

Symposium Proceedings

Designing an integrative model of fisheries and mangrove resource management for disaster risk reduction in the typhoon-prone island of Catanduanes Island, Philippines

Jimmy T. Masagca*

Natural Science Department, College of Arts & Sciences, Catanduanes State University, Calatagan, Virac 4800, Catanduanes, Philippines

Abstract

The idea of co-management has relied on the relationships of two systems, natural and social science systems. An integrative model was developed at the Catanduanes State University (CatSU) in Catanduanes Island (Luzon, Philippines) by adopting interactive governance theory, climate change and disaster risks management models. The model has the qualifiers of a) Typhoon *Preparedness*, b) Pre-typhoon *Prevention*, c) Community *Response* through Typhoon Education and d) Post-Typhoon *Recovery* through Diversified Livelihood or P2R2 components. Preparedness and Prevention (P2) through mangrove biobelting and biosheltering and mangrove protected areas projects; and *Response* and *Recovery* (R2) through appropriate technology infusion in inland fisheries production, integrated indigenous rice-fish production and tilapia fish fortification and nutrient enrichment projects on post-harvest are the sub-components. As an integrative model, SURMABIOCON (Sustainable Resource Management for Mangrove Biodiversity Conservation) consists of community engagements (*Preparedness and Prevention*) guided by the interactions of structural and functional units in natural and social systems based on the experiences of the university and other cooperating institutions and organizations. This funded program of the Commission on Higher Education National Agriculture and Fisheries Extension System (CHED-NAFES) includes scientific knowledge generation through the Income Generating Programs (IGP) in support to a green university concept. The model puts premium on *Planning* before implementing (*Acting*) numerous community engagement activities that will render changes on the attitudes, values and perceptions of the local communities as to the importance of mangrove biodiversity; and conservation to ensure a better life (*Living*) through a current research programs for children, youth, women, educators, the local people, local government and other stakeholders involved in CHED NAFES funded SURMABIOCON program.

Key words: Management model, climate resiliency, island sustainability, typhoons, tidal surge

INTRODUCTION

Typhoons are the major natural disturbances that agitatedly shape island landscape, seascape and persistently disturb societies and alter socio-economic and developmental agenda, a serious case in the Philippine islands frequented by typhoons. Many planners and governmental agencies pay most attention to damage caused by typhoons on infrastructures, properties and human lives. But it appears that the real focus must be on how the local people understand the necessity of

preparedness, prevention, response and recovery through massive typhoon education campaign within the agenda of both public and private entities. Many islands of the Asia Pacific Region including the Philippines are ranked as risk places in the world in terms of full-spectrum disaster risk but the formulation of typhoon risks reduction agenda are wanting. With volatile social, economic, and geologic environments and the real threat of typhoons, tidal surges, tsunamis, flooding, landslides and earthquakes, the governments of different countries have made public appeal to

*Correspondence. E-mail: jtibarmasagca@gmail.com, jtmasagca27@gmail.com

raise awareness and reduce the impact of disasters. Typhoon disasters not only devastate property and the ecology, but in general can cause striking and long-lasting impacts on biological diversity, cultural patterns and the future of societies particularly in islands, thus, preparedness, local capabilities and resiliency are critical to reducing the impacts of typhoons in small islands in the Philippines like Catanduanes.

Mangroves act as natural defenses that protect people and property from flooding reducing coastal risks (Beck et al. 2018). Yet these protective benefits are often not fully accounted for policy and management decisions. Moreover, even the small-scale fisheries in both marine and inland waters have not been given great attention. In managing inland fisheries according to Song et al. (2018) and so with small scale fisheries are now gaining much attention within the context of governance (Chuenpagdee and Jentoft 2018) as the issues of climate change continue to disturb all peoples of the world, the need for a holistic and integrated approaches is urgently recognized. Although developing countries have little historical responsibility for climate change, they are likely to be most affected by it since they lack resources and capacity to cope with or to adapt to its effects (Simoes et al. 2010, Williamson 2010, Masagca and Araujo 2018). This capacity centers on the ability of a system to evolve, and in coastal communities, this is how the local people cope with the effects of severe climate impacts (IPCC Summary, Chapter 6 & 17). It was revealed that adaptation projects that work through village or community institutions and promote the participation of local people are few but growing (Dumar 2010). In the Philippines, the unfavorable climatic conditions, strong winds, frequent floods, landslides with storm waters and runoffs, tidal surges, poor water and quality, lack of expertise and technical knowhow of researchers, and the lack of projects to promote the use of community-based approach (CBA) contribute much in justifying this proposed project.

In the light of the importance of hazard awareness education together with the policies that enhance social and economic equity, reduce poverty, decrease the discharge of wastes, improve environmental management (see IPCC Summary chapter 6, p.6), and improve quality of life in the isolated coastal communities of the island provinces in the “typhoon highway” of the Philippines, SURMABIOCON is introduced as a model to address the links or nexus of mangroves, fisheries, food security and climate. The global value for risk reduction is now highlighted in international and global networks and is now slowly influencing the local communities, thus requiring integrative approaches contrary to the fragmented models. The Catanduanes State University (CatSU), the so-called green university is now in the midst of re-designing its efforts to develop programs that cross

disciplines for risk reduction and integrated programs traversing the nexus of livelihoods, ecosystems and mangroves. These are intended to improve programs on water-based food extraction livelihoods and the aquaculture of fish, mollusks and crustacean in coastal dwelling areas highly vulnerable to climate variability as shown in changing typhoon path, occurrence and changing windiness in the east coast of this island, typhoon highway, tuna highway and a more recent development as a gateway to the Philippine Benham Bank.

METHODOLOGY

The paper adopts that of what Glass et al. (2013) emphasized on the need to integrate a many different disciplinary perspectives when translating sustainability principles for application in the “real world” that is emblematic of a shift towards trans-disciplinary research approaches (Reed et al. 2009, Pohl et al. 2010). In order to have the multi-method that can truly reveal the complexity and multidimensionality of this work, different methods were employed in gathering numerous data to develop this integrative model. Ying (2004, cited in Masagca, Xunxiang and Masagca 2009) stressed that the use of multi-methods not only provides a more in-depth data set but also allows to validate findings and thus increases reliability and plausibility. As currently practiced in the university, the data gathering component of this paper relied on quantitative and qualitative methods to develop a working model within SURMABIOCON. The model could help citizen science project planners and implementers design their integrative programs to successfully achieve their objectives in fisheries resource and mangrove conservation supporting the global value to reduce risks.

Features of Catanduanes island

The study took place in an island state university in Bicol Region (Region V). The island lies on the eastern Philippine seaboard at coordinates 13.5⁰- 14.1⁰ N Lat. and 124.0⁰- 124.5⁰ E Long. (Department of Environment and Natural Resources-Catanduanes, 2009) with the area 1,511.5 km² (Department of Science & Technology, 2010). It is separated from the Bicol peninsula by the Maqueda Channel and Lagonoy Gulf. In 2010 census, it is already home to 246, 300 human population (NSO, 2013) which generally inhabit its coastal boundaries. Catanduanes nestles on the latitude where final waves of North Equatorial Current encounter terrestrial soils for the first time and merge on the waters north westward and becomes the Kuroshio Current - an oceanic current running from Eastern Philippines to Japan passing Taiwan. The sea current location is frequently visited by typhoons. Figure 1 shows the map of

the Philippines with Catanduanes Island pointed by an arrow. This island is predicted to have the highest typhoon intensity (WFP, 2015; Aldea and Masagca, 2016).

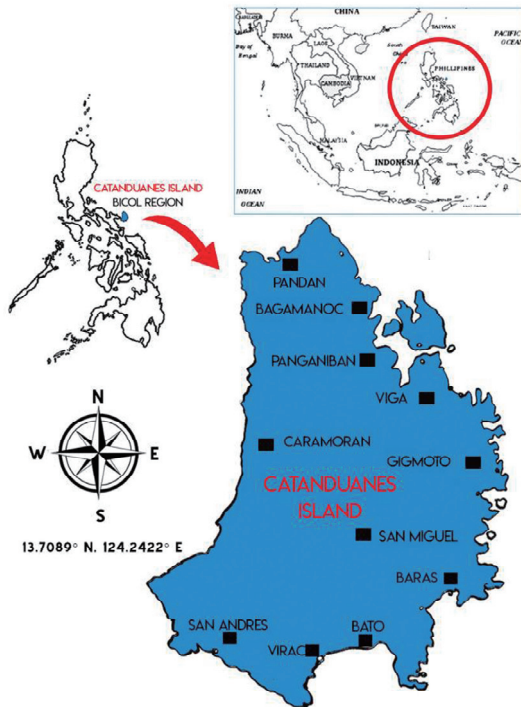


Fig. 1. Catanduanes island, with respect to the Philippine archipelago.

Q-Squared approach

The Q-squared approach (see Morales, Masagca and Arajo, 2017) was used in this initiative. There have been a number of initiatives to promote a more systematic integration of quantitative and qualitative approach known as “Q-Squared” originally applicable to poverty analysis (Shaffer, 2013) but used in the analysis of research productivity and on how to improve low performance in research and publications. This approach was used in studying the three factors in improving the university’s R&D management program at the individual, institutional and societal aspects affecting students and faculty members.

Narrative inquiry

A narrative inquiry was used here as a qualitative research method for gathering information through storytelling, which according to Connelly and Clandinin (1990) is normally done by people who are storytelling (see Masagca and Londerio, 2008) organisms who lead storied lives. Following Tan (2007), stories of such lives shall be told by the study’s informants and narratives of the experiences were organized.

Action research

The development of action research has sprung from the idea that one needs to take into consideration the power relations that exist between researcher and the people that are the main subject under study (Bryman and Bell, 2003). Action research plays a particular role in bridging the gap between researchers and participants, since the output of the research evolves through involvement with members in the academic community or the faculty under study. Action research enables the subjects under study to play a more active part in design and output of the study, and intend to contribute both to the academic theory as well as to the organization. Coghlan (2007) states that “issues of organizational concerns such as system improvements, organizational learning, and the management of change are suitable subjects for participant research since they provide opportunities for both effective action and learning”. Since the intention of this paper is to contribute both to theory and to the improvement of disaster risks reduction in the coastal areas.

Participatory research processes

A participatory research process was followed here that includes a series of field work, interviews, focus group discussions (FGD), general assemblies and council meetings for some practices in SURMABIOCON.

Documentary analysis.

Appraised extant literature and gathered official documents from the government units, conference reports, unpublished or under review papers and news clippings about fisheries resources and mangroves conservation and management. Documentary data were organized from the materials on relevant university policies and the Research Manual related to research and publishing and institutional collaboration.

Data analysis

Following Tan (2007), the transcripts of the interviews were organized, synthesized, and searched for common and significant patterns of behavior and ways of thinking. Categories were evaluated on the basis of their homogeneity, which according to Patton (1990), is the extent to which the information belongs to a category and the extent the categories differ and/or are unique. The documentation of the brief history of SURMABIOCON from the 1990s to 2018 in developing the P2R2 *Framework* and innovation strategies of the model for an island state university is carried-out in order

to tackle (1) governance issues; and (2) develop new project activities for SURMABIOCON. The development of a working model of SURMABIOCON has been the focus of the combined commitment for effective and efficient achievement of the goals of the nation's and the province's remaining and dwindling mangroves.

RESULTS AND DISCUSSION

Timeline for the development of the framework and innovative strategic model for SURMABIOCON.

In tracing the history of SURMABIOCON, four periods are discussed briefly in this paper – Period 1 Eritrean Red Sea, Ministry of Education-Asmara University/Catanduanes State Colleges Doctoral Dissertation on Mangroves with SURMABIOCON; Period 2- De La Salle University-Dasmariñas Graduate School Mangrove Studies; Stage 3- Pacific Island Institute of Pedagogy (Pacifitech) on SURMABIOCON; and Stage 4- Catanduanes State University CHED funded SURMABIOCON. The beginning of SURMABIOCON can be traced back from 1997-1998 when the author was assigned in Eritrea, Northeast Africa as an expatriate teacher in the Ministry of Education/Asmara University, then in 1999 when the author defended his doctoral dissertation containing Project SURMABIOCON (conception years), continued in De La Salle University in Dasmariñas from 2000-2008 (inception years), then with Pacific Island Institute for Pedagogy, Technology, Arts & Sciences from 2009-2012 (initiation years), continued with the Catanduanes State University from 2013 - 2015 (model formation years) to 2016 to 2018 (model formulation years) when funds of the Commission on Higher Education (CHED) National Agriculture and Fisheries Extension System (NAFES) was obtained by CSU.

1. Stage 1 - Red Sea Mangroves in Eritrea, Northeast Africa (1997-1998).

Tracing the history of SURMABIOCON, it started in

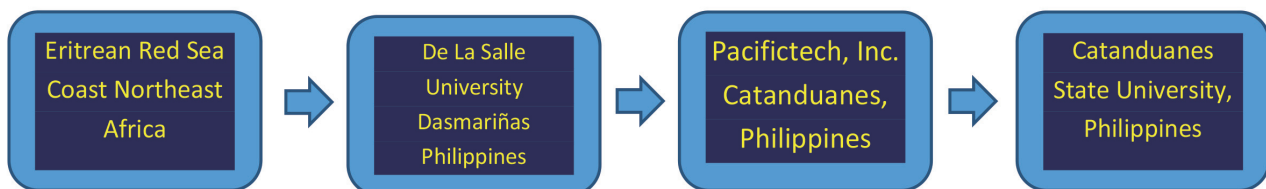


Fig. 2. Timeline of conceptualizing, developing, formulation and adoption of the model of SURMABIOCON. Stage 1- Eritrea Red Sea Northeast Africa, Ministry of Education-Asmara University; Stage 2- De La Salle University-Dasmariñas, Philippines; Stage 3- Pacific Island Institute of pedagogy (Pacifitech, Philippines; and Stage 4- Catanduanes State University, Philippines.

1998 when the author met in Northeast Africa the recipient of Rolex Award for Enterprise - Dr. Gordon Sato, a Japanese-American who authored the Red Sea World Food Hunger with Mangroves project in northeast a region. This was followed by the approval of a DPhil doctoral project with Sussex University Institute of Migration and Culture Studies on a dissertation about “Migration and Land Formation in Philippine and Eritrean Red Sea Mangroves”. The war in the Sahelian Region (Ethiopia, Eritrea, Uganda, Sudan & other northeast African countries) discontinued the mangrove project of the author forcing him to return to Catanduanesisland, Philippines. The unfinished doctoral dissertation for the Doctor of Education was continued and completed with a *Meritissimus* Award (Outstanding Dissertation) from the doctoral panel containing the Project SURMABIOCON as an offshoot of the research.

2. Stage 2 - Cybermangroves for kids at De La Salle University (1999-2007).

Cybermangroves and public-private partnerships through Boating, etc. Papers published included that in BIOTROP, BIOTA papers, funded project reports on mangroves.

3. Stage 3 - Pacifitech mangrove projects and birth of the first and only scientific meeting in Catanduanesisland (2009-2012).

The birth of BIOME was instrumental in continuing the SURMABIOCON concept introduced in 2010. Pacifitech-CSC partnership, a very small unknown school was the partner.

4. Stage 4- Catanduanes State University and SURMABIOCON initiatives (2013-2018).

The entry of SURMABIOCON into the university started when the author was re-employed as faculty member of the university in 2013 (part-time) and full-time permanent in 2014.

Developing the innovation strategic model of SURMABIOCON for climate change and disaster risk reduction.

Since 2016, CatSU has no existing pattern, theory or strategy on how R&D and Citizen Science for community engagement are managed in the university. Together with the search of a model for university research management (see Masagca *et al.*, 2018), all fisheries and mangrove studies are integrated in SURMABIOCON. The search for the R&D productivity enhancement with Citizen Science models and strategies at CatSU, started with the thinking of “*How to ensure that CSUs Programs Win*”. A general working framework was developed to ensure success towards achieving the objectives of SURMABIOCON following *P2R2* framework path (see Fig. 2). Whether the CatSU model for SURMABIOCON adopts the collegial, formal, cultural or political models in educational management has been resolved (see Masagca *et al.*, 2019). It was not clear on what Innovation Strategic Model must be followed in carrying-out the different projects, initiatives and activities of SURMABIOCON which is on DRR. Thus, the need to develop innovation strategies for SURMABIOCON is clearly recognized when *P2R2* framework was formulated. Externally-funded programs on mangroves started 2013, when the 1.5 million pesos funding for CSTIFDP and 3.5 million pesos funding for R&D were received by the university from the Philippine Bureau of Fisheries and Aquatic Resources (BFAR) and Department of Agriculture (DA), respectively. Research and development funding was also provided to the university from the CHED-BFAR Philippine National Aqua-Silviculture (PNAP) program. After implementing the R&D programs, it appeared that there is an urgent need to have a SURMABIOCON Program Innovation Strategy to implement it so that the IREP functions of the university can be achieved and to specifically address the institutional concern to improve quality and reliability of R&D. In general, a strategy is a plan to achieve a specific competitive goal. As described by Pisano (2015), an innovation strategy is a plan to create value by market share growth, cost reduction or profit generation through product, service or business model innovation. In this case, SURMABIOCON centers on service, product and technology as this program initiates the development of citizen science through several community engagement schemes in the university with FMRM for CC and Disaster Reduction.

Realizing the need to have integrative nature of implementing FRMC (fisheries resource and mangrove conservation) consistent with the recent focus on the Global Value of Mangroves for DRR, the desired model was finally brought to the table after CHED NAFES awarded a PhP 7 million project for two years from 2017-2019 known as *Community Engagement for Science-Based Sustainable Use of*

Marine Resources and Community-Based Mangrove Biodiversity Conservation (SURMABIOCON) in Catanduanes Island.

SURMABIOCON R&D + citizen science strategic model.

A strategy is nothing more than a *commitment to a pattern of behavior* intended to help win a competition (Pisano, 2012; 2015). This strategy provides a guiding orientation for a broad range of decisions such as the selection of new strategies for SURMABIOCON, the design, the composition of project teams, the choice of faculty staff, the focus of mangrove conservation campaigns, the layout of the brochures and flyers or IEC for increasing awareness and even hiring of people. The innovation strategies for SURMABIOCON imply patterns of behavior with respect to all of these decisions. The strategies selected for FRMC follow the three requisites of *consistency, coherence, and alignment*. *Consistency* considers a cumulative outcome of a series of decisions, actions, and behavior over time (Pisano, 2012; 2015). For instance, consistency in dealing with the cumulative effects of various environmental factors on climate effects in mangroves provides strategic ways on how to look at the cumulative effects of sea level rise, temperature change and typhoon frequency. Research studies of the university must therefore consider this requisite.

Coherence refers to the many decisions being made (Pisano, 2015) in SURMABIOCON that can shape competitive capabilities in the green university. Decisions are to be made on which pieces of equipment are prioritized to be bought, and which NGO partners are to be selected to be engaged in SURMABIOCON for collaboration, etc.). The innovation strategies developed for SURMABIOCON provides the integrating mechanism to ensure these decisions are coherent with the intent to ensure sustainable islands for the future. For instance, SURMABIOCON started to achieve coherence by creating committees composed of numerous faculty members from different departments and colleges, but in the end realizing that this is too costly and becomes a poor strategy in implementing R&D + CS, thus the present innovation strategy puts premium on communication mechanisms with the use of social media, popularly FB for invitation and participation. This ensures that decisions within SURMABIOCON are integrated. Finally, *Alignment* as a requisite capitalizes that strategies are aligned to the realities of the environment and isolated location of Catanduanes Island to look into the broader organizational context in which SURMABIOCON should operate. The SURMABIOCON program is aligned or being “harmonized” with the broader R&D model or innovation strategy within the university’s Instruction, Research, Extension and Production schemes. In

other words, the university started with the notion “What it takes to win” in the R&D competition in the Bicol region and the nation as well. For instance, in our simple example at the outset, the strategies of “clusterization” of faculty researchers as “Alpha, Beta and Gamma” or “Agricultural Production Clusters” and CatSU has initially trialled a strategy of preparing the students for research skills development in the “Integrated Research Training Program” by attending several research seminars, colloquia, workshops, discussions and attendance in regional/national conferences to assist the students in preparing and submitting thesis with very few pages (maximum of 30 to 35 pages) (see Masagca *et al.*, 2018).

1. Designing the R&D + Citizen Science Strategic Model

Inspired by the Eritrean Manzanar Project on Mangroves in the deserts of Hirgigo, Eritrea near Massawa in the Eritrean Red Sea coast (see Fig. 2), SURMABIOCON was conceived to be a “simple, practical and effective solutions to the planet’s most critical problems” (see McKeehan, 2018).

Within the funding limits of SURMABIOCON, a working model is presented in the succeeding paragraphs that reflect on the innovativeness, best practices of previously funded programs of the university. Modifying the working paper of Pisano (2012) on defining the “game plan” for SURMABIOCON in order to have a competitive edge over the other funded programs are broken down into 4Ps strategic switches or levers: Plan, Protocol, People and Portfolio (see Fig. 3).



Fig. 3. Ensuring a risk free Catanduanes island through SURMABIOCON with 4P Levers. (Modification of Pisano, 2012; 2015; 2018).

Water, Energy and Food towards a sustainable island of Catanduanes. The model is currently being pursued with the intent to address change and complexity associated with anthropogenic and natural disaster within the Land, Water, Biodiversity continuum or the Ridge to Reef notion to

implement projects and initiatives within SURMABIOCON. In this regard. The integrated model of Fisheries and Mangrove Resource Management for Disaster Reduction is holistic and directly anchored on the university’s vision – mission on Green University for island Innovation research.

It has been an administrative practice in this university to develop models in order to address problems on failures to render impacts. This model in SURMABIOCON has been re-developed to be anchored on the pillars of the National Climate Change Action plan’s priorities and that of Sendai’s commitment on sustainability introduced to the United Nations. The GLOCAL notion begins with local problems and solutions but with a global touch. Models for R&D and Community Engagement are intended to improve the implementation of SURMABIOCON.

According to Pisano (2012), the failure of many organizations to improve R&D performance is not due to lack of effort or commitment by the management or people involved. It is due to a misconception about the drivers of R&D performance. In many universities exploring on different ways to improve R&D, the search for new models in research management is an endless exercise. Unfortunately, there is no one best model for R&D that is universally superior (Pisano, 2012).

Fisheries and mangrove resource management framework for disaster risk reduction in Catanduanes island, Philippines.

This framework is shown in Fig. 4.

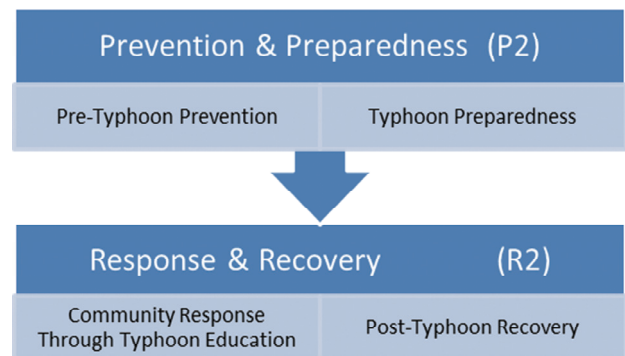


Fig. 4. The P2R2 Fisheries and mangrove resource management framework for disaster risk reduction.

Qualifiers of the SURMABIOCON framework

1. Preparedness and Prevention (P2)

These components of the SURMABIOCON working model includes *Typhoon Preparedness* and *Pre-typhoon Prevention*, which are focused on mangrove on mangrove biobelting and biosheltering (see Masagca anMasagca, 2010) mechanisms. Included is the provision for establishing

additional marine or mangrove protected areas (MPA) in the island province of Catanduanes. As an integrative model, SURMABIOCON consists of extension and community engagements (*Preparedness and Prevention*) guided by the interactions of structural and functional units in natural and social systems based on the experiences of the university and other cooperating institutions and organizations from 1999 (when SURMABIOCON was coined), continued from 2013 - 2015 (*formation years*) to 2016 to 2018 (*formulation years of the integrative model*) when funds of the Commission on Higher Education (CHED) National Agriculture and Fisheries Extension System (NAFES) was obtained by CSU.

2. Response and recovery (R2)

These components of the model include *Community Response through Typhoon Education* and *Post-Typhoon Recovery through Diversified Livelihood*. These components are carried out through appropriate technology infusion in inland fisheries production such as the CSTIFDP, integrated indigenous rice-fish production in CIRDEP and tilapia fish fortification and nutrient enrichment projects on post-harvest. The framework integrates citizen science in fisheries resource management for the governance of community protected marine spaces (CPMS) with Integrated Coastal Resource Management (ICRM), marine protected areas (MPA) for “mangrovization” (or mangrove restoration). Children, youth, women, educators, the local people, local government and other stakeholders are involved in this CHED NAFES funded SURMABIOCON program.

A home-grown SID-SIN-SEN scheme [*Stakeholder Identification (SID) -Stakeholder Inputs (SIN) -Stakeholder Engagement (SEN)*] was formulated (see Masagca et al., 2018), as well as a modified decision support system for small-scale multispecies marine fish hatchery; and other aquatic livelihood related protocols to ensure a sustainable island as a vision of the green university in Catanduanes.

Selected thematic components of SURMABIOCON R&D + CS innovation strategy (Masagca, 2018)

Initial experiences and best practices with the use of this Innovation Strategic Model in SURMABIOCON are described in selected integrative themes or scope in SURMABIOCON on Adopting Interactive Governance of Fisheries and Mangroves; Livelihood, Ecosystems and Poverty; *Introducing the “Q-Squared” Approaches*; Integrated Research Training Program in SURMABIOCON; and Kuroshio Science Integrative Concepts of Kochi University for future studies on Philippine Rise (Benham Bank) or Kalipung-awan in the Catandungan dialect; Science-Agro-Ecology (SAGE) Tourism Event.

1. Adopting interactive governance, climate change and disaster risks management theories

The idea of co-management has relied on the relationships of two systems, natural and social science systems. This is within Jentoft’s Interactive Governance Theory. The concept of local governance in the marine coastal resources and the importance of maintaining and enhancing awareness of the local dwelling communities through public awareness and education in this regard, remain to be inextricably linked with different initiatives to prevent and manage natural disasters (e.g. typhoons, tidal or storm surges, flooding, landslides and tsunamis).

Using the “Q-Squared” approaches

In studying the four components (Availability, Access, Stability and Utilization) and analyzing the dimensions of food security, the use of different approaches are necessary to better understand the issues of poverty, climate effects, wellbeing and wellness of the coastal and island communities. With the large body of literature emerging to promote a more systematic Integration of “quantitative” and “qualitative” or “Q-Squared” approach was used to the analysis of poverty alleviation in mangrove coastal dwelling communities. It is worthwhile and meaningful to apply the flourishing approaches in the Philippines and the rest of the ASEAN region as a response to Ravi Kanbur’s challenge: Do “Q-Squared” approaches add value for understanding and explaining poverty? A meta-theoretical literature analysis dealing with driving causes of food insecurity in the Philippines, the ASEAN or SE Asia and the Asia Pacific Region. Meta-analysis has become a widely acceptable research tool that encompasses a wide range of procedures applied in a variety of disciplines such as labor economics, environmental science, and transportation science (Zou, 2012). A meta-analysis provides solution to synthesize amount of studies and get to the essences of problems with at least as possible of little bias. It was Beecher (1995) who carried out the earliest example of a meta-analysis work and Glass (1976) was responsible for introducing the term “meta-analysis” to refer to a philosophy, not a statistical technique. According to Nijkamp and Pepping (1997-98), meta-analysis method started as a statistical procedure for combining and comparing research findings from different studies focusing on similar phenomena). A variety of terms were used to refer to “meta-analysis”, such as “meta-synthesis”, “synthesis review”, and some other as meta-theoretical analysis. A meta-theoretical literature analysis on FS and more specifically to answer the question: What makes Filipinos food insecure? The database of Science Direct of Scopus Elsevier was used here. Moreover, the relationships between FS and Biodiversity Conservation,

Climate Change, Nutrition, Agricultural Production, Wellbeing and Poverty reduction. A specific ocean governance tool known as Marine Protected Areas (MPAs) or Marine Reserves (MR) were also included considering the growing body of knowledge of this scientific area which may have significant impacts on the food security status in coastal and small island communities.

1. Integrated research training program (RTP)

This is a capability building component of the integrated SURMABIOCON model focusing on the science-based mangrove and beach forest rehabilitation and conservation. Most recent SURMABIOCON activity utilizes Zoological Society of London-Philippines protocol on mangrove seedling and transplantation using wildlings from mother trees of *Avicennia* and *Sonneratia*. The said research skills training session gathers undergraduate BSc students, MA/MAT students, faculty members and invited university alumni during Wednesday sessions similar with “KapihansaRiserts”. Initially carried-out in 2015, the training is a support initiative starting from the Writing of Scientific Papers course (3 units) and during senior level of the BS in Biology program study. This scheme can facilitate transition to labor market as a Student Assistant (SA) in research and as Research Aide and then as a Research Assistant in the university’s R&D Services. The program includes specialist subjects/courses, transferable skills training on writing, literature reviewing and retrieval of digital documents for research. Prior to the Thesis Defense in a Panel or within academic year (s) after enrolment at the end of the senior level.

In institutionalizing the RTP, a publication pre-print or draft for the BS in Biology student to be published in any CSU journals, CSU-CJR (CAS Journal of Research), the Research Digest and now the *Asia Pac J IslSust*. At least a pre-print is submitted to the Editor by the faculty member involved. Specific style sheets for thesis in the *Alpha*, *Beta* and *Gamma* research areas or programs must be in place.

2. Global change, climate change and disaster risks management

The risks of climate change are now giving heavy pressures on coastal marine ecosystems of the island province of Catanduanes on which many local communities depend. Over the past 50 years, the conversion of marine coastal areas like mangroves into fish ponds and industrial sites is a significant anthropogenic practice that will have long-term effects on the overall aspects of ocean and marine governance. The situation in the island is critical because of vulnerabilities to different natural disasters. The province (with its 11 municipalities) is always battered by tropical cyclones and storm surges due to its strategic location in the country's

"typhoon highway." Economic development has been considerably hampered and poverty remains to be a problem in the coastal dwelling communities. The island province is basically agricultural and local coastal dwelling people are engaged in both fishing and farming (e.g. abaca, root crops, home vegetable farming, swine, poultry production) as well as other small and sustainable economic activities. Completely surrounded by the Philippine Sea, and a little further off the Pacific Ocean, the island province has fishing grounds and mangrove areas found in Cabugao Bay and the Maqueda Channel that continue to be under pressure due to increasing industrial activities and other pollutant-producing activities in households and agricultural farms. Recognizing this situation, CatSU believes that there is a need to ensure sustainability, conservation and management of mangrove resources of Catanduanes through the intensified *school-community-government partnerships*. In response to the firm commitment of seasoned researchers at CSU.

3. Kuroshio framework and SURMABIOCON

As a collaborating university in SURMABIOCON, the vitality of developing a working model that harmonizes with Kochi University’s Kuroshio Science Program of Japan. Biodiversityconservation is an important tool to consider to maintain the richness of natural resources. Unfortunately many of the world’s mega diverse areas are experiencing biodiversity loss due to natural and anthropogenic influences. The Kuroshio Region has not escaped from this global phenomenon. Catanduanes Island, which is located at the forefront of Kuroshio Current faces species decline for the past years due to overexploitation accompanied by limited initiatives and directive guidelines. Many species are already threatened in this island from smaller siganid fish to large fishes and birds. The case of marine gastropod for example is biodiversity declining from the last 10 years (Aldea *et al.*,2015).

The Innovation Strategy of SURMABIOCON R&D + CS follow the framework of Kochi University Kuroshio Science program on global warming, climate and global change. The model puts premium on *Planning* before implementing (Acting) numerous community engagement activities that will render changes on the attitudes, values and perceptions of the local communities as to the importance of mangrove biodiversity and conservation to ensure a better life through a current research pillar on *Island Happiness IndexSAGE Tourism for Science Program, Publication and Innovation*. In support of the food security initiatives of SURMABIOCON, CSU has been regular holding of scientific meetings as part of the *science-agro-ecology (SAGE) tourism* as Philippine National Biodiversity Meeting (BIOME) running for the fifth time this October 15-17, 2018. During the fourth BIOME in 2014, the concept of integration was followed

when the “sandwiched” concept was followed through the International Symposium on BIOISLANDCULTURES with the sub themes on food security. This scientific meeting tourism is being held during the annual island cultural festival known as *Catandungan Festival* of the Catanduanes Provincial Government. BIOME 5 was held in 2018 and will again be held in 2020 as BIOME 6 with focus on mangrove crabs and mangrovization.

CONCLUSION

Ensuring the sustainability of small islands in the Philippines like Catanduanes could be realized following an integrative and holistic model through SURMABIOCON by having components on integrative thinking and practices embedded to provide instruction, research, extension and production functions of this rapidly expanding university. The integration across disciplines in addressing problems of the local coastal dwelling communities has been the focus of SURMABIOCON. Similar with international organizations and networks dealing with the global value of mangroves in disaster risks reduction or management, the model of SURMABIOCON as developed workable and feasible projects on the marine protected areas of the province following SID-SIN-SED as well as other decision protocol on the risks reduction of community leaders and MPA managers in planning implementing program for mangrove associations such as those that are experienced and being cascaded to LGUs and mangrove planters associations in the island utilizing funds from the CHED NAFES funded program for CSU SURMABIOCON. The on-going research and extension projects of Community Science Teachers for fisheries and mangroves conservation capitalizes on the integration of activities across disciplines. With the previous experience on inland fisheries technology infusion and integrated rice-fish projects, the integrative model of SURMABIOCON addresses the urgent concern on an integrative livelihood-mangrove-ecosystem and disaster reduction schemes currently under trialling expecting a more positive result after having some setbacks in carrying out the inland fisheries resource management projects without regards to the so-called Interactive governance theory cutting across the Natural Science and Social Sciences.

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