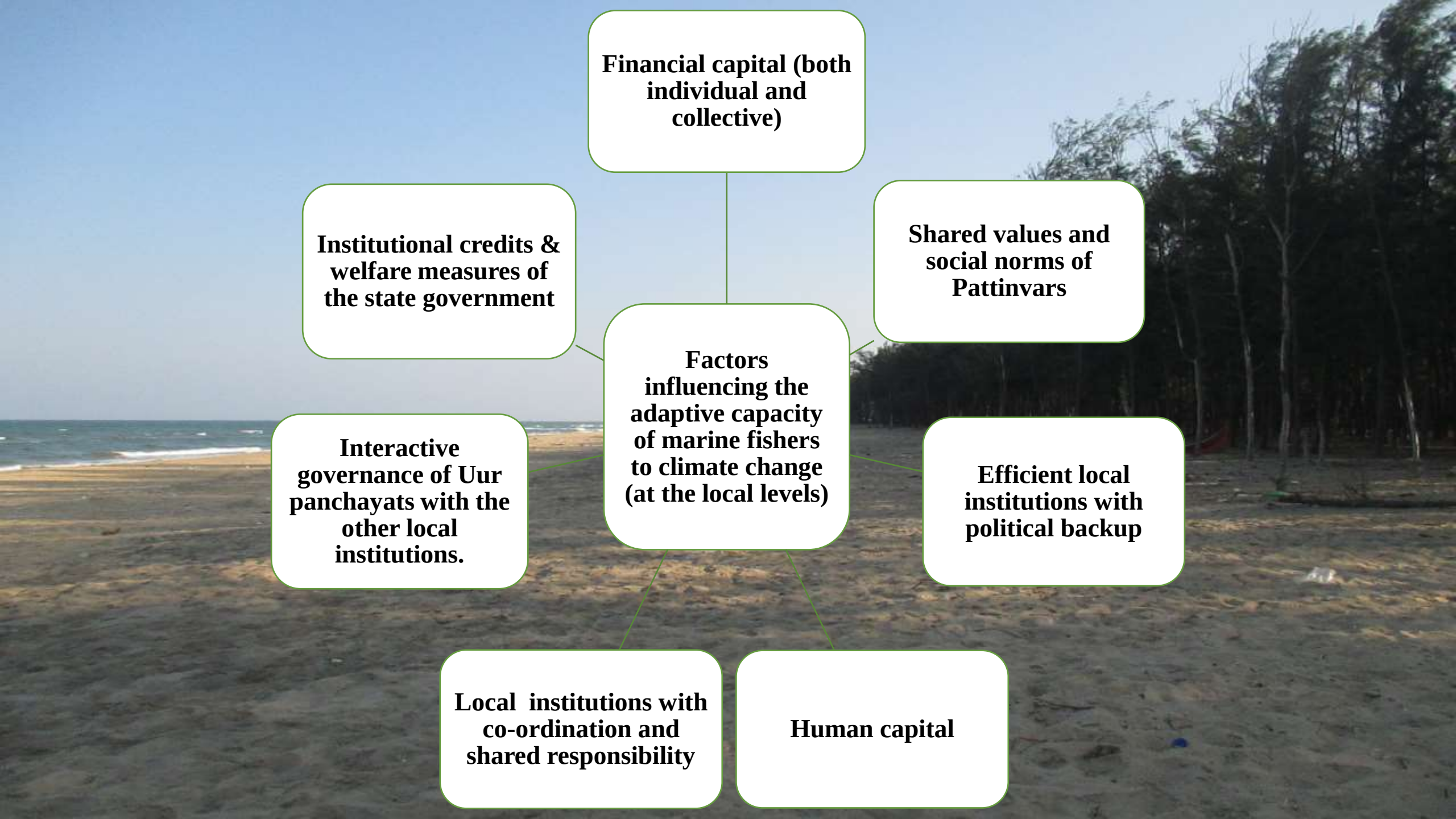
Support of the external agencies.

Vulnerability of one of the fishing hamlet (Chinnamedu) to extreme climate conditions

Insecure Lives Under Extreme Climate Conditions: Insights from a Fishing Hamlet in Tamil Nadu, India

by Devendraraj Madhanagopal, on 17 April 2018

Tags: fishing | climate change | social change | precarity | insecurity | poverty | vulnerability | safety | India | Tamil Nadu


Financial capital (both individual and collective)
Institutional credits & welfare measures of the state government
Shared values and social norms of Pattinvars
Factors influencing the adaptive capacity of marine fishers to climate change (at the local levels)
Interactive governance of Uur panchayats with the other local institutions.
Efficient local institutions with political backup
Local institutions with co-ordination and shared responsibility
Human capital

Shrinking coastal spaces and raising vulnerability of marine fishers

Increasing threats of coastal erosion over the years.

Weak capacity and lack of proper planning intensifies the vulnerability of fishers.

Inadequate economic and political capital – small-scale fishing villages (for ex: Chinnamedu & Chavadikuppam).

Disaster risk reduction capacity of the fishers across the study area was weak as their local institutions have had not strategized in responding to disasters and climate risks.

Fishermen out-migration – climate change coping/adaptation?

Difficult to think of any long-term adaptation interventions in responding to climate risks and change. The possible option is “migration.” “Migration” through their social networks.

Migration of fishermen have promoted their social resilience and well-being of their fishing households.

Fisherwomen across the study region have supported the “idea” of migration of fishermen of their family.

Livelihood diversification activities? Poverty motivates the fisherwomen?


Communication/Technological Barriers (Lack of decentralized and localized technological and information assistance to marine fishers
Cultural and Social Barriers: rigid social norms of Pattinavar fishers, weak representation to the fisherwomen in all domains (Gomathy, 2006; Thamizoli & Prabhakar 2009; Bavinck, 2016).
Barriers and limitations to coping and adaptation efforts of marine fishers in responding to climate change
Information Barriers (Improper disaster education, lack of regular evacuation and rescue trainings to the fishers in responding to disasters and climate risks)
The apathy of the state government towards marine fishers (Weak compensation measures, improper understanding of marine fishers' life and culture).

Scope and limits of the local institutions in coping and adaptation to climate change

Local institutions along Tamil Nadu's Coromandel Coast: underexamined, undervalued, or overvalued?

i. What roles and contributions do informal local institutions of marine fishers play in sustaining community-based climate adaptation efforts?

ii. How and to what extent do the capitals/assets of marine fishers influence their vulnerability to climate change?

iii. What are the limitations of local institutions in adapting to climate change at the local level?

Key actors of the coastal fishing communities across the study villages

Uur panchayats

Local-self government

Political parties

Fishermen co-operative society

Fisherwomen co-operative society

Women self-help groups

Non-governmental groups

Other groups (all informal and unorganized groups – not to say institutions)

Power equations among the local institutions – who "wins" and "who" losses? – discussions from the fieldwork.

- Pattinavar uur panchayats – the influential local institutions across the study region.

  "Pattinavars historical engagement with fishing, the environment that they live in, the deep-rooted shared values and indigenous symbols have naturally formed the traditional institutions to govern and regulate the coastal commons. Pattinavars' traditional institutions are well known for its strong internal cohesion, self-organisation, self-autonomy and the egalitarian nature" (Gomathy 2006; 2011).

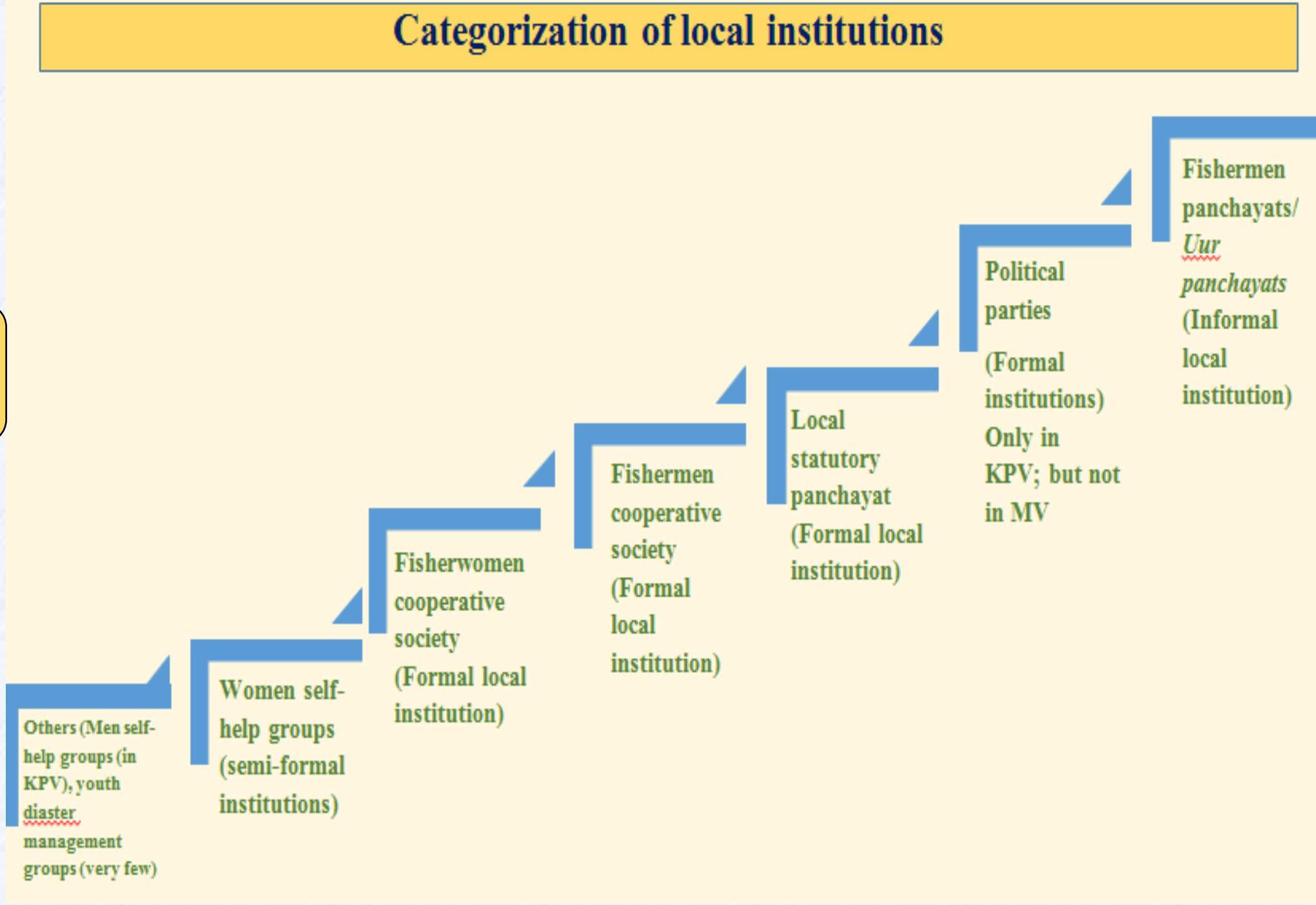
  Two legal systems and the sources of the income of uur panchayats.

  Structure and governance nature of Uur panchayats at the hamlet levels

  Key activities and influence of uur panchayats over the marine fishers

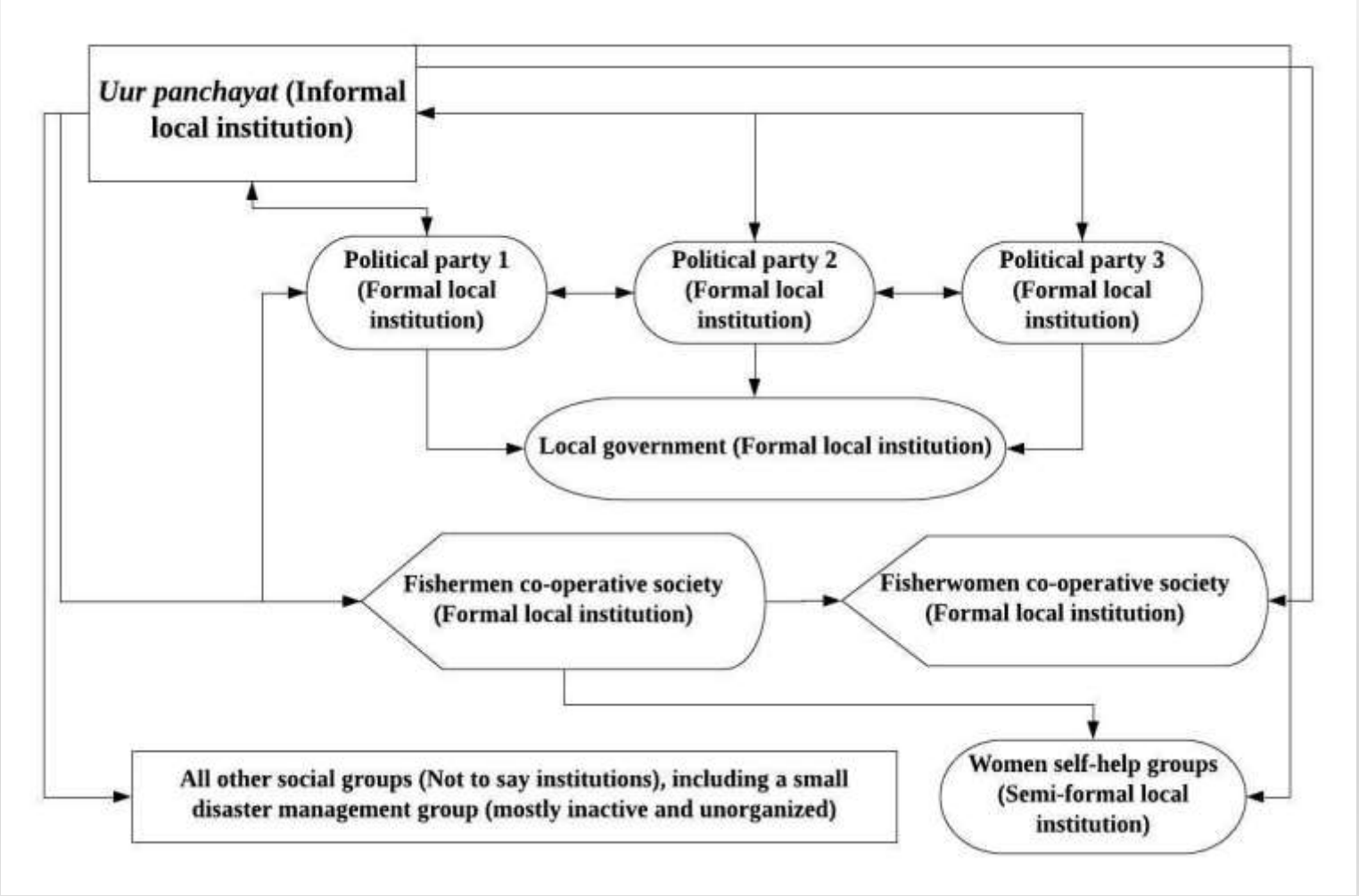
- Local-self government – its historical background – key activities and its social networks.
- Political parties – Active and influential but visible only during the elections.
- Fishermen co-operative society - key activities and its social networks.
- Fisherwomen co-operative society – a defunct local institution.
- Women self-help groups – the active women based local institution.
- NGOs – Active but were not rooted at the local levels. Mostly involved in developmental activities.
- Other groups.

Categorization of the local institutions based on its influence

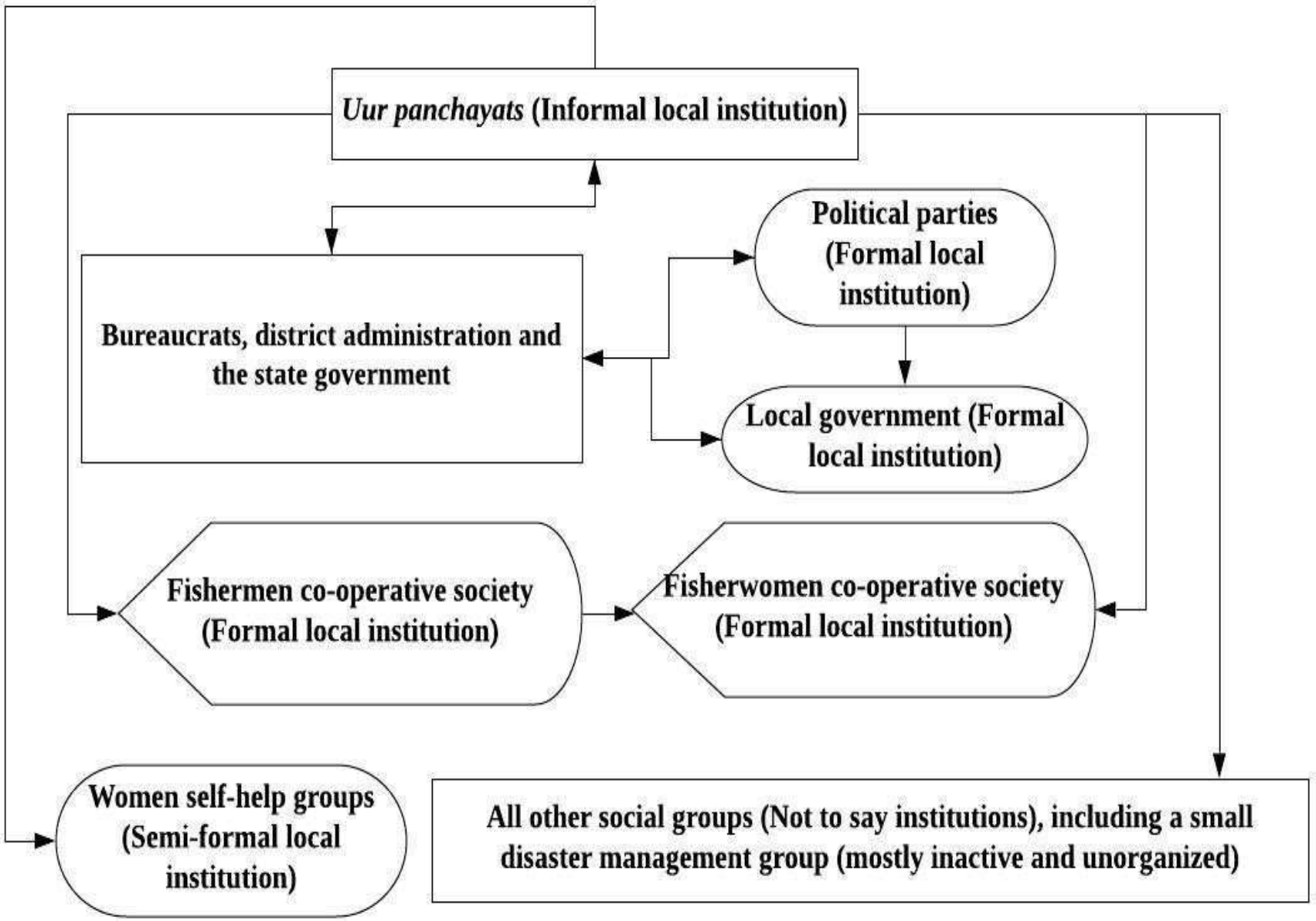


Focusing the local governance systems of two fishing villages – Kodiyampamalayam and Madavamedu

Interactions and the patterns of influence among the local institutions in the study village, Kodiyampalayam.



Interactions and the patterns of influence among the local institutions in the study village, Madavamedu.



- Governance systems of the local institutions: Scope and complications in climate change adaptation actions.
- The influence of “capitals” and the scope of local institutions in localized adaptation actions to climate change and extremes.
- “Participation” and “Non-participation of the key actors of the local institutions in the fishing villages.
- Resource sharing, less competition, substantial economic and political capital – The key factors that influence the internal governance systems of the local institutions in adapting to climate change.
- Leadership, beliefs, political networks, and shared values of the leaders of the uur panchayats.
- Power-relations within and among the fishing villages.
- “Inclusion”, “Exclusion” and “Lobbying” of the key actors of the local institutions – its impacts on the overall adaptation interventions of the fishing villages. Dominant influence of uur panchayats on climate change adaptation efforts – mainly – on coastal defense. But what about the local institutions and its key actors?

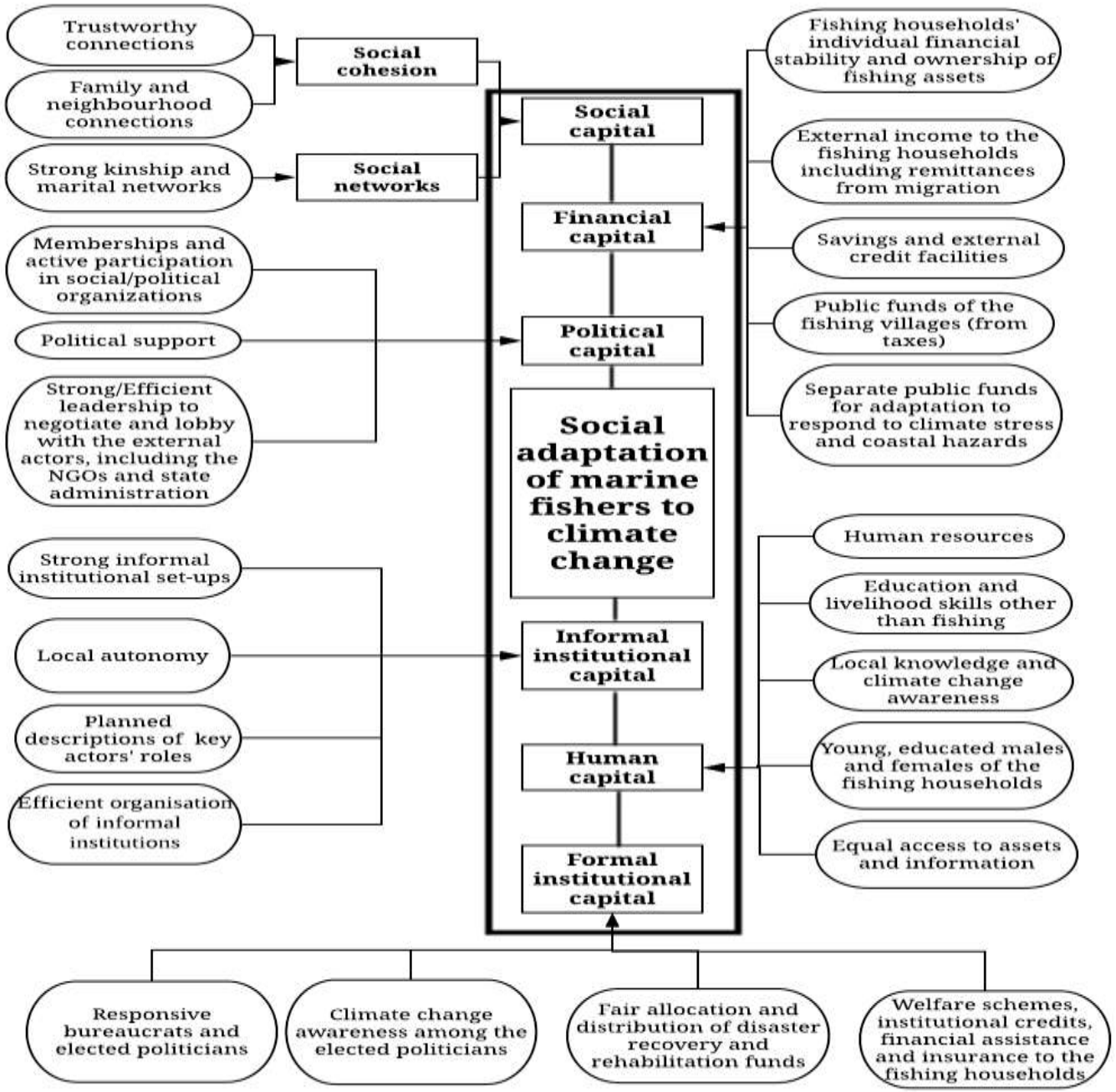
Are local institutions responding to coastal erosion? Field narratives

In somewhere around 2006, we, the villagers, made initiatives to construct the coastal dunes on the coast of our village. But, it regularly gets eroded during the rough seasons. Therefore, we have no option other than to maintain again and again. In general, we utilize the MGNREGA program to maintain the dunes. In such case, the government pays the required salary to us. There were also a few instances that we could not garner the support of the government to maintain the dunes. In such situations, we have to utilize our village public funds to provide the salary to the fishers. The dunes are highly beneficial to us. It saved this village during the 2011 Thane cyclone and the recent cyclone in 2015 heavy rainfall events.

(Uur panchayat leader: Madavamedu, May 2017)

"Every year the shoreline changes happen for about 15 m, and after the tsunami disaster, the changes in the shoreline have become high. During the rough seasons, it is common that our vessels and gears get damaged. Though seawalls have problems, the threats can be avoided by creating a separate pathway in the nearby river to board our boats".

Coastal dunes in Madavamedu: An example of community-based adapatation to climate change. April 2016. Source: Fieldwork



Conceptualising the social adaptation of small-scale marine fishers to climate change

Limits of the local institutions in climate adaptation

Lessons from the field

- Weak financial capital
- Confusions about the 'roles' of the key actors among the local level institutions
- Complete dependence of the government and other external support
- Expectations of 'credits' rather than support to build the community resilience
- Social and cultural barriers
- Apathy of the state government and bureaucracy
- Unstructured local governance systems - disasters
- Lack of shrewd local leadership
- Lack of awareness - disaster management and climate change planning.

Fisherwomen and their agencies: Scope and challenges in adapting to climate change

- *Gender does not just simply describe of what the aspect of a person is, it is fundamentally what one does and what does recurrently in interaction with others* (West and Zimmerman 1987)

In Tamil Nadu, there's been no thorough study of how gender dynamics intersect with power within local fishers' institutions in climate adaptation.

Focusing on gender, along with power, caste, and class (Novak Colwell, 2016) in Pattinavar fishing villages, can offer valuable insights into gender implications in climate adaptation efforts.

The patriarchal rules of the Pattinavar community strictly bar women from accessing cultural and political assets.

“Gender” in marine fisheries of Tamil Nadu – a brief background with the focus of disasters

Notable accounts of work were done to understand the gender systems and gender divisions of labor among the fishing communities in coastal Tamil Nadu, especially on Mukkuvar women of southern Tamil Nadu and Kerala (Ram, 1992; Busby, 1995; Hapke, 1996; Sundar, 2010).

Significant works have examined the 2004 Indian Ocean Tsunami disaster through the “gender” lens, with a particular focus on Tamil Nadu (MacDonald, 2005; Pincha, 2008; Juran, 2012).

Fishing and allied activities/Category	Women	Men
Fish capturing	×	✓
Boat buying, maintenance and repair	×	✓
Fish drying, curing and vending	✓	×
Fish transport	×	✓
Fish auctioning	✓	✓
Fish marketing	✓	✓
Ice production, supply and preserving the fish	✓	✓
Supply of nets/gears and net weaving	×	✓
Nature of the work	Less risky	Risky – It depends on the nature of fishing vessels, gears, distance and access to information
Time of the fishing activities	Mostly day time	Both day and night

Gendered divisions of small-scale fisheries – focusing the Pattinavar fishing community (from Kruks-Wisner, 2011; Novak Colwell, 2016; Koralagama, Gupta & Pouw, 2017; Fieldwork of the author)

“Gendered” institutions – Post-tsunami and aftermath

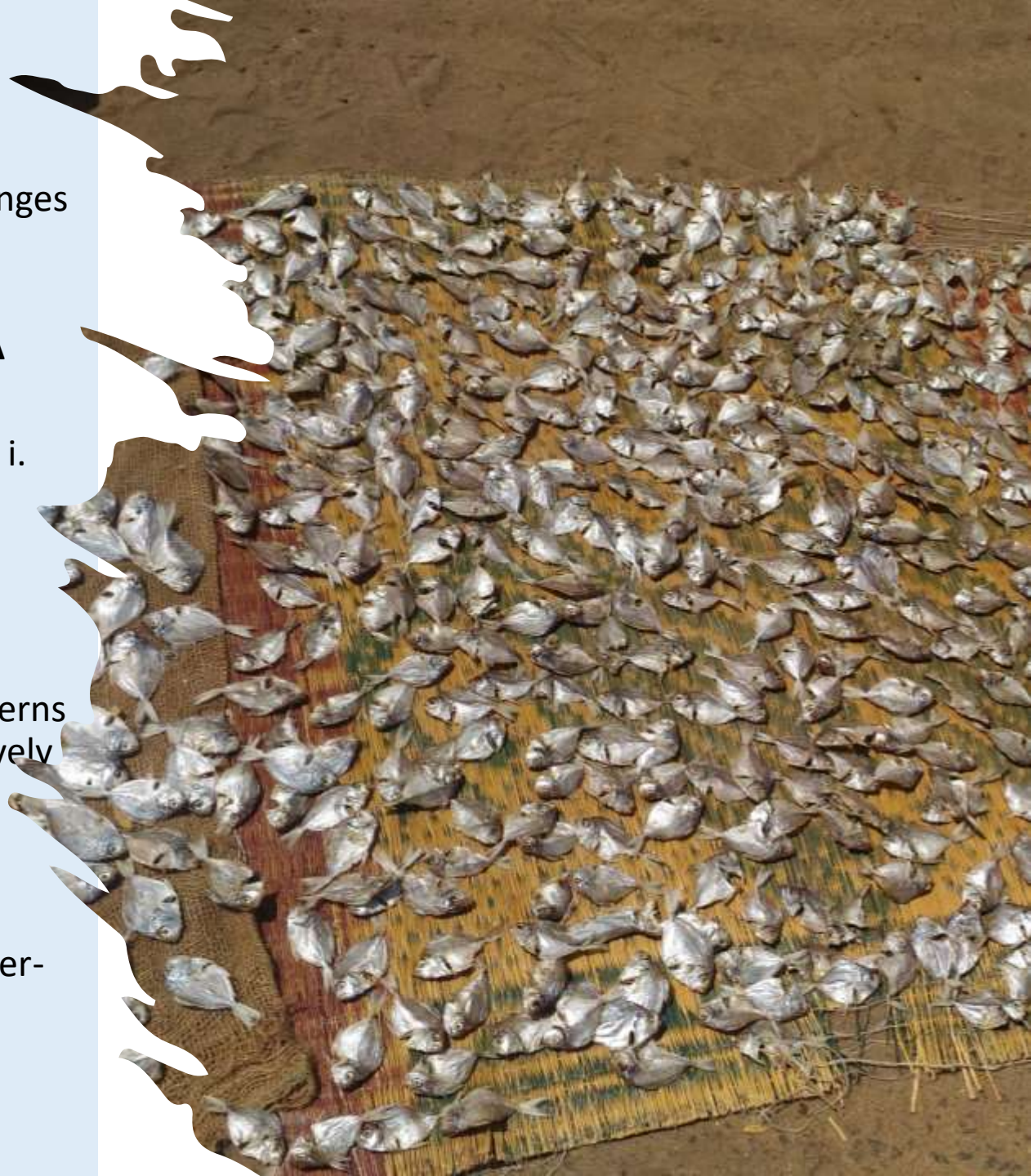
- Post-tsunami and aftermath, the inflow of external actors and external institutions to the coastal villages made long-term changes in the socio-economic lives of marine fishers of Tamil Nadu and Puducherry.

Status of women in the formal and informal local institutions – A historical overview

- Representations to the women in the local institutions of India: i. Panchayats in single-caste villages. ii. Panchayats in multi-caste villages (Ananthpur 2007).
- Are customary village councils of India undermining local democracy?
- How do the influential local institutions deal the “gender” concerns and how it intersects with the local institutions that are exclusively meant for women, and what are the implications of “gender” concerns in coping and adaptation actions to climate change?

Field reflections on “gender” concerns

- Policies and practices within the fisheries sector are often gender-blind and gender biased.
- Gender concerns of the local institutions (particularly, uur panchayats)?



Exclusion of women and its implications on adaptation actions to climate change in the fishing villages – raising "gender" concerns

- Uur panchayats categorically discourage the special interest groups to stay away from volunteering or initiatives in the fishing hamlets even if it is meant for the right cause and apolitical.
- The incidences of volunteering to facilitate the meetings between the local leaders of women self-help groups and the district administration by the outside agencies (NGOs) are highly rare.

Some local voices…..

*"Our uur panchayat leaders are mostly non-cooperative when it comes to supporting the women to initiate any new things/projects in the village. It is the common and collective mentality of our men. It does not matter who elects as the leader of the uur panchayat. In general, men of this village are not cooperative to us, especially to support the women to lead any good cause" (*An ex-active member of women self-help groups in Kodiyampalayam

"It's our tradition that women should perform their roles in the households and we have to practice this customs for generations. What is the need to separately include women in urr panchayat as they are enough to take care of all the fishing and local activities? Women are not oppressed here. They are entirely free to do all the tasks in the fishing villages. Many of us (fishing households) provide good education to all our girl children in English-medium schools. We have not felt yet the necessity to include the women's participation in our panchayats" (Fishermen council leader of Madavamedu).

Women self-help groups in Tamil Nadu – historical overview

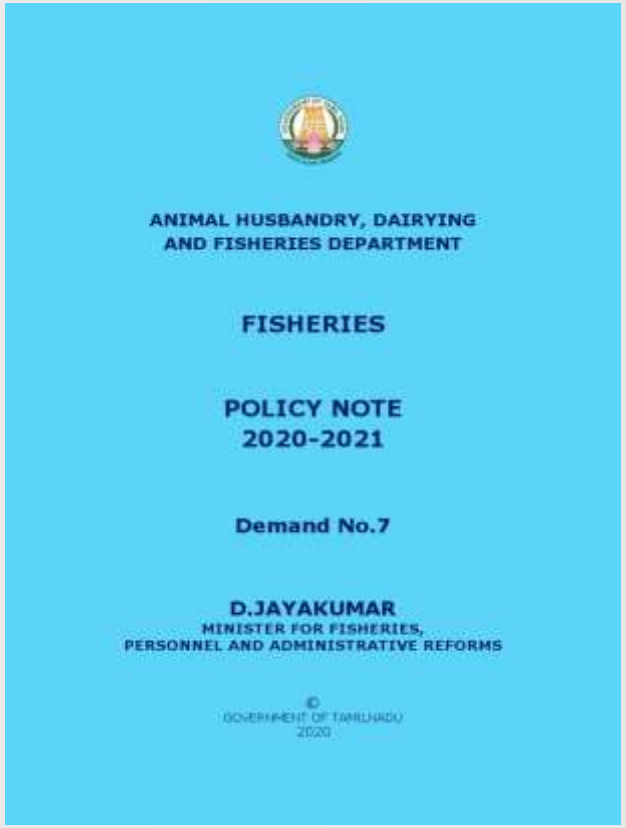
- Women self-help groups and microfinance: prospects and a few questions
- Credit networks of women self-help groups across the research region
- Women self-help groups and its encounter with the Uur panchayats

Implications of women self-help groups in adaptation to climate change?

- The significance and potentials of engaging women self-help groups and fishermen co-operative society for achieving climate adaptation at the household and the community levels.
- The changing trends in the governance systems of the local institutions – some positive reflections
- The fishing villages which are financially stronghold strict social relations, and the local institutions of the fishing villages are insensitive to gender concerns.
- Fishing villages which are economically weak acknowledge the inherent income certainty and they are liberal and receptive in welcoming the external agencies and stay away from imposing restrictions.

Some recommendations and policy measures

- The recent fisheries policy note (Government of Tamil Nadu, 2018) have provided least attention to the tasks, operations, visions and financial resources of fisherwomen cooperatives. It needs to be regularly updated in line with the growing literature, and there is a strong ground need to delineate and distinguish the tasks and visions of fisherwomen cooperative societies.
- Secondly, there is a pressing need to form a separate district and Taluk level committees to monitor and assess the performance of fisherwomen cooperative societies.
- Thirdly, the fisherwomen cooperative societies should have separate offices at the hamlet levels, and district administration needs to regularly oversee the meetings and discussions.
- Fourthly, and most importantly, the fisheries department need to update the data and to ensure constant material and non-material support to the fisherwomen cooperative societies through the proper channels, in creating the climate and disaster resilient fishing community.



Final insights and the way forward…

- Marine fishers across the study area (including the entire Tamil Nadu coast) strongly perceive the impacts of climate change, especially since the 2004 tsunami disaster.
- Marine fishers have had various coping and ‘adjustment’ measures to confront vulnerability to climate change.
- Fishers’ institutions regularly take various actions and decisions to confront their livelihoods stressors. Though many such activities are not directly meant to respond to climate change to impacts, it indirectly supports the adaptive capacity of the marine fishers.
- Shared values, social bonding, and local leadership of the marine fishers play influential roles in adaptation to climate change.
- Local leaders of the fisheries institutions play vital roles in increasing the social resilience of the fishers to respond to multiple stressors, including climate change. However, informal local institutional governance systems of the coastal fishers do not have cohesive planned strategies to respond to climate change.

- Significant barriers and limitations have had increased the vulnerability and reduced the adaptive capacity of the marine fishers across the study region.
- Cultural and social barriers, financial barriers, information barriers, and institutional barriers delimit the climate adaptation efforts of the coastal fishers.
- Socioeconomic factors and political power tacitly decide the strengths and vulnerability of the marine fishers in adapting to climate change at the local levels.
- Inadequate financial resources, insufficient knowledge diffusion, and weak participation of the marginal fisherwomen have plagued the capacity of the local institutions in responding to climate change.
- There is a pressing need to form a separate district and Taluk level committees to monitor and assess the performance of fisherwomen cooperative societies.
- The state government needs to acknowledge the potentials of women self-help groups and fisherwomen co-operative societies in engaging with the ongoing disaster risk reduction and climate change adaptation activities.

- In south India, the scholarships that categorize and critically discuss the local institutions of marine fishing communities and its potential relevance in the broader debates of climate change and adaptation are highly limited.
- No research has investigated ‘how’ the local level institutions of Pattinavar fishing villages can contribute to reducing the vulnerability of the marine fishing community to climate change, and at ‘what’ extent it can contribute the coping and adaptation efforts to respond to climate change impacts.
- This study fills the existing research gaps by taking the case of coastal Tamil Nadu and provides scope to the future researches that intend to discuss the “social” and “political” capitals of the local institutions and its relevance in adaptation to climate change.
- It tries to integrate the knowledge that comes from different domains: “academic,” “practical,” “local” and “international.”
- The methods and the conceptual approach to examine the local institutions vis-à-vis climate change (that centers on coastal areas of South India) is something that has not been addressed in the previous literature.
- The conceptual contributions of this research lie on introducing the modified framework (from Sustainable livelihoods framework and AIL framework) to investigate the vulnerability, adaptation and local institutions of marine fishing communities of traditional small-scale fishing communities to the impacts of climate change.

Way forward….

- Recent literature highlights climate hazard crises in Asia (Krüger et al., 2015; Sternberg, 2017; Ahmed et al., 2020).
- Many studies focus on macro-level disasters and policy aspects, leaving significant gaps in understanding regional and local impacts, vulnerabilities, and adaptation actions of resource-dependent communities.
- Coastal India especially lacks attention in addressing various climate change aspects at regional and local levels.
- Scholarly focus now extends to foreign policies, conflicts, and cooperation regarding disasters and climate change.
- Ilan Kelman explores disaster diplomacy and its implications for nations (Kelman, 2003, 2006b, 2011b, 2016).
- How do climate change and coastal disasters affect tensions and collaborations among Tamil Nadu's coastal regions and other states in India?
- Unanswered questions persist regarding conflicts and cooperation due to climate change and disasters in Tamil Nadu and other Indian coastal states.
- Disaster risk reduction and climate change adaptation (CCA) show similarities and differences (Thomalla et al., 2006; Schipper & Pelling, 2006; Tearfund, 2008; Mercer, 2010; Kelman et al., 2015).
- Gaillard (2010) advocates for addressing vulnerability, capability, and resilience through an integrated approach.
- Examining fishing communities' risks and adaptive capacities is crucial.
- Identifying potential "winners" of climate change and learning from each other's experiences can aid in better adaptation strategies globally.

Way forward…

- Indian government agencies, the union government, and international organizations are actively engaged in district-level climate adaptation and disaster risk reduction efforts.
- There's a growing integration between climate change adaptation (CCA) and disaster risk management (DRM), emphasizing the need for strong political will to mainstream adaptive climate planning within broader development frameworks.
- Policies and strategies for climate change adaptation must address issues of gender, inequality, development, and sustainability to be effective (Kelman et al., 2015).
- In coastal Tamil Nadu, disaster management institutions are well-established, with the Tamil Nadu State Climate Change Cell (TNSCCC) working on various climate change initiatives since 2014.
- However, recent climate action plans in Tamil Nadu have been criticized for lack of clarity on intended outcomes and insufficient consideration of social and political dimensions, particularly in coastal regions.
- Similarly, climate action plans in Odisha and Kerala have been criticized for neglecting the engagement of marginalized and vulnerable populations in climate change adaptation actions (Madhanagopal & Jacob, 2022).
- The discussions and assertions made in this research regarding CCA will pave the way for additional studies to determine how political parties are involved and how they influence domestic and international organizations in obtaining material and non-material support to make maritime fishing villages more robust to disasters and climate change.

THANK YOU……