



Political ecology and social representations on mangrove conservation, rehabilitation and restoration in Catanduanes Island, Philippines

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Abstract. Mangrove forest conservation, rehabilitation and restoration (or 'mangrovization' as used in this paper) is practiced throughout the island province of Catanduanes in Luzon, Philippines to halt deforestation and degradation of coastal ecosystem and biodiversity. This study critically assesses mangrovization practices within the discourses on mangrove destruction and rehabilitation practices in this island using the lens of political ecology and Moscovici's theory of social representations emphasizing institutional arrangements and the community dynamics. Analysis was based on interviews with 61 respondents from four municipalities of Virac, San Andres, Caramoran and Baras having intact mangroves covered in the Commission on Higher Education (CHED) – National Agriculture and Fisheries Extension System (NAFES) funded program SURMABIOCON of the Catanduanes State University (CSU). A huge majority of the population in the island live along the low elevation coastal zone and are experiencing and exposed to the effects of climate change and disasters as shown in typhoon occurrence, windiness, landslide, and tidal surges. The coasts of Catanduanes are predominantly shaped coastal changes, mangrove flora and beach forest vegetation which together provide protection against coastal erosion and trap sediments resulting in coastal accretion. Results of the study shows how formal and informal institutions created by both distinct stakeholder relations can lead to some success in mangrovization. There appears to be overlapping situations and inconsistencies in the implementation of science-based and community-based mangrovization programs in support of the overall coastal resource management (CRM) as outlined in local governance. Then need for state universities to be involved in mangrovization programs/projects/activities which center on decision-making power regarding science-based and community-based initiatives on how, where, and when mangrovization should be carried out, specifically on the location of replanting or restoring mangroves in the island. The strong LGU-community-academe institutional arrangement in the island provides better contribution to the success of mangrovization. Contemporary narratives from two progressive mangrovization projects having collaboration, cooperation, and monitoring schemes with the state university is central to the notion that these projects could lead to successes. The study demonstrates how weak stakeholders can become stronger in the implementation of mangrovization initiatives that begins with capacity building and strengthening academe-mangrove association partnerships thus leading to effective coastal governance, particularly on mangrove biodiversity conservation and mangrove rehabilitation and restoration in this island of Catanduanes.

Key Words: mangroves, mangal, coastal resources, biodiversity, beach forest, Catanduanes.

Introduction. Higher institutions of learning (HILs) in the Philippines have great roles to play in terms of developing and finding solutions on the technological and institutional innovations required to manage and improve the utilization of these ecosystems for food and environmental security in the island province, frequented by storms and tropical

cyclones. These institutions have to contribute immensely in increasing awareness among the local communities and the rest of the rural population as to the wider role of water in supporting aquatic agricultural production for food and incorporating fully into water management decisions for diversifying livelihoods. More importantly is the role of rivers, estuaries and wetlands (REWs) in the country for sustained fish production to feed the growing population in support of the United Nations Sustainable Development Goals (SDG) Nos. 1 and 4. Worthy to note in this island province is rapid destruction of mangroves due to excessive cutting and conversion to aquaculture and extracting aquatic and fisheries resources. The advent of climate change phenomenon exacerbated these declining trends in some aquatic products from the mangrove areas such as mangrove crabs (*Scylla*, *Thalamita* and *Charybdis*); and shrimps such as prawns, *Penaeus* and *Metapenaeus*.

Mangroves exist on every continent except Antarctica (Koh & Teh 2021). Asia encompasses the largest land area of mangroves and the Philippines (Camacho et al 2020) has been the focus of many decades of published research on mangrove forests. According to Romañacha et al (2018) that although the status of mangrove forests varies by country and region, many mangrove forests experience similar threats to their persistence from urban development and timber harvest to conversion for other land uses such as agriculture and aquaculture.

Asia has the largest land area of mangrove forest, encompassing 42% of the world's mangroves (Long et al 2014). Within Asia, Indonesia and Malaysia have the largest mangrove areas. Malaysia has about 575,000 ha of mangrove forest, reduced from 695,000 in the 1970s; that is, reduced by 17%, due to land conversion/reclamation for agriculture, aquaculture, urbanization, infrastructure development and natural causes mainly from coastal erosion (Romañacha et al 2018).

According to Ounvichit & Yoddumnern-Attig (2018) local mangrove communities could be presumed to have the strongest incentives to protect the quality of their environment for their own quality of life. Gaining food, herbs, fuels, fodder, and base materials for their living, health, and shelters from the mangroves, the communities are likely to manage their mangroves in a holistic way, balancing the social, economic, and environmental ramifications without trading off any of it for their sustainable living. They have been viewed as environmental stewards, not destroyers (Peluso 1992). There is evidence that they can manage mangroves without government oversight (Smith & Berkes 1993) and that their practices could enrich mangroves over time (Fairhead & Leach 1996).

This paper presents the analysis on the political ecology of mangrove conservation, rehabilitation and restoration, henceforth termed as “mangrovization” of Catanduanes Island in Luzon, Philippines and social representations of people in the mangrove-dwelling communities looking into institutional arrangements and the community dynamics. Threats on mangrove resource degradation and the island state university’s (Catanduanes State University or CSU) responses in tackling these issues and concerns by transforming the island province into a heaven of mangroves conserved, protected and viable mangrove eco-tourism ventures are highlighted here. Finally, collaboration with the country’s LGUs and peoples organizations maximizing community-participation guided several research and development (R & D) programs of CatSU, such as the fish hatchery (Masagca 2016), the Integrated Research Training Program (IRTP), SURMABIOCON as model for citizen science (Masagca et al 2018) and CSU Strategic Innovation Model for mangroves conservation and rehabilitation (Masagca et al 2020).

Political ecology. The relationships between political, economic and social factors with environmental issues and changes in inland and estuarine waters or REWs of an island province are presented. This attempts at integrating ecological social sciences (Peet & Watts 1993, 1996) in the themes of degradation of freshwater systems within the view of dwindling stocks in rivers and estuaries, marginalization of local communities, environmental conflicts, conservation, restrictive policies and social movements (Robbins 2004). The act of resolving conflicts over the water resources is the greatest challenge facing national and local government units (LGUs) in the Philippines particularly in areas

when resources continue to be depleted. Inland fisheries resources at the same time, protecting access to traditional lands and resources upon which outcomes on cultural, heritage, economic and more recently on the “social wellbeing” (see McGregor (2007) and Britton & Coulthard (2013)) are to be observed in fishing communities of Catanduanes island.

In dealing with natural resource utilization and conservation of resources in REWs respect to political ecology, this paper tackles the divergence of ideas, issues, and troubles, especially when looking at conservation through biodiversity and the creation of conservation units. Sutton & Anderson (2004) defines political ecology as “the study of the day-to-day conflicts, alliances, and negotiations that ultimately result in some sort of definitive behavior; how politics affects or structures resource use”. It is a matter of who is involved and what they eventually want the outcome to be, such as the views from the non-governmental organizations (NGOs) or those of the local people and the government of the occupied land. All stakeholders must consider their engagements or involvement in this regard.

Social representations theory. The Social Representation Theory of Serge Moscovici (1961, 1980) is a social psychological framework of concepts and ideas to study psycho-social phenomena in modern societies. This can be properly understood as these are seen to be embedded in historical, cultural and macro-social conditions. A social representation is a collective phenomenon pertaining to a community which is co-constructed by individuals in their daily talk and action. In the present inquiry, we observed talk and actions of various social groups in the study sites community system. A social group (a minimum of 4 persons), which is a set of at least 2 persons which confront at least one other group in the social setting that can be men, women, barangay leaders, children, students, teachers, administrators, other stakeholders of the local communities. Because a group is a subset of a universe of people, the shared understanding of their world and of the objects composing it provides the ground for communication and other forms of co-action. Social objects are constituted by representations, i.e. discourse and concerted action of the members of the group that maintain a homogamic communication (=people prefer to communicate to others of similar opinions and to read newspapers which are likely to confirm one’s own beliefs instead of confronting opposite opinions). This paper attempted to use the lens of political ecology in describing the predominant discourses on mangrove destruction and managing mangrovization within climate change and disaster. Escobar (1996) claims that political ecology includes the analysis of representations as social facts inseparable from what is commonly thought of as “material reality” and also pertains to the view that that language is not a reflection of reality (Stott & Sullivan 2000). To some extent, the process research approach was applied here in order to understand some of the key processes and relationships that different individuals, households and social groups engage in as they seek to achieve different outcomes on cultural, heritage, economics and the social well-being. Mixed approaches of qualitative-quantitative research methodologies with a sub-sample of different individuals, social groups and fisher-folks households (n = 61) from selected mangrove communities covered by the CSU CHED-NAFES SURMABIOCON project together with documentary analyses were used gathering profiles of the community and the use of resources.

Material and Method. The topic of this study was born out of multiple discussions with the faculty members, administrators and researchers of CSU and the local people of mangrove areas in San Andres, Virac, Baras, and Pandan from 2017 to 2018. Conversations during assemblies of the mangrove association in Agojo Point Marine Reserve and Fish Sanctuary in San Andres, Catanduanes, Philippines known as ACOMDO in the 1990s and in 2018 as AMPAI (Agojo Mangrove Planters Association, Inc. (AMPAI)). Initially, the first author (JTM) was primarily interested with climate change in the coastal towns of small islands in the Philippines and how institutional arrangements and citizen science innovation strategic models or schemes are important in carrying out mangrovization activities are done in community-managed mangrove areas and how restoration are planned, organized and monitored in the island province of Catanduanes.

The second, third and fourth authors are interested on the socio-economic dimensions of protecting, conserving and rehabilitating mangroves in the island with their intent to relate to the institutional arrangements between CSU and the mangrove associations covered a series of papers (Masagca et al 2018; Masagca et al 2020).

The research teams composed of the CHED NAFES and CHED IDIG BCPRO grants were divided into groups according to the themes that included aspects on livelihoods, biodiversity conservation, crab production, biophysical conditions, climate change, resiliency of local people, mangrove conservation and rehabilitation policies and other aspects of fisheries resource management in mangrove areas. During fieldwork, the research team members similar with Derman & Ferguson (2000) found themselves in agreement with the conclusion of Vayda & Walters (1999) that solid empirical work is required to assess complex intersections between power, politics and environmental change. These authors further suggested that one should begin by observing environmental changes and then move from there to seek causes, rather than assuming that the most important causal factors are political. However, the research team reversed their agreement, by stressing that it would be difficult for them to determine the episodic and variety of environmental changes that occurred prior to the fieldwork. The local peoples' testimonies and their claims during interviews and group discussions about the mangrove ecosystems and associated systems in the sea grass beds and coralline areas would be enough and plausible considering that the initiative of CSU on SURMABIOCON is founded on the tenet of trust. It is therefore valid to agree that the most acceptable causal factor is political in the deteriorating conditions of the mangroves in the island of Catanduanes with the significant reduction of mangrove trees in the study areas, reduction of fish stocks in the neighboring open coastal waters and including the phenomenon of climate change and extreme weather disturbances with the rainfall status.

Semi-structured interviews. Semi-structured interviews were done and some documentary or archival or literature review (mainly on the papers of the first author, JTM) to collect data for the analysis of discourses, social contract and environmental histories. Interviews are often used as alternatives because they allow the informants to explain his/her experiences in more details. They are usually unstructured or semi-structured which means that the interviews are very fluid (Masagca & Masagca 2009; Masagca et al 2009) or dynamic so that the researchers or interviewers are free to move in unanticipated directions.

Documentary, archival and secondary data or literature review. There is a paucity of published or scientific peer reviewed materials except for some papers published in the Kuroshio Science Journal of Kochi University in Japan (Aldea et al 2015; Aldea & Masagca 2016) on the topics pursued in this study. Reports of government agencies, conference papers, symposia reports and annual reports were available for the authors to be included in their analysis. Articles published in the provincial newspaper, *Catanduanes Tribune* were also essential in the documentary analysis to look into the communication patterns for mangrove conservation, rehabilitation and restoration or "mangrovization" in this paper.

Discourse analysis. This analysis has been a commonly accepted world view in geographic inquiries and a pillar in political ecology research. Discourse analysis is pre-occupied with the process through which hegemonic ideas and substantive theories not just the lives of the participants or informants that are being focused as to their experiences in the society either singly or in social groups as contained in the social representations perspectives following Moscovici's Theory of Social Representations. Discourse analysis is a method according to Escobar (1996, 1998) that exemplifies post-structuralism, a movement in which the constitutive role of language is (re)-examined.

The researchers led to understand to believe that the concepts of "biodiversity", "conservation", climate change, mangrove rehabilitation, sustainability and other environmental themes or crisis of natural resource depletion are part of a hegemonic

discourse that carry a lot of “political baggage”, “political interference” and “political representations”. Even the terms “natural resource” or the culture in the communities carry with it the social dimensions that need to be constructed in the minds of the local community. The discourse analysis in this study is basically anchored on the political ecology of mangrove conservation, rehabilitation and restoration or mangrovization and how these relate to institutional arrangements in the conduct of mangrovization programs.

Finally, certain aspects of development histories are tackled here. This is how a marine protected area has been established and how the processes were recognized and the nature of institutional arrangements have been applied in the research sites were considered.

Research sites in Catanduanes (Municipalities of San Andres, Virac, Baras and Pandan). Catanduanes Island lies east of the southeastern leg of Luzon Island and a part of the Late Eocene-Oligocene Northeast Luzon–Polillo–Catanduanes magmatic arc that is associated with subduction in the East Luzon–Philippine Trenches (Carranza 2010). As to gold-copper deposits, this island is not well-explored but it contains some small prospects Cu/Au. Geological formation described here as The Catanduanes Formation forms the stratigraphic basement of the island and is inferred to be Jurassic and consists mostly of strongly folded indurated sandstones (Carranza 2002, 2010). Overlying this formation unconformably is the Yop Formation [*Hinipaan, Bagamanoc*]. It is inferred to be Cretaceous and is composed mainly of spilitic basaltic lavas with intercalations of tuffaceous volcanoclastic rocks (Miranda & Vargas 1967).

Results and Discussion

Socio-economics and aspects on mangrove rehabilitation and conservation

Population and dwelling units of the local people. With the present population of 19,269 people, the town of Bato has 3,712 households, thereby placing the average family size at 5 members. It has a total of 3,667 occupied dwelling units made of both cement and wooden structures but rarely on materials coming from the mangrove areas except for the nipa roofing and walling of bamboo slats. Of this dwelling units, 1,908 or 52.03% used concrete/brick/stone as their outer walls followed by bamboo/sawali/cogon and nipa which composes 29.42%. Asbestos/glass is the least used which accounts for only 7 houses or 0.19%. In Caramoran, the NEDA (2015) census indicates that the population of was 30,056 people, with a density of 110 inhabitants per square km or 280 inhabitants per square mile. The population in Virac, the capital town is expected to be the highest, while San Andres follows the trend. On the dwelling units in San Andres, the nature of houses is basically the same with almost 60% having cemented materials, bricks or hollow blocks and only 25% to 30% with bamboos or cogon (*Imperata* sp.) and nipa (*N. fruticans*) which come from the mangrove areas. Although the number of houses are becoming fewer as to the use of nipa and other mangrove-associated materials, the percentages of the dwelling units having these materials are still high. This means that the pressure on the mangroves being brought by the continued utilization of nipa and other mangrove-associated materials could not be stopped as these are the readily available, cheaper and ease or difficulty in extraction. This could be the reason that even the beach forest species which contain mangrove-associated vascular flora are threatened as observed by Primavera & Esteban (2008) and Primavera & Sadaba (2012).

Age, gender, occupation and income. As to age, the majority of the respondents interviewed are between 20 to 29 years old (Table 1). Majority of the respondents chosen following both hazard sampling (by walking around the barrio and talk to anybody who are around during fieldwork) are mostly female. This is consistent in all study sites wherein females or the wives are left behind in their dwellings while the husbands and male and their sons are engaged in migrant work in different types from construction, food processing, abaca stripping, carpentry, family drivers and delivery work of food businesses, hotels, restaurants and supermarkets. Majority of the respondents are

educated up to high school level. Table 2 shows that their main source of income is in agriculture, with respondent's main source of income. The highest mean income earned is between Php 5,000 to Php 9,999 and according to them their income also depends on luck, as revealed during social representation data collection tool by gathering 3 to 4 respondents in a certain place and directly interview following traditional "pakikipagkwentuhan" strategy (Javier 2004).

Table 1
Data on the socio-demographic profile of the informants (respondents)

Profile	Frequency of respondents in four towns with mangrove areas			
	Virac (n = 46)	Baras (n = 55)	San Andres (n = 58)	Pandan (n = 45)
<i>Age</i>				
20-29	17	16	25	13
30-39	15	15	17	15
40-above	14	14	16	17
<i>Gender</i>				
Male	24	36	16	20
Female	22	19	22	25
<i>Civil status</i>				
Married	22	33	34	35
Single	24	22	24	10
<i>Educational attainment</i>				
Elementary	11	8	12	13
High school	23	32	32	20
College level	12	15	14	12
<i>No. of years stay in Barangay</i>				
10-16	3	15	12	8
17-21	13	13	14	8
22-26	14	12	13	14
27-above	16	15	16	15

Table 2
Sources of income of the informants of the study

Source of income (occupation)	Percentage (%) of the respondents			
	Virac (n = 46)	Baras (n = 55)	San Andres (n = 58)	Pandan (n = 45)
Agriculture	37	27	22	26
Fisheries	25	40	28	47
Livestock	13	13	17	7
Mangroves	19	13	22	13
Others	6	7	11	7

Mangrove destruction discourses

Mangrove seascape architecture and mudflats. The approximately 1,650 km² area of Catanduanes reports 1,400 ha and its coastline that includes to 1,600 ha (Masagca et al 2020) of mangroves is characterized by three to four different seascape or architecture having prominent features. First, is a mono specific population of nipa, *Nypa fruticans* in the towns of Viga and Panganiban of the north-eastern coasts of the island with the large river deltas of Oco river. The second prominent feature is a combination of mangrove forests (predominantly *Avicennia marina*, *Sonneratia alba* and some planted *Rhizophora* species) and mudflats dominate extent that of Palnab, Virac with Palnab-Pajo riverine system with ridges of sand and shell deposits. Third are the mangroves of San Andres, Caramoran and Pandan towns in the north developed from marine sediments with the mangrove belt, especially in the western part of the island. These remain important areas

for many migratory birds, and could provide income opportunities from bird-watching and eco-tourism but not yet fully realized. These prominent mangrove features are important sources of fish protein for coastal-dwelling communities. The low-lying coasts of Viga and Panganiban towns consist largely of muddy to clay soils and historically been built on these ridges. These features in the north-eastern coasts of the island are the results of features described in the geologic history of the island by Carranza (2002) and were formed during the early to late Cretaceous period. Mudflats and mangroves together are involved in a slow process of land acquisition. Mudflats are formed in Viga-Panganiban by the interaction of silt and clay from the Oco River in Viga until Panganiban. There are no exact or estimated measurements of the mudflats and this could be in the order of 10 and 20 km long and appears to be having movement in westerly direction. This is an under-research topic and needs deeper inquiries. While mudflats are expected to provide the first line of defence from wave action and allowing mangroves to recover and land to accumulate, the coastlines in Catanduanes between mudflats is protected by mangroves and the beach forest or coastal vegetation in the towns of Virac, Bato, Panganiban, Bagamanoc and San Andres.

Mangrove patches. The presence of small mangroves patches close to the shoreline of Baras to Gigmoto is also a good indication that larger waves are possibly reduced in these towns of the eastern coasts and the western coast of Caramoran and San Andres. *Avicennia* are quickly growing mangrove trees reaching to 10 m in the trunk, while root systems give it the ability to establish in shallow tidal waters of the mangrove areas of San Andres and Baras. Each tree has hundreds of small roots (pneumatophores) protruding from the soil upward preventing these trees from suffocation during tidal surges in the typhoon months of June to October.

Mangroves as traps and filtering system. Looking into the global discourse and perspectives, these mangroves play very important roles in shaping the physical coastline by trapping sediments and stabilizing the coasts of tropical countries like the Philippines and Indonesia. There are many ecological, economic and social services that these mangroves provide to the local people. Ecologically, mangroves act as filters and trap pollutants, providing important habitat for a large number of economically important aquatic species. In Catanduanes the very profitable mangrove crab industry and prawn or shrimp fisheries are dependent on the mangroves. Natural coastal wetlands are widely recognized for their ability to trap sediments (Perillo et al 2009; Barbier et al 2011; Moller et al 2014; Chen et al 2018). Mangroves act for defence potential against the action of waves and tidal flows (Temmerman et al 2013; Horstman et al 2015; Carus et al 2016). Mudflats provide the first and most important 'line of protection' and could allow mangroves to recover and enhance the land in the coastal areas to accumulate. Where mudflats are absent, as they continuously move west in Catanduanes, mangroves provide the second line of protection. Studies revealed that heavily vegetated mangrove systems normally trap sediments during the flood tide, and that there is generally no significant export of sediments during the ebb due to the deceleration of the tidal currents by vegetation-induced friction (Wolanski et al 1990, 2001; Furukawa et al 1997; Kitheka et al 2003).

Wave attenuation function. Mangrove trees are bio-shields or bio-armors as coastal protection primarily through their extensive root systems (Alon et al 2019). Mangrove trunks and roots trees absorb wave energy which provides natural protection against normal wave energy as well as tsunamis and tidal surges in the eastern and western seaboard of Catanduanes Island. Mangroves of Catanduanes are very important as protection from typhoons which normally pass yearly average of 20 typhoons (www.ardc.asia) until 25 annually including the other provinces of Albay, Camarines Sur and Camarines Norte in the Bicol region, Philippines (<http://www.ifrc.org/>). Contrary to previous reports, mangroves are now accepted to act as storm protection from high winds and strong waves which was fiercely debated in the past (Kathiresan & Rajendran 2005; Feagin et al 2010).

Mangrove root systems that are commonly referred to in such discourses are the prop roots of *Rhizophora* with *R. mucronata* and *R. marina* with none of *R. mangle* or red mangrove (since this is not reported in Catanduanes). *Rhizophora* species are popularly re-planted in every mangrove area of Catanduanes as their role in coastal protection from waves is therefore very high and extensive. Where patches of mangroves do exist along the coastline, they withstand wave energy but appeared to be defoliated and mutilated during typhoons as shown in the mangroves of Cobo and Balanganon in Pandan; Paniquian in Baras and that of Palnab in Virac.

In the Philippines, very few or practically no studies are available for the use of this paper. Observations made and as reported by the local people in Paniquian and P. Teston mangrove areas in the town Baras show that specific locations in these barangays have provided protection from waves where mangroves usually establish and grow into denser forests.

Mangroves for floods and typhoons. Discourse about coastal protection from flooding and typhoons is still mostly focused on mangroves and the construction of permanent structures like breakwater and seawalls in Catanduanes island. The idea on the presence of protecting mudflats with the mangroves seems not to be clearly understood by the local people. These discourses include concepts of mangrove 'destruction' created by humans who are removing mangrove trees, i.e. for fences or construction of beach houses within the mangrove environment. An example of the 'destruction' discourse is visible in the mangrove awareness notices placed near mangrove areas by the local people. In Batalay Eco-Park in Bato, Catanduanes the notices speak of the importance of mangroves for coastal protection.

In other parts of the island the campaigns also address destruction of mangroves by humans but there seems to be no announcements that show how mangrove trees are destroyed by wave action which is a natural process. This image is not common in the mangrove destruction discourses in Catanduanes.

Coastal resource management. Government in both local or barangay, municipal and provincial officials who are involved with implementing and developing coastal resource management plans and programs commonly repeat the mangrove destruction discourse by the following instances: people have been and are still cutting mangroves trees and beach forest species and they are responsible for the erosion problems. In some barangays of Catanduanes, local communities have been confronted that coastal communities even those living very near mangroves are the ones destroying their mangroves. However, occurrence of this observation is not true in other municipalities when those whose houses or residents are far from the mangroves are the ones destroying the trees and those migrant fishers are the ones involved in illegal activities within the mangrove environs. Local mangrove communities could be presumed to have the strongest incentives to protect the quality of their environment for their own quality of life (Ounvichit & Yoddumnern-Attig 2018). The communities are likely to manage their mangroves in a holistic way, balancing the social, economic, and environmental ramifications without trading off any of it for their sustainable living. They have been viewed as environmental stewards, not destroyers (Peluso 1992).

Road construction and development. The destruction discourse also assumes that fishermen use mangrove trees as poles that are placed in the ponds for attaching nets. But this has been disputed by the informants that were interviewed noting that the use of bamboos is the most widely practiced in construction. They explained that alternative wood species from the beach forest areas last much longer. These woody beach forest species belong to the screwpine family, e.g. *Pandanus tectorius* and *Sararanga philipinensis*.

Developers, road construction and the workers of the DPWH are also part of the destruction discourse and have been known to clear land for creating parcels. The northern and southern fringes of the island are observed to have these clearing operations. As the research informants come from the urban and rural areas where

developers are not part of the local narrative, this study did not include developers' perspectives or voices in the analysis. It is clear that this group has significant or stronger political power in Catanduanes and elsewhere in the Philippines. Their positions or perspectives using social representations would be significant here but will be reserved for other series of reports. Looking at the media (provincial newspapers: Catanduanes Tribune and 'Bikol Periodiko') this study reveals a lukewarm treatment of the mangrove discourses except for a previous report on the Viga-Panganiban issue on nipa cutting for a pond construction and the infamous former Provincial Board Member the late George Reyes on a strip of mangrove in Magnesia del Sur that was cut to give way to his private resort development (Masagca et al 2020).

In general, the discourses are never elaborated in the local media in response to public criticism, and if we have attempted to collect data from this group of new respondents and informants from the four towns of Catanduanes, this may not have been possible because the exact identities of the people who develop the southern and northern fringes of the island remain unclear to the researchers. Despite the concern that this group in Bato town is not included in the analysis, it should be noted that much of this area is actually not mangrove forests but it is nevertheless low lying beach forest areas in Pananaogan and Batalay in Bato. This scenario in Bato may just be the same in other parts of the island. The informant from Bato was deliberately removed as the researchers discover some spillage of information that reached the developers in Bato when the speakers of BIOME5 SEDTE3 conducted the whirlwind fieldwork in October 17 to 18, 2018. A separate report is available about the suggestion clear the ricelands of Bato instead of the beach forest areas in Batalay and Pananaogan.

On erosion, it should always be a primary concern that these mangrove swamp forests should not be cleared because their function in flood prevention is removed, and it will cost the island much more to keep these areas dry in the future. Future erosion would require mangroves to move further inland, and swamp areas would naturally change from mixed beach forest vegetation to mangroves. McLeod & Salm (2006) stressed that physical barriers to upland migration of mangroves are one of the constraints of sea level rise adaptation.

Mangrove rehabilitation by planting and growing trees (e.g. SURMABIOCON introduces *Planting, Growing and Caring of Mangroves with Knowledge, Understanding and Loving*) is a common climate change adaptation response in different parts of the world. In the Philippines including Catanduanes, this practice is very common. Rehabilitation, conservation and reforestation are being practiced in the island and has successfully shown to reduce vulnerability to storm surge. Red mangrove, or other mangrove species with stilt roots, are normally used for mangrove rehabilitation. The dynamics of nipa forests in Bato, Panganiban, Viga and to some extent Bagamanoc are generally not well understood in terms of hydrodynamics and land building. Local respondents indicate that nipa plantation in Panganiban and Viga are slowly being wiped out and needs greater attention among the LGUs as to its health and wellness condition.

Social representations on sustainable mangrove conservation for climate change. Recent R & D efforts of CSU in Luzon, Philippines are within the thematic scope of S.E.E.D. at the College of Arts and Sciences that needs to be addressed by having water-related programs on fish, rice and mangroves (FIRM). The goal of alleviating poverty as expressed in SDG on poverty and achieving food and environmental security among rural communities in the Philippines remains elusive and distant. This is being exacerbated by the impacts of climate change and the effects of extreme weather conditions. Again and again, the pursuit to achieve these human securities is placed on top along with the priority programs of the Philippine government. Initiatives of several entities of the government converged and are focused to achieve the same through various water, energy and climate change related R&D programs. During fieldworks, representations of the local residents in Barangay Agojo in San Andres were known and determination of their mangrove rehabilitation activity to adopt such aquasilviculture and conservation initiatives in the prospects of climate change were made. Using social

representation as a tool of analysis, several themes were derived from the responses during FGDs, interviews and one-on-one interrogation.

The following are the themes which were derived from the narratives:

Effects of climate change. Local people are aware of the phenomenon that climatic conditions and extreme weather conditions are bringing substantial changes to the coastal marine waters and mangrove communities surrounding the island of Catanduanes so that various activities in inland fisheries and aquaculture are also having changes. For example, when local fishermen cannot have greater extraction in the coastal or municipal waters for fishes due to bad weather, they rely mostly on the inland or riverine organisms for food and the need to take care of the areas or produce something from the systems that are adjoining their houses. They believe that the climatic changes have disturbed the marine fishing activities in coastal villages and have placed so much pressure in the mangroves of the island.

Bio-ecological and physical impacts of climate change. On the ecological and physical impact of climate change, the local people may not basically know this aspect but the expressions and narratives constructed by the research team reveal greater similarity. For instance, the local women during the interviews, reported the increasing number of species of fish like "sandig" or the rabbit fishes (*Siganus vermiculatus* and *S. canaliculatus*) and other oceanic species that enter into the mangrove areas. Migration patterns in the brachyurans particularly mangrove crabs *Scylla*, *Thalamita* and *Charybdis* appear to have been difficult to be collected or harvested but in other areas, these species continue to thrive possibly affected by changing quality of the water. The combined effects of salinity, temperature, windiness, typhoon frequency and tidal surges have something to do with the movements of organisms near the mouth of the river and tended to also been affected these crabs. Among fishes, the most rapid changes in fish communities will occur with species that are expected to shift to deeper water portion of the rivers to counteract rising surface temperatures.

Local migration, livelihoods and adaptation. The mangroves and estuarine area communities and fisher folks of the four towns of the island are experiencing the effects of climate change in many ways. One of which is the rapid disappearance of different species of mangrove crabs (*Scylla* spp.) in the mangrove areas rivers which could be due to uncontrolled collection. Some houses have been constructed at the higher elevation or have driven households away from the mangrove areas for various reasons such as the fear of flooding and tidal surges. Some have decided to live nearer mangrove areas to collect more fish and crustaceans during difficult times. The frequency of typhoons although is not affecting the local residents due to resiliencies as revealed in the transcripts of the interviews, the general observation indicates that the effects of climate change on coastal waters can be seen in the unstable livelihoods and the changes in the availability and quantity of fish for food of the respondents in the study. Certain adaptive capacities of the local people can be seen in the various community assets like the bio-geo-physical features of the towns under study. Looking into the microculture, such as the positive attitude to send their children to college studies with the free tuition in state colleges and universities (SUCs) most likely developed the cohesive family with unified solutions to poverty brought about by many factors such as the availability of little budget for the children (who received bursary, grants or scholarships while studying in the university as student research assistants) to return to their families in the mangrove areas during vacation which will provide avenues to transfer new knowledge from their education. As observed in previous fieldwork in riverine systems, adaptations of the local people living near mangrove areas appear to have not been constrained by culture (Masagca et al 2018). Changing cultural patterns in these remote towns of Catanduanes have to be carefully studied by a series of fieldwork that go into the actual lives through phenomenological approach. However, some current institutional and governance frameworks on mangrove-dwelling people of the island have to be reviewed to be truly

responsive to the marginalized people in order to improve access to adaptive resources to support the growing family needs.

Social representations on mangrove resource destruction and depletion. A total of 100 words were accumulated and listed from the responses as to whether mangrove trees, vines and bushes including associated fish, shrimps and crabs will be done in the mangrove areas under study if poverty will be intense. These words were subjected to the computation of tentative indices of polarity and neutrality (de Rosa 1987, 2002; de Rosa & Manarinni 2021; de Rosa et al 2021) and it shows that the words are towards neutrality. This indicates that the local people consider the importance of mangroves resources and other industries in the locality. On the words associated with “mangrove extraction or collection”, the local people equate it with “destruction”, “death”, “income”, development, “lugi” (or bankruptcy) and “kahirapan” (or economic difficulties). Their representations of mangrove resources, mangrove biodiversity and other resources are positive stressing the words “masagana” (or abundant), “mayaman” (or rich and affluence), “basog” (or with stomach full of food always), “igwahanon” (or feeling rich as a middle income family) and many other terms such as “swerte” (or being lucky), “blessed by the graces from God”. These representations were analyzed and found that the words written by the informants reveal their strong knowledge about the ill effects of mangrove destruction or depletion or how these natural resources have direct effects on their lives. Thus, mangroves resources are extremely important in the daily lives of people.

Role of the university in mangrovization. It was noted that the new role of the state university is to popularize new knowledge and research findings on the environment by explaining to the local people about the importance of technology and innovations. Likewise, new approaches of implementing mangrove eco-tourism activities and other diversified livelihood opportunities for those local people who depend only on mangrove crablet extraction or collectors contributing to biodiversity loss in the four towns. However, it was not very clear to the local people as to the economic viability of the unique places as eco-tourism sites. There is a reflection on the development and acceleration of new “scientific and economic sense” in which popularized conceptions are found in the process of “modernizing” the local people with the inputs coming from the students of the university (who go home to the village during semestral breaks) and the research team.

The scientific community in the university involved in these water-related R&D initiatives such as mangrove conservation and mangrove rehabilitation has been delivering to the local communities the knowledge necessary that helped them to assess the risks that island dwelling people are facing from various aspects of climate change. It provided knowledge of how can these people effectively mitigate dangerous and extreme weather changes and cope with changes that they cannot manage. However, the researchers described the relationships between political, economic and social factors with environmental issues and changes prior to full implementation of the following programs.

A wide range of social, political, ecological, economic and institutional aspects of the mangroves conservation in the areas under study are relevant to the implementation of this CHED NAFES funded SURMABIOCON. Projects such as the upcoming programs on Mangrove Crabs Academic-Community partnership are taking place within the context of community objectives, which inherently reflect the aspirations and values of the local residents in relation to the research team’s divergent topics, issues and concepts. From the responses and thematic analysis is evident that the local people of the mangrove areas in Virac, San Andres, Baras and Pandan have been experiencing the effects of climate change and extreme weather conditions. Governmental policies, the RDE (research, development and extension) programs of academic institutions and the values of the local communities when taken into account can explain the interactions between inland fisheries, ecosystems under stress and the wide range of complexities in the management of inland water resources. The frames, behavior, decision-making of the

leaders and the local citizens' ways of using the river resources are needed in developing the institutional arrangements which the state university considered to have the cohesive effort in the management of resources in REWs.

Mangrovization: restoration for biobelting/armoring for sustainable coastal wetlands in Catanduanes Island, Luzon. The sustainable governance of mangroves in Catanduanes demands a more integrative approach and the application of science-based or 'mangrove science' and knowledge of ecosystems services and functioning. Mangrove governance at the local and national scales is of great importance, particularly when rapid mangrove destruction occurs due to multiple stressors exacerbated by extreme weather and climatic conditions in typhoon prone islands of the country. It was known during the inquiry that the (1) lack of strong scientific consensus on the status of mangroves, estuaries and coastal wetlands (i.e. water quality, physical habitat, mangrove associated aquatic life); (2) dearth of studies on time dimension for mangrove ecosystem functioning; (3) fewer research results on 'mangrove science' are transferred to policy and practical applications; and (4) lack of clear identification of problems and solutions about mangrove protection and rehabilitation for governance.

It appears that there is an absence of strong academic offering on 'mangrove science' in forestry, forest biology, estuarine fisheries, aquatic biology, aquasilviculture, and even coastal marine sciences in the island province. Academics and other groups are challenged to protect the unique conditions of this island province as to the mangrove distribution, associated organisms, associated ecosystems, and biological processes that depend on large scale process (i.e. climatic, geo-morphological and hydrological) and the local biotic features. The pressing need to address the uncertainty of the behavior of mangroves, marine coastal waters and assessment of altered environmental flows for integrative approaches (i.e. ICM, EBM, MPA networks) in support of sustainable mangrove governance is clearly recognized. Distressing issues on tidal surges, saline intrusion into crop fields, flash floods, landslides and other natural disasters required stronger and purposeful inclusion of coastal or shoreline armoring with mangroves and a strong 'mangrove science' in governance.

Several RDE initiatives have been carried out by the University for Sustainable Mangrove Governance in the coastal wetland areas that included (1) mangrove biodiversity studies of faculty and students, (2) inquiries on the relations of aquatic organisms in altered water flows in mangrove-estuarine flows, (3) research-extension programs on fish and rice. Academic programs introducing a new 'mangrove science' in this island with a conceptual framework of developing a Green University that includes a mangrove eco-park facility in support of the four-fold functions of the university for water related initiatives, marine governance and climate change solutions are now in place.

Conclusions and Recommendations. The coasts of Catanduanes are predominantly shaped coastal changes, mangrove flora and beach forest vegetation which together provide protection against coastal erosion and trap sediments resulting in coastal accretion. It can be generalized that formal and informal institutions created by stakeholder relations can lead to success in mangrovization initiatives. There appears to be overlapping situations and inconsistencies in the implementation of science-based and community-based mangrovization programs in support of the overall coastal resource management (CRM) as outlined in local governance. Then need for state universities to be involved in mangrovization programs/projects/activities which center on decision-making power regarding science-based and community-based initiatives on how, where, and when mangrovization should be carried out, specifically on the location of replanting or restoring mangroves in the island. The strong LGU-community-academe institutional arrangement could lead the success of mangrovization after a decade or so. Contemporary narratives from two progressive mangrovization projects having collaboration, cooperation, and monitoring schemes with the state university is central to the notion that these projects could lead to greater successes.

The use of a scheme in a developing country's university inter-college initiatives for water-related R & D programs on food, environment and climate change built on the

foundation of trust following the research mentoring and strong community participatory process research on SEED (science, environment, economics and development) can result to different benefits. Involving the local people and local government units (LGUs) through the academe-LGU-mangrove association institutional arrangement in generating knowledge within the lens of political ecology has already revealed a complex set of interactions that influence processes of rivers, estuaries and coastal wetland (REW) zone influencing mangrove ecosystems and transformation in Catanduanes Island.

Any conservation policies and food production practices for fish, rice and mangroves (FIRM) directed towards ecological integrity and sustainability must, therefore, consider and address the influence on the local community's water resource management systems within the notions of poverty, equity, social wellbeing and unclear restrictive water policy frameworks and political agendas that are supportive of other powerful resource interests. Although not highly felt in the island's condition, aspects on property rights and dynamics in local water resource management practices are to be addressed in this context. The use of social representations is appropriate to a supportive approach to address the challenges of sustainability research for managing inland fisheries and aquaculture in REWs (rivers, estuaries and wetlands) and mangroves. A wide range of social, political, ecological, economic and institutional aspects of the island province as seen in a sample village are relevant to the implementation of food and environmental security programs of the university on managing the REWs within the prospects of climate change.

Projects on inland fisheries, indigenous rice production, community-based multispecies hatchery must be integrated with the mangrove and beach forest reforestation for a green-beltting scheme in Catanduanes Island are now taking place within the contexts of community objectives, which inherently reflect the aspirations and values of the local residents' cultural heritage, economics and social wellbeing in relation to the university's research team and the administration's divergent topics, issues and concepts.

Governmental policies, the RDE programs of the university and the values of the local communities when taken into account can explain the interactions between inland fisheries, REW ecosystems under stress and the wide range of complexities in the management of inland water resources. The frames, behavior, decision-making of the leaders and the local citizens' ways of using these river resources are needed in developing the institutional arrangements which the universities in the Philippines and other developing countries of the world can consider to have the cohesive effort in the management of these dwindling resources. These will also provide a platform for the interacting social and economic forces, and the piecemeal, compartmentalized ('chopsuey') approach in managing the dwindling resources in inland waters to induce actions that are compatible to the local people's objectives of improving lives within the prospects of climate change. These processes (e.g. geo-physico-processes within a world of complexity in a remote island of Catanduanes can provide the effective vehicles to better recognize or address the wide range of complexities in managing rivers, mountain streams and estuaries for inland fisheries and aquaculture venture for a successful of fisheries management, biodiversity conservation for small islands and small island states.

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