Assessment of Conservation Programs in Aquatic Ecosystems Traversing Pampanga River

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The conservation programs implemented in the aquatic ecosystems traversing Pampanga River were assessed based on the following parameters: protection of the environment, change in social behavior, economic benefits from resource use, and policy formulation. Assessment of the outcomes of the conservation programs revealed that local communities' involvement in policy regulation was a significant predictor of the improvement of the river and its biodiversity. Mangrove reforestation was a significant conservation program on improving local communities' overall well-being. In terms of increasing the awareness of local communities through the conservation programs, capability building was an essential aspect. Lastly, in terms of enforcement of and compliance to policy regulations, the mangrove reforestation program was a significant conservation effort intended for the formulation of new policies. For policy makers, environmental agencies, NGOs, and other stakeholders, it is important to consider the involvement of local communities in river management, and mangrove conservation and reforestation programs. Local communities should also participate in capability building programs and policy regulations or patrolling.

Keywords: Mangrove reforestation, clean-up drives, policy regulation

INTRODUCTION

The Philippines is one of the world's largest archipelagos. It consists of 7,641 islands and has an estimated 36,000 km of coastline. It has a total territorial water area of 2.2 million square kilometers, of which 266,000

square kilometers are coastal waters and 1.9 million square kilometers are oceanic.

The country's water supply comes from different sources which include rainfall and surface water resources, i.e., rivers, lakes, reservoirs, and groundwater resources. According to the National Water Regulatory Board (NWRB), the country has 18 major river basins and 421 principal river basins. The total available freshwater resource is at 145,900 MCM/year based on an 80 percent probability of surface water, while groundwater recharge or extraction is at 20,000 MCM/year (NWRB-SPM, 2003; PEM, 2003; ASEAN, 2005, as cited in Greenpeace Southeast Asia, 2007).

Pampanga River is the second largest river in Luzon. It crosses the plains of Central Luzon, and it traverses the provinces of Nueva Ecija, Pampanga, and Bulacan. The river has a total length of 260 kilometers. The headwaters of Pampanga River come from the mountains of the Sierra Madre and drains via the Lanbangan Channel and into Manila Bay. The river has small branches that empty to several fishponds particularly in the town of Candaba. Moreover, Pampanga River provides irrigation to about 363,246 hectares of farmlands in the provinces of Nueva Ecija, Pampanga, and Bulacan (Arbotante et al., 2015). The upper reaches of the river are fit for municipal use, while the lower reaches of the basin are used primarily for irrigation (Kurian, 2004).

The upper reaches of the Pampanga River are endowed with the Pantabangan-Carranglan Watershed Forest Reserve (PCWFR) by virtue of Proclamation No. 561 in May 21, 1969, which established the reserve's boundaries and protecting the area for watershed purposes. The PCWFR borders the Sierra Madre and Caraballo Mountains in Aurora and Nueva Vizcaya. This watershed covers 84,500 hectares (209,000 acres) of the drainage basin surrounding the Pantabangan Lake, an impoundment of the Pampanga River by the Pantabangan Dam. Supplying water to the dam are two rivers that meet at the municipality of Pantabangan: the Pantabangan and Carranglan Rivers (Galvez, 1984). The Carranglan River originates from the Caraballo on the north, while the Pantabangan River originates from the Sierra Madre on the east. In Central Luzon, the PCWFR is considered a critical watershed for the agricultural economy and hydroelectric power generation (Lasco, Cruz, Pulhin, & Pulhin, 2010).

Numerous conservation programs have been implemented to conserve

and protect the aquatic ecosystems in Pampanga River. A recent initiative is the Coastal Resources Management Program (CRMP) which involves reforestation of mangrove areas and protection of old-growth mangrove forests within the coasts of Bulacan and Pampanga. The program provides support to the Manila Bay Coastal Strategy for the conservation of critical marine habitats and biodiversity through the following activities: coastal resource assessment, mapping, and database development; formulation of Coastal Zone and Sea Use plans; establishment of coastal and marine sanctuaries; monitoring and law enforcement, and policy support; and capacity development and IEC. In 2004-2008, about 85 ha of new mangrove forests were established, and 170 ha of old growth mangrove forests were maintained and protected (DENR-EMB, CDC, PPDOs, 2008-2009, as cited in NWRB, 2011).

The NIA-UPRIIS's Watershed Management Program, which started in 1997, is a continuing collaborative undertaking by the NIA-UPRIIS, DENR, and organized POs and cooperatives. These entities co-manage the 10,356 ha of Pantabangan-Carranglan Watershed Forest Reserve (PCWFR). The program includes maintenance of established timber plantations and agro-forests, and protection activities such as patrolling, surveillance, monitoring, and fire management. About 100 ha of the Pantabangan-Masiway watersheds has been rehabilitated by the NIA-UPRIIS in cooperation with the Energy Development Corporation (DENR-EMB, CDC, PPDOs, 2008-2009, as cited in NWRB, 2011).

NPC'S Watershed Management Program, which started in 1995, is a continuing initiative that manages the watersheds supporting two hydro-electric dams in the basin (i.e., Pantabangan and Angat WFRs) through the environmental charges collected from power consumers. In partnership with organized community volunteers, this program involves forest protection such as patrolling, surveillance, and apprehension of violations. In 2008, a total of 90 ha in Pantabangan-Carranglan WFR and 130 ha in Angat WFR were planted (DENR-EMB, CDC, PPDOs, 2008-2009 cited in NWRB, 2011).

Designed to double the forest cover of Pampanga river basin from 24% to 48%, the Pampanga River Basin Rehabilitation Project (PRBRP) was undertaken from 2004 to 2008 in response to flood events in the Pampanga River Basin. The program involved the CBFM beneficiaries who were contracted to undertake the reforestation and maintenance activities. In

2008, a total of 10,075 ha was established through tree plantation, while 5,766 ha was maintained and protected, benefiting a total of 62 POs (DENR-EMB, CDC, PPDOs, 2008-2009 as cited in NWRB, 2011).

The Integrated Research and Development Program on Biodiversity Assessment and Conservation of Selected Forest Ecosystems in Central Luzon (2011-2015) was undertaken by Central Luzon State University and other agencies in the Carranglan Watershed, Bataan, Bataan Natural Park, and Baler Forest Reserve. The program aimed to assess the diversity and status of plant and animal resources; develop green technology from biological resources; and promote conservation, management, and sustainable use of these resources (Paz-Alberto et al., 2016).

Bangkung Malapad, now known as the Sasmuan Bangkung Malapad Critical Habitat and Ecotourism Area (SBMCHEA) was also established in Brgy. Batang II, Sasmuan, Pampanga. PENRO Pampanga identified Bangkung Malapad mudflats as a critical habitat ecotourism area for its enormous migratory birds. The SBMCHEA is a mangrove islet formed by volcanic sediments. Conservation activities included regular clean-up, restoration, and mangrove planting (Samuan Municipal Agriculture Office, 2017).

First Gen Hydropower Corporation involvement in conservation programs in Pantabangan and Carranglan areas is through biodiversity monitoring and conservation. First Gen is a subsidiary of First Philippine Holdings Corporation (FPH), one of the oldest and largest conglomerates in the Philippines. First Gen's main interest is in power generation, power distribution, infrastructure, manufacturing, and property development. In cooperation with the LGUs and local communities, First Gen has supported community development projects that address economic, socio-cultural, health, education, and environmental concerns. As financial benefits to local communities within their area, First Gen allocates Php0.01 per kilowatt-hour of their total electricity as mandated by the implementing rules and regulations of Republic Act No. 9136, otherwise known as the Electric Power Industry Reform Act of 2001 (EPIRA), and Energy Regulations No. 1-94 of the Department of Energy (DOE). The financial benefits are devoted to electrification, development and livelihood, or reforestation, watershed management, health and /or environment enhancement projects identified by LGUs as directly beneficial to the local communities. In addition, First

Gen also collaborates with various NGOs to develop and implement projects that have a significant impact on environmental conservation and education (First Gen Hydropower Corporation, n.d.).

The Manila Bay Coastal Strategy is a continuing Supreme Court mandamus that provides a comprehensive environmental management framework. The strategy covers the social, economic, and environmental aspects of Manila Bay in relation to people's values and the threats that impair those values. The coastal strategy provides a comprehensive environmental management framework, targeted outcomes, and a series of action programs involving the participation of both government and non-government sectors. This coastal strategy covers about 1,800 km2 surface area of the Manila Bay and the surrounding watershed areas of 17,000 km2 (Partnership in Environmental Management for the Seas of East Asia [PEMSEA], 2001). Under the operationalization of the coastal strategy, the Manila Bay Rehabilitation Project (MBRP) was formulated and is being implemented. The MBRP covers the Manila Bay Region such as Region 3, Region 4A, NCR, and Part of Nueva Vizcaya. Through its management interventions, MBRP aims to identify at least one area as a critical habitat; review Protected Areas (PAs) Management Plans of selected priority Pas in the Manila Bay Region; raise coastal community's awareness on protection and management of marine resources; and review the implementation of the Integrated Coastal Management (ICM) Plans as well as assess DENR issued Tenurial Instruments in the Manila Bay Region. The project has formulated four outcomes, namely, (a) identification and mapping of critical habitats in Manila Bay region, with the help of various management interventions from DENR Field Offices concerned, in cooperation with the LGUs; (b) increased awareness of PA Management Boards on the importance of water quality and quantity, as part of the Protected Area Management Plans of priority PAs in the Region (PCWFR, BNP, MPMGPL, MBSCPL and HTPL); (c) increased awareness and knowledge of coastal communities regarding the management of Marine Turtle, Macrobenthic Community, and Avi-fauna; (d) promotion of organic farming in the selected eighteen; and (e) DENR issuance of tenurial instruments in the Manila Bay Region (BMB, n.d.).

Outside the Philippines, conservation programs have also been implemented. In Indonesia, Sriyana (2018) noted that river conservation practices were solely depending on social engineering, and cultural, economic,

and environmental approaches without considering law enforcement. Meanwhile, Yun et.al (2017) reported that a transboundary river like the Mekong River, which has six riparian states, and different imperfect and impertinent water legislation and policies, had established conventions and agreements which included Joint Declaration of Principles for Utilization of the Waters of the Mekong Basin, Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin, The Greater Mekong Sub-Region Economic Cooperation Program Strategic Framework, and the Kunming Statement. However, establishments of these conventions and agreements did not have legal standing and were not signed by all six riparian countries. As result, a comprehensive water pollution management was difficult to achieve (Yun et al, 2017).

In southeastern part of Europe, particularly in Romania, an integrated basin-level approach has been used for many decades. A River Basin Water Agency (ABA), which is tasked with water resources management planning and implementation, and operation of large facilities, has been established in each of its 11 internal river basins (The World Bank Europe and Central Asia Region, 2014). In the western context, Duffy (2011) has stated that one of the several programs implemented by the United States Department of Agriculture (USDA) was the Wetlands Reserve Program (WRP). WRP had resulted in the restoration of approximately 29,000 hectares in California's Central Valley (CCV) and roughly 12,300 hectares in Oregon's Upper Klamath River Basin (UKRB). These water resources were agricultural dominated landscapes that had experienced extensive wetland losses and hydrological alteration. Restored habitats in the CCV and UKRB were thought to provide a variety of ecosystem services, but the actual benefits from these services were not known. The study considered ecosystems services in the assessment of conservation programs. Ecosystem services used were as follows: soil and vegetation nutrient content, soil loss reduction, floodwater storage as well as avian, amphibian, fish, pollinator use, and habitat availability.

It is evident that conservation programs and initiatives have focused on the management, conservation, and protection of Pampanga River. Majority of the programs and initiatives are geared towards people empowerment, resource protection, conservation, rehabilitation, and sustainable management. Various stakeholders such as the national

government, local communities and government units, fisherfolks, and others continuously help in the conservation, management, and protection of Pampanga River. Moreover, there is an ever-increasing concern for the conservation, management, and protection as evidenced by the promulgation of conservation of programs related to aquatic ecosystem. However, the sustained involvement and commitment of local communities might be influenced by factors such as incentives, grants, financial support, and others. It was in this context that this study was conducted in order to assess the conservation programs on aquatic ecosystems traversing the Pampanga River.

METHODOLOGY

The study covered five selected areas where river and mangrove ecosystems traverse Pampanga River. These areas were as follows: (a) Upper portion of the Pampanga River (i.e., Barangay Conversion, Pantabangan, Nueva Ecija, and Barangay Bunga and R.A. Padilla, Carranglan, Nueva Ecija; (b) Middle portion: urban ecosystems in Cabanatuan City, Nueva Ecija; and (c) Lower Portion: Sasmuan, Pampanga and Calumpit, Bulacan. The study was conducted from April 2018 to December 2018.

The different local communities living near the Pampanga River and its tributaries comprised the respondents of this study. The respondents were selected through a stratified two-stage random sampling method. The researcher-designed questionnaire used in data gathering was pre-tested among selected members of the People's Organizations in Barangay Tapil Bunga, Carranglan, Nueva Ecija.

Descriptive statistics such as frequency counts and percentages were used in describing the data. The Chi-Square using Cramer's V coefficient was used to analyze the association between categorical variables. The hypotheses were tested at 1 and 5 percent level of significance. Binary logistic regression analysis was used to predict the likelihood of the improvements in the environment, social, economic, and policy formulation of the outcomes of the different conservation efforts. Outcomes were analyzed using the SPSS.

Factors and Sub-Factors Associated with the Different Conservation Programs

The factors and sub-factors that were considered to be associated with the conservation programs are presented in Table 1. These conservation efforts were perceived to be associated with the following factors: protection of the environment; change in practice of the local communities; economic benefits from resource use; and formulation, amendment, revision, and termination of environmental laws. Under each factor, sub-factors were formulated and were used to measure the strength of association between the conservation programs and their outcomes. The sub-factors were classified according to the following aspects: improvement of ecosystem and biodiversity; improvement of the overall well-being of communities; improvement in the distribution of economic benefits from resource use; increased awareness of environmental resources conservation; change in behaviors for the improvement of species, habitat conservation, and policy formulation, amendment, revision, and/or termination.

Table 1
List of Factors and Sub-factors Perceived to Have Association with the Different Conservation Programs

Factors	Sub-Factors
RIVER Protection of the Environment Environmental Aspect: Improve Ecosystem and Biodiversity	• Improvement in the quality of water • Improvement in the flow of water • Presence of wildlife in the river which indicate that the river can still support wildlife • Improvement in the overall condition • Numerous fish compared to 5 years ago • Conservation programs increased population of fishes • Presence of algae floating in the river giving life to other species • Underwater grasses that thrive in the river • Abundant population of clams, mussels, and other invertebrates in the river • Birds feeding on the river's fish and invertebrates • Presence of fish species that were not seen for many years • Massive sedimentation and erosion, making the river narrow

MANGROVE Protection of the Environment Environmental Aspect: Improve Ecosystem and Biodiversity	• Improvement in mangrove forest cover • Improvement in productive capacity of timber • Trees as product product of conservation • Improvement in soil quality • Benefit on wildlife • Improvement of overall condition • Growth of trees in the mangrove areas, making the wildlife multiply • Presence of wildlife which indicate that the mangrove can still support wildlife • Presence of same species • Presence of numerous birds thriving in the mangrove • Presence of lots of insects in the mangrove
Economic Aspects: Economic Benefits from Resource Use	• Getting enough income from the use of natural resources • Being able to send children to school through the income coming from the use of natural resources • Needing extra job that is not dependent on natural resources • Being satisfied with earning from the use of natural resources • Being paid for planting trees • Engaging in nursery management and seedling production and being paid for it • Getting additional income through my active participation in the organization • Having access to the use of natural resources • Being allowed to engage in selective tree cutting • Being allowed to fish in the river • Being allowed to get water from river for irrigation
Change in Practice of the Communities Social Aspect: Increased Awareness on Environmental Resources Conservation	• People who are engaging in electro-fishing • People who are not segregating their waste • People who hunt wildlife • Communities that are poaching timber • People who are dumping waste anywhere • Industrial discharge to the river • Urban land development • Soil erosion from farmland • Industrial discharge to agro-ecosystem
Change in Behaviors to Improve Species and Habitat Conservation	• "I engaged in conservation practices that contribute to the protection and conservation of the environment." • "My activities in the land/water-bodies does not make much difference in overall condition of the environment." • "If I wanted to, I have the ability to change the way I used resources to protect the environment." • "I have the knowledge and skills I need to use conservation practices." • "Farmers/fishermen/local communities in my community have the ability to work together to change land/river use practices." • "My community has the leadership it needs to protect the environment."

Policy Formulation	• There are new ordinances that have been formulated and enforced in the community. • There are ordinances/laws that have been amended. • There are ordinances/laws that have been revised. • There are ordinances/laws that have been terminated.

RESULTS

The Study Area: Pampanga River

The Pampanga River Basin has a total area of 11,195.17 km2 spanning five regions (i.e., Region I, II, III, IV-A, and NCR) and traversing the provinces of Pangasinan, Nueva Vizcaya, Zambales, Tarlac, Pampanga,Nueva Ecija, Bulacan, Bataan, Aurora, and Rizal. The basin covers about 101 municipalities constitued by 2,109 barangays. The area also includes seven rivers namely Pampanga, Angat, Peñaranda, Coronell, Pantabangan, Rio Chico, and Pasac Rivers.

Description of the Aquatic Ecosystems

Providing livelihood to the communities and irrigation to their farms, the river ecosystem was found in all of the study areas. The ecosystem was rich in different fish species, crustaceans, mollusks, and other invertebrates. Table 2 shows the characteristics of the sites covered.

Table 2
Characteristics of the Various Sites Covering Aquatic Ecosystems of the Pampanga River

CLASSIFICATION OF THE AREA	STUDY AREAS					
	Brgy. Conversion, Pantabangan, Nueva Ecija	Brgy. R.A. Padilla & Bunga, Carranglan, Nueva Ecija	Brgy Sta. Lucia & Meyto, Calumpit, Bulacan	Brgy. Batang II Sasmuan, Pampanga	Brgy. ValdeFuente & Mabini Homesite, Cabanatuan City	Brgy. Sumacab Sur & Norte, Cabanatuan City
Forest Ecosystem	Yes	Yes	None	None	None	None
Mangrove Ecosystem	None	None	Yes	Yes	None	None
Near a River System	Yes	Yes	Yes	Yes	Yes	Yes
Near a Watershed	Yes	Yes	None	None	None	None
Near a Bay or Estuary	None	None	None	Yes	None	None

Presence of Livestock/ Poultry Areas	Yes	Yes	Yes	Few	Few	Few
Presence of Agro-Ecosystem	Yes	Yes	Yes	None	Yes	Yes
Next or Near Industrial Areas	None	None	Yes	Yes	None	None
Aquaculture	None	None	Yes	Yes	None	None
Urban Area	None	None	None	None	Yes	Yes
Presence of:	None	None	None	None	Yes	None
Buildings						
Transportation networks	Rough road	Cemented & rough road	Yes	Yes	Yes	Yes
Modified Surfaces such as Parking Lots, Roofs, and Landscaping	None	None	Yes	Yes	Yes	Yes
Residential or Housing	Yes	Yes	Yes	Yes	Yes	Yes
Industrial, Commercial, and Transportational Uses	None	None	Near to commercial and industrial areas	Next to industrial areas	Presence of commercial areas	Presence of commercial areas
Major Forest Type	Dipterocarp, mossy and pine forest, grassland	Dipterocarp, mossy and pine forest, grassland	Presence of mangrove forest (sasa)	Mangrove Forest	None	None
Endangered, Threatened, Rare Species	Wild boar/ deer, wild chicken, bayawak, Bignay, Binayoyo, Tibeg, Akleng Parang	Wild boar/ deer, wild chicken white and red lauan, Phil. Eagle, white and red lauan, Philippine Bulbul and King Fisher	Sasa	-	-	-
Harvested in the Area	Different kind of vegetables, palay, fruits, fish	Different kind of vegetables, palay, fruits, fish	Different kind of vegetables, palay, fish	Fish, crustaceans	Different kind of vegetables	Different kind of vegetables
Other Uses of the Forestland/Aquatic areas	Education/ Tourism (minimal)	Education/ Tourism (minimal) Source of livelihood	Recreation-Fishing Contest Source of livelihood	Eco-Tourism/ Recreation/ Education Source of livelihood	Irrigation/ quarry Source of livelihood	Irrigation/ quarry Source of livelihood

Source: Focus Group Discussions and Key Informant Interviews

Participation in Conservation Programs and Initiatives

As shown in Table 3, the study determined the participation of the respondents in different ecosystem and biodiversity conservation programs, capability building, information campaign using IEC materials, and policy regulation.

Ecosystem and Biodiversity Conservation Programs

Clean-up drives and mangrove reforestation programs were the main conservation programs participated in by local communities (Table 3). About 36% of the respondents participated in the clean-up drives. Based on the survey, the respondents from Bulacan and Pampanga participated in the river clean-up drives that were part of the Manila Bay Clean-up Rehabilitation and Preservation Program. As members of BFARMC, respondents from Bulacan and Pampanga were encouraged to participate in cleaning the river. This was a regular activity conducted once every month. In Bulacan, reports of the monthly conduct of river clean-up were submitted to Municipal's DILG. In Pantabangan and Carranglan, only a few respondents were aware of the river clean-up drives. The respondents were seldom engaged because they were in the mountain most of the time. Moreover, female members of the Rural Improvement Club in Cabanatuan City reported that river clean-ups were conducted in their area, but these were mostly participated in by men. Women were the ones cleaning the barangay premises.

Table 3
Number of Participants in the Different Conservation Programs, Capability Building Programs, Information Campaign Using IEC Materials, and Policy Regulations

CONSERVATION PROGRAMS	Freq.	%
Ecosystem and Biodiversity Conservation Programs		
River clean-up drives	72	35.82
Monthly clean-up drives	-	-
Mangrove reforestation program	30	14.93
Capacity Building Programs and Information Campaign using IEC Materials		
Capability building programs	40	19.9
Information campaign using IEC materials	89	44.28
Policy regulation/ patrolling	16	7.96

The mangrove reforestation program was participated in by about 15% of the respondents (Table 3). Based on the survey results, majority of those involved in the mangrove reforestation program were from Sasmuan, Pampanga. They were involved in planting mangroves in the SBMCHEA area. The respondents were paid for their involvement in this mangrove reforestation program. As reported by one of the key informant barangay counselors from Sasmuan, Pampanga, the program participants collected, propagated, and planted seeds of mangroves in the protected area. At the time, they were being paid about P2.00 per seedling. However, since the propagation of mangrove seedlings is seasonal, it could only be done during the summer season. In addition, based on the survey, only a few respondents from Bulacan participated in sasa planting. Sasa is a species of mangrove that thrives in the river area in Bulacan. During the survey, respondents did not mention that they were paid for the activity. Unfortunately, the respondents reported that the sasa they had planted were washed-out by water coming from the river, and some of the plants were damaged by the riprap construction activity.

Capability Building Programs and Information Campaign using IEC Materials

Some of the respondents (20%) participated in the capability building programs (Table 3). As gleaned from the survey, the LGU in Sasmuan, through its Municipal Agriculture Office, was able to provide training-seminars on bantay bakauan, fish processing, bantay dagat, wetland conservation, and fishery law enforcement. Similarly, in Bulacan, the Municipal Agriculture Office provided trainings on fish handling or processing, technology training on aquaculture, and banca mo gawa mo project. An orientation seminar for fish vendors was also conducted. In addition, a key informant barangay counselor from Sasmuan, Pampanga reported that those who were involved in the mangrove reforestation program were provided with the necessary training on mangrove plantation, maintenance, and management.

Only about 44% of the respondents were involved in the information campaign using IEC materials. According to the Municipal Agriculture Office of Calumpit, Bulacan, brochures/flyers on *Batas o Alituntunin sa Pangangalaga ng Alimasag, Balik Sigla sa Lawa at Ilog* (BASIL), *Mga Paglabag*

at Akibat na Kaparusahan Ayon sa Naamyendhang Batas Pangisdaan, Malinis at Masaganang Karagatan were distributed to the members of BFARMCs. An agricultural or aquaculture technician/agent was also active in providing assistance to farmers/fisherfolks in their barangays. Furthermore, according to the Municipal Agriculture Office of Sasmuan, Pampanga and based on the key informant interview with the tourism officer, the following information campaign IEC materials were used: flyers, brochures, posters, wall calendars, billboards, video clips, barangay lectures, and dalaw-turo. Topics included solid waste management and policy regulations, among others.

Policy Regulation

Only 8% of the respondents were involved in policy regulation (Table 3). As derived from the key informant interviews, only a few of the respondents were patrolling the area of SBMCHEA in Sasmuan, Pampanga. There were also a few respondents who were tasked to guard the protected area. In addition, the key informant barangay counselor reported that CCTVs were installed in the protected area. Visits to the area should be pre-arranged with the tourism officer. A minimal entrance fee was collected in order to maintain and finance the patrolling and guarding of the area. Visitors were required to clean the area and were prohibited from leaving any trash. The key informant also reported that fishermen were not allowed to fish inside the protected area. Cutting of mangrove was also strictly prohibited. However, in terms of policy regulation in the river, the key informant reported that there was no *Bantay Ilog* in their barangay during the time of the survey. He mentioned that only the barangay officials were patrolling the river and enforcing the laws.

Protection of the Environment: Improved Ecosystem and Biodiversity

River ecosystem. Respondents dwelling in areas near the river were involved in mangrove reforestation programs, clean-up drives, capability building programs, information campaign using IEC materials, and policy regulations. Table 4 shows the measures of association, using Cramer's V, between improvement in aquatic ecosystem (i.e., the river) biodiversity and local communities' involvement in different conservation efforts.

Table 4

Sub-factors with Significant Association with Improvement of Aquatic Ecosystem and Respondents' Participation in Conservation Programs Using Cramer's V

Conservation Programs	Sub-factors	
	River	Mangrove
Ecosystem and Biodiversity Conservation Programs		
Clean-up Drives	quality of water, flow of water, presence of wildlife, overall condition, numerous fish compared, increased population of fishes, presence of algae, presence of underwater grasses, presence of clams, mussels, and other invertebrates, birds feeding on the river, presence of fish species that were not seen for many years, and presence of invasive species	mangrove forest cover
Mangrove Reforestation Programs	numerous fish, increased population of fishes, and presence of clams, mussels, and other invertebrates	mangrove forest cover, trees are product of conservation programs, and improvement in soil quality
Capacity Building Programs and Information Campaign using IEC Materials		
Capability building programs	quality of water, flow of water, presence of wildlife, river overall condition, numerous fish	None
Information campaign using IEC materials	wildlife, overall condition, increased population of fishes, presence of algae, and presence of clams, mussels, and other invertebrates	None
Policy regulation/ patrolling	numerous fish, increased population of fishes, presence of algae, presence of underwater grasses, presence of clams, mussels, and other invertebrates, and birds feeding on the river	mangrove forest cover, timber productive capacity; trees as product of conservation programs, soil quality, benefits on wildlife, overall condition of the mangrove, growing trees, presence of wildlife, presence of same species of trees, presence of birds, and presence of insects.

Out of the 13 sub-factors under the factor protection of the environment for the "improvement of ecosystem and biodiversity," 12 sub-factors showed a strong positive association (P-Value less than/equal to 0.05/Cramer's V value

ranges from 0.30 – 1.00) with the respondents' involvement in the conservation program's clean-up drives (Table 4).

Six out of the 13 sub-factors showed a strong positive association with the conservation programs regarding policy. Five sub-factors had a moderate association with the local communities' participation in conservation programs, particularly in the information campaign using IEC materials. There were three sub-factors with strong a positive association and two sub-factors with a moderate positive association with the local communities' participation in capability building programs that focused on conservation. Lastly, there were three sub-factors with a strong positive association with the local communities' participation in conservation programs, particularly in the mangrove reforestation programs (Table 4).

Mangrove ecosystem. In mangrove areas, all of the sub-factors showed a strong positive association with the respondents' participation in conservation programs on policy regulation. Three sub-factors have a strong positive association with the respondents' participation in conservation programs particularly in mangrove reforestation (Table 4).

Protection of the Environment: Improvement in the Overall Well-Being of Communities and Distribution of Economic Benefits from Resource Use

River ecosystem. In terms of improvement of the overall well-being of communities, the conservation programs such as mangrove reforestation and clean-up drives were found to have a strong positive association with all the sub-factors. Moreover, involvement in policy regulation showed a strong positive association with five sub-factors (Table 5). Local communities' involvement in capability building programs was also found to have a strong positive association with three sub-factors.

The sub-factors, namely, distribution of benefits from resource use, involvement of communities in mangrove reforestation, capacity building programs, and policy regulation showed a strong positive association with only one sub-factor (Table 5).

Mangrove Ecosystem

Regarding the improvement of the overall well-being of local communities, the respondents' participation in capability building programs was found to have a strong positive association with six sub-factors (Table 5). Three sub-factors showed a strong positive association with the respondents' participation in policy regulation. One sub-factor showed a strong positive association with involvement in mangrove reforestation programs and clean-up drives.

In terms of improvement in the distribution of economic benefits from resource use, only one sub-factor showed a strong positive association with involvement in information campaign using IEC materials.

Table 5
Sub-factors with Significant Association with the Overall Well-Being, Economic Distribution of Benefits, and Respondents' Participation in Conservation Programs (Using Cramer's V)

Conservation Programs	Sub-factors	
	River	Mangrove
Improvement in the Overall Well-Being		
Ecosystem and Biodiversity Conservation Programs		
Clean-up Drives	enough income, sending children to school, needed extra job, satisfied with earnings, being paid for planting trees, additional income from active participation in the organization	being satisfied with earning from the use of natural resources
Mangrove Reforestation Programs	enough income, sending children to school, needed extra job, satisfied with earnings, being paid for planting trees, additional income from active participation in the organization	being paid for planting trees
Capacity Building Programs and Information Campaign using IEC Materials		
Capability building programs	getting enough income from the use of natural resources, able to send children to school from the income coming from the use of natural resources, and getting additional income through active participation in the organization	getting enough income from the use of natural resources, able to send children to school from the income coming from the use of natural resources, needed extra job that is not dependent on natural resources, satisfied with earning from the use of natural resources, being paid for planting trees, and getting additional income through active participation in the organization

Policy regulation/ patrolling	getting enough income from the use of natural resources, needed extra job that is not dependent on natural resources, satisfied with earning from the use of natural resources, being paid for planting trees, and getting additional income through active participation in the organization	satisfied with earning from the use of natural resources, being paid for planting trees, and getting additional income through active participation in the organization
Improvement in the distribution of economic benefits from resource use		
Ecosystem and Biodiversity Conservation Programs		
Mangrove Reforestation Programs	allowed to engage in selective cutting of mangrove	None
Capacity Building Programs and Information Campaign using IEC Materials		
Capability building programs	sustainable use of the aquatic resources	None
Information campaign using IEC materials	None	sustainable use of the resource
Policy regulation/ patrolling	allowed to engage in selective mangrove cutting	None

Change in Practice of Communities: Increased Awareness of Environmental Resources Conservation and Change in Behaviour to Improve Species and Habitat Conservation

River ecosystem. One of the evaluated outcomes of the various conservation programs implemented for the benefit of the river ecosystems in the study areas was the change in the practices of the communities. Specifically, the study analyzed the increase in the respondents' awareness of environmental resources conservation and the change in behavior of the communities for the improvement of species and conservation of habitats. In terms of "increase in awareness on environmental resources conservation," results showed that there were five sub-factors that had a strong positive association with the respondents' participation in mangrove reforestation programs (Table 6). Five sub-factors showed a strong positive association with involvement in clean-up drives, while five sub-factors showed a strong positive association with involvement in policy regulation. Meanwhile, involvement in the EIC campaign showed a strong positive association with one factor.

In terms of "change in behavior to improve species and habitat conservation," there were two strong positive associations (e.g., "activities does [sic] not make any difference," "have the knowledge and skills") and

one moderately positive (e.g., "engagement in conservation practices") association between the sub-factors and participation in clean-up drives (Table 6). Participation in information campaign using IEC materials had a strong positive association with having "knowledge and skills" and a moderate positive association with "engagement in conservation programs" and having "the ability to change the way resources are used". Participation in mangrove reforestation and policy regulation was found to have a moderate positive association with one sub-factor.

Table 6

Sub-Factors That Have Significant Association with Increased Awareness/ Change in Behavior and Respondents' Participation in Conservation Programs Using Cramer's V

Conservation Programs	Aquatic Ecosystem	
	River	Mangrove
Increased Awareness on Environmental Resources Conservation		
Ecosystem and Biodiversity Conservation Programs		
Clean-up Drives	urban land development, soil erosion from farmland, fertilizer and pesticide usage, livestock and poultry production, and improper disposal of domestic waste	None
Mangrove Reforestation Programs	industrial discharge, soil erosion from farmland, fertilizer and pesticide usage, improper disposal of industrial waste, and aquaculture activities	industrial discharge, urban land development, soil erosion from farmland, use of fertilizer and pesticides, and improper disposal of domestic/industrial waste
Capacity Building Programs and Information Campaign using IEC Materials		
Capability building programs	people engaging in electro-fishing, Livestock and poultry production, Aquaculture activities	communities are poaching timber, urban land development, livestock and poultry production, improper disposal of domestic waste, and aquaculture activities
Policy regulation/ patrolling	industrial discharge, urban land development, livestock and poultry production, improper disposal of domestic waste, and improper disposal of industrial waste	industrial discharge, urban land development, soil erosion from farmland, fertilizer and pesticide, improper disposal of industrial waste
Change in Behaviour to Improve Species and Habitat Conservation		
Ecosystem and Biodiversity Conservation Programs		
Clean-up Drives	activities does not make any difference and have the knowledge and skills, engagement in conservation practices	none
Mangrove Reforestation Programs	have the ability to change the way resources are used	none

Capacity Building Programs and Information Campaign using IEC Materials		
Capability building programs		association with engagement in conservation programs, have the ability to change the way resources are used, and have knowledge and skills needed to practice conservation
Information campaign using IEC materials	have knowledge and skills, engagement in conservation programs, have the ability to change the way resources are used	None
Policy regulation/ patrolling	have the knowledge and skills	None

Mangrove ecosystem. In terms of increase in "awareness on environmental resources conservation," five sub-factors had a strong positive association with the communities' involvement in capability building programs (Table 6). Moreover, six sub-factors showed a strong positive association with the respondents' involvement in mangrove reforestation programs, while five sub-factors had a strong positive association with the respondents' involvement in policy regulation.

In terms of "change in behavior to improve species and habitat conservation," the respondents' involvement in capability building programs had a strong positive association with three sub-factors.

Policy Formulation

River ecosystem. Another outcome that was evaluated was the enforcement of and compliance with the policies. The analysis particularly focused on policy formulation, amendments, revision, and termination (Table 7). Results show that four sub-factors had a moderate association with the respondents' participation in capability building programs. Moreover, strong positive associations were found between participation in clean-up drives and one sub-factor (i.e., "there are new ordinances that have been formulated and enforced in my community") (Table 7). The same sub-factor was found to have a moderate positive association with the local communities' participation in mangrove reforestation programs.

Mangrove ecosystem. Regarding the mangrove ecosystem, results showed that the respondents' participation in capability building programs had a moderate association with four sub-factors (Table 7).

Table 7

Sub-Factors with Significant Association with Policy Formulation and Respondents' Participation in Conservation Programs Using Cramer's V

Conservation Programs	Aquatic Ecosystem	
	River	Mangrove
Ecosystem and Biodiversity Conservation Programs		
Clean-up Drives	New ordinances have been formulated	None
Mangrove Reforestation Programs	New ordinances have been formulated, Ordinances/laws have been terminated	New ordinances have been formulated, ordinances/laws have been terminated
Capacity Building Programs and Information Campaign using IEC Materials		
Capability building programs	New ordinances have been formulated, Ordinances/laws have been amended, Ordinances/laws have been revised, Ordinances/laws have been terminated	None

Binary Logistic Analysis on Factors/Conservation Programs and Improvement in Ecosystem and Biodiversity

River ecosystem. The results of the Chi-Square/Cramer's V Analyses were used in the Binary Logistic Analysis. Conservation efforts that had significant associations were further run in a Binary Logistic Statistical Analysis and were treated as factors or variables that predicted or estimated the likelihood of a resultant protection of the environment, i.e., improvement in the ecosystem and biodiversity. Results presented in Table 8 show that participation in conservation programs, particularly in clean-up drives and policy regulation, was a significant predictor of the likelihood of improvement in aquatic ecosystem and biodiversity. This is indicated by the P-Value of 0.12 and 0.50, and a Ratio (ExpB) of 0.187 and 2.748. It can be inferred that the odds of improving the river ecosystem and biodiversity would likely increase by about 2.75% if local communities would participate in policy regulation and patrolling implemented in their area.

In terms of the association between the local communities' involvement in clean-up drives and improvement in river and biodiversity, an inverse relationship was established (Table 8).

Table 8

Significant Conservation Programs/Factors Associated with the Improvement of the Environmental, Social, and Economic Aspects of the Various Ecosystems in the Study Areas

FACTORS/SUB-FACTORS	COEFFICIENT ODDS P-VALUE		
	B	Ratio (ExpB)	Sig
Protection of the Environment			
River Ecosystem			
Improvement in Ecosystems and Biodiversity			
Clean-up Drives	-1.677	.187	.012
Policy Regulation	1.011	2.748	.050
Improvement in the overall well-being of communities			
Mangrove Reforestation	2.135	8.453	<.0001
Mangrove Ecosystem			
Improvement in Ecosystems and Biodiversity			
Policy Regulation	2.566	13.009	0.001
Improvement in the Overall Well-Being of Communities			
Clean-up Drives	1.141	3.129	.050
Change in Practice of the Communities			
River Ecosystem			
Change in Behavior to Improve Species and Habitat Conservation			
Clean-up Drive	-.752	.471	.032
Capability Building Programs	1.369	3.931	<.0001
Mangrove Ecosystem			
Change in Behavior to Improve Species and Habitat Conservation			
Capability Building Programs	1.669	5.308	.001
Policy			
Aquatic Ecosystem			
Enforcement/Compliance of/to Policy Regulation			
Mangrove Reforestation	1.348	3.849	.003

Significant at α = .05

Mangrove Ecosystem

The Binary Logistic Regression Analysis results in Table 8 shows that the conservation program that focused on communities' involvement in policy

regulation was a significant predictor of the improvement of the mangrove ecosystem and biodiversity, as indicated by the P-Value of 0.001 and Ratio (ExpB) of 13.009. The statistical value could mean that the odds of improving the mangrove ecosystem and biodiversity would increase by about 13.009% if local communities would participate in policy regulation in the mangrove areas.

Binary Logistic Analysis of Factors, Improvement in Overall Well-being, and Distribution of Economic Benefits

River ecosystem. Participation in mangrove reforestation programs was a significant predictor of improvement in the overall well-being of the local communities (Table 8). It can be deduced that the odds of seeing improvement in the overall well-being of local communities were likely to increase by about 8.453% if they would participate in mangrove reforestation programs.

Mangrove ecosystem. The communities' involvement in conservation programs that focused on clean-up drives was found to be significant predictor of improvement in the overall well-being of the communities, as indicated by the P-Value of 0.050 and the Ratio (ExpB) of 3.129 (Table 8). Statistical results revealed that the odds of improvement in the overall well-being of local communities were likely to increase by 3.129% if they would get involved in clean-up drives.

Binary logistic analysis of factors, change in behavior, and increased awareness of the river ecosystem. Participation in clean-up drives and capacity building programs were significant predictors of the likelihood of changing local communities' behavior towards improving species and habitat conservation. This is indicated by the P-Value of 0.032 and <.0001, and Ratio (ExpB) of 0.471 and 3.931, respectively (Table 8). The significant association means that the odds that the local communities would change their behavior for the sake of improving species and conserving habitats would likely increase by 0.47% and 3.93% if these communities would participate in clean-up drives and capability building programs, respectively.

Mangrove ecosystem. The analysis showed that participation in capability building programs was a significant predictor of change in behavior of the communities in order to improve species and practice

habitat conservation. This is indicated in the P-Value of 0.001 and the Ratio (ExpB) of 5.308 (Table 8). The significant association means that the odds of seeing change in the behavior of local communities for the purpose of improving species and conserving habitats would likely increase by 5.308% if these communities would participate in capability building programs.

Binary Logistic Analysis on Factors and Policy Formulation

River ecosystem. Based on the results of the Logistic Regression Analysis, involvement in mangrove reforestation programs was a significant predictor of the enforcement of and compliance with policy regulations as well as the formulation, amendments, revision, and termination of policies that concern river aquatic ecosystem (Table 8). The odds that policies would be formulated, amended, revised, or terminated were likely to increase by 3.849% if local communities would participate in mangrove reforestation programs.

DISCUSSION

The conservation programs implemented in the aquatic ecosystems (i.e., river and mangrove) in Pampanga River were assessed in terms of their environmental, social, economic, and political outcomes.

River ecosystem. An assessment of the conservation programs revealed that local communities' involvement in clean-up drives and policy regulation was a significant predictor of improvement of the river and its biodiversity. Meanwhile, mangrove reforestation was found to be a significant conservation program intended for the improvement of local the communities' overall well-being. Pursuant to the implementation of the Marine Conservation and Development Program (MCDP), local communities were empowered to enforce environmental laws. The overall impact of the project was increased fish biomass and stable fishery catch as a result of the protection of the ecosystem and its biodiversity. Increased fish yields, increased fish diversity, abundance within the sanctuary areas, slightly improved coral substitute cover resulting from the use of less damaging fishing methods, and increased tourism in Apo and Sumilon Islands were some of the achievements of the program (De Jesus et al., 2008). Similar

findings were obtained as regards the implementation of the Fisheries Resource Management Project (FRMP) through mangrove rehabilitation projects that were established nationwide (De Jesus et al., 2008). In Bani, Pangasinan, an increase in fish catch from 2 kg to 3.5 kg/ day, 25 endemic and migratory bird species, and over 15 commercially important finfish and shellfish species were monitored. Based on the survey conducted in Quezon, there was an increase in fish catch from 3 kgs to 5 kgs/day. In the same survey, the respondents from Honda and Puerto Princesa Bays reported an average of 6-10 kgs catch per day.

In terms of increasing the awareness of local communities, clean-up drives and capability building programs were found to be essential conservation programs. The involvement of local communities in capability building programs would likely influence their behavior towards the improvement of species and conservation of habitats. This is consistent with the findings of the CRMP which has a capability building program component. In CRMP, local communities were capacitated with skills in monitoring marine sanctuaries and other activities to enhance their skills relative to CRM. Such activities had boosted local communities' confidence and had encouraged active participation of communities in the protection and conservation of marine sanctuary (De Jesus, et al., 2008).

Lastly, in terms of the enforcement of and compliance with policy regulations, the mangrove reforestation was found to be a significant conservation program in relation to the formulation of new policies intended for the river ecosystem. Through the involvement of local communities in the mangrove reforestation program in Sasmuan, Pampanga, the mangrove area had been declared protected and reserved. The declaration of the Sasmuan Bangkung Malapad Critical Habitat Ecotourism Area had been instrumental in the formulation of new ordinances that were being enforced in the area with the help of the local communities. Pertaining to this, Posa, Diesmos, Sodhi, and Brooks, (2008) stressed that the devolution of environmental governance to local government, through the Local Government Code of 1991, had given the local government a share in the responsibility of maintaining ecological balance and enforcing regulations within its territorial jurisdictions. Such devolution of authority had benefited organized communities by giving them control over their own resources, with the support of the local governments. This had led to the success of conservation programs.

Mangrove Ecosystem. Policy regulation was also a significant conservation program for the improvement of the mangrove ecosystem and its biodiversity. Involvement in clean-up drives was also vital in improving local communities' overall well-being. Clean–up drive activities that were conducted both in the vicinities of barangays and in river or mangrove areas minimized pollution. Minimizing pollution in the aquatic ecosystem had resulted in better water quality, thus providing aquatic species an environment that is conducive to growth. Fishes, crustaceans, clams, mussels, and other aquatic species could thrive and multiply in mangrove areas, hence providing increased catch for the local communities that depended on aquatic resources. There are sets of evidence from international case studies of protected area performance that show the interdependence between conservation and socio-economic outcomes.

CONCLUSION

The study assessed the different conservation programs implemented in the aquatic ecosystems traversing Pampanga River. Binary Logistic Analysis showed which among the conservation programs would likely lead to the improvement of the environment and the economic well-being of the local communities; change in practice geared towards biodiversity conservation; and formulation of laws. However, due to limited time and financial resources, the assessment of the conservation program was limited to the analysis of the perception of the communities whose livelihood depended on the aquatic ecosystems.

Local communities should therefore be involved in mangrove reforestation, clean-up drives, and policy regulation to improve the ecosystem, its biodiversity, and the well-being of the communities. Furthermore, it is suggested that the mangrove ecosystems traversing Pampanga River should be declared as a reserve or protected area. Doing so will help restore the ecosystems as well as the biodiversity thriving on them.

Further studies should focus on the enabling mechanisms and inputs that can be provided to local communities in order to increase their awareness and promote change in behavior that would help achieve species and habitat conservation. The corporate social responsibilities of private companies such as Rice Millers in the Nueva Ecija, feed millers in Bulacan area, and

aquaculturists should be further assessed. Analyzing the commitment of these sectors will provide ideas and strategies on how they can be involved in conserving the Pampanga River.

Longitudinal studies should be conducted to assess the long-term impact of the conservation programs in terms of improving the ecosystems, promoting local communities' overall well-being, changing current practices, and formulating policies.

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