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Research Article

Valuation of Bamboo Along Pampanga Riverbank in San Simon

Manuel U. Nucum*

The Graduate School, Bulacan State University – Main Campus, City of Malolos, Bulacan, 3000, Philippines

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*Corresponding author:

E-mail:

manuel.nucum.u@bulsu.edu.ph

ABSTRACT

The Barangay San Pedro in San Simon, Pampanga, partially bounded by the Pampanga River, faces seasonal flooding due to river inundation and soil erosion. Bamboo, with its ecological and economic benefits, plays a crucial role in mitigating adverse weather effects. Studying bamboo and documenting residents' valuation of this plant can inform intelligent responses to annual riverside community challenges. The mixed-methods research aims to create an action plan for implementing a bamboo planting program to address these issues. A field study shown that the Barangay San Pedro, situated along the Pampanga River, already boasts diverse bamboo species. Six bamboo species were mapped and identified: *bayog*, Buddha belly, *kawayan dilaw*, *kawayan tinik*, *kawayan tsina*, and Taiwan bamboo. A survey of 310 adults residing near the riverbank revealed that despite difficulties in identifying bamboo names, they were aware of its ecological significance, characteristics, and uses. On average, riverside residents expressed moderate interest in learning about bamboo cultivation and using it for livelihood. Interviews with 21 residents further highlighted their deep appreciation for bamboo. The barangay community leader even acknowledged previous bamboo initiatives but highlighted deficiencies in the existing broad action plan. The study's proposed action plan rectifies these gaps and ensures effective implementation of the bamboo planting program. Riverside residents of the barangay recognize the value of bamboo but lack comprehensive knowledge about its diversity. The study recommends targeted information campaigns, prioritizing native bamboo like *kawayan tinik*, and integrating bamboo planting into the basic education curriculum and community greening efforts through multisectoral collaboration.

Keywords: *Bamboo, Barangay San Pedro, Municipality of San Simon, Pampanga riverbank, Valuation*

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Introduction

Barangay San Pedro, in San Simon town, province of Pampanga, is one of the barangays partially bounded by the Pampanga River. As such, it experiences flooding during the rainy season due to the inundation of the river and soil erosion along the riverbank. Bamboo, one of the plants commonly found along the Pampanga Riverbank, plays an essential role in preventing soil erosion and hastening the subsidence of floods in the barangay. Due to bamboo's ecological and economic potential, it is important to study and document the residents' valuation of bamboo. Valuation is the act of valuing and passing judgment on the worth or character of something. Human acts or processes that show the valuation of bamboo include awareness, acknowledgment of the worth of the plant, and interest in it. Information on the valuation of bamboo could help riverside residents deeply understand and respond intelligently to the problems they experience annually. The study aimed to produce an action plan for the implementation of a bamboo planting program in the riverside community.

Methods

The study is a mixed-methods research. It utilized sequential explanatory design where quantitative data were gathered first through surveys, followed by qualitative data gathered through interviews. It is also a field research since most data were collected outside a laboratory – where nature is the laboratory (Tomovic, 2001). In this study, the riverside community served as the locale where data were obtained. In terms of sampling, two different groups of samples were identified in the community: bamboo species and riverside residents. Listing and collecting bamboo specimens or their photographs, identification, description of characteristics and growing conditions, and ecological mapping were done to gather information about the bamboo species. To add to the information, survey and interview questionnaires were floated to obtain data about the riverside residents. The descriptive research approach was also applied in the study to describe, explain, and interpret the present conditions, practices, differences, or similarities of the samples in the survey. It

refers to research that describes a phenomenon or a population under study through identification of characteristics (Leedy, 2016). In the study, descriptive information was collected through surveys and interviews. For qualitative data analysis, phenomenology was employed. Phenomenology is applicable in studying a small number of participants to determine the essence of their experiences with the phenomenon (Creswell, 2003) and generate patterns and discover associations of meaning that create new information. In this approach, the researcher conducted an interview.

The researcher did field observation to identify and map the distribution of bamboo along the Pampanga Riverbank. Permit to conduct the research was obtained first from the municipality of San Simon and the local government of San Pedro before the field study was commenced. The handbook authored by Cristina A. Roxas (2012) of the Department of Environment & Natural Resources (DENR) Ecosystems Research & Development Bureau served as reference for bamboo identification. The collected data were presented to and corrected for validation by the DENR Ecosystem Research & Development Bureau (ERDB). Field observation and survey were conducted to look for bamboo in nearby areas as referred by residents. While in this procedure, photo capturing of bamboo species with similar structures from the obtained sample specimens was performed with the use of GeoCam, a mobile application to record the exact coordinates of the specimens. Alternatively, when GeoCam was unavailable, the plant location was obtained by locating the coordinates through GPS. If the site was not accurate, it was estimated through satellite imaging from Google Maps (2019). Then lastly, digital labeling of the image of the species was done. Note-taking using paper and pencil served as alternative for labeling species when the technological mode posed difficulties.

Photographs of bamboo species samples collected were sent to DENR ERDB for validation. This was followed by the printing of pictures for future use. Lastly, the map of the distribution was drafted through Microsoft Office Tool by plotting the estimative coordinates of bamboo species on the map.


A survey was also conducted where there were 310 respondents as a representative sample of adults in San Pedro, San Simon. The respondents were riverside residents with ages ranging from 18 and above. Based on the 2015 census, there were 1,558 households in San Pedro (PSA, 2015; Office of Sangguniang Barangay of San Pedro, 2020). Due to the large population of adults in the barangay, respondents were selected in the community through systematic sampling wherein individuals were chosen at regular intervals based on household numbers. That is, by visiting every 5th household in the barangay. Twenty-one (21) riverside residents were interviewed face-to-face in the selected purok/sitio in Barangay San Pedro to discern their appreciation of the value of bamboo in their lives. The researcher selected the respondents in the community also through purposeful sampling. Purposeful sampling is a sampling technique used in a qualitative research where respondents or a groups of respondents are particularly experiencing about an event or existing issue (Creswell & Plano Clark, 2011). There were three considerations in selecting the interviewees based on the researcher's judgment. First, interviewees should be knowledgeable of the situations in the community. Second, they should have experience using bamboo in various ways. Third, they should be willing to share their experiences and express their thoughts and ideas.






Questionnaires for surveys and structured interview questionnaires were utilized in the study. The survey questionnaire consists of three parts: Knowledge of and Awareness

about Bamboo, Interest in Planting Bamboo, and Interest in Using Bamboo as Source of Income. The first part comprises four items about the knowledge and awareness of respondents. In the first item, the respondents were asked to write the local name of bamboo below its picture. In the second and third items, they checked if they were aware (YES) or unaware (NO) of the listed products/uses and environmental benefits of bamboo. In the fourth item, they were asked to choose whether they agree or disagree with the statements about the characteristics and ecological niche (functions) of bamboo. Also, the study utilized an interview questionnaire to obtain qualitative data for the study. The questionnaire covered four questions on how respondents show appreciation for the ecologic and economic uses of bamboo in their lives. The riverside residents were asked how they value bamboo as a plant and material, support the development of the local bamboo industry, and sustain and improve the diversity and population of bamboo along the Pampanga Riverbank. An informed consent form was also provided during the survey and interview and explained to each respondent before participating to ensure that the ethical standard is followed.

Frequency distribution, mean, percentage, tables, and bar graphs were utilized for data processing and statistical treatment of quantitative data. For qualitative data processing, the perceptions and opinions of the respondents were recorded, translated, and interpreted. The study also utilized manual data integration in the data analysis.

Table 1. List of Extant Bamboo Species Near Pampanga River, their Population, Characteristics, Uses, and their Occurrence in Barangay San Pedro, San Simon

Local/Common Names	Scientific Names	Population	Habit	Distinct Characteristics	Uses
1. Thorny bamboo or kawayan tinik	<i>Bambusa blumeana</i> J.A. & J.H. Schultes	103		Large-sized clump, densely tufted culms, sympodial bamboo, with spiny basal branches. Erect culms are up to 15-25 meters tall and 20cm in diameter. (PROSEA, 2020)	Food, fences, hedges, construction, furniture, and prevention of soil erosion on the riverbank

Local/Common Names	Scientific Names	Population	Habit	Distinct Characteristics	Uses
2. Yellow bam-boo or <i>kawayan dilaw</i>	<i>Bambusa vulgaris</i> Schrad ex Wendl var <i>striata</i> (Lodd. ex Lindl.) Gamble	14		Large-sized moderately loose clump, densely tufted yellow culms with green stripes and dark green leaves. It has no thorns. Erect culms up to 10-20 meters and 4-10 cm in diameter.	Ornamental, fuel, fodder, hedges, live fences, and prevention of soil erosion on the riverbank
3. <i>Bayog</i>	<i>Bambusa merilliana</i> (Elmer) Rojo & Roxas comb. nov.	5		Large-sized clumps often have curved culm with very thick walls and prominent walls. (NTFP, 2016)	Food, fences, construction, furniture, and prevention of soil erosion on the riverbank
4. Taiwan bam-boo/ blowpipe	<i>Bambusa dolichomerithalla</i> Hayata	2		Medium-sized clump	Screening, ornamental, crafts, and blowguns
5. Hedge bam-boo or <i>kawayan Tsina</i>	<i>Bambusa multiplex</i> (Lour.) Raeuschel ex J.A. and J.H. Schultes	1		Medium-sized clump, slender culms, and dense foliage. Dwarf bamboo but can grow as high as 4.5 meters.	Ornamental, hedges, live fences, weaving, and papermaking
6. Buddha belly	<i>Bambusa ventricosa</i> McClure	2		Large-sized clump with deep dark green culms with bulging or swollen internodes resembling the fat belly of the Buddha. It can grow 12-16 meters.	Ornamental and prevention of soil erosion on the riverbank

As shown in Table 1, species found in Barangay San Pedro were kawayan tinik with 103 clusters, kawayan dilaw with 14 clusters, bayog with five clusters, Taiwan bamboo with two clusters, hedge bamboo with a single cluster, and Buddha belly with two clusters. These bamboo species belong to the genus *Bambusa*. They are typically sympodial (clumping), meaning each rhizome (root) turns upward to form an erect culm. Their culm contains auricles that are lobe-like and bristly at the

margins, a dominant primary branch with one to several secondary branches and branchlets found at the base, and leaf blades, which typically obtuse the base (Roxas, 2012).

Looking at the map in Figure 1, it shows that bamboo species found in San Pedro along the Pampanga Riverbank have clumped distribution; this means that neighboring clusters are close to one another. It also provides a view of how diverse bamboo species are in the area. Several environmental factors can be the causal

agents of this phenomenon. It can be because sympodial bamboos are sluggishly spread since offspring are very close to the parent plant. It can also be explained by the irregular distribution of nutrients or other resources in the ecosystem. Bamboo tends to flourish in areas with

fertile soil and abundant groundwater supply. The riverside ecosystem supports a wide variety of plant and animal species that compete in obtaining nutrients, which can directly affect the dispersal of bamboos.

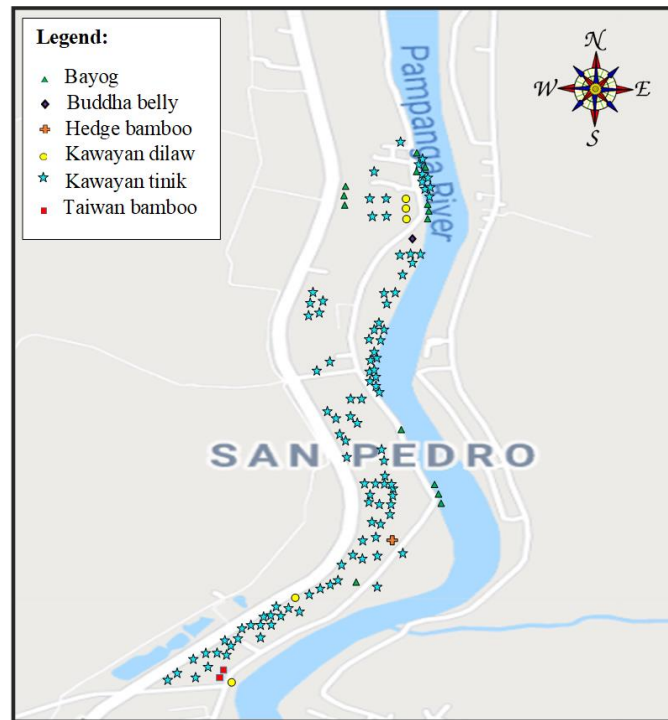


Figure 1. Map of Bamboo Distribution in Barangay San Pedro, San Simon, Pampanga

Table 2. Respondents' Identification of Six Bamboo Species Found in Barangay San Pedro

Rank	<i>Kawayan tinik</i>	<i>Kawayan dilaw</i>	<i>Bayog</i>	Taiwan bamboo	<i>Kawayan Tsina</i>	Budhha belly
1	<i>Kawayan</i>	Don't know/ No response	Don't know/ No response	Don't know/ No response	Don't Know/ No response	Don't Know
2	Don't know/ No response	Chinese Bamboo	<i>Kawayan</i>	<i>Kawayan</i>	<i>Kawayan</i>	<i>Kawayan</i>
3	<i>Kawayan tinik</i>	<i>Kawayan</i>	<i>Kawayan kiling</i>	Buho	Bamboo	Bamboo
4	Bamboo	<i>Kawayan tinik</i>	<i>Baugin/Baogin</i>	Bamboo	Anos	Buddha belly
5	Philippine Bamboo	Yellow bamboo/ <i>Kawayan dilaw</i>	<i>Bayog</i>	Bulo/Bolo	Native Bam- boo	Ventricosa

Respondents were asked to name the six bamboo species found in their locality to describe their awareness of the diversity of bamboo. Table 2 presents the top five most frequent responses for each bamboo species. As shown in the table, majority of respondents had difficulty identifying bamboo species such as

kawayan dilaw, *bayog*, Taiwan bamboo, *Kawayan tsina*, and buddha belly.

Most respondents recognized the many uses of bamboo to humans as evinced in Figure 2. They are also mostly informed about the six commonly known environmental benefits of bamboo as revealed by the data in Figure 3.

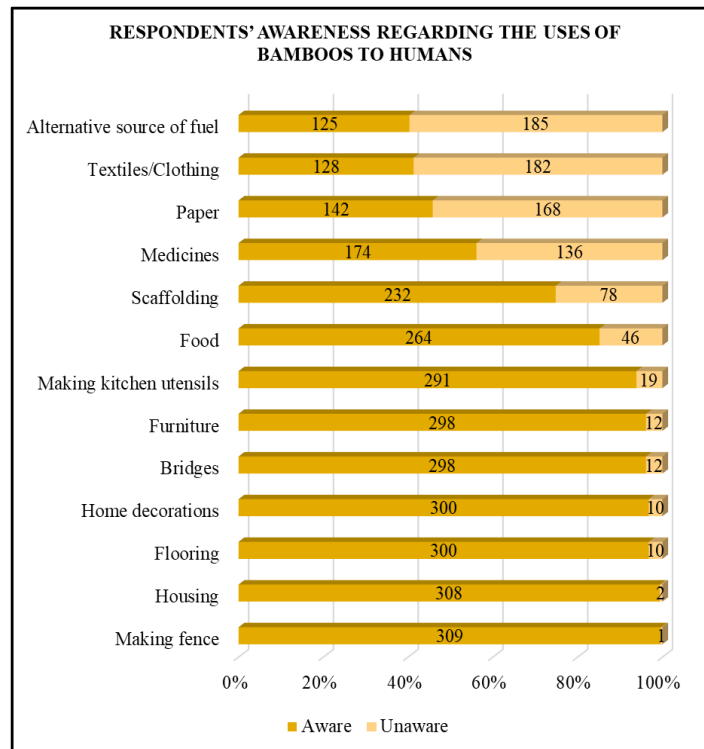


Figure 2. Respondents' Awareness Regarding the Uses of Bamboos to Humans

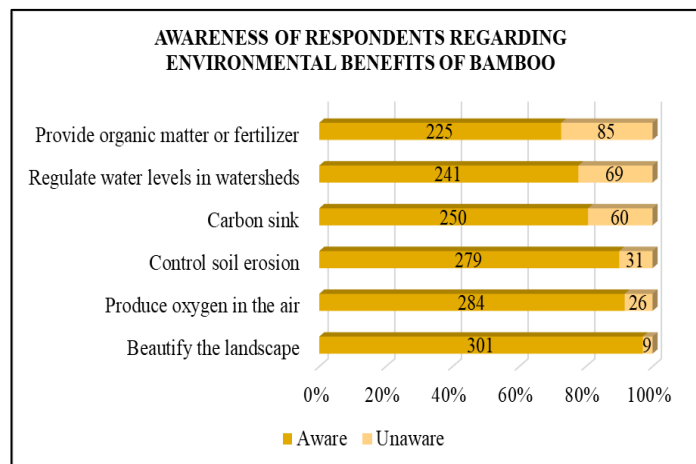


Figure 3. Awareness of Respondents Regarding Environmental Benefits of Bamboo

Table 3. Mean of Responses on Interest in Learning about Bamboo Cultivation

Activities	Responses	
	Mean	Interpretation
1. Learn about the characteristics of different bamboo species	3.31	Moderately Interested
2. Learn about methods in bamboo propagation	3.21	Moderately Interested
3. Learn how to sustain and protect the growth of bamboo	3.21	Moderately Interested
4. Join bamboo planting activities in the community	2.89	Moderately Interested
5. Promote bamboo planting in the community	3.04	Moderately Interested
Interest in learning about bamboo cultivation	3.13	Moderately Interested

Table 3 shows the mean responses on interest in learning about bamboo cultivation. The mean value of riverside residents' responses is

3.13, indicating that, on average, they were moderately interested in doing these activities.

Table 4. Mean of Responses on Interest in Bamboo as Source of Livelihood

Activities	Responses	
	Mean	Interpretation
1. Participate in community livelihood program on cultivation and harvesting of Bamboo	3.05	Moderately Interested
2. Participate in community livelihood program on manufacturing bamboo-based products	3.13	Moderately Interested
3. Sell bamboo as a raw material	2.81	Moderately Interested
4. Manufacture and sell bamboo-based products	2.93	Moderately Interested
5. Use bamboo in livelihood or business	3.08	Moderately Interested
Interest in bamboo as source of income	3.00	Moderately Interested

Table 4 presents the interest of respondents in using bamboo as source of livelihood. In sum, the mean value of riverside residents' responses is 3.00, which means that they were moderately interested in using bamboo for income-generating purposes.

Result and Discussion

Through field study, bamboo species found along the Pampanga Riverbank within Barangay San Pedro were mapped and identified. The six bamboo species found and taxonomically identified were bayog, Buddha belly, kawayan dilaw, kawayan tinik, kawayan tsina, and Taiwan bamboo. Based on the pattern of bamboo distribution in the vicinity, these bamboo plants are clumped, which means clusters of bamboo grow close to each other.

After the field study, a survey was conducted among selected 310 adults who reside near the riverbank. The survey shows that most of the riverside residents, although having difficulties in identifying bamboo names, were aware of its ecological niche and characteristics as well as its uses to human beings and the environment. In terms of their interest in engaging in at least five activities in learning about bamboo cultivation, on average, the riverside residents of Barangay San Pedro were moderately interested (3.13). And in undertaking at least five activities in using bamboo as a source of livelihood, they were moderately interested (3.00) as well.

Interviews were conducted among 21 riverside residents in the select Purok/Sitio in Barangay San Pedro to determine their appreciation of the value of bamboo in their lives and to validate survey responses from the survey. The results of the interview show that all interviewees recognized the importance of bamboo in their lives. They were all aware of the value of bamboo as a commodity with many uses in their community. They all supported the development of the bamboo industry in their place. Most of them stated that planting and protecting the bamboo plants by joining bamboo programs and preserving the plants in the barangay would improve diversity and population.

The barangay captain of San Pedro revealed that bamboo projects had been initiated before. These projects included the utilization of bamboo poles from kawayan tinik to construct a bioengineered slope stabilizer to prevent soil erosion in the riverbank in Purok Fortunate (2018), the expansion of a small section of Timac Road (2019), and clean-up drives along the Pampanga Riverbank. To ensure the continuation of these initiatives, the Office of the Sangguniang Barangay of Barangay San Pedro headed by the barangay captain established a bamboo planting program integrated into the solid waste management program congruent with the solid waste management plan of the Sangguniang Barangay. But when examined, the plan was found to be too broad or lacking specific details that are important in implementing the program.

PROPOSED ACTION PLAN FOR BAMBOO PLANTING PROGRAM

The program aims to promote sustenance and growth of the bamboo population and diversity through information dissemination and by planting bamboo in selected areas near the river. Planting bamboo can help build a climate-resilient community because it will save the forests, help the people in their livelihood, control flooding, and at the same time protect the environment, biodiversity, and the ecosystem. Bamboo grows fast and can therefore be a sustainable and renewable source of charcoal and flood-resistant construction materials.

Objectives	Strategies	Program	Activities	Office-in-Charge	Persons Involved	Resources Needed	Specific Time Frame	Means of Verification	Success Indicators
<ul style="list-style-type: none"> Disseminate information about bamboo through a seminar to improve environmental awareness, interest, and appreciation among the riverside residents Plant bamboo seedlings along riverbanks Involve the community and parents in the conservation and preservation of bamboo in schools and community 	<ul style="list-style-type: none"> Conduct meetings Send request letters to partner institutions Ensure active collaboration among project proponents and stakeholders through various means of communication Sign pledge of commitment Ensure the safety and health of the participants during the activity Monitoring condition of the bamboo plants weekly Proper documentation of activities 	Bamboo Planting Program	<ul style="list-style-type: none"> Meeting and planning with community and school leaders Acquisition of seedlings and planting materials from DENR (PENR and MENRO) or other sectors Information dissemination through seminar School-based bamboo planting 	Barangay Council	Barangay officials and representatives of PENRO, MENRO, schools, and other government and non-government organizations	Action plan and baseline data from previous years' Bamboo Planting Program and Monitoring and Evaluation Report	January	<ul style="list-style-type: none"> Minutes of the Meeting Attendance Signed Resolutions 	<ul style="list-style-type: none"> Improved awareness, interest, and appreciation on the value of bamboo Increased population and diversity of bamboo Promotion of bamboo conservation and preservation of bamboo
				Barangay Council	Barangay officials and representatives of PENRO, and MENRO, or other GOs and NGOs	Letter of request and budget for transporting of seedlings	February	<ul style="list-style-type: none"> Signed Deed of Donation and Acceptance Photographs Any documents showing approval of request for grants. 	
				Barangay Council, PENRO, MENRO, and/or other GOs and NGOs	Teachers, parents, and students	Projector/ TV, laptop, sound system, food, handouts, and other learning materials	February or March	<ul style="list-style-type: none"> Activity completion report Photographs, video, or any supporting documents 	
				School Administration	Teachers, parents, and students	Bamboo seedlings, cleaned garden space,	Every first week of March	<ul style="list-style-type: none"> Activity Completion Report 	

The study's proposed action plan addressed some concerns and issues observed based on the analysis of data. The main objective of the proposed action plan for the bamboo planting program is to promote the sustenance and growth of the bamboo population and diversity through information dissemination and by planting bamboo in selected areas near the river. There are three identified specific objectives of the program. First is to disseminate information about bamboo through a seminar to improve environmental awareness, interest, and appreciation of bamboo among the residents. Second is to plant bamboo seedlings along riverbanks. And third, to involve schools, parents, and the community in conserving and preserving bamboo. The activities included in the program, in chronological order, are: meeting and planning with community leaders; acquisition of seedlings and planting materials from DENR (PENRO and MENRO) or other sectors; information dissemination through a seminar; school-based bamboo planting activity; community clean-up drive; community-based bamboo planting activity; monitoring/care of bamboo plants; and monitoring and evaluation. The success of the program can be ascertained if the following indicators are observed: increased population and diversity of bamboo; improved awareness, interest, and appreciation of the value of bamboo; and promotion of conservation and preservation of bamboo.

Conclusion and Recommendations

Six bamboo species were planted in the area along the Pampanga Riverbank in Barangay San Pedro, San Simon, Pampanga. These bamboo species were kawayan tinik (*Bambusa blumeana*), bayog (*Bambusa merrilliana*), kawayan dilaw (*Bambusa vulgaris* var *striata*), Taiwan bamboos (*Bambusa dolichomerithalla*), hedge bamboo (*Bambusa multiplex*), and Buddha belly (*Bambusa ventricosa*). The total number of sympodial bamboos found and identified within the area came to 127 clusters. Out of the total number, 103 bamboo clusters were kawayan tinik, 14 were bayog, five were kawayan dilaw, two were Taiwan bamboos, one was a hedge bamboo, and two were Buddha belly. Sympodial bamboos in the riverside areas of Barangay San Pedro showed a clumped

distribution as the clusters of bamboo were near each other. This could be explained by the nature of clumping bamboos – they tend to spread slowly because offspring are remarkably near to the parent plant.

In terms of the riverside residents' awareness about bamboo, most of the residents could not identify the common names of all six species showing how inadequate their knowledge was about bamboo diversity. But most of them could recognize at least ten products/uses and six environmental benefits of bamboo. In terms of the residents' perception on the characteristics and ecological niche of bamboo, most could recognize at least eight characteristics or ecological niches. In terms of interest, on average, the riverside residents in Barangay San Pedro were moderately interested in learning about bamboo cultivation and in using bamboo as a source of livelihood. They also still appreciate the value of bamboo to people and the environment and manifest this through caring, respecting, conserving, recognizing its importance to the environment, and educating other people about its value.

The barangay captain of San Pedro revealed that bamboo projects had been initiated before. To ensure the continuation of these initiatives, the Office of the Sangguniang Barangay headed by the barangay captain established a bamboo planting program integrated into the solid waste management program as approved under the Solid Waste Management Plan by the Sangguniang Barangay. However, it was found to require specific details that are important to implement the program successfully. Therefore, a detailed action plan was proposed for the bamboo planting program to promote sustenance and growth of the bamboo population and diversity through information dissemination and planting bamboo plants in selected areas near the Pampanga River.

Based on the conclusions derived from findings of the study recommendation includes: (a) prioritization of native /indigenous bamboo species such as kawayan tinik, kawayan dilaw, and bayog, which are commonly found on riversides as plant propagules in bamboo propagation and planting activities along the riverbank; (b) consideration of ecological factors in choosing the location for planting

bamboo; (c) awareness campaigns especially about bamboo identification and propagation; (d) information dissemination campaign through seminars; (e) integration of bamboo planting activities in the educational and greening programs in riverside communities; (f) establishment of multisectoral partnership in implementing different bamboo programs; (g) application of research findings to riverside communities in other provinces as solution to flooding in their areas; and (h) research on the effectiveness of the bamboo programs and best practices in implementing local bamboo projects.

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