Grantham Research Institute on Climate Change and the Environment

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May 2026

Grantham Research Institute on Climate Change and the Environment
Working Paper No. 448

ISSN 2515-5717 (Online)

Grantham Foundation for the Protection of the Environment

Global School of Sustainability

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This paper was first published in May 2026 by the Grantham Research Institute on Climate Change and the Environment at the London School of Economics and Political Science.

Suggested citation:

Howai N, Bian A, De Guzman-Mortillero A and Robinson E (2026) *Mangrove livelihoods in Palawan, Philippines: individual and joint household preferences with exemption interviews*. Grantham Research Institute on Climate Change and the Environment Working Paper 448. London: London School of Economics and Political Science

DOI: 10.21953/researchonline.lse.ac.uk.00138521

Mangrove livelihoods in Palawan, Philippines: individual and joint household preferences for mangrove resources and exemption interviews

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Abstract

Mangroves, especially in coastal areas, provide collective benefits to households, not just individuals. In this study, we undertake a comparison of individuals' and couples' intra-household decision-making on preferences for mangrove preservation expenditure and benefits using a discrete choice experiment (DCE) in Palawan province in the Philippines. We find that men's and women's individual preferences differ when responding separately to the survey, and that their joint preferences align more with the men's preferences. We also conducted in-depth interviews with a subset of the population considered to be marginalised and exempt from contributing to mangrove preservation payments under the DCE. The findings from the exemption interviews suggest strong support for community co-management of mangrove marine protected areas (MPAs), provided that income-generating alternative livelihood projects are created. This, in turn, is combined with the couples' preferences in the DCE. The resulting preferences for mangrove benefits and their valuation can be used to inform the design and financing of MPAs that include co-managed mangrove protection and restoration projects with locals, as well as policies for the use of mangrove resources on the island.

JEL codes: C11; C25; D12; Q57

Keywords: Discrete choice experiment; intra-household preferences; in-depth interviews; hierarchical Bayesian logit; mangroves

1. Introduction

Mangroves are tropical and sub-tropical intertidal trees or shrubs that provide myriad benefits to people, but which also face many threats (Barbier, 2017; Friess *et al.*, 2019). These benefits have economic values that can be categorised by their use (direct, indirect and option) and non-use (existence and bequest) value to people (Dixon and Pagiola, 1998). Direct use values include forestry and fisheries products; indirect use values include coastal erosion protection and storm protection; option values include future eco-jobs; existence values include aesthetics; and bequest values include intergenerational benefits (Kathiresan, 2012; Das, 2022; Howai, 2023). There are also non-anthropocentric (intrinsic) values that have inherent worth in and of themselves. These may overlap in their contribution to people's well-being and be ascribed as non-use values, such as species and genetic diversity (Pascual *et al.*, 2017; Díaz *et al.*, 2018). Despite the benefits and subsequent values that mangroves provide globally, they have been lost at a rate of 0.2% to 0.7% annually since the 2000s, with particularly high loss rates of 6% in Southeast Asia (Friess *et al.*, 2019; Spalding *et al.*, 2021). These losses can be attributed to deforestation, aquaculture, agriculture, tourism, and weather and climate shocks (Polidoro *et al.*, 2010; Richards and Friess, 2016).

In the Philippines, overexploitation over the past century has led to mangrove losses, from around 500,000 ha in 1918 to around 120,000 ha in 1995 (Cayetano *et al.*, 2023). The people most affected by this mangrove loss tend to be from coastal communities. Yet, when it comes to decision-making, coastal residents are not always included in environmental protection planning, climate adaptation and policy development (Gera, 2016; Nabong *et al.*, 2021). At present, there is a drive in

research for greater coastal community participation on issues pertaining to their health, well-being, resource use and environmental quality (for example, D'Agnes et al., 2010; Richter et al., 2021; Sumeldan et al., 2021). A starting point for increasing coastal community participation has often been to survey these populations to understand how they value local ecosystem services (benefits to people) with the 'household head' or one decision-maker per household being surveyed. Yet empirical evidence suggests that conducting surveys with just one member of a family may be inappropriate, as household decision-making can involve a bargaining process among family members (Bateman and Munro, 2009; Boto-García *et al.*, 2023). Consequently, our overarching research aim centres on determining to what extent coastal residents value increased mangrove benefits due to greater environmental protection, and the extent to which these valuations differ among decision-makers in a household. We address this by way of a discrete choice experiment (DCE), comparing the separate, individual preferences of couples (dyads or spouses/sentimental partners) with those of joint household preferences.

We contribute to the literature in the following ways. First, though this approach has been used in previous studies in the areas of health, transport and marketing, it remains relatively rare in environmental valuation. In health-related studies, it has centred on couple-based interventions and medical treatments, with sample sizes varying from around 50 to 100 dyads (for example, Abdulrahim et al., 2021; Choi and Templin, 2024; Choi et al., 2025). The transport and marketing literature studies that focus on intra-household decision-making include topics such as residential purchases, automobile purchases and fuel type (for example, Marcucci et al., 2011; Hensher et al., 2017; Beck and Rose, 2019). Other studies have investigated how well one partner knows the other partner's preferences when it comes to vacation choices (for example, Boto-García et al., 2023; Boto-García and Mariel, 2024). Closely related are Beharry-Borg et al. (2009) and Rungie et al. (2014), which investigated the individual and joint preferences of 45 couples with respect to beach water quality improvements in Tobago, and of 80 couples with respect to tap-water quality in Italy, respectively. Our research also extends this literature by using hierarchical Bayesian choice modelling to derive estimates, which possesses advantages for our application and is discussed in section 2.4.

Previous studies show a variety of outcomes across partner preferences. For example, one gender may have a dominant influence on joint preferences (for example, Beharry-Borg et al., 2009; Yang and Carlsson, 2016). Couples may also compromise, so that their joint preferences lie between both individual preferences (for example, Hensher et al., 2017; Mariel et al., 2018). The reasons for the variation can depend on societal and marital roles, intra-couple norms, the time available for household decision-making, control over household resources, and which partner has the greater bargaining power (Boto-García *et al.*, 2023). However, the literature shows joint preferences tend to be dominated by the male partner (for example, Carlsson et al., 2013; Michaud et al., 2020). Our expectations were that: i) men and women would possess different individual preferences; and ii) joint preferences would lie somewhere between the two, potentially dominated by women, but depending on the specific intra-couple norms in each household. Ashraf (2009) notes that, in the Philippines, decision-making influence tends to be skewed towards the person who controls the household's savings. In this context, women largely make the major decisions when it comes to expenditure and savings.

There is another strand in the literature that shows how people's willingness to pay (WTP) and support for environmental policies increase when fairness and vertical equity measures, such as exemptions for low-income households, are taken into consideration (Cronin *et al.*, 2019). Not everyone can afford to pay for environmental goods and services (Andor *et al.*, 2018). This may be due to sociodemographic or other factors that make their household vulnerable, for example, familial physical or psychological challenges, income-earning capacity or sociocultural circumstances. Although Andor et al. (2022) shows that these individuals can be exempted from programmes involving WTP scenarios without negative consequences for WTP estimates and policy support, we suggest it is valuable to explore their thinking and preferences using in-depth interviews (for example, Langevin et al., 2013).

Qualitative research using interviews, focus groups and public deliberation has been used in stated preference studies for environmental decision-making (for example, Brouwer et al., 1999; Powe et al., 2005; Rakotonarivo et al., 2017; Gorton et al., 2023). The use of in-depth interviews has generally been found to add value to DCEs (Vass *et al.*, 2017). We undertake in-depth interviews with exempted individuals to supplement the DCE, terming them 'exemption interviews'. To the best of our knowledge, this is the first time this has been done. The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES)[1] and ecological economics paradigm have recommended integrating economic valuation with other valuation approaches for a more pluralistic outlook for example, by taking a sociocultural narrative approach in conjunction with economic valuation (Pascual *et al.*, 2017; Jacobs *et al.*, 2018; Costanza, 2020).

The remainder of this paper is as follows. Section 2 describes and explains the study site, the experimental and in-depth interview design, and model selection. Section 3 presents the findings of the DCE and in-depth interviews. Section 4 discusses the findings and section 5 presents our conclusions.

2. Methods

2.1 Study site selection

Palawan is an island province in the Philippine archipelago and the largest of 81 provinces. It has an approximate total area of 1,489,626 ha, comprising 1,780 islands and islets, with 2,000 km of coastline (Sumeldan *et al.*, 2021). The province is named after the main island and is bordered by the South China Sea to the west, and the Sulu Sea and Malaysian Sabah Island to the east and south (Cayetano *et al.*, 2023). Mountain ranges cover approximately 63% of the main island; the remaining area is flat, with gentle, habitable slopes near the coastline (PCSD, 2015). It is the coastal areas that are the focus of our study, as mangroves are usually found in the intertidal zones.

Palawan is referred to as the Philippines' 'last ecological frontier' due to its rich biodiversity, and mangroves are one component of its diverse ecosystem. Mangroves in Palawan are concentrated in the coastal zone, for example, in riverine sites and bays (Cayetano *et al.*, 2023). The largest mangrove areas are found on the eastern part of the island. There have been considerable mangrove losses over the past century (Cayetano *et al.*, 2023). Historically, mangroves in Palawan are in better condition than those in the wider Philippines, and losses have been lower, but there is still cause for concern in terms of protecting the mangroves for the future.

The province has an abundance of resources that provide economic opportunities for residents, ranging from fisheries and forestry to agriculture and tourism (PCSD, 2015). Importantly, the coastal areas surrounded by mangroves provide livelihood opportunities for many communities, including rich offshore and nearshore fishing grounds, wild mangrove honey harvesting, and eco-tourism opportunities (Matias *et al.*, 2018; Madarcos *et al.*, 2021). However, destructive fishing practices and pollution pose a substantial threat to these livelihoods (Gajardo *et al.*, 2023).

Palawan was declared a mangrove swamp forest reserve in 1981, designated as a United Nations Educational, Scientific and Cultural Organization (UNESCO) Biosphere Reserve in 1990, and made subject to strict protection under the Strategic Environmental Plan for Palawan Act (Republic Act No. 7611) (Haworth *et al.*, 2024). The creation and enhancement of MPAs to incorporate mangroves to curtail these challenges is one approach to achieving sustainable mangrove management systems. Alongside nationally designated MPAs, indigenous groups, such as the Tagbanua tribe, have developed local practices to manage the mangrove system with some documented success (Buncag *et al.*, 2023).

[1] IPBES is the largest intergovernmental organisation mandated with synthesising knowledge and improving the interface between science and policy on biodiversity and environmental services (IPBES, 2019).

This DCE survey and in-depth interviews focus on coastal 'barangays' (villages) close to mangrove areas on Palawan's main island. The study sites were pre-selected by marine and fisheries scientists at Western Philippines University (WPU) to give a spread of coastal communities across the island, primarily based on a National Institute for Health and Care Research (NIHR)-funded Global Community Food for Human Nutrition and Planetary Health project. The selected barangays included Bunog, Rizal and Poblacion, Aborlan in the south; the more centrally located San Jose, Santa Loudes, Sicsican and San Rafael in Puerto Princesa city; and New Ibajay, El Nido to the north.

2.2 Discrete choice experiment design and implementation

The DCE design and selection of attributes began with an examination of: i) the literature on mangroves, MPAs and opportunities for increased benefits to people from mangrove protection in Palawan; ii) the relevance of the findings from the literature to mangrove protection in Palawan, after discussion with scientists; and iii) the availability of information to quantify attributes and associated levels.

The preamble scenario (see Appendix A) considers the establishment of a mangrove MPA that provides measurable benefits to communities through improvements to the four selected non-price attributes of eco-tourism jobs, fisheries catch, mangrove honey and MPA revenue for local community projects to improve food nutrition and security. The cost attribute is a tax that residents would pay for ten years. The cost range was calculated based on parameter estimates from prior mangrove and coral-reef contingent valuation studies in Palawan (for example, Carandang et al., 2013; Subade and Francisco, 2014). The alternative levels of attribute were set within a realistic range of variation, validated in discussions with scientists at WPU. Table 1 shows the final list of attributes and alternative levels.

Table 1. Mangrove DCE attributes and levels

Attributes	Levels
Eco-tourism jobs on average	Status quo: 8,500 jobs i. 15% increase (9,775 jobs) ii. 25% increase (10,625 jobs) iii. 40% increase (11,900 jobs) iv. 55% increase (13,175 jobs)
Fisheries catch per year on average	Status quo: 100,000 tonnes i. 15% increase (115,000 tonnes) ii. 35% increase (135,000 tonnes) iii. 55% increase (155,000 tonnes) iv. 70% increase (170,000 tonnes)
Mangrove honeycomb per year on average	Status quo: 65 kg i. 15% increase (71 kg) ii. 35% increase (84 kg) iii. 45% increase (90 kg) iv. 70% increase (105 kg)
Revenue from marine park for local community projects per year on average	Status quo: ₱1,900,000 i. 15% increase (₱2,185,000) ii. 25% increase (₱2,375,000) iii. 40% increase (₱2,660,000) iv. 55% increase (₱2,945,000)

Annual tax (cost per household)	Status quo: ₱0 i. ₱50 per year, ii. ₱125 per year iii. ₱200 per year, iv. ₱250 per year v. ₱350 per year, vi. ₱500 per year vii. ₱900 per year, viii. ₱1,200 per year ix. ₱1,500 per year, x. ₱3,000 per year

Note: Philippine peso conversion rate to US dollars is ₱58.51: US$ 1.

A D-Optimal (efficiency) design was used to create 40 choice tasks in Anaconda Jupyter notebook version 6.6.3. One advantage of the D-Optimal design is that it derives attribute-level combinations efficiently, compared with classical design approaches in the case of multi-attribute and multi-level choice tasks (Louviere *et al.*, 2011; Harkness and Areal, 2018). In the first instance to design the choice tasks no priors were used on non-price attributes, with a small negative prior on the price attribute. On creation, the 40 choice tasks were split into five blocks of eight choice tasks each. One block of choice tasks was used in the complete questionnaire setting to test the design and how comprehensible it was to respondents.

We tested the survey on ten Palawan residents. This provided useful information on the general understandability of the survey, with feedback from some respondents, for example, stating that the tax range was too low at a maximum of ₱900. We used the test, along with the researcher expert judgement espoused by Bliemer and Collins (2016), to re-design the choice tasks in the survey for final implementation. Based on the test, the tax was approximately tripled and the D-Optimal design re-done using small positive priors on the non-price attributes and a small negative prior on the price attribute to reflect the expected directional change of increases in attribute levels to make up the revised 40 choice tasks (Howai *et al.*, 2025). Figure 1 shows an example of the final choice task used.

Ethical clearance was obtained from the London School of Economics and Political Science (LSE) Research Ethics Review Board and the purpose of the study, along with participant involvement and rights, were explained to each household before starting the surveys. In addition to the two researchers on site, six locally based enumerators from WPU were trained to deliver the final survey and explain the preamble, attributes and levels to the respondents without influencing the respondents' decision-making in the choice tasks. The enumerators were trained to give budgetary reminders (based on their household expenditures) to each respondent before and during the survey to mitigate hypothetical bias (Mariel *et al.*, 2021). The survey was written in English and, in those instances where respondents did not understand English, the survey was translated by the enumerators into the local language (Tagalog). The survey time ranged from 40-45 minutes per household.

The survey was conducted over the course of one week in September 2025. The two key decision-makers in each household answered the questionnaire separately and then together. Respondents completed eight choice tasks; this was followed by debriefing questions on sociodemographic background and attribute attendance. On completion, each respondent received monetary compensation (₱250 per respondent) for their time and participation in the survey. Each household answered one of five survey blocks in order to estimate the key decision-makers' choices for the same choice tasks. The 50 households were completed with n=50 women, n=50 men and n=50 joint responses, providing a total of n=150 responses (30 responses per block) for all five blocks, where each block had three responses per household (one female, one male and one joint).

Attribute	Status Quo (SQ-Baseline)	Option A	Option B
Eco-tourism jobs 	8,500 jobs	No change	55% ↑ (13,175 jobs)
Fishing catch per year 	100,000 tonnes	15% ↑ (115,000 tonnes)	15% ↑ (115,000 tonnes)
Mangrove honeycomb per year 	62 kg	70% ↑ (105kg)	70% ↑ (105kg)
Revenue from marine park for local community projects per year	₱1,900,000	40% ↑ (₱2,666,000)	55% ↑ (₱2,945,000)
Annual tax (cost to you per house)	₱ 0	₱900 per year	₱1,200 per year
Choose one Please tick [√]	[ ]	[ ]	[ ]

Figure 1. Example choice task

2.3 In-depth interviews design, implementation and analysis

The design of the in-depth interviews was based on an understanding of the local development context in Palawan, informed by a literature review. Not all residents in Palawan are able to contribute financially to the provision of mangrove ecosystem benefits, highlighting the need for government interventions to protect vulnerable individuals. The qualitative interviews aimed to understand the specific needs and challenges of vulnerable populations whose livelihoods may be disproportionately affected by the introduction or expansion of mangrove MPAs, as well as the increasing impacts of climate change, and to inform policymakers in co-designing equitable interventions.

Poverty and inequality remain key challenges. In the Mindoro, Marinduque, Romblon and Palawan (MIMAROPA) region, the annual per capita poverty threshold is ₱26,321, which is lower than the national average of ₱28,871, based on 2021 data (Philippine Statistical Authority, 2021). This

suggests that a Filipino living in Palawan requires approximately ₱2,193 per month to meet basic food and non-food needs. In parallel, MPA management faces severe challenges. It is evident that existing MPAs in Palawan have been of limited benefit to coastal communities, primarily due to inadequate funding, ineffective management, a lack of alternative livelihood opportunities and limited community participation (Galveia and Macusi, 2025). As a result, small-scale fishers remain marginalised.

To address social equity concerns, underrepresented groups were oversampled. Vulnerable individuals were defined as people with monthly incomes below the national and regional poverty lines, individuals experiencing food insecurity, those belonging to socioeconomically disadvantaged groups, including older people, and those with pre-existing conditions, pregnant women, single parents and persons with disabilities. Based on these selection criteria, our WPU collaborators pre-identified 20 vulnerable participants across six study sites, comprising eight men and 12 women: two in Bunog, Rizal; 11 in San Jose, Santa Lourdes, and San Rafael, Puerto Princesa City; four in Poblacion, Aborlan; and three in New Ilbajay, El Nido.

Semi-structured interviews were conducted using open-ended questions (see Appendix B). These interview questions were designed to generate evidence of vulnerable populations' perceptions of the role of mangroves and MPAs in food security and livelihoods. They were structured so as to examine the perceived direct and indirect impacts of MPAs on coastal livelihoods, including those of fishers and non-fishers in villages with mangrove cover, regardless of whether these areas were included in locally managed MPAs. In addition, the interviews included questions on the effectiveness of government social protection interventions, primarily social assistance, in targeting the poor during disaster preparedness or during fishing restrictions due to MPA implementation. Lastly, the questions explored perceptions of the importance of alternative livelihood opportunities in supporting community co-management of MPAs for mangrove protection and restoration.

Our WPU collaborators assisted in conducting the interviews. Each interview lasted 30-45 minutes. Ethics approval for the qualitative interviews was obtained from the LSE Research Ethics Review Board. Before conducting each interview, the WPU collaborators explained the informed consent form in Tagalog and emphasised that respondents' participation was entirely voluntary. As some questions involved potentially sensitive information, particularly participants' personal views and perceptions of government interventions of MPAs and social assistance, strict data management measures were put in place. Participants who agreed to take part received remuneration of ₱350 per person, above the compensation of ₱250 provided for the DCE surveys. All participants identified agreed to take part in the interviews, reflecting the high level of trust and strong community partnerships established by WPU.

Exemption interviews involved initial probing and contextualisation of site conditions, which provided deeper insights into how participants perceived mangrove ecosystems and the establishment of MPAs. Because the data consisted of qualitative narratives from local respondents, manual thematic analysis was used to identify common and recurring responses on specific topics. In addition, simple descriptive statistics were used to describe the distribution of respondents and to reveal potential patterns.

Other issues identified related to support for local communities, food sufficiency and nutrition. Most respondents did not focus on or appeared to have limited information on or awareness of financial support from government or private sources pertaining to the establishment of MPAs. Rather, their responses referred primarily to general forms of assistance, such as post-typhoon or post-disaster aid, senior citizen allowances and the Pantawid Pamilyang Pilipino Program (4Ps) of health and education allowances. In terms of food sufficiency and nutrition, based on the tabulated results, most respondents were highly reliant on wages from fishing, which they used to purchase staple foods such as rice and vegetables. There were no indications of insufficient access to fish as a food source. However, because

respondents preferred other staples, such as rice and vegetables, issues of food insufficiency emerged, particularly regarding access to healthy and balanced diets.

We used a simple typology to disaggregate the 20 individuals interviewed. Primary dependants are those directly engaged in fishing and related activities, such as selling fish products or harvesting mangrove honey. This category also includes individuals who undertake part-time jobs related to the fisheries sector, for example, fishing during the southwest monsoon season and working in construction during the northeast monsoon season. Secondary dependants are micro, small and medium-sized enterprise owners from whom primary dependants purchase goods, as well as the parents, spouses or family members of primary dependants, who do not earn directly from coastal or marine resources. Indirect dependants include other stakeholders, local residents or community leaders who may not earn directly from coastal and marine ecosystems, but still consume or purchase food from primary dependants, or who value the presence of mangroves from a personal perspective.

2.4 Model specification and selection

Discrete choice is grounded in Lancastrian and random utility theory and well established in the economic valuation literature (Lancaster, 1966; McFadden, 1974). We use the hierarchical Bayesian logit model, also known as the Bayesian mixed logit, to estimate preferences. This approach has two main advantages. First, it facilitates diverse preferences by estimating separate preferences for individuals or estimating one set of preferences for everyone (Regier *et al.*, 2009; Howai *et al.*, 2025). Second, it can incorporate relevant prior knowledge, and DCEs are rich in monetary and non-monetary prior information by design. When estimations are conducted in the WTP space, as in our case, using prior information can yield better estimates than not using it, regardless of whether it is rich or weakly informative (Akinc and Vandebroek, 2018; Gorton *et al.*, 2023).

The model specification begins with the assumption that individual j's utility is linear in terms of choice options:

$$U_{ijt} = V_j(x_{ijt}) + e_{ijt} \quad (1)$$

U_{ijt} is the j^{th} respondent's utility from option i in the t^{th} choice task. The x_{ijt} is a $k \times 1$ random vector of observed attributes faced by the respondent. $V_j(x_{ijt})$ is the systematic or observed utility that the j^{th} individual gets from x_{ijt}. The unobserved utility is the error term e_{ijt}, which is assumed to be the type 1 'extreme value', also called Gumbel-distributed, independent of x_{ijt} and uncorrelated across choices and individuals. The probability of choosing option i for the j^{th} individual in the t^{th} choice task is:

$$P_{ijt} = \frac{e^{V_j(x_{ijt})}}{\sum_i e^{V_j(x_{ijt})}} \quad (2)$$

We interpret directly from the β_n coefficients in the WTP space, as estimates in the preference space usually contain some instability (Train and Weeks, 2005; Scarpa *et al.*, 2008; Balcombe *et al.*, 2022). The $exp(\alpha_j)$ is the scale parameter and $-price_{ijt}$ is the tax payable by residents for the mangrove protection programme. This has a negative sign, as we expect utility to decrease with a price increase. The attributes and opt-out comprise a vector of coefficients $\beta_{1,j}, \ldots, \beta_{4,j}$ and θ respectively from the j^{th} person, which varies for each individual.

$$V_j(x_{ijt}) = exp(\alpha_j) \times [-price_{ijt} + \beta_{1j}Jobs_{ijt} + \beta_{2j}Fish_{ijt} + \beta_{3j}Honey_{ijt} + \beta_{4j}Revenue_{ijt} + \theta Optout_{ijt}] \quad (3)$$

In similar fashion to Tanasache et al. (2025), the hyper parameters are specified with standard normal and gamma distributions for the group-level (β_k), scale (α) and opt-out (θ) parameters. Our hyper parameters are as follows: $(\mu_\beta, \sigma_\beta)$ = (0, 0.3), $(\mu_\alpha, \sigma_\alpha)$ = (0, 1), $(\mu_\theta, \sigma_\theta)$ = (0, 0.3), (a_β, b_β) = (1, 0.05), (a_α, b_α) = (1, 0.05) and (a_θ, b_θ) = (1, 0.05).

Price and non-price attributes are scaled between 0 and 1, so the price ranges from ₱0 to ₱3,000 and the minimum to maximum percentage change for non-price attributes lies in the 0 to 1 range. In particular, the maximum price is scaled by ₱3,000 to get it to 1 and the prior mean WTP for each β is ₱0, with a standard deviation of 0.3, equivalent to ₱900. There is also an imposed condition that each β mean estimate does not exceed the highest tax payment of ₱3,000 or, equally, go below -₱3000 for each individual attribute (Balcombe *et al.*, 2022). This condition is reasonable given the information gathered at the DCE test stage to increase the payment.

The model was estimated in Stan using a Jupyter interface. Stan estimates by way of the Hamiltonian Monte Carlo algorithm to efficiently simulate the posterior distribution using the No-U-Turn sampler. Four independent chains were run with a 'warm-up' of 500 iterations that were discarded and followed by 1,000 draws per chain for a total of 4,000 draws. Lastly, convergence was observed using the Rhat diagnostic (Vehtari *et al.*, 2019). Our Rhat values are 1.00, implying unity and convergence (Tanasache *et al.*, 2025).

3. Results

We present the main results of the mean estimates in the WTP space individually, jointly and as merged models. We end with insights from a subset of the vulnerable members of the population on their preferences for opportunities and improved livelihoods; these people, however, are exempt from the WTP aspect of the study. The summary statistics are available in Appendix C.

3.1 Discrete choice experiment

In Table 2, the mean estimates show both commonalities and certain salient differences in preference between men and women. The WTP for the opt-out, the attribute-specific constant, is negative for all models, corresponding to the regular findings in the literature. Importantly, the most preferred and least preferred non-price attributes are clearly eco-tourism jobs and mangrove honey, respectively, across all models. Interestingly, eco-tourism jobs possess mean estimates of approximately ₱6 above fish catch for a 1% increase in jobs per year, irrespective of gender.

Key differences lie in the order of preference for more fish catch and revenue for livelihood projects. In model 1, women prefer more revenue for livelihood projects to increased fish catch, whereas in model 2, men prefer increased fish catch over revenue for livelihood projects. The reason for this difference could be that the primary income-generating activity for men in the coastal communities of Palawan is fishing (Madarcos *et al.*, 2021; Jontila *et al.*, 2022). Women may consider increased revenue for livelihood projects centred on mangrove protection, health and nutrition to be more important for themselves and the overall well-being of their family (Jontila *et al.*, 2022).

In all models, all attributes apart from mangrove honey possess a posterior probability mass with credible interval ranges either side of zero, which corresponds to the classical interpretation of means being 'significantly different from zero.' The most noteworthy difference is in model 1, where women's preferences for mangrove honey have a credible interval range that is almost evenly spread either side of zero. Increases in mangrove honey are the least popular among both women and men. This may may be down to a combination of lack of knowledge of mangrove honey production and a fear among women and men in coastal communities of the potentially negative effects of being stung by bees and similar insects, such as the native 'turong', a type of hornet (GMA Public Affairs, 2025).

There are also differences between individual and joint preferences. Men are generally observed to have higher mean estimates than women across all attributes and this could be due to the higher income levels reported by men in Appendix C. In model 3 (joint preferences), fish catch increases from both individual models and more than doubles compared with model 1 (women). This suggests that the input of men in joint decision-making on preferences for fish catch increases might be a substantial factor. The joint preferences for mangrove honey decreases from model 2 (men) but increases compared with model 1 (women). This suggests that in the joint model, there is more of a 'middle ground' when it comes to preferences for mangrove honey, though it still has credible intervals either side of zero.

Merging the models generates mean estimates by combining the separate and joint responses of key household decision-makers. The merged model also has a slightly better model fit, with a difference in Watanabe akaike information criterion (WAIC) of 17.42, compared with models 1-3, both individually and summated, giving a value of 1,873.85. However, the difference is small and, given the standard error WAIC range of 22 to 40, it is still useful in interpreting household decision-makers' WTP from both an individual and joint perspective.

A benefit of using Bayesian approaches is the flexibility they afford model preferences. Individual preferences are derived for each respondent. In Figure 2, IDs are labelled from 1 to 50 for the men's, women's and joint responses of each household. Women's overall WTP for a maximum increase in all attributes ranges from about ₱1,000 to ₱2,000 per year. Men's willingness and joint preferences lie between ₱2,500 and ₱3,000 per year, on average. This suggests that joint household preferences are generally closer to men's preferences in this study. Paired t-tests show that joint household WTP differs significantly from women's WTP ($t = -15.21, \rho < 0.001$), but not from men's WTP ($t = -1.55, \rho < 0.13$). Additionally, the absolute difference between joint household and men's WTP is significantly smaller than between joint and women's WTP ($t = 8.45, \rho < 0.001$), suggesting that joint responses align more closely with men's valuations.

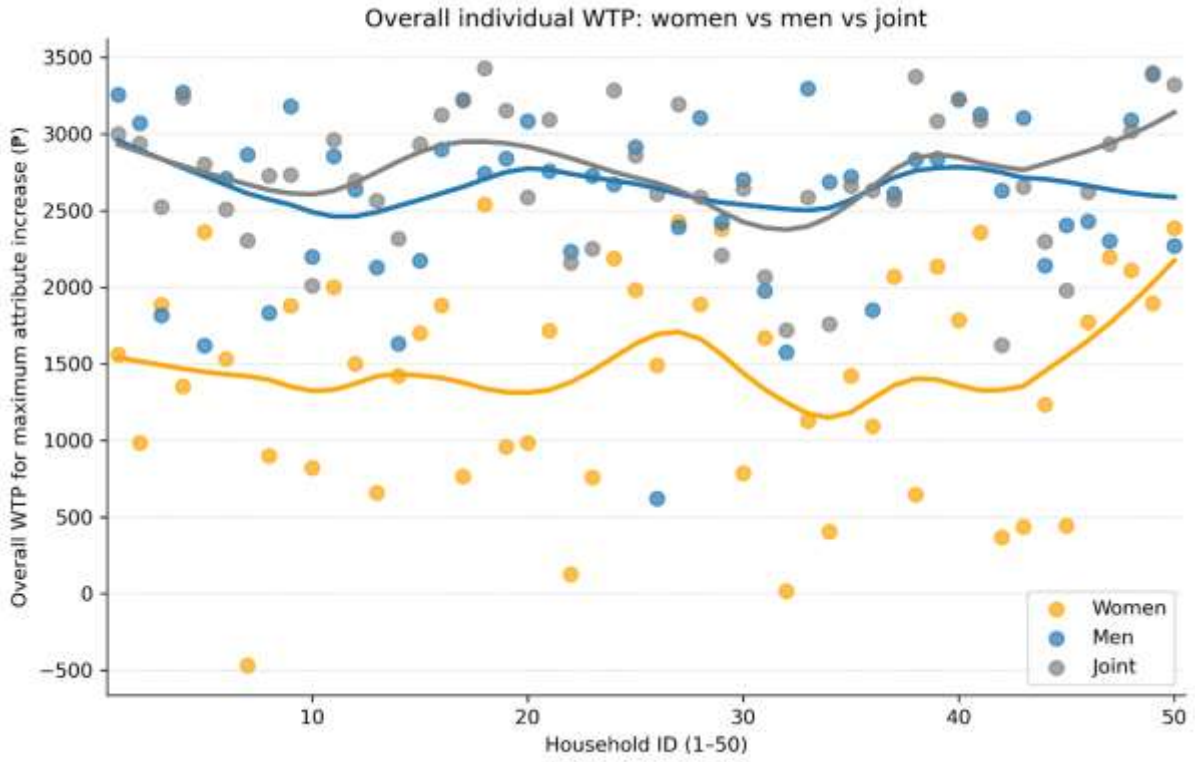

Figure 2. Individual versus joint household preferences

Table 2. Mean willingness-to-pay estimates

Annual WTP in PHP (₱)	Women	(1) 2.5% CI	97.5% CI	Men	(2) 2.5% CI	97.5% CI	Joint	(3) 2.5% CI	97.5% CI	Merged	(4) 2.5% CI	97.5% CI
1% increase in jobs	10.45 (3.13)	4.48	16.68	16.93 (3.47)	10.23	23.89	18.02 (3.29)	12.06	24.68	14.38 (1.81)	11.01	18.18
55% increase in jobs	574.99 (172.06)	246.55	917.30	931.19 (190.62)	562.78	1314.03	991.28 (181.15)	663.57	1357.14	790.91 (99.63)	605.74	999.89
1% increase in fish	5.20 (2.33)	0.66	9.93	10.94 (2.76)	5.78	16.50	12.73 (2.53)	7.86	17.69	9.04 (1.42)	6.37	11.98
70% increase in fish	364.10 (162.95)	46.03	695.32	765.75 (192.91)	404.89	1155.13	890.84 (177.34)	550.07	1238.03	633.12 (99.25)	446.20	838.29
1% increase in honey	0.36 (2.30)	-4.05	4.91	4.56 (2.40)	-0.05	9.49	2.93 (2.40)	-1.74	7.71	2.25 (1.24)	-0.13	4.77
70% increase in honey	25.11 (160.73)	-283.58	343.75	318.90 (168.00)	-3.71	663.99	205.36 (167.80)	-122.02	539.70	157.77 (86.89)	-9.16	333.59
1% increase in revenue	7.90 (3.26)	1.71	14.47	9.80 (3.36)	3.50	16.83	10.87 (3.20)	4.78	17.40	8.91 (1.72)	5.65	12.49
55% increase in revenue	434.69 (179.03)	94.04	795.85	538.91 (184.65)	192.45	925.75	597.89 (175.74)	262.78	957.05	490.13 (94.73)	310.68	686.89
Opt-out	-975.39 (244.04)	-1465.05	-476.78	-608.69 (252.36)	-1071.42	-96.93	-574.56 (279.30)	-1124.74	-36.49	-764.79 (148.41)	-1044.80	-470.82
WAIC	641.19			623.41			609.25			1856.43		
Se_WAIC	22.83			22.06			24.92			40.67		
Psis_loo_cv	-325.54			-314.75			-308.65			-938.59		

Note: Mean estimates in Philippine pesos; standard deviations in parentheses; CIs are the credible interval ranges; Se_WAIC is the standard error of the WAIC; Psis_loo_cv is the pareto smoothed, leaving out one cross-validation; models 1 to 3 have a sample of n=50; model 4 is merged, with n=150.

3.2 Exemption interviews

The results in Table 3 suggest that common perceptions about food sufficiency and access to nearby mangrove patches among interviewees from different geographical locations are not linked to the capacity of the ecosystem itself, but rather to an indirect pathway through income earned from fish catch. Fiorella et al. (2014) reported similar observations among fishing and non-fishing communities around Lake Victoria, Kenya, where a study showed that the abundance of fish catches and direct fish-producing livelihoods did not necessarily equate to better food access and sufficiency. This was primarily down to socioeconomic factors, with income a key element. Although indirect, these observations show similar trends to those identified by McClanahan et al. (2015), who found that food insecurity was greatly affected by poverty traps brought about by low productivity, declining fishery production, shifts in consumption patterns and local conflicts.

Insufficiency was raised by a majority of interviewees when referring to other food sources, though responses from direct dependants noted that the abundance of food from the sea still provided them with adequate fish-based food. For instance, one of the respondents from Bunog, Rizal said, "No money? Go to sea!", suggesting that in the absence of financial capabilities, residents could still eat and survive thanks to food provided by fishing.

Table 3. Perceptions of mangrove ecosystems and effects on food access, nutrition and livelihoods

Respondent type	**Mangrove ecosystem contribution**	
	Food and nutrition	**Livelihood**
Primary/direct dependant	- Most direct dependants, such as fishers, viewed food access and sufficiency as being closely related to (and dependent on) wages and earnings from fishing or fish catch. - Some respondents mentioned restrictions associated with mangrove areas, due to limitations on growing vegetables for household food consumption.	- The majority believed that mangrove forests could help improve fish stocks, in turn enhancing fish catch and increasing livelihood opportunities. - Respondents acknowledged the importance of mangroves in protecting communities from storm surges, thereby safeguarding homes and livelihoods. - Some respondents emphasised opportunities such as mangrove honey production as potential alternative livelihoods within mangrove areas.
Secondary dependant	- There were no significant anecdotes and no emphasis was placed on food sufficiency or access to nearby mangrove areas within their community. This is probably due to respondents' current reliance on their children to meet their daily food consumption and needs.	- One respondent (out of three) emphasised that mangrove ecosystems helped provide fishery products, thereby enabling local fishers to catch more fish for higher income. This, in turn, created a ripple effect for her as a local business owner (food and catering service), whose main clients are fishers.

Indirect dependant	- Similar to secondary dependants, respondents who were indirectly dependent on mangrove ecosystems placed no significant emphasis on food access or issues related to mangrove presence, instead linking food security primarily to salary or wage income.	- If MPAs were established within their areas, indirect dependants would probably be supportive, but with a greater emphasis on the availability of alternative livelihood opportunities for local communities.

As shown in Figure 3, two major standpoints on supporting MPA establishment can be inferred from the responses in the exemption interviews. In general, there is positive support, with the major themes being: i) support due to mangroves' provision of ecosystem services (benefits to people) and ii) support, but with preconditions. Primary dependents of coastal marine ecosystems tend to express a deeper relationship with and understanding of the mangroves. Direct or primary dependants are more appreciative of the direct and indirect use values provided by the mangroves, such as the provision of fishery products for consumption or sale in markets as a livelihood, as well as coastal protection from typhoons and flooding. Interviewees emphasised the importance of mangrove conservation for intergenerational justice, with one saying that "it is for my children and my fellow people" (English translation). Some interviewees lent further importance to mangrove protection, drawing parallels with the way in which families should be taken care of, with one respondent saying: "I hope many will support [MPA establishment/protection of coasts] ... It is like our family, which needs to be taken care of and protected" (English translation).

Secondary and indirect dependants also support MPA development, but rather than highlighting the importance of mangroves, their responses tend to focus on the 'preconditions' that should be met. Among the most frequently cited preconditions is the need to ensure that alternative livelihoods are provided upon MPA establishment. This is due to the perceived link between 'no-take' zones within MPAs and the direct impacts on local fishers. While some direct dependents also mentioned the provision of alternative livelihoods, the main difference between the two groups is that direct dependants place greater value on the future and intergenerational benefits of mangrove conservation.

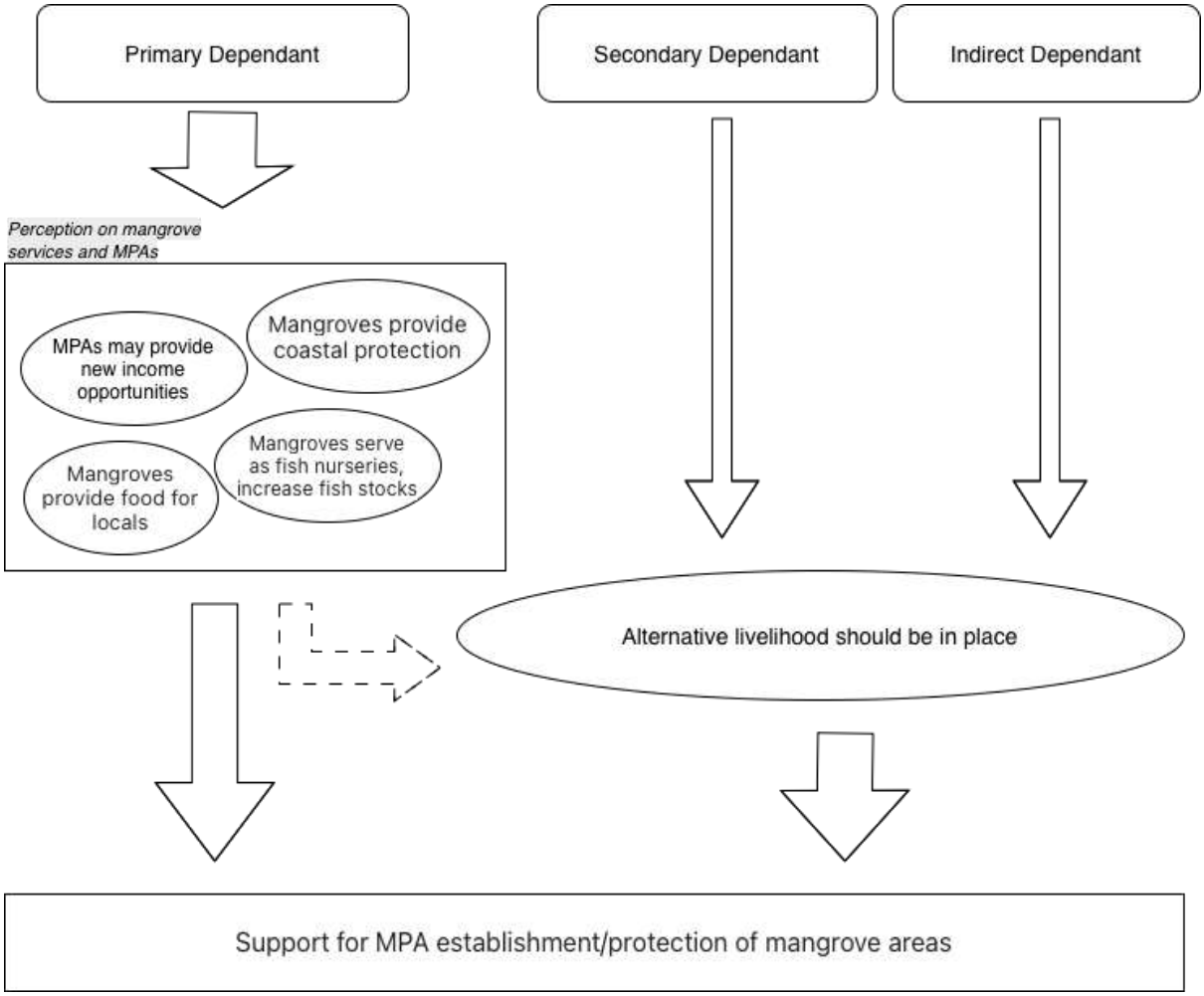

Figure 3. Support among marginalised people for MPA establishment

4. Discussion and policy implications

In this paper, we have examined couples' preferences for mangrove use values. DCE respondents answered the questionnaire individually, then jointly, to investigate intra-household preferences. This approach allows us to contribute to a strand of literature in environmental valuation investigating couple's preferences (for example, Beharry-Borg et al., 2009). It also draws novel insight from in-depth interviews with people exempted from payments for greater mangrove benefits. The mean estimates and in-depth interview findings can be useful in developing mangrove protection policies based on residents' preferences.

The expectations were that men and women would have different preferences on an individual basis, but that their joint preferences would be a compromise between the two, potentially dominated by the woman's preferences. This was based on the expectation that, in the Philippines, women tend to dominate when it comes to major decisions on couples' intra-household expenditure and savings (Ashraf, 2009). Our findings suggest that, in the case of annual household payments for increased mangrove benefits, women's and men's preferences differ. Mean estimates for women place increases in fish catch third out of the four non-price attributes. In other studies, differences have been observed between individual and joint preferences (for example, Rungie et al., 2014).

In Beharry-Borg et al. (2009) women's preferences were found to dominate in the joint choice experiment. In contrast, Yang and Carlsson (2016) found that men had a stronger influence than women in couples' joint preferences. In this study, joint preferences were closer to men's individual preferences

when it came to overall WTP and the order of preferences across attributes, contrary to the expectation that women might dominate joint preferences. This might be due to the perception that expenditure for mangrove benefits such as eco-tourism jobs, fish catch and revenue for livelihood projects is advantageous to the household as a whole. Consequently, adjusting the joint preferences to bring them closer to men's preference for increased fish catch (as the second-preferred non-price attribute) and increasing overall WTP is less of an issue for women.

Our research suggests that Palawan residents generally recognise the values and benefits of mangrove ecosystem services. Fishers usually benefit directly from the increase in fish stocks that results from mangrove restoration activities, including improved income security and food security. Fishers also notice the time it takes for mangrove planting to generate and increase fish stocks. Well-managed mangrove conservation initiatives, such as those supported by the Bureau of Fisheries and Aquatic Resources, can enable mangroves to grow quickly, in turn enabling fishers to benefit quickly.

The exemption interviews yielded a strong message of support for community co-management of mangrove MPAs, provided that alternative livelihood projects are created. First, non-fishers employed in micro, small and medium-sized enterprises have a strong preference for eco-tourism jobs, which are perceived as being more stable and higher-income opportunities. Fishers also prefer eco-tourism jobs, because they see their fishing incomes as being more vulnerable to the increasing impacts of climate change on fisheries productivity and to reduced access to fishing. They also note that occupations such as tour guiding require a higher level of educational attainment than many fishers have. Coastal communities could also benefit from MPAs through potential revenue-sharing mechanisms that support local livelihood projects.

However, there is limited awareness of mangrove beekeeping as a livelihood opportunity, as it is not widely known in Palawan, which may diminish the valuation of honey harvesting preferences. Where there is knowledge, it seems to include concern over the possibility of being stung. Some female respondents from exemption interviews highlighted their interest in seeing this potential opportunity introduced. Mangrove honey can provide significant medicinal benefits and offer higher income than standard beekeeping projects, and beekeeping activities can contribute substantially to pollination, thereby supporting food security, as evidenced in Vietnam (Albers *et al.*, 2011; GCF, 2023; FAO, 2025). However, capacity building and training are needed for local communities to ensure that appropriate safety measures are in place for beekeeping activities.

Our research reveals a number of policy insights. Given the overfishing challenges in villages within and outside MPAs, it is important to recognise that some fishers in MPA villages experience conflicts with outsiders who enter MPA areas to fish. This highlights the need to improve MPA management across the full marinescape to reduce the likelihood of such conflicts among fishers (Robinson *et al.*, 2014). In addition, the targeting of social safety-net mechanisms could be enhanced to reach the most vulnerable populations. For example, vulnerable or lower-income fishers may not receive free fishing nets because they are not part of small-scale fisherfolk associations. An equitable institutional arrangement, therefore, could be to enhance the inclusion criteria to take into account climate vulnerability. There is an increasing trend among certain older people with pre-existing conditions, who prefer to receive cash assistance or food assistance with higher nutritional value rather than highly processed foods. Lower-income individuals or households with limited access to affordable healthcare services and inadequate savings for future generations also prefer more diversified forms of social assistance, including health and education allowances.

5. Conclusion

There is growing recognition that the concept of a single or dominant 'head of household' decision-maker does not chime with reality. Yet only a few choice experiments in environmental valuation, such as ours, have explicitly taken this into account. Indeed, many economic household surveys focus on a

'head of household', thus excluding women as key decision-makers almost by default. Understanding whether and how women and men make individual and joint decisions in a household is particularly important when considering the broad range of benefits that mangrove marinescapes offer, as women and men often interact with and benefit from these marinescapes in different ways, albeit for the collective benefit of their households.

In this paper, we do not just demonstrate the importance of recognising multiple decision-makers within a household, but also, by combining quantitative and qualitative methods, such as exemption interviews, are able to include the voices of some of the most marginalised individuals. As there is also increasing evidence that efforts to tackle climate change and enhance prosperity are more likely to be effective if they take into account distributional impacts, we believe this type of approach will be increasingly important. The economic valuation of mangrove benefits as perceived by coastal communities, combined with the sociocultural narrative of marginalised individuals, contributes to the evidence base for increasing the social acceptability of financial investments in MPAs.

Acknowledgements

We would like to thank Professor Lota Alcantara Creencia for allowing us the opportunity to partner with Western Philippines University (WPU) and for presenting this collaborative research activity to the Palawan Council for Sustainable Development Staff and the Palawan Knowledge Platform for Biodiversity and Sustainable Development. We would also like to thank the enumerators for their assistance in English-to-Tagalog translation and for collecting data in both the choice experiment survey and in-depth interviews. This valuable translation and data-collection assistance was provided by Cristobal Cayetano, Tracy Angela Ventilacion, Hersan Cainong, Noried Jean Sobron, Lawrence Bacomo, Sheryl Balbutan and Juliebel Herrera. Lastly, we acknowledge the funding support of the London School of Economics Saw Swee Hock Southeast Asia Research Fund for primary data collection, research and dissemination, as well as the LSE's Global School of Sustainability and Grantham Foundation for the Protection of the Environment. Ethics approval for this project was obtained from LSE Research Ethics Review Board No. 534951.

Appendix A DCE survey preamble

Marine Protected Areas (MPAs), often called marine national parks and reserves, are important for improving fisheries management to help fish stocks recover faster, potentially protect mangroves, and support local livelihoods.

Mangroves are increasingly under threat from overuse and destruction and without improved management of MPAs, fishing communities and fishers who depend on healthy mangroves could be negatively affected. More frequent extreme heat, rainfall and disasters like storm surges and flooding can also affect coastal communities in Palawan, potentially leading to increased health risks for residents and threatening the health of marine ecosystems when mangroves are degraded.

Our researchers from the London School of Economics and Western Philippines University propose an improved management programme for existing eco-tourism parks in Palawan with increased mangrove conservation, co-managed by the local government, villages and a local NGO.

Some of the benefits you would get from better management of the coastal area, including the mangrove forests, includes:

1) More eco-tourism jobs for community members.
2) An increase in fish stock from higher fish catches over the longer-term.
3) An increase in honeycombs, from both wild and managed bee hives.
4) A share of the tourism revenue from the eco-tourism national parks.
5) Better protection from coastal erosion, flooding, and extreme heat.
6) More patrols for improved security and safety for locals and tourists.
7) Similar benefits for future generations.
8) Mangrove education activities for communities and schools.

The cost of managing an MPA is high, so it is important for a wide range of groups like the local authorities, environmental NGOs and residents to be involved in the programme providing their support. With your contribution a successful programme to strengthen MPA management in exchange for the benefits listed above and having your voices be heard in decision-making can be achieved.

From L to R: fishers in Palawan, eco-tourism tours in Palawan, mangrove beekeeping in Vietnam.
Source: Author's own, bestdivingphilippines 2024, UNDP, 2021

Appendix B. Qualitative interview

Some sample interview questions were adapted from the Food Insecurity Experience Scale, including:

- What are the main sources of income or food for you and your household?
- What factors most influence your ability to access sufficient and nutritious food?
- How do you think the mangroves around you influence your access to sufficient and nutritious food? Why?
- How do you think the coastal areas around you influence your access to fishing opportunities? Why?
- Have you received any support from the community or local government to compensate for lost fishing income when coastal areas are protected?
- Would you be interested in participating in coastal area management with your neighbours to help protect your food security and income?

Appendix C. Descriptive statistics

	Female (%)	Male (%)		Female (%)	Male (%)
Gender	100	100		100	100
Age Group			**Education**		
<25	0	0	Primary	30	36
26-35	26	24	Secondary	52	48
36-45	24	18	Undergraduate	14	10
46-55	26	30	Postgraduate	0	0
56-65	18	22	Other	4	0
>65	6	6	No formal	0	6
Prefer not to say	0	0	Prefer not to say	0	0
Location			**Annual income range**		
Bunog	16	16	< 15,000	14	2
New Ibajay	26	26	15,001-30,000	16	8
Poblacion	20	20	30,001-50,000	8	16
San Jose	6	6	50,001-75,000	12	30
Santa Lourdes	14	14	75,001-125,000	8	20
Sicsican	10	10	125,001-200,000	6	18
San Rafael	8	8	200,001-300,000	2	2
Prefer not to say	0	0	300,001-400,000	0	0
			>400,000	0	0
Employment			Prefer not to say	34	4
Full-time	8	26			
Part-time	14	10	**Household**		
Self employed	40	58	1-3	28	28
Unemployed	36	2	4-6	64	64
Other	2	4	7-9	8	8
Prefer not to say	0	0	10 or more	0	0
			Prefer not to say	0	0

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