

## Symposium Proceedings

### Political ecology and social representations on inland fisheries and aquaculture in Catanduanes Island, Philippines

Jimmy T. Masagca\*, Minerva I. Morales, Aurora E. Araojo

Catanduanes State University, Virac 4800, Catanduanes, Philippines

#### Abstract

This paper presents the analysis on the political ecology of inland fisheries and aquaculture in Catanduanes island in Luzon, Philippines; and the social representations of people in the rural communities on diversifying livelihoods within climate change phenomenon. Threats on natural resource degradation and the Catanduanes State University's responses in tackling these issues and concerns by transforming the island province into economically viable agricultural and aquacultural production ventures are highlighted here. Finally, collaboration with the country's agriculture department and the fisheries/aquatic resources bureau and maximizing community-participation guided several R&D programs of the university's research thematic group "PISOG" or S.E.E.D. (Society, Environment, Economics and Development) for inter-/multi-disciplinary initiatives on water, energy, food and climate change for human security to attain the goals on poverty and environment.

Key words: rivers, inland fisheries, aquaculture, Catanduanes, Philippines, political ecology

#### INTRODUCTION

The Philippines is an archipelago of 7,107 islands covering 300,000 km<sup>2</sup> (30 million ha) of land and 1,830 km<sup>2</sup> of water. In recent years, the country is now facing crisis in the water resources and the need for concerted efforts to utilize these more efficiently is clearly becoming a high priority. Catanduanes island (found north of the Philippine Sea) have economically and ecologically important rivers, estuaries and coastal wetlands (REWs) that need to be managed sustainably. Sustainable development as a process in which present and future human needs can be satisfied without degrading the socio-environmental systems has to be emphasized in understanding poverty, equity and the over-all social well-being of rural communities dependent on the ecological functioning and ecosystem services of REWs.

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 important is the role of REWs in the country for sustained fish production to feed the growing population. In this island province, rapid decline of some fisheries due to excessive recruitment and less restrictive policies on extracting aquatic and fisheries resources in REWs. The advent of climate change phenomenon exacerbated these declining trends in some delicacies such as gobies, *Gobius* spp. ("kabonbon"), freshwater shrimps, *Macrobrachium* spp. ("urang") and the freshwater eels or "kasili" (*Anguilla* spp.). Other molluscan gastropods ("tibayong") also suffered the same fate of significant reduction in stocks in the major rivers of San Miguel and Bato in southeastern portion of the island.

This paper presents the analysis on the political ecology of fisheries and aquaculture in REWs of the island province of Catanduanes (Luzon) and social representations of people in the rural communities on diversifying livelihoods within climate change phenomenon. Threats on natural resource

---

\* E-mail: jtibarmasagca@gmail.com

degradation and the new state university's responses in tackling these issues and concerns by transforming the island province into economically viable agricultural and aquacultural production ventures are highlighted here. Finally, collaboration with the country's agriculture department and the fisheries/aquatic resources bureau and maximizing community-participation guided several R&D programs of the university's College of Arts & Sciences (CAS) carrying the thematic scope of "PISOG" or S. E. E. D. (*Society, Environment, Economics and Development*) for inter-/multi-disciplinary initiatives on water, energy, food and climate change for human security to attain the Sustainable Development Goals (SDG) on poverty and environment.

## APPLYING POLITICAL ECOLOGY AND SOCIAL REPRESENTATIONS

### 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 and Watts 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, 2009; Britton and Coulthard 2013) are to be observed in fishing communities of the island province of Catanduanes.

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 (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. In the present study, questions like

"Are the actions of the local people organizations, the academic institutions and other community groups contributing an asset to the inland fisheries resources? To what extent are these governmental agencies and People's organizations (POs) in effect causing more harm than good in the northeastern towns of Catanduanes? Are the NGOs, academic institutions helping the situation and for whose benefit? What are the roles of the government in the many issues on inland fisheries and aquaculture? Where do these groups stand?"

### 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 1) describing the predominant discourses on managing inland fisheries and aquaculture in REWs within the prospects of climate change; (2) analyzing the concepts of the local people (using a Barangay or village in a municipality as an example) in relation to the socio-nature found in the rivers and streams. Escobar (1996) claims that it 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 1999). 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 wellbeing. Mixed approaches of qualitative-quantitative

research methodologies with a sub-sample of different individuals, social groups and fisher-folks and farmers households together with documentary analyses were used gathering profiles of the community and the use of resources.

Included is a discussion of Barangay Hinipaan, Municipality of Bagamanoc in Catanduanesisland as an example of analyzing the socio-political reasons used in benchmarking for the conduct of programs on water, food, and environment. Certain aspects on the justifications of the local peoples' choices in relation to these programs and options for implementing these endeavors in the locality. Since collective action occurs in a political world and the social world (as viewed in the Social Representations Theory), the paper attempted to discover how the main players or participants in the sample barangay or village strive to understand how the world looks from two standpoints: (1) condition wherein extreme weather conditions occur or the signs of climate change; and (2) condition wherein there is the intensification of inland fisheries management and aquaculture. Moreover, some aspects were gathered on how the local people interact with one another and persuade the others to believe that cage aquaculture, gold mining and eco-tourism in the barangay can have benefits to the barangay, and to look outside their interests of utilizing the rivers and streams for food security.

### The geo-physical aspects of Catanduanes (from Carranza, 2010)

Catanduanes Island lies east of the southeastern leg of Luzon Island (Fig. 1) 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



Fig. 1. Catanduanes island, with respect to the Philippine archipelago. (from Google).

prospects Cu/Au. Geological formation described here as The Catanduanes Formation (Carranza, 2010) forms the stratigraphic basement of the island and is inferred to be Jurassic and consists mostly of strongly folded indurated sandstones and, in places, phyllitic schists and conglomerates (Miranda & Vargas, 1967). 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 volcaniclastic rocks.

### A river without fish: Managing inland fisheries and aquaculture of Hinipaan in Bagamanoc, Catanduanes (Philippines) within the prospects of climate change

#### THE BARANGAY (= VILLAGE)

Hinipaan belongs to one of the barangays of the Municipality of Bagamanoc (lat. 13° 53'00"; long. 124° 11' 00" to 124° 23' 00") which is in the outlying area. The municipality has a population of about 10,183 and its 18 barangays belong to the rural areas in the Philippines. While some of the barangays developed some modern semi-urban structures, some others, especially those which are seated in the outlying areas, remained to be completely rural. By the end of 2007 Hinipaan had 456 residents.

A success story of Hinipaan's barangay leader is well noted here. The Philippine Department of Social Work and Development (DSWD) KALAHI-CIDSS (*Kapit-Bisig Laban saKahirapan-Comprehensive and Integrated Delivery of Social Services*) program is the way the residents of Hinipaan in Bagamanoc united to build a durable, 116-meter river control project costing less than P3 million. Included in the figure is the barangay chairman Edwin de Leon (center) with KALAHI-CIDSS area coordinator David Villacorta and Bagamanoc Mayor Odilon Pascua.

Fieldworks done in Hinipaan, Bagamanoc intended to benchmark on the implementation fish, rice and mangroves or FIRM R&D of the only university in the island. These activities were carried out in April to May, early June, August in 2012 and January in 2013. Initially, the intention was to explore on the areas where to implement the projects under FIRM within three government-funded programs. While the focus was on the scientific criteria of fish cage aquaculture and the earlier papers on inland aquaculture site selection choosing the suitable sites with the assistance of the local people, the barangay officials, the contact persons and the mayor delved on the appropriateness of a barangay which is known to tilapia (family Cichliidae) fish culture in the mountainous area of Hinipaan.

We note with great interest as to the mayor's explanation on the best suited site considering several factors like (1) local

people's over-all acceptability of governmental programs, (2) riverine and freshwater areas which are found to be appropriate for cage and pen aquaculture, (3) presence of a cohesive community which can assist the CSU research team as shown in the local people's support for the KALAHI CIDDs program of the Social Welfare, and (4) the peace and order situation of the barangay, which is a component of the site evaluation protocol.

The difficulty in traversing the unending presence of damaged roads greeted the researchers. However, the freshness of the area in terms of the river systems, abaca planted land interspersed with acacia trees, yakal, narra and the other Philippine mahogany group of the Dipterocarpaceae introduced the research team. Upon reaching Hinipaan, we were greeted by a group of children and the local people. When the barangay captain and other leaders arrived to meet the team, the local people tended to have metamorphosed their initial reaction from slightly doubting appearance to a very friendly accommodating and welcoming stance, "this is a nice place, we suffer here but we do not mind... we have fishes, shrimps, small crabs, abaca, coconut and vegetables that we plant to be provide food for the *poblacion*..." (*says an elder, 78 years old*). He continued, "...even if there are typhoons, we are not worried about it... we have lesser number of people who are sick... even if the government does not come here to provide us with their programs, we can still survive..." (*translated into English from the local dialect*).

The research team was divided into groups according to the themes on livelihoods, river fishing, biodiversity conservation, indigenous rice, tilapia production in the upland, government programs, biophysical conditions, climate change, resiliency of local people, benchmarking and forecasting for sustainable inland fisheries and aquaculture.

During fieldwork, the research team members similar with Derman & Ferguson (2000) found themselves in agreement with Vayda & Walters' (1999) conclusion 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 remarkably productive freshwater systems of the immediate past in Hinipaan would be enough and plausible considering that this initiative is founded on the tenet of trust. It is therefore valid to agree that the most acceptable causal factor is political in the

rapidly deteriorating conditions of the rivers with the significant reduction of fish stocks and not so much with the phenomenon of climate change and extreme weather disturbances.

Based on the interviews, it appears that the actions of the local people organizations and other community groups contribute fairly as an asset to the inland fisheries resources. It is also worthwhile to note that the extent that these governmental agencies support the environment in effect causing more harm than good with the less restrictive and laxity in the implementation of policies and in the northeastern towns of the island. The local people are not aware of the various government programs on water, food and environment which they think have contributed to the rapid decline of fish stocks in the riverine systems. The research commodity of "water" will remain to be controversial as more rural populations depend on the rivers and mountain streams. The adoption of a human right to water framework (Gleick, 1999) was a concept that seems to be new to the local people but with the drying up of rivers and reduced flows lead them to believe that it is the right of the poor to be afforded with this resource specifically in drinking water.

### **Social representations on sustainable inland fisheries and aquaculture within the prospects of climate change**

Recent R&D efforts of this state university in the Philippines are within the thematic scope of S.E.E.D. that needs to be addressed by having water-related programs on fish, rice and mangroves (FIRM). The goal of alleviating 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 the fieldwork, representations of the upland/riverbank dwellers of Barangay Hinipaan were known and determination of their management behavior as inputs to decision and activity to adopt such inland fish culture 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 focus group discussions and one-on-one interrogation.

The following are the themes which the team derived based on the narratives.

#### INFLUENCE OF DEVELOPMENT AND GLOBALIZATION

Barangay Hinipaan as an isolated place is not free from the influence of development that are taking place in other places of the province and the country as well. Aside from the broadcast media or television and other print sources were known. When students from the university have the regular vacation from semestral breaks, it tended that teachers' inputs in the classroom about new ideas on development (e. g. *globalization* and *internationalization*) are most likely brought by these students to the place. Likewise, businessmen or middlemen of coconut products and abaca are most likely contributing to the creation of new knowledge.

#### EFFECTS OF CLIMATE CHANGE IN WATER PRODUCTIVITY

Local people are aware of the phenomenon that climatic conditions and extreme weather conditions are bringing substantial changes to the harvest in the marine waters 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 municipal waters for fishes due to bad weather, they rely mostly on the 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 of the island which they feel and confirm when buying little and fewer marine fish species available in the market or when the fish sellers bring the freshwater tilapia fish to the village instead of these truly marine finfishes.

#### 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 freshwater brachyuran (true) crabs of the family Varunidae, Sesarmidae and Grapsidae which move upstream and can be caught by the local people in larger number. When asked what could be the reason, the women said "*sobrang asgad tabi sasuba kaya uya nagasakat sa pataas ning pongko nahababa ang asgad*" (water in the estuaries are very salty and fishes, crabs migrate to the upstream). Migration patterns in the brachyurans particularly the *Varuna* spp. and grapsids are due to increasing salinity in the downstream and estuarine areas. The combined effects of salinity and temperature have something to do with the movements of riverine organisms near the mouth of the river and tended to also affect even the *Varunalitterata* and *Parathelphusa* spp. a truly freshwater crab. 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. Moreover, the timing of many animal migrations will be affected and have been observed by the local people in Hinipaan even women washing clothes in the rivers when interviewed by the researchers. The gastropod locally known as "tabagwang" (*Melanoides* or *Jagora*) situate themselves in the deeper profundal zones (Libtong) rather than the shallower portions of the embankments (also due to excessive extractions).

#### LOCAL MIGRATION, LIVELIHOODS AND ADAPTATION

The river bank communities and fisherfolks of Hinipaan are experiencing the effects of climate change in two ways: the rapid disappearance of freshwater organisms in the rivers tended to have driven them to upstream house locations and those who are far from the rivers tend to have decide to live near the river to collect more fish and crustaceans during difficult times. The frequency of typhoons although is not affecting the local residents due to resiliencies, the general observation indicates that the effects of climate change on inland waters can be seen in the unstable livelihoods and the changes in the availability and quantity of fish for food. Certain adaptive capacities of the local people can be seen in the various community assets like the bio-geo-physical features of the village. Looking into the microculture, such as the positive attitude to send their children to college studies in the island and Manila most likely developed the cohesive family with unified solutions to poverty brought about by many factors which will be the next focus of future studies. Adaptations of the local people appear to have not been constrained by culture. However, some current institutional and governance frameworks have to be reviewed to be truly responsive to the marginalized people in order to improve access to adaptive resources.

#### RESOURCE DEPLETION AND GOLD MINING

On the economic aspects, the local people believe that if these resources in the rivers and streams will be depleted due to over-exploitation and destroyed due to natural disasters, options like the alluvial or river gold mining will be acceptable as long as there is a limitation. The local people perceived positively on the prospects of getting Au/Copper deposits of the area. However, thematic analysis using social representation indicates there is a dichotomy as to the acceptability of the phrase gold mining. A total of 50 words were accumulated and listed from the responses as to whether Au/gold mining or precious chemical extraction will be done in Hinipaan if poverty will be intense. These words were subjected to the computation of tentative indices of polarity and neutrality (see methods in Social Representation theory) and it shows that the words are towards neutrality. This indicates that the local

people consider the importance of other industries in the locality. On the words associated with “gold mining”, the local people equate it with “destruction”, “death”, “income”, development, “swerte” (lucky) and prosperity.

#### CREATION OF A UNIVERSITY, MODERNIZATION AND ECO-TOURISM

It was noted that the new role of the state college (now a state university) as an intervening institution to explain among the neighbors about the dimensions of innovativeness and novelty in proposing some eco-tourism activities. 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 vacation) and the research team.

#### **A state university’s response in tackling an island’s natural stock depletion of fish, indigenous rice production and restrictive water management policies**

Within the notions of collaboration and maximizing community participation in Catanduanes island province, frequented by typhoons (hurricanes) the R&D initiative of *Aquatic Research and Development Consortium for Food and Environmental Security* with different programs were proposed and carried out in 2011 up to the present. These programs are on fish, rice and mangroves (FIRM) that centered on food and environmental security through the use of mature and sustainable technologies as a vehicle towards poverty alleviation in partnership with the farmers-fishers, women and youth. Most projects are *in-situ* and community-based technology assistance approach defined by the best suited technology/ies to the locality (location-specific approach) considering the agro-climatic uniqueness inherent to geographical location and climate change thereby generating sustained income to the marginalized sector of the island province. Aside from ensuring human security of the impoverished farmers-fishers, women (as the neglected sector) are being engaged in the post-harvest projects in processing and marketing of the fortified tilapia products to support women development initiatives.

The scientific community in the university involved in these water-related R&D initiatives have been delivering to the local communities the knowledge necessary that helped them assess the risks that island dwelling people is 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.

#### INLAND FISHERIES PROGRAM FOR REWS (RIVERS, ESTUARIES AND COASTAL WETLANDS)

The use of an inter- and multidisciplinary approaches in research, instruction and community services of this state university in the tropical developing country of the Philippines. The current R&D program on water, food and climate change are built on the foundation of participative, mentoring and trust following the research mentoring and participatory research scheme that involved the local people in generating knowledge within the lens of political ecology and the use of social representations. A wide range of social, political, ecological, economic and institutional aspects of Hinipaan are relevant to the implementation of this study on programs of managing the rivers and streams within the prospects of climate change. Projects such as the Community-Based Hatchery following the Lying-in Concept of the BFAR-CHED National Aquasilviculture (NAP) Models applied to freshwater systems and the River Cage Project of the Catanduanes Sustainable Technology Infusion in Inland Fisheries Development Program (CSTIFDP) 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 it is evident that the local people of Hinipaan are now 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.

Despite the caveats of climate change and over-exploitation, aquaculture in REWs Catanduanes in all likelihood remains to be important. The threats of climate change affecting inland fisheries resources are in turn driven by the local government efforts to transform the northeastern barangays like Hinipaan into economically viable aquatic agricultural systems production ventures in the rivers. The unique conditions of rivers and streams great potentials for aquaculture were noted. Local inhabitants believe that the

food fishes (and other aquatic organisms will just seek shelter in the deepest places (or natural reservoirs) known as “Libtong” (profundal zones) where bigger rocks are found surrounded with large tree trunks and boulders. The abundance of gobies, mullets, carps, freshwater shrimp, eel and gastropods among others is due to their own conservation efforts like controlled fishing, collection and simple fish extraction methods just enough for family consumption, and not using electricity for fishing. The addition of tilapias or intensification of tilapia in cages will be constrained as to the acceptability of the food fish among the local people. Extension of certain species for aquaculture is acceptable among the locals but they prefer mostly that the existing endemic species are used for aquaculture expansion and not the addition of some exotic species.

A conservation strategy on the captive breeding following the lying-in concept of a community-based hatchery is described in the succeeding section for further representation analysis. Moreover, another strategy is the practice of planting upland rice and vegetables in the mountain to avoid landslides aside from their regular practice of planting of trees like “narra”, “apitong” and other Philippine mahogany groups. For the point of view of the policy measures in managing the dwindling forest and inland resources of the barangay under study, the DENR and BFAR in tandem with academic institutions undertake more fieldwork for greater effectiveness.

The *Six-point Barangay Plan for the Sustainable Management of Inland Fisheries and Aquaculture within the Prospects of Climate Change*. This plan prepared by the technical working group of the university’s CSTIFDP Research Team consisted the following strategic components:

1. Designing of water-supply systems that can provide the needs of the changing river flow patterns in Hinipaan including increased flash floods, storm waters and mountain runoffs;
2. Adopting from a comprehensive, municipal-wide schemes to water management that will initially maintain adequate e-flows to preserve flexibility and build sustain resiliencies.
3. Constructing some water infrastructures in support of water supply for homes and agricultural needs or farm lots.
4. Restoring dried up streams that can provide flood storage and construct a Barangay Water Filtration system for safe drinking water sources of the local population.
5. Dismantling unnecessary structures and re-direct river flows that alter fish and crustaceans migrations from the midstreams to upstreams and from cooler to warmer waters as temperatures increase.
6. Developing a Captive Breeding Project in Natural Conditions through a Community-Based Hatchery (CBH) for inland waters following the *Lying-in Concept* (see guidelines of the

BFAR-CHED Philippine National AquasilvicultureProgram) for stock enhancement in the Rivers of Hinipaan.

INDIGENOUS KNOWLEDGE, INDIGENOUS RICE PRODUCTION FOR WATER CLOGGED AND NON-IRRIGATED AREAS; AND GLOBALLY INGENIOUS HERITAGE SITE (GIAHS) FOR INTEGRATED RICE-FISH PROGRAM

Rice is one of the most important food crops in the world, and staple for more than half of the global population (Maredia, 2012; Faroq et al., 2011). Its production must increase to meet future food requirements amid strong competition for limited resources (Laborte et al., 2012). Being at the heart of the food security programs, rice has to be produced sufficiently in the Philippines to feed its rapidly growing population. Taking the population growth into account and climate change effects, Catanduanes island has to increase its present output to contribute to this target of self-sufficiency in rice production. More importantly, cultural practices and indigenous knowledge when harnessed and used as anchorage for development projects have been proven to gain successes. It is within Bengwayan’s (2010) traditional rice varieties comeback within the notions familiarity, belongingness and sense of ownership of the endeavors that the Catanduanes Indigenous Rice Development Program (CIRDEP) was carried out by the university. This program aimed at focusing on the production of traditional rice varieties utilizing local knowledge as a vehicle towards poverty alleviation and food security. Indigenous varieties are underscored and marketed, among others, as health food. Likewise, matured rice production technologies are being re-introduced, infused and integrated to traditional rice farming production systems at the farmer’s level in order to increase production, income, achieve food security and contribute towards alleviation of poverty. Such systems are very special in terms of their ecological singularity and subsistence value and their conservation would invariably add to availability of food and protection of genetic diversity (Chandramohan & Mohanan, 2012). Recent studies show that traditional rice varieties should be conserved through the co-culturing of rice and fish (Xie et al., 2011). Traditional co-culturing of rice and fish is one of the five “globally important agricultural heritage systems” (GIAHS) that have been established by the FAO and are defined as: remarkable land-use systems and landscapes which are rich in biological diversity and have evolved from the adaptation of a rural community to its environment to realize socio-economic, cultural, and livelihood needs (Kooohanfkan and Furtado, 2004). This concept on GIAHS is found to be acceptable among small-scale farmers in the island current economic and cost and return analysis indicate convincing results that need to be re-evaluated and re-tested in areas where water-clogging and salinity intrusion in low lying

portions of rivers near estuaries of the island.

#### COMMUNITY-BASED MARINE MULTISPECIES FISH HATCHERY OPERATION IN THE ISLAND

The operation of the university's *Catanduanes Marine Multispecies Fish Hatchery*, funded by the Philippine Bureau of Fisheries and Aquatic Resources (BFAR) and the Commission on Higher Education (CHED) Philippine National Aquasilviculture Program (PNAP) supports the university's four-fold function of Instruction, Research, Extension and Production (IREP). This fish hatchery project is tackling the three benefits of (1) out of season production of aquatic organisms such as fish, crabs, shrimps and some mollusks (FCSM); (2) genetic manipulation or improvement, conservation and stock enhancement; and (3) reduction of high reliance to the wild-caught juveniles. This hatchery focuses on maintaining abundant FCSM populations for the purpose of providing greater harvest opportunities to fish farmers and traditional artisanal fishers of the island. The multispecies hatchery program relies on returning the wild adults that can be captured and artificially spawned to produce the next generation of different aquatic organisms.

After capture, adult FCSMs are to be kept in Natural Hatchery Set-up (Lying-in Concept) located and in outdoor/indoor holding tanks or earthen ponds at the hatchery facility until they are ready to be spawned. The females' eggs are harvested, fertilized and incubated using simple protocols and traditional techniques to maximize egg viability and perform some health and wellness strategies. Once the eggs hatch, the young FCSM are reared and fed at the hatchery larval and nursery rearing tanks or ponds until they are ready to be released back into the natural environment in rivers, estuaries and wetlands (REWs) where they can migrate to the ocean to live and grow.

#### MANGROVE RESTORATION FOR BIOBELTING/ARMORING FOR SUSTAINABLE COASTAL WETLANDS IN CATANDUANES ISLAND, LUZON

The sustainable governance of mangroves in the Philippines demands a more integrative approach and the application of recent trends in '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. Based on our inquiry we observed 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, geomorphological 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 an Ecoville 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.

## CONCLUSION

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) 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 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). 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 and mangrove reforestation for a greenbelt in Catanduanes island are 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. From the responses and thematic re-analyses it is evident that the local people of the island province have been experiencing the effects of climate change and extreme weather conditions. 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.

## ACKNOWLEDGEMENTS

The author acknowledges the inputs provided by the members of the CSTIFDP Research team composed of Profs. Sonia R. Sapico, Estrella Tribiana, Delia Sorra, Dr. Meda Mercado, Prof. Ma. Luz Floralde, Dr. Myrna A. Santelices, Mrs. Imelda Bernal, Prof. Judith Orsolino, Prof. Danny Murillo, Prof. Vincent Padilla, and the late Prof. Rey Soneja and Ms. Monette Tugay. Their assistance during the conduct of this ancillary study paved the way for the completion of this paper. Funding of the BFAR and the Congressional District of Catanduanes; the Department of Agriculture Regional Field Unit 5 for the indigenous rice cultivars (CIRDEP); and the BFAR-CHED PNAP is greatly appreciated. More importantly, we express profound thanks to the assistance of the municipal mayor of Baras, Hon. Odillon Pascua and the vehicle provided by the mayor of Panganiban, Hon. Robert 'Obet' Fernandez. The cooperation of Barangay Captain Edwin de Leon is greatly appreciated.

## REFERENCES

- Batterbury S. (2001). Landscapes of diversity: A local political ecology of livelihood diversification in South-Western Niger. *Ecumen* 8(4):437-464.
- Batterbury S., Forsyth, T. and Thomson, K. (1997). Environmental transformation in developing countries: Hybrid research and democratic policy. *The Royal Geographical Society*, 126-131.
- Bengwayan M. (2010). Indigenous People's Traditional Rice Varieties Making a Comeback. *KASAMA*, Vol. 24 No. 3 / July-August-September 2010 / Solidarity Philippines Australia Network.
- Berkes F. (1989). Cooperation from the Perspectives of Human Ecology. In F. Berkes (Ed.) *Common Property Resources: Ecology and Community-based Sustainable Development* (pp. 70-88). London: Belhaven Press.
- Blaikie P. (1994). *Political ecology in the 1990s: An evolving view of nature and society*. In a Paper presented at the Workshop on Political Ecology, 15-17 April, Centre for Advanced Study of International Development (CASID), USA.
- Britton J., & Coulthard, S. (2013). Assessing the social wellbeing of Northern Ireland's fishing society using a three-dimensional approach. *Marine Policy* 37: 28-36.
- Bryant R. (1992). Political ecology: An emerging research agendas in Third -World studies. *Political Geography* 11 (1): 12-36.
- Borras S.M., & Franco, J.C. (2010). Contemporary discourses and contestations around pro-poor land policies and land governance. *Journal of Agrarian Change* 10(1): 1-32.

- Carranza E.J.M. (2010). From predictive mapping of mineral prospectivity to quantitative estimation of number of undiscovered prospects. *Resource Geology* 61 (1): 30-51.
- Chandramohan K.T. and Mohanan, K.V.(2012). Kaipad rice farming in North Kerala-An indigenous saline resistant organic farming system. *Indian Journal of Traditional Knowledge* 11(1): 185-189.
- Derman B. and Ferguson, A. (2000). *The value of water: political ecology and water reform in southern Africa*. Paper for the Panel on Political Ecology for the Annual Meetings of the American Anthropological Association, San Francisco, November 15-19.
- Escobar A. (1998). Whose Knowledge, Whose Nature? Biodiversity, Conservation and the Political Ecology of Social Movements. *Journal of Political Ecology* 5: 53-82.
- Farooq M., Kadambot ,H.M., Siddique, H., Rehman, Aziz, T., Lee, D-J., and Wahid, A. (2011). Rice direct seeding: Experiences, challenges and opportunities. *Soil and Tillage Research* 111(2): 87-98.
- Glass J.H., Scott, A.J., & Price, M.F. (2013). The power of the process: Co-producing a sustainability assessment toolkit for upland estate management in Scotland. *Land Use Policy* 30: 254-265.
- Gleick P. (1999). The human right to water. *Water Policy* 1: 487-503.
- Halide, H., Stigebrandt A., Rehbein, M., & McKinnon, A.D. (2009). Developing a decision support system for sustainable cage aquaculture. *Environmental Modelling & Software* 24: 694-702.
- Koohanfkan P. & Furtado, J. (2004). Traditional rice-fish systems as globally indigenous agricultural heritage systems (GIAHS). *International Rice Commission Newsletter* 53: 66-74.
- Laborte A.G., de Bie, C.A.J.M., Smaling, E.M.A., Moya, P.F., Boling, A.A., Van Ittersum, M.A. (2012). Rice yields and yield gaps in Southeast Asia: Past trends and future outlook. *European Journal of Agronomy* 36(1): 9-20.
- Maredia M.K., & Raitzer, D.A. (2012). Review and analysis of documented patterns of agricultural research impacts in Southeast Asia. *Agricultural Systems* 106: 46-58.
- McGregor, J.A. (2007). Researching wellbeing: from concepts to methodology. In: I. Gough & J.A. McGregor (eds.), *Wellbeing in Developing Countries: From Theory to Research*. Cambridge: Cambridge University Press.
- Moscovici S. (1961). La Psychanalyse, son image et son public. *Revue Française de Sociologie* 2 (4): 328-330. (Translated into English).
- Moscovici S. (1980). Toward a Theory of Conversion Behaviour. In L. Berkowitz (Ed.) *Advances in Experimental Social Psychology* (vol. 13). New York: Academic Press.
- Peet R., Watts, M. (1993). Introduction: development theory and environment in an Age of Market Triumphalism. *Economic Geography* 69(3): 227-253.
- Peet R. and Watts M. J. (1996). *Liberation ecologies: environment, development, social movements*. New York: Routledge.
- Pohl C., Zimmerman, S., Fry, A., Gurung, P., & Schneider, G. S. (2010). Researchers' roles in knowledge co-production: Experience from sustainability research in Kenya, Switzerland, Bolivia and Nepal. *Science and Public Policy* 37(4): 267-281.
- Reed M.S., Bonn, A., Slee, A., & Behary-Borg, W. (2009). The future of the uplands. *Land Use Policy* 26(5): 5204-5216.
- Shrestha K. K. (2005). *Collective action and equity in Nepalese community forestry*. Doctoral Dissertation, University of Sydney, Australia.
- Stott P., & Sullivan, S. (2000) Introduction. In: P. Stott & S. Sullivan (eds.), *Political Ecology: Science, Myth and Power* (pp. 1-14). Arnold Press, London.
- Sutton M. Q. and Anderson E. N. (2004). *Introduction to Cultural Ecology*. Altamira Press, California.
- Robbins P. (2004). *Political ecology: a critical introduction*. New York: Blackwell Publishing.
- Vayda A. P. and Walters B. B. (1999). Against political ecology. *Human Ecology* 1(27): 169-179.
- Xie J., Wu X., Tang J., Zhang J.J., Luo S., and Chen X. (2011). Conservation of Traditional Rice Varieties in a Globally Important Agricultural Heritage System (GIAHS): Rice-Fish Co-Culture. *Agricultural Sciences in China* 10(5): 754-761.