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Exploring Landscape Values and Willingness to Pay for Perceived Ecosystem Services: The Case of Malampaya Sound, a Socio-Ecological Production Landscape and Seascape

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Abstract: Since the 1990s, the Philippines has established numerous protected areas aimed at preserving regions with distinct biological and ecological characteristics. However, transitioning towards a more comprehensive approach to managing these protected areas, one that effectively conserves biodiversity while also supporting the welfare of local communities, remains a formidable task. Understanding the sources of the goods and services upon which communities rely, whether directly or indirectly, and their perceptions of ecosystem services (ESs) is a crucial aspect that can inform decision-making for both protected area managers and policymakers. This research specifically examines the mapping of landscape values as perceived by local communities within Malampaya Sound Protected Landscape and Seascape (MSPLS) in the Philippines. Using survey questionnaires administered to 114 randomly selected participants, the study identifies the ESs within MSPLS and maps the associated landscape values. The respondents were tasked with assigning values to the ESs using a typology of 14 landscape values, and their willingness to pay (WTP) to enhance the ESs within MSPLS was also investigated. Analysis of socio-demographic data, the identified ESs, and the perceived landscape values was conducted to uncover significant relationships between the variables. Our findings reveal that the respondents prioritize provisioning services, particularly fisheries, agriculture, and agroforestry. Regarding landscape value preferences, economic value is most prominently perceived (37.4%), followed by subsistence value (30.8%) and life-sustaining value (6.8%). This study further unveils the socio-economic factors influencing the ranking of ESs and trends in WTP for ES improvements in Malampaya. Additionally, a potential payment for ecosystem services scheme in MSPLS is estimated at PHP 532,000, approximately USD 10,600.

Keywords: socio-ecological production landscapes and seascapes; ecosystem services; community landscape values; participatory mapping; contingent valuation

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1. Introduction

1.1. Background

Areas that are important to biodiversity conservation or those of high conservation value provide significant benefits to people. These landscapes and seascapes are essential to human wellbeing, as they provide various goods and ecosystem services, and in most cases, they are inherently resistant to external shocks and stresses, having been shaped and strengthened by long-term interactions between nature and people. The Philippines, considered one of the biodiversity hotspots in the world, housing diverse types of ecosystems and species, faces biodiversity loss and habitat degradation due to climate change, land use changes, and other anthropogenic factors. This can ultimately cause changes in the provision of ecosystem services and affect the natural capital that many people depend on. Since the 1990s, a number of protected areas have been established to safeguard areas that have biologically and ecologically unique features and characteristics; however, the need

to transform protected area management (PAM) systems into a more holistic approach remains a challenge [1]. More recently as well, the Philippines adopted the Global Biodiversity Framework, with 23 targets on safeguarding biodiversity to achieve by 2030, and this is specified in the Philippine Biodiversity Strategy and Action Plan 2015–2028 [2]. This entails effective conservation management of at least 30% of the world's land, inland waters, coastal areas and oceans, with emphasis on areas of particular importance to biodiversity ecosystem functioning and services [3]. In 1993, the Philippine government, through the Palawan Council for Sustainable Development (PCSD), initiated the establishment of the Environmentally Critical Areas Network (ECAN) in Palawan, the largest island province in the Philippines. ECAN employs a graded zoning scheme designed to safeguard and regulate the management of Palawan's remaining natural resources, both terrestrial and marine, as outlined in the Philippines Republic Act 7611 [4]. According to this strategy, areas with natural resources requiring the highest level of protection are designated as core zones, followed by zones with progressively less stringent regulations (buffer and multiple-use zones). The initial maps delineating the ECAN zones were created in 1994 (PCSD Resolution No. 94-44).

1.2. Literature Review

Key to conservation goals is understanding and recognizing how people interact with the environment, how they depend on the environment directly and indirectly, how different externalities (e.g., land uses, institutional policy and protection zoning, etc.) come into play, and how the delivery of ecosystem services can be sustained while balancing development and conservation. The interaction between human and nature over many years have resulted to dynamic mosaics of land and sea uses called socio-ecological production landscapes and seascapes (SEPLS) which are characterized by various ecosystem types and functions [5]. Ecosystem services (ESs) are equitable to the goods/benefits humans obtain from ecosystem functions [6]. While there are a lot of approaches to recognizing, valuing, and capturing ESs and nature's contribution to people (NCP), there is still a need to widely assess the suitability of the type of methodological valuation to be used for the local context in order to avoid the danger of expressing the value of natural systems solely in economic terms. Most recently, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), through its Values Assessment Report released in 2022 [7], highlighted how different worldviews and knowledge systems influence the ways people interact with and value nature. The report emphasized the embedding of the diverse values of nature into decision-making and as a policy instrument for transformation. Mismatched values owing to multiple resource users and trade-offs among ESs generate conflicts in natural resource management, development, and planning [8]. Thus, it is important that a framework that incorporates local community values into the design of ecosystem-based policies be formulated. Among the possible tools for local ES management, (1) payment for ecosystem services (PES) based on an analysis of willingness to pay (WTP) and (2) mapping ES values are two major tools.

PES is widely accepted as a promising tool at the local level for enhancing or safeguarding the provision of ESs [9]. With this policy instrument, beneficiaries pay in cash or in kind/labor for management costs. As a process of crafting a public PES scheme, contingent valuation is used to estimate the WTP, and its sum is targeted at public welfare and goes to the stakeholders/beneficiaries directly managing the ESs. Existing studies on WTP in the Philippines are limited, although these suggest that WTP is influenced by social factors. For instance, Calderon et al. [10] found that among socio-economic variables, educational attainment affect WTP for improved ecosystem services in a watershed area. Bueno et al. [11] found that household income, willingness to participate in the management activities, and place of residence influence WTP for water quality improvement of a freshwater lake. Similarly, but in a different geographical region other than the Philippines, age, income, and nationality were observed to significantly affect WTP for a natural park management [12]. There is a growing body of stated preference studies advocating for a

more deliberate integration of the spatial dimension into the examination of environmental preferences [13,14].

Value maps provide an extensive array of information valuable for policy- and decision-making and as a point of reference in stakeholder meetings. Visualization methods like mapping serve as valuable tools in environmental management. A single landscape may hold value for various reasons, resulting in intersections or focal points of values, which provide information on the actual use of resources [15]. Participatory GIS offers a distinct method for involving civil society in decision-making by combining local knowledge with intricate spatial information [16]. Mapping is a way of expressing ecosystem benefits within a common framework and in a way that is visual and appealing. Mapping values have been used in multiple applications for natural resource and environmental planning and management [17]. Participatory mapping of ESs can help increase awareness of nature's benefits, foster empowerment, and incorporate local knowledge into management decisions [18].

1.3. Research Objectives

The attention toward the ESs concept has grown in policy and scientific communities in recent decades, and the ecosystem services framework is gaining salience as a policy-relevant research tool [19]. While the ESs concept and its approaches are increasingly promoted through international and national policies, municipalities and local communities are still struggling with translating them into practice [20]. There are significant challenges such as the complexity of the assessment approach, the insufficient stakeholder capacity for participation, and a lack of research that incorporates local perceptions.

In this research, mapping ecosystem services—specifically in the form of landscape values—was used as a tool to assess the delivery of ecosystem services in a broader landscape context. We aimed to identify whether there are any mismatches in the current management regime and local perception and recommend alternative management strategy based on the spatial overlaps between the perceived landscape values and existing zoning. The general objective of this study was to identify and assess the ecosystem services in Malampaya Sound Protected Landscape and Seascape (MSPLS) exploring the use of a landscape-level approach to ES valuation and landscape value mapping and create a basis for policy recommendations for decision-makers. Specifically, it aimed to:

1. Identify the most important or priority ESs that local people associate with Malampaya and their overlap with the existing zoning;
2. Determine how and why local communities perceive ecosystem services as they do through landscape value mapping;
3. Examine the willingness to pay (WTP) for the improvement of ESs in Malampaya and the factors affecting WTP.

2. Materials and Methods

2.1. Conceptual Framework

Recent studies have emphasized the potential of participatory mapping to assess ecosystem service provision as a platform for stakeholders [21]. Additionally, ecosystem service concepts can facilitate participation in decision-making by explicitly explaining the role of the ecosystem in sustainable environmental management [22]. Based on participatory approaches, national MPAs can be contextualized for local communities and the environment [23]. An ecosystem service map itself cannot completely overcome the power disparities between participants, and thus methods using maps need to be further developed [24]. In this study, we elevated the importance of triangulation in holistic planning and PA management (as highlighted in Lukman et al., [25], Hockings et al. [26], and IPBES [7] and utilized an integrative conceptual framework to contribute to the mainstreaming of ESs into policies and practices.

To achieve our research objectives, we proposed a three-pronged framework (Figure 1) to ascertain the local communities' dependence and impact on ESs and identify mismatches

with MSPLS' current management regime. We used the Millennium Ecosystem Assessment (the Millenium Ecosystem Assessment (MA) classification involves four types of ESs, which are cultural, provisioning, regulating, and supporting.) [27] as an umbrella concept to distinguish between provisioning, regulating, cultural, and supporting services and adopted the value mapping methodology developed by Reed and Brown (2003) [28] and Brown (2004) [29], in which a subset of 14 landscape values were used for ES delineation/identification. To illustrate the values at the spatial level, we digitized and vectorized all the value points identified by respondents and calculated the number of points for each value in each vector cell. A rasterization of the total number of points per value based on WTP was computed, creating heat maps. WTP was measured to understand place-specific values with a high priority for the local people and identify varied socio-demographic factors influencing WTP. This could help in identifying places in the area where policymakers can target environmental improvements. Zoning policies (ECAN zones) may need to be improved or adjusted based on the result of the spatial overlaps between social perception and the protection categories, and future management can be re-aligned with local communities' needs, reducing conflicts and increasing spatial synergy.

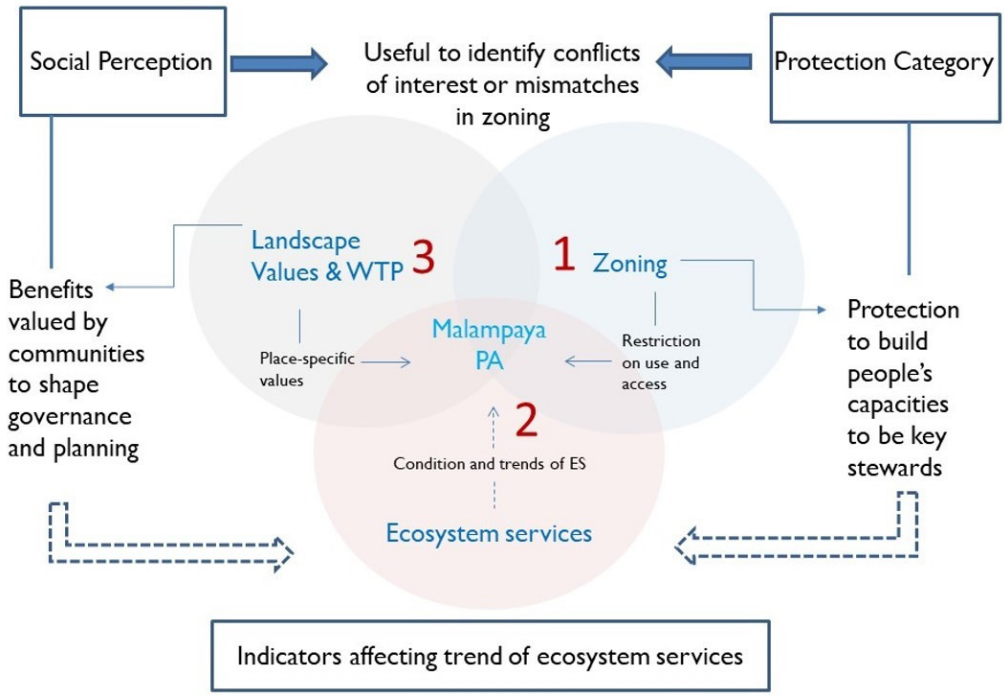

Figure 1. Conceptual framework of the study (Source: authors).

The specific approach to measuring WTP was contingent valuation, which is a common method for measuring ecosystem values, using a survey-based technique for the economic valuation of non-market resources [30]. The advantage of using this is that since the price range is not given or not identified, respondents have the freedom to choose their answer. The disadvantage is the value can be very high or low, as it will depend on the respondent's key assumption of the ecosystem value. There has been no research on WTP in MSPLS, and in future research in the area, the predetermined range for payment based on our study could be used. A description of the study site and the detailed methodology are described in the sub-sections below.

2.2. Study Area (Malampaya Sound)

Malampaya Sound is one of the richest fishing grounds in the Philippines, which was declared a protected area on 12 July 2000 as per Presidential Proclamation No. 342, signed by former President Joseph E. Estrada and as part of the Republic Act No. 7586 or the National Integrated Protected Area System of the Philippines. It is also a watershed reserve

and home to wide array of endemic flora and fauna. It is located in the northwestern part of the province of Palawan and is approximately 217 km by road from Puerto Princesa City. It dominantly belongs to the municipality of Taytay, and a portion of it is part of the municipality of San Vicente. The Sound is a 34-km elongated body of water and is divided into two sections: the Inner and the Outer Sound. The Inner Sound is brackish water, where plenty of shrimp, crabs, and snappers are caught. The Outer Sound contains seagrass beds and corals that invite plentiful fish. Malampaya in local dialect means "rich in fish". It is a word of the Tagbanua tribe, the first inhabitants of the place.

Conflicts on resource utilization in Malampaya arose several decades ago with the advent of commercial logging and fishing activities. This fierce competition for resources persisted over the years, leading to the depletion of fisheries by the 1970s. Periodic restrictions were imposed on commercial fishing. However, officials frequently introduced conflicting policies and programs concerning commercial development and resource conservation, often lacking sufficient community involvement and support [31]. With the establishment of the Protected Area Management Board (PAMB), some efforts were kicked off to establish a linkage between stakeholders and/or local communities through facilitated top-down public dialogues and workshops.

The study area comprises households from two neighboring barangay (a barangay is referred to as a small territorial and administrative district, forming the most local level of government in the Philippines.) (villages) located in Malampaya Sound. These are Barangay Pancol and Barangay New Guinlo. Figure 2 shows a map of the study area, and the two villages of focus are shaded in notched gray.

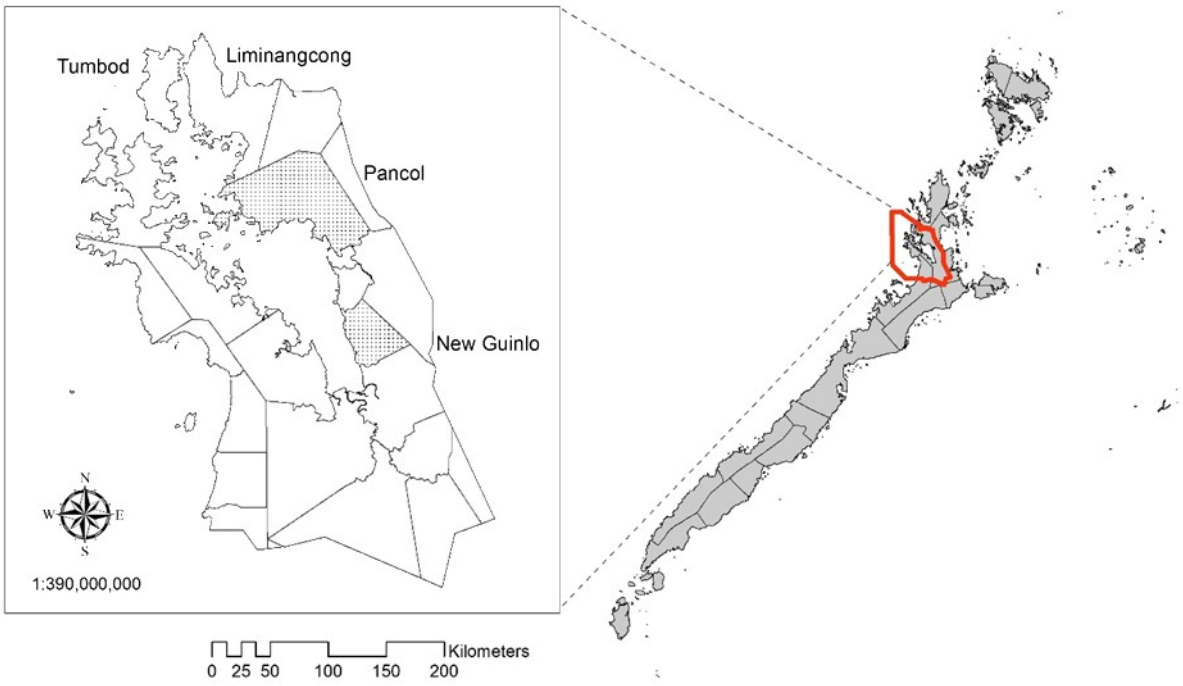

Figure 2. Administrative map of Taytay and location of the study site (Source: authors).

2.3. Respondent Selection and Sampling Scheme

One-hundred fourteen (114) respondents were selected from the two barangays of Taytay in Malampaya Sound (Figure 2, outlined in red). Based on the census list of household representatives from the Municipality Office of Taytay (National Statistics Office, Taytay, Palawan), the total household number in Pancol is 366, and the total household number in New Guinlo is 616, summing up to 982 households. Of the total number of household representatives in Pancol and New Guinlo, the percentage of male and female representatives is 28.0% and 71.9%, respectively.

The number of samples was decided considering the sample size computed at a 95% confidence interval with a 5% sampling error using Cochran's formula [32]. It was calculated based on statistical data from 2017 using the following formula: n = n0/(1 + n0/N), where n0 = (t2 * p * q)/d^2, t is the value of the selected alpha level ($\alpha = 0.05$, critical value = 1.96), p is the possible proportion of the population that has the attribute in question (0.5), q = 1 − p, d = acceptable margin of error (0.05), and N = population size. The calculated sample size was 87, and the study's sample size was larger than that. Employing stratified random sampling, this sample size was proportionally allocated to two barangays, and the respondents (representative household head) were selected.

In terms of the survey questionnaire, it was pretested on 17 January 2017, and the mapping method was improved in such a way that images/illustrations that described the landscape values were added to accompany the survey. The survey was carried out focusing on Brgys. Pancol and New Guinlo for the following reasons: (1) both of them are communities which represent the Inner Sound villages (Inner Malampaya Sound) that are accessible by automobile or boat (other coastal communities are difficult to access because of the poor road condition); (2) both of the villages' main livelihood includes fishing and farming.

2.4. Landscape Values Typology

We used landscape values as operational measures of sense of place [29] and to facilitate ES identification and determine local land uses that are in agreement with the existing zoning. The following 14 value typologies were used in the study (Table 1) (adopted from Hashimoto et al., [33]; and Havas, et al., [34]). The landscape values were modified and shortlisted based on their applicability to the conditions in Malampaya Sound Protected Landscape and Seascape (MSPLS).

Table 1. Typology of values of ESs used in the study.

Typology	Definition
Access	Places valued mainly because people can have free access to the benefits and services of the area.
Aesthetic	Places valued because of their beautiful scenery.
Biodiversity	Places valued for the presence of biodiversity and/or a wide array of different forms of life.
Economic	Places valued because of their components which are related to commercial use and profitability.
Future	Places valued for their characteristics and/or importance that can be passed on to or used by future generations for their wellbeing.
Historical	Places valued because they are areas of natural and human history.
Identity/Symbolic	Places valued for their important symbolic features that play a role in the identity of the place itself and the community.
Intrinsic	Places valued for their intangible unique characteristics, with which people have developed a highly personal and meaningful relationship over time.
Learning	Places valued because of the learning one can gain from nature.
Life-Sustaining	Places valued for benefits that are fundamental and life-supporting and without which people would cease to survive.
Recreation	Places valued because they provide recreational areas.
Subsistence	Places valued for their landscapes and/or seascapes and the components of them people use to survive or to make a self-sufficient living.
Therapeutic	Places valued for their medicinal properties and characteristics that support health and wellbeing.
Wilderness	Places valued because they offer primitive, unconfined types of recreation and serve as areas for scientific exploration and spiritual inspiration.

Using meta-cards and illustrations, the respondents were asked to list the benefits they receive from Malampaya and how they value these benefits. Afterwards, the respondents were requested to give weights or a rank of importance to the benefits identified. The process flow is described in Figure 3, wherein the researcher asked the respondents to map the places where they engaged in various activities which require resources from the land/sea. The perceived landscape values were identified, marked with colored dot stickers, and ranked by the respondents in order of importance. The respondents were also asked about the trend in the ESs or the benefit provided by or generated from the specific places identified. All the location points were digitized and visualized as point features with a density surface and further overlaid with the existing zoning. The density analysis for each category and for the overall evaluation vis-à-vis the respective willingness to pay (WTP) values was configured spatially. The rank of importance of the benefits or landscape value points was used as weighting for the density analysis of each landscape value, converting the rank information into numbers from 1 (not important) to 5 (most important) to represent the weights of 1 to 5 indicated in the questionnaire. On the other hand, annual WTP maps for landscape values with high counts of marked dots/points were generated using a point density function. A kernel density surface map for all the aggregated landscape value points was generated using the Spatial Analyst tool available in ArcMap 10.4.1.

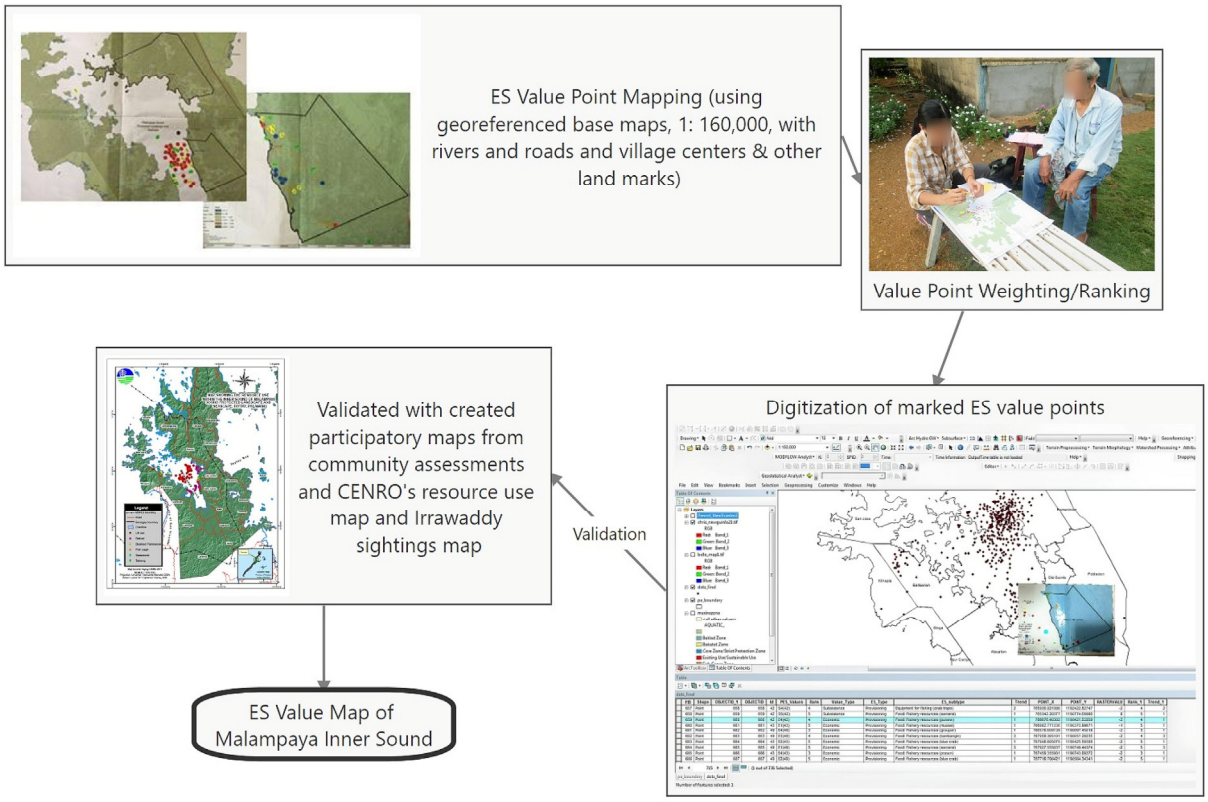

Figure 3. Process flow for landscape value point mapping.

2.5. Data Analysis

All the data collected from the survey were analyzed using descriptive and summary statistics such as frequency and counts. The Chi-square statistic was used to determine significant associations between the barangays and the ES benefits perceived. As for the GIS analyses, aside from density estimation, overlap analysis was used to identify the gaps between the valued areas and the zoning areas and to generate counts of the perceived landscape value points in each ECAN zone. Using Spearman's Rho or rank correlation coefficient, the presence of a significant correlation between the rank of and trend in benefits

and/or services as grouped by barangay was measured. In addition, analysis of variance (ANOVA) and linear regression were used to analyze the respondents' attributes and the perceived landscape values and ESs.

3. Results

3.1. Respondents' Profile

The survey was conducted during 30 January to 10 February 2017 among persons aged 20 years older. It was conducted with the help of personnel from the Community Environment and Natural Resource Office (CENRO) of Taytay, Palawan. The total number of respondents was 114, which corresponds to 12% of the household population of the two barangays/villages of focus (Pancol and New Guinlo) (National Statistics Office—Taytay, Palawan). Of the total respondents, 30 (26.3%) were male and 84 (73.7%) were female (Table 2). The most frequent respondent age group was 41–50 years of age. A total of 48 (42.1%) were migrants and 66 (57.9%) were native. The number of respondents with immediate 0–2 family household members was 21 (18.4%); 3–4 was 39 (34.2%); 5–6 was 31 (27.2%); 7–8 was 15 (13.2%); and 9–10 was 8 (7.0%).

Table 2. Socio-demographic characteristics of the respondents.

Socio-Demographics	Data Collected
Age (years)	Average respondent's age: 46
Gender	Female: 73.7%; Male: 26.3%
Residence length (years)	Average: 37.3 years; Highest: 83 years; Lowest: 2 years
Status of residence	Native: 57.9%; Migrant: 42.1%
Income dependent on nature	Fishing: 68 (59.6%); Farming: 33 (28.9%); Others: 13 (11.4%)

As for the occupation of the respondents, 59.6% of them are engaged in fishing, 28.9% are farmers, and 11.4% are non-dependent on the natural resources of Malampaya (Table 2), which includes those working as office staff, construction workers, and salespersons at commercial establishments.

3.2. Perceived ESs and Landscape Values in MSPLS

3.2.1. Priority ESs

The ESs perceived by the respondents were characterized into different groups, such as those relating to agriculture, forestry, fishery, livestock, wildlife/bushmeat, medicinal plants, water, etc. (see Supplementary Materials Section S1). The most important or priority ESs in MSPLS by way of community valuation were the provisioning services: fisheries, agriculture, and agroforestry. The figure below is a spatial distribution of the provisioning, regulating, cultural, and supporting services in MSPLS (Figure 4).

Pancol's respondents identified a total of 148 values landscape points with 108 value points (73.0%) linked to provisioning ESs, 28 value points (18.9%) linked to cultural ESs, 6 (4.1%) to regulating ESs, and 6 (4.1%) to supporting ESs. New Guinlo's respondents, on the other hand, identified a total of 375 landscape value points, with 296 points (78.9%) linked to provisioning ESs, 67 cultural ESs (17.9%), 8 regulating ESs (2.1%), and 4 supporting ESs (1.1%), respectively (Figure 5).

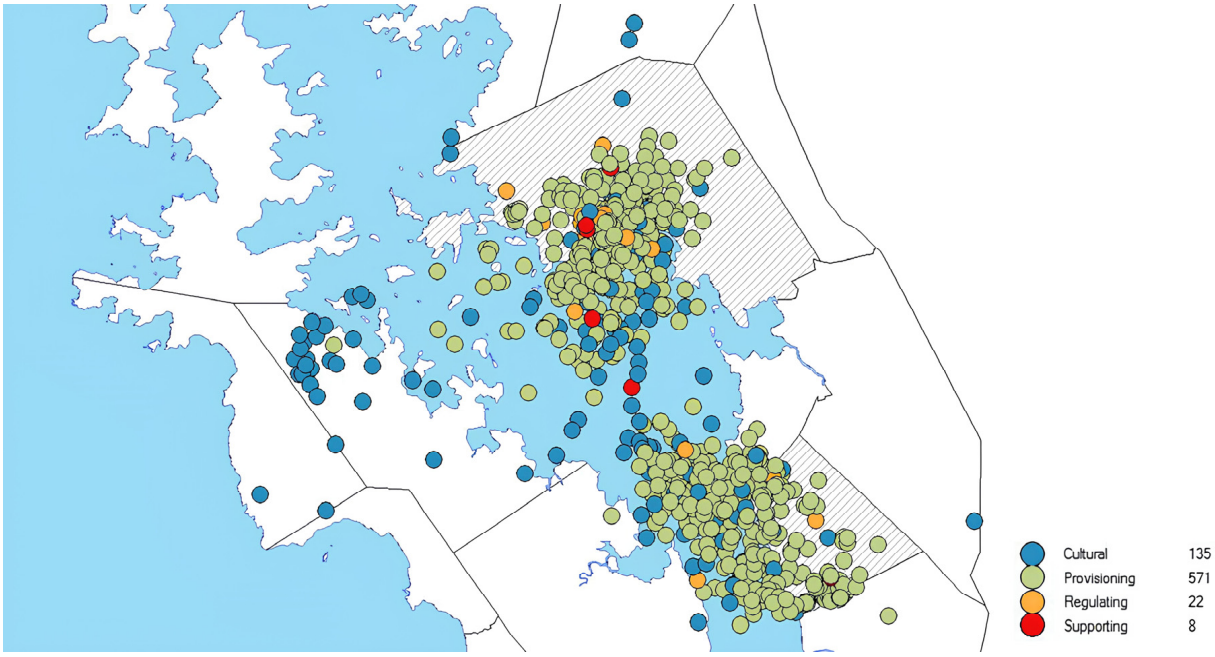

Figure 4. Type of perceived ESs in Malampaya based on MEA classification.

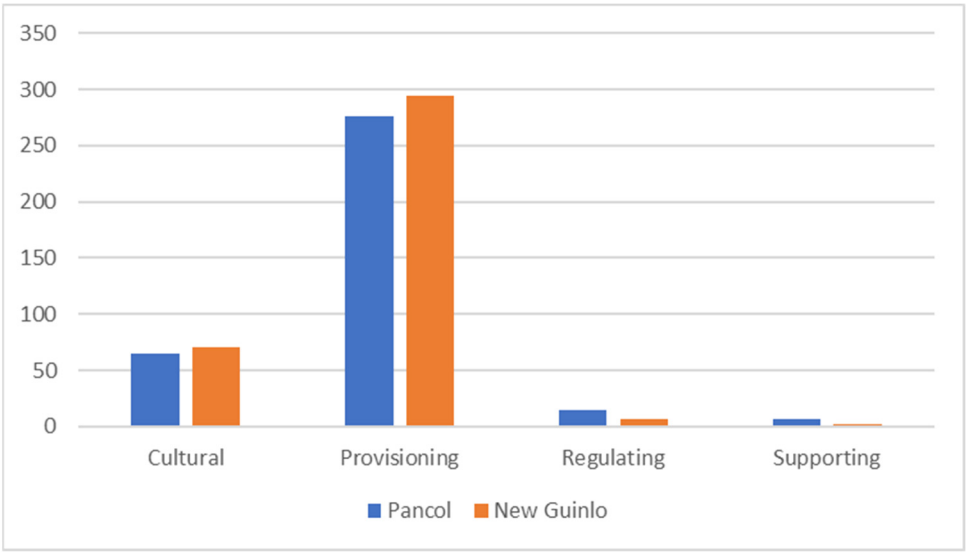

Figure 5. Distribution of mapped landscape points based on ES type and grouped by barangay.

3.2.2. Perceived Landscape Values in MSPLS

The total number of places indicated by the dot stickers/points was 736, averaging 6 stickers per respondent. The Brgy. Pancol respondents identified a total of 362 landscape value points, while the Brgy. New Guinlo respondents identified 375 landscape value points. The total proportion per landscape value was counted, and we found that economic landscape value had the highest frequency count (37.4%), followed by subsistence landscape (30.8%) and aesthetic landscape value (6.8%), respectively (Figure 6).

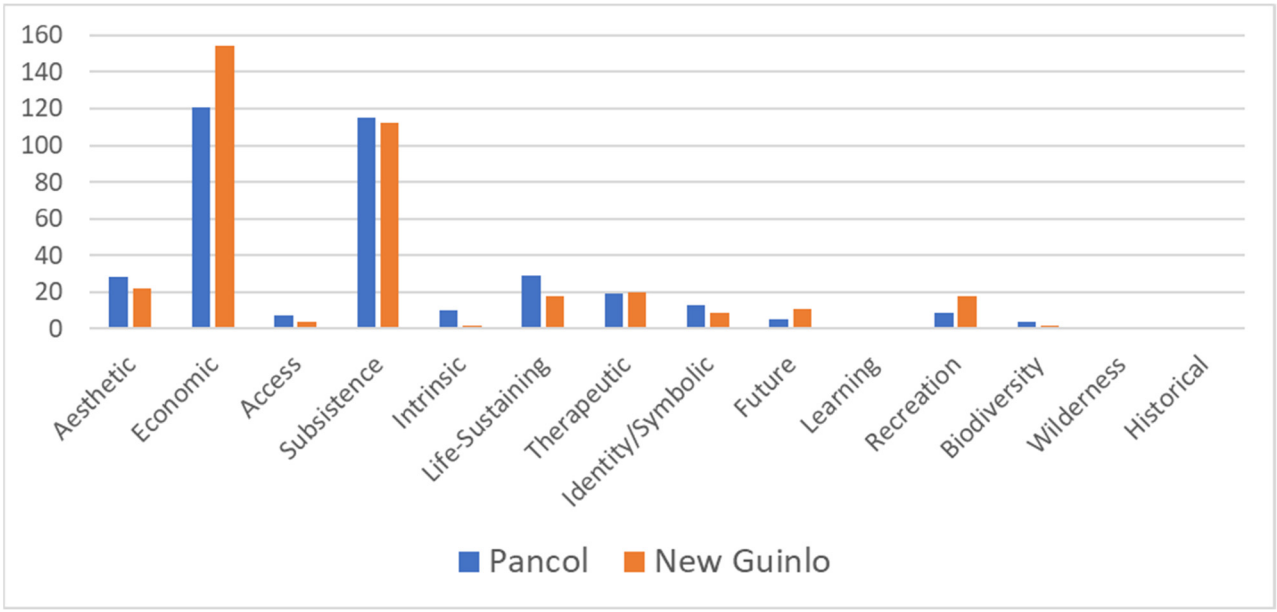

Figure 6. Distribution of perceived landscape values identified by respondents.

3.3. Rank of Importance of the Perceived Landscape Values and Their Trends

The total landscape value points were validated using existing spatial data from CENRO and using Google Earth 8.0 and were mapped, making sure that the appropriate Coordinate and Projection System (WGS 1984, Luzon N51) was used consistently in the point digitization. For all the identified landscape value points, the rank or weights of importance were summed up, and based on the responses, a total of 498 location points were deemed "Very important" by the local communities.

3.4. Spatial Attributes of the Perceived Landscape Values

The spatial distribution of important places across the landscape was examined numerically. The total count of places on land and in the sea for each landscape value was calculated (see Table 3). For one category (subsistence value), more than 50% of the important places were located on land. This was followed by economic and life-sustaining values. This reveals the importance of the Malampaya Sound to local residents in terms of livelihood and demonstrates that the communities' wellbeing is linked with Malampaya. The value categories with the most sea-based (offshore) locations were economic, subsistence, and identity/symbolic. As for the overlaps or mismatches between the ECAN zoning and the perceived value points, the Count-to-Polygon command was used to generate the number of perceived landscape value points that fell into a specific zone. Out of a total of 736 points, 365 of the points recognized were located terrestrially, while 371 points were in the water/marine zones.

Table 3. Count of perceived landscape value points in Malampaya Sound under each ECAN zone (both terrestrial and marine zoning).

Summary of Value Mapping and Allocation									
		Total	**Core**	**Restricted**	**Controlled**	**Traditional**	**Multiple-Use**		
ZONES	On land	365	88	3	27	152	95		
	In the sea		Baklad Zone	Bokatot Zone	Core/Strict Protection	Communal Fishing Ground	Fish Cage Zone	Navigational Zone	Tourism Devt. Zone
		371	140	14	0	174	15	28	None

Note: A "Baklad" zone refers to an area with fish corrals, while a "Bokatot" zone refers to an area with crab pots and lift nets. These are considered local fishing gear in Malampaya.

Figure 7 illustrates the distribution and estimated location in Malampaya Sound of the perceived landscape value points. It shows that economic value (275 points) had the highest number of points, followed by subsistence value (227 points) and then aesthetic value (49 points). This result shows the capacity of Malampaya to support an economic- and subsistence-specific bundle of ESs and also underscores the demand for ESs in Malampaya with economic, subsistence, and aesthetic values.

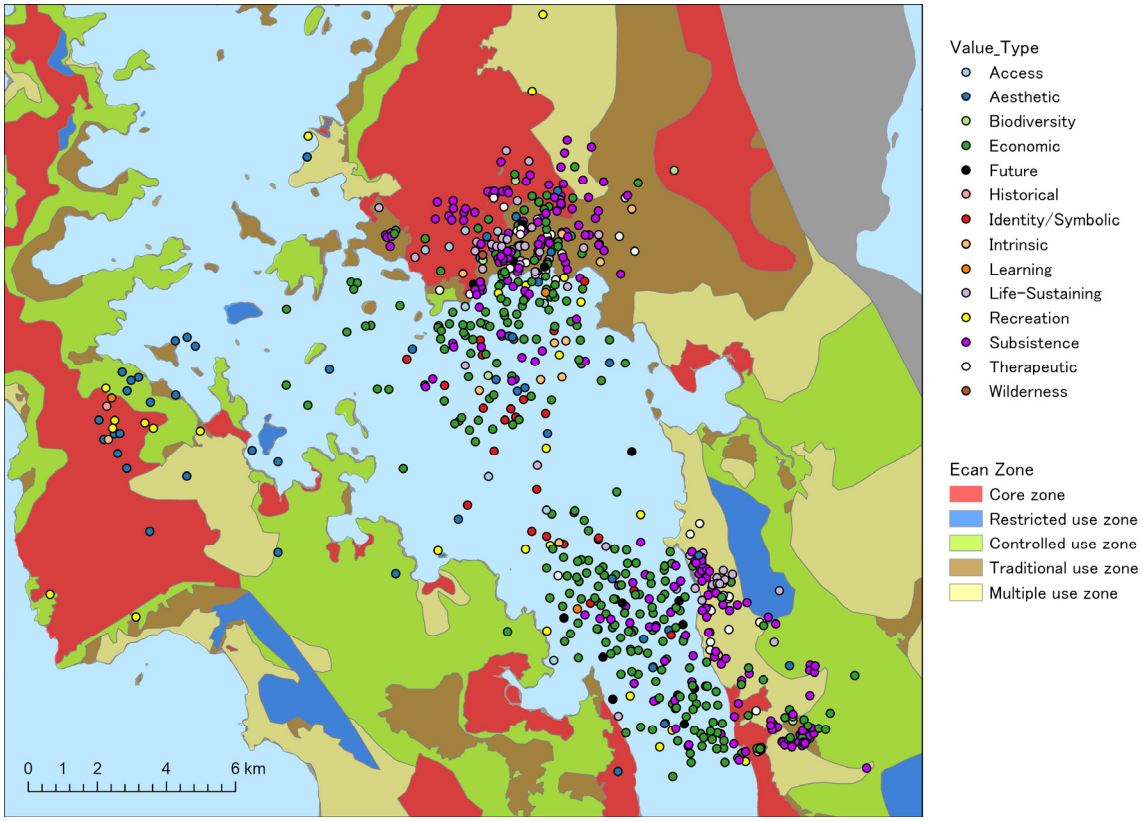

Figure 7. Location of the identified landscape value points in Malampaya overlaid with the terrestrial ECAN zones.

The map displays quantitatively the total identified value points in each zoning category (indicated in the legend). The results show that most of the identified value points in the terrestrial zones were detected in the traditional zone protection category. They also show that the core zones had 88 value points detected. As for the points within the marine zoning, most of the points were in the communal fishing ground (174 points), and none fell into the core and strict protection zones.

3.5. Weight of Importance of the Landscape Values

The distribution of the landscape values and their weight of importance based on the survey responses from two barangays/villages were also analyzed. In Figure 8 below, the top three landscape typologies with the largest proportions, respectively, of respondents perceiving the places as highly important were (1) economic value, with 275 location points; (2) subsistence value, with 227 points; and (3) aesthetic value, with 50 value points. The historical value and the wilderness value, although rated highly important, only had one location point each. Furthermore, the geographical distribution of the important places across the landscape was examined, and we found that the greatest number of places identified were for economic value (37.4%) and the lowest were for historical value (0.14%) and wilderness value (0.14%).

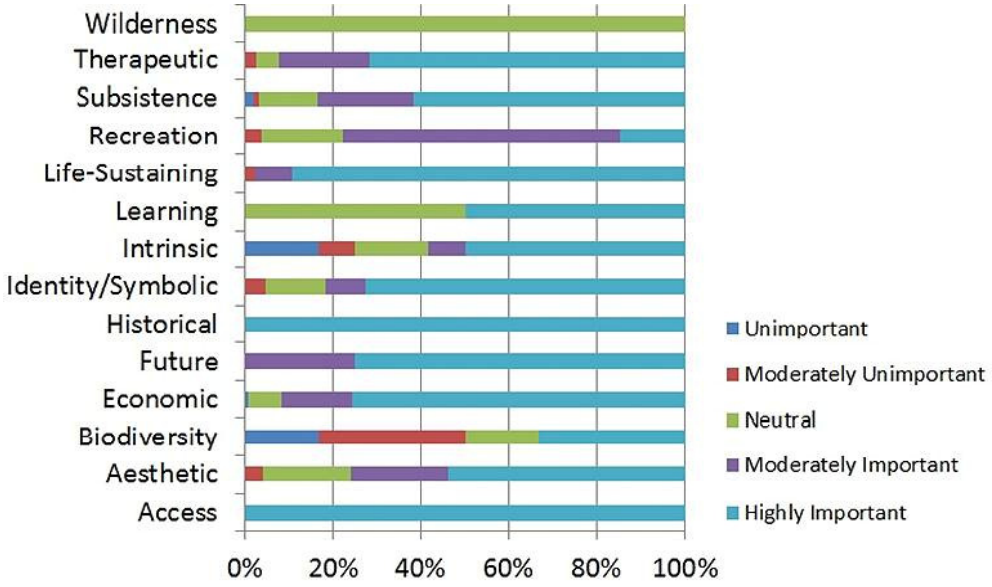

Figure 8. Weight of importance of perceived landscape value typologies.

3.6. Relationship between Place of Residence and Landscape Values' Weight of Importance and Trends in ESs

According to the Spearman's Rho rank order correlation results, the relationship between rank and trend (in both Pancol's and New Guinlo's respondents' aggregated landscape values) is significant at a 10% level of significance. The relationship is weak and is inversely related. Comparing the two barangays, Pancol shows significant correlation at a 10% level of significance. The relationship is weak and is inversely related. On the other hand, New Guinlo does not signify any relationship between the respondents' perceived landscape values' rank of importance and trend (Table 4).

Table 4. Relationship between weight of importance of landscape values and their trends in two places of residence, Pancol and New Guinlo.

Trend in ES	Rank of ES	Correlation Coefficient	Significance Value (*p*-Value)	Remarks
Trend (all)	Rank (all)	−0.068	0.064	Relationship is significant at a 10% level of significance; relationship is weak, inversely related
Trend (Pancol)	Rank (Pancol)	−0.098	0.062	Relationship is significant at 10% level of significance; relationship is weak, inversely related
Trend (New Guinlo)	Rank (New Guinlo)	−0.037	0.478	Not significant @ at 5% level of significance

3.7. Willingness to Pay (WTP): Importance, Trends, and Individual Attributes of Respondents

To have an understanding of how the respondents subjectively assigned WTP to the ecosystem services, we analyzed the socio-economic attributes of each respondent (Table 5). Five types of landscape values were found to have a high association with socio-economic attributes, which were age, gender, and nativeness. Detailed results are provided in the Supplementary Materials Section S2. As an example, we found that aesthetic value was found to be more important to older respondents based on the count of the value points. As for the trend in places with aesthetic value, female respondents tended to think that the aesthetic value of such landscape places was diminishing. Moreover, it was found that male respondents tended to perceive economic value more highly than female respondents. In terms of recreation value, non-native respondents perceived it

more highly than native respondents. For the trend in places with recreation value, non-native respondents, compared to native respondents, perceived that recreation value is increasing. For subsistence value, male respondents perceived its importance more highly than female respondents did. Lastly, places associated with therapeutic value were perceived as important mostly by younger respondents, and they perceived this trend to be increasing.

Table 5. Analysis result of respondents' attributes and subjective valuation.

	Count of Value Point	Rank	Trend	WTP
Aesthetic	Age (+)		Male > female	
Economic	Male > female			
Recreation		Non-native > native	Non-native > native	
Subsistence		Male > female		
Therapeutic		Age (−)	Age (−)	

Note: Variables such as gender and nativeness are binary variables, and ANOVA was used for analysis. Age as a continuous variable is analyzed using linear regression. (+) and (−) means positive and negative correlations, respectively, while blank spaces mean no statistically significant correlations were found.

In terms of the identified ESs, socio-economic attributes, and WTP, three ES types were found to have an association with the respondents' socio-economic attributes. These are cultural, provisioning, and supportive ESs. For the cultural ES, female respondents perceived its importance more than male respondents did. The count of the value points signifies that non-native respondents tended to recognize the rank of importance of cultural ESs more highly than native respondents. As for WTP for cultural services, natives may tend to pay more than non-natives.

In Table 6 below on the relationship between ES type and WTP, the results indicate that male respondents perceived the importance of provisioning services as higher than female respondents did based on the count of the value points under each ES type and their rank of importance. However, we found that female respondents tended to have a higher WTP for provisioning services than male respondents. For the supporting ESs, there was no correlation between the socio-demographic attributes and WTP, but the count of the value points showed that older respondents recognized the supporting ESs more highly.

Table 6. Analysis result of perceived ESs and subjective valuation.

	Count of Value Point	Rank	Trend	WTP
Cultural	Female > male	Non-native > native		Native > non-native
Provisioning	Male > female	Male > female		Female > male
Supporting	Age (+)			

Note: Variables such as gender and nativeness are binary variables, and ANOVA was used for analysis. Age as a continuous variable is analyzed using linear regression. (+) means positive correlations, while blank spaces mean no statistically significant correlations were found.

3.8. Annual Potential PES Revenue Based on WTP

The respondents were asked about their willingness to pay to improve or enhance the quality of ecosystem services without any predetermined choices or options for payment. Based on the findings of the survey, the WTP statistics were calculated, and they are shown in the table below:

Table 7 indicates the descriptive measures of the WTP of the community. The average mean WTP was almost PHP 95.00 or USD 2.00, while the maximum WTP was PHP 3000.00.

Table 7. Willingness to pay statistics as per answers of the randomly selected respondents when asked how much they were willing to pay, in a year, to improve ESs in Malampaya.

	Minimum	Maximum	Mean	Std. Deviation
WTP	0.00	3000.00 (PHP 3000)	94.91 (PHP 95)	266.75 (PHP 267)

3.9. Relationship between Willingness to Pay (WTP) to Enhance the ESs' Benefits in Malampaya and Respondents' Income

The relationship between WTP and the income of the respondents was analyzed using correlation analysis, and the study found that WTP and Pancol's respondents' income had a significant relationship at a 10% level of confidence (Table 8). However, the relationship was weak and inversely related. Other than that, there appeared to be no significant relationship at a 5% level of significance between WTP and New Guinlo's respondents' income, as well as between WTP and respondents' income regardless of barangay and income.

Table 8. Relationship between WTP and income of the respondents.

WTP	Income	Correlation Coefficient	Significance Value (*p*-Value)	Remarks
WTP (all)	Income (all)	−0.128	0.176	Not significant @ at 5% level of significance
WTP (Pancol)	Income (Pancol)	−0.229	0.099	Relationship is significant @ a 10% level of significance; relationship is weak, inversely related
WTP (New Guinlo)	Income (New Guinlo)	−0.040	0.759	Not significant at 5% level of significance

3.10. Opportunities for Payment for Ecosystem Services (PES)

Payment for ecosystem services is an economic tool that gives positive conditional incentives for the provision of ecosystem services which has been widely used in terrestrial conservation [35]. A PES approach can also be applied by way of user fees or membership fees as another possible instrument for managing ESs. Based on the results indicated in Section 3.8, the estimated mean willingness to pay accounts for:

- 0.22% of the Pancol respondents' income
- 0.16% of the New Guinlo respondents' income

The above result translates into a potential annual revenue for payment for ecosystem services which, if collected, could amount to PHP 532,000 (from an estimated 5600 households in MSPLS) or approximately USD 10,600 (average PHP-USD conversion rate, June 2017. In current USD currency, this is equivalent to approximately USD9600 (March 2024)). Generally, the respondents were open to paying for the improvement of the ESs' benefits in MSPLS. As per the findings of the contingent valuation, the estimated PES one household family was willing to disburse could amount to PHP 95.00 or USD 2.00 annually. This potential financial resource, if pooled from all the households in Malampaya, could be used to implement viable development and conservation goals and projects for MSPLS.

3.11. ES Heat Maps Based on WTP

There were six landscape values identified in Malampaya which dominantly received high recognition from the local communities, and these are the following: (1) economic; (2) subsistence; (3) aesthetic; (4) life-sustaining; (5) therapeutic; and (6) recreation, respectively. Through point density estimation and using WTP as the predictor value, heat maps were generated. Figure 9 shows the "hotspot" locations based on the WTP values assigned by the respondents, which are illustrated on heat maps. These are the predictive surfaces of

each of the six landscape values, assuming that the underlying factors that contribute to the supply and distribution of the ESs do not change. It can be observed that the landscape value points were less sparsely distributed, indicating that some areas in Malampaya contain multiple ESs. The heat maps also show that the closer the value point is to the coastline, the higher the WTP allocation is.

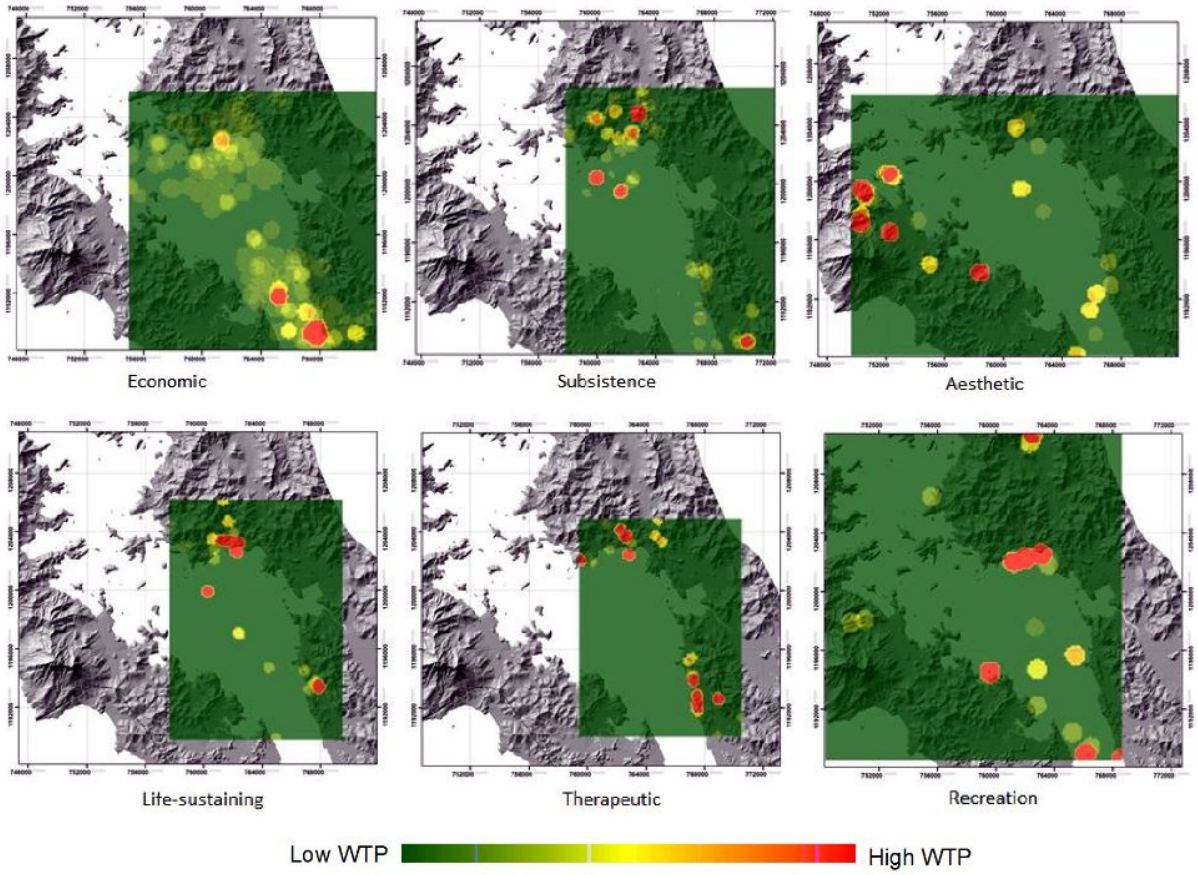

Figure 9. Density hotspot maps of six landscape typologies based on WTP for enhancement of ecosystem services in MSPLS. Note: Kernel density surfaces were automatically generated with a 500 m search radius.

4. Discussion

The local communities in MSPLS identified several ESs in their localities based on the Millenium Ecosystem Assessment (MA) classification. In general, the respondents' direct and indirect relationships with the ESs, based on the landscape value point typology, varied depending on gender, age, and residency origin (nativeness). It was observed that, in terms of the ECAN terrestrial zoning, the highest number of landscape value points was detected to be in the traditional use zones, multiple-use zones, and core zones, respectively. In the ECAN marine zoning, the highest number was found in the communal fishing grounds, indicating the presence of traditional resource use in the communal fishing grounds. The result of a spatial overlap between the value points and the terrestrial zoning suggests some mismatches between local resource use and terrestrial zoning policy (i.e., economic value points detected in the terrestrial core zoning). Hence, raising awareness of environmental conservation in Pancol and New Guinlo, especially for those who depend on agriculture, forestry, and fishery in the area where development is restricted, should be implemented. These findings are similar to those of a study on ECAN zoning and critical habitats in Palawan that recommended the integration of data such as local community resource use to contribute to improving environmental management strategy [36]. Our results,

however, provided in-depth information on the relationship between the local perception of landscape values and people's attributes in a protected area that previously was an open access area. The influencing factors of the relationship between landscape value recognition and individual attributes, as well as its implications for PA management, are presented as follows:

4.1. Socio-Economic Factors Influencing Landscape Values' Importance and Trends

In the Results section, we found that male respondents tended to perceive landscape locations associated with economic and subsistence values, which are categorized as provisioning services. Possible reasons for this result might be male respondents are engaged in livelihood and economic activities such as fishing more frequently than female respondents. As Yang et al. [37], in reviewing the research on perceptions of ESs, found that a large number of papers detected the gendered nature of food production and preparation, we also found the gender differences in local perceptions of ESs were related to food production.

On the other hand, the female respondents tended to recognize the importance of cultural services and may have also thought that the aesthetic value in Malampaya is decreasing. It was also observed that the female respondents tended to have a higher WTP for provisioning services than the male respondents. This suggests differences between genders since the results show that the female respondents tended to recognize non-material contributions and were concerned about the decline in landscape values and its possible impact on wellbeing. This concern might be associated with and reflected in a high WTP for another ES (i.e., provisioning). The result is consistent with the result of Shen et al. [38], who showed the female WTP was higher than that of the male respondents in terms of ocean ecosystem services, including fish production. However, as Obeng and Aguilar [39] found in their nationwide survey in the United States, the male population might have a higher WTP for forest watershed conservation. The relationships between WTP value and gender might be different depending on the target ES types.

The non-native respondents tended to recognize the importance of cultural services, such as those with recreation value, whereas the native respondents tended to have a higher WTP than the non-native respondents. It might be that non-native and native respondents both recognize the importance of cultural services, but they differ in their perceptions of trends (i.e., recreation value). Natives tended to think that the recreation value of Malampaya is decreasing, and this may suggest a high WTP for native respondents owing to their place attachment and their probably richer knowledge and experience of the past. In addition to place attachment, native residents tend to have place identity [40]. The higher WTP values of the native respondents might be related to their place attachment and identity. Demirović et al. [41] identified that native residents tended to show more concern about the environmental impacts of the tourism industry. The tendency that they found for native residents is aligned with that in our findings.

Some studies underline the differences in the demand for and valuation of ESs between young and old people and their personal histories or experiences during childhood in terms of interaction with nature [42,43]. Similarly, we observed a positive correlation between the high importance of aesthetic value and age, as well as that of supporting ESs and age. This relationship might be due to their subjective perception of and living history in Malampaya given that they have had longer direct and indirect interactions with the PA environment. For instance, in a study by Li and Ando [44], it was found that people who participated in outdoor activities or grew up near grasslands during their childhood see a higher value in grassland restoration than people who did not.

Finally, landscape in Malampaya with therapeutic value was recognized by the younger respondents more as an important value. In addition, although not strongly correlated with rank of importance, the results show that they tended to think that the positive status/trend of these landscapes with therapeutic value (e.g., medicinal plants) is increasing. This subjective valuation and expectation may be related to the younger

respondents' greater access to more knowledge sources than that of the older respondents, such as mass media, etc.

4.2. WTP as Potential PES and Implications for PA Zoning Policy

In the review of Dang et al. [45] on ES assessment and policy integration in Southeast Asian countries, it appears that the Philippines has insufficient land use policy-planning-related research. For Malampaya to sustain its supply of ESs, it is important that its local communities understand and are engaged in the mapping of multiple ESs across the landscape and not only for a single ES for which demand is high. In Figure 9, we illustrated the key landscape values perceived by the local communities and associated them with ESs. These were attributed to WTP, serving as an example of how human perception and recognition of place can be integrated into PA management. If PA zone setting and management are aligned with local perceptions and needs, negative attitudes toward Pas, as observed in existing studies (e.g., Amin et al., 2015) [46], can be decreased, and more effective implementation of PAs can be achieved based on collaborations between various stakeholders. Furthermore, as suggested by González-García et al. [47], who showed the efficacy of ES mapping for solving the spatial gaps between demand and supply, the regional ecosystem service maps generated by our research can be applicable to PA management to sustain ES supply considering ES demand.

Also, in this study, we found that the landscape values focusing on ESs were less sparsely distributed and created a pattern of WTP hotspots in Malampaya. WTP is found to be influenced by a number of factors, such as gender, age and nativeness. Based on the spatial distribution of the ESs and their values, landscape functional zoning can be developed [48]. The detected spatial patterns of the WTP values and hotspots need to be considered in PA zoning policies.

In the future, with the potential annual PES (estimated USD 10,600 in total or PHP 95 per household) in Malampaya, PA managers can consider increasing efforts toward ES awareness among residents and visitors and promote conservation goals and targets for the PA. This can support effective conservation planning and landscape-level management, including re-evaluation and/or updating of the current ECAN zones. Research on WTP was conducted in this study to develop PES schemes. If the local needs are reflected in the selection of target ESs, it will be an acceptable scheme, as demonstrated in existing case studies [49,50]. Our findings can be the basis for crafting PES schemes in the survey site, and the schemes can have synergistic relationships with the PA zoning policies based on local perceptions.

5. Conclusions

Our study identified the value points of the ESs in Malampaya and predicted areas of richness and areas of decline. From the locations of the 736 value points digitized, different aspects of ES supply and generation were captured, including spatial distribution and scale. In Malampaya, it seems that provisioning services with economic and subsistence values tend to be ranked highly. This high demand and dependency on provisioning services will affect the supply of ESs in the long run, and thus the management of provisioning services is a critical factor in Malampaya. To safeguard the integrity and resilience of the PA, measures that allow for the recovery and regeneration of the landscape and seascape with the involvement of local communities should be considered. Alongside this, decision-makers and managers can take into account the potential to create alternative livelihood and employment options, as well as make people more aware of the importance of Malampaya for their own wellbeing through public involvement planning and consultation processes.

The study also presented a methodological development involving landscape value point mapping, undertaken with the participation of the local communities. The results of this participatory mapping process are crucial in determining resource use management conflicts between resource managers (i.e., governments) and local users/beneficiaries. The key results on the overlap between the landscape value points and the zoning policy can

be the basis for ascertaining the importance of some terrestrial/marine zones in MSPLS and for inclusive PA management. The study also indicated that the traditional zones have a high concentration of landscape value points, which suggests that residents in the area have long utilized the traditional zones. Additionally, it was found that compared with the terrestrial/land zones, marine zones had more value points that are declining. This implies that fishery resources, as the main provisioning service in MSPLS, is threatened as a result of pressures from population growth and migration. Developing sustainable approaches and the diversification of livelihood activities (e.g., the enhancement of the communal fishing ground, developing ecotourism development areas and visitor education/demonstration sites, etc.) should be considered. There was also an observed importance of the multiple-use zones given the relatively high value perception from the communities, and therefore increasing efforts into strategic resource planning and management should be concentrated on these zones.

The results our study generated on WTP confirms that local communities are willing to contribute in monetary form towards improving the ESs in Malampaya, and this reveals the potential of Malampaya to implement a sustainable financing strategy for conservation. The institution of such approaches could be funded by potential PES revenue and aimed annually at advancing both environmental conservation and poverty alleviation goals.

We conclude that mapping landscape values using our three-pronged framework can be used to assess the comprehension of local people of ecosystem services, their significance, and trends in MSPLS. Here, since we were able to spatially identify several ESs that are important to the local communities and hold diverse values, we demonstrate that the output of this research (value maps) can aid in crafting policies that are based on a comprehensive understanding of not only the ecological significance of different areas but also of the community's demand for ESs.

6. Recommendations

Perceived landscape values and ES recognition are influenced by local people's socio-economic attributes, and thus the social perception of ESs should be incorporated into the updating of the ECAN zoning. Spatial integration analysis with other indicators such as stressor data layers can be further conducted. This was outside the scope of our paper but is a future research area which can supplement the outcomes of the value mapping.

Through our findings, we confirm that regulating and supporting ecosystem services were not recognized well by the respondents, and therefore increasing their awareness and understanding among local residents in Malampaya is crucial since they are vital to the community's livelihood, wellbeing, and survival. Future research could focus on land use changes according to the dimension of regulating and supporting ecosystem services and how these land use changes would be reflected in Malampaya's ecological functions and natural capital over time. Methods such as stakeholder workshops incorporating mental models and future-thinking approaches can be used for these processes.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/su16083210/s1, Table S1. Overview of perceived ESs in Malampaya Sound; Figure S1. Correlation between count of landscape value points (aesthetic value) and age; Figure S2. ANOVA of count of landscape value points (economic value) and gender; Figure S3. ANOVA of count of landscape value points (cultural value) and gender; Figure S4. ANOVA of count of provisioning ESs and gender; Figure S5. Correlation between count of supporting ESs and age; Figure S6. ANOVA of trend in landscape value points (aesthetic value) and gender; Figure S7. ANOVA of rank of landscape value points (recreation value) and nativeness; Figure S8. ANOVA of trend in landscape value points (recreation value) and nativeness; Figure S9. ANOVA of rank of landscape value points (subsistence value) and gender; Figure S10. Correlation of trend in landscape value points (therapeutic value) and age; Figure S11. ANOVA of rank of cultural ESs and nativeness; Figure S12. ANOVA of WTP for cultural ESs and nativeness; Figure S13. ANOVA of rank of provisioning ESs and gender; Figure S14. ANOVA of WTP for provisioning ESs and gender; Figure S15. Example of a base map used in landscape values mapping with colored dot stickers.

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