UNDERSTANDING LOCAL FISHERMEN'S PREFERENCES AND WILLINGNESS TO ACCEPT COMPENSATION FOR COMMERCIAL SEA CUCUMBER FARMING IN THE JAFFNA LAGOON, SRI LANKA

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Abstract. This study examines the willingness of local fishermen to accept compensation for establishing commercial sea cucumber farms in the Jaffna Lagoon, Sri Lanka. A choice experiment was used to assess preferences for key attributes, including the rearing area of sea cucumbers, breeding sites for fish and crustaceans, tourist facilities, mangroves, and cost. A total of 164 respondents were randomly selected, and a random logit parameter model was used to examine their preferences. The study found that local fishermen are willing to accept compensation for sea cucumber farming in the Jaffna Lagoon and are also willing to pay more for enhanced fish breeding sites, tourist facilities, and mangrove protection. The estimated annual mean willingness to accept (WTA) compensation for the establishment of commercial sea cucumber farms in the Jaffna Lagoon is LKR 1842.25. Additionally, their mean annual willingness to pay (WTP) for improvements in breeding sites, tourist infrastructure, and mangrove conservation is estimated at LKR 1622.48, LKR 1272.48, and LKR 700.48, respectively. Furthermore, fishermen's choices regarding fish and crustacean breeding sites are influenced by education and income. These insights provide valuable guidance for policymakers to develop sustainable strategies for commercial sea cucumber farming in the Jaffna Lagoon.
Keywords: *choice experiment, sea cucumber farms, random parameter logit model, willingness- to-accept, willingness-to-pay*

Introduction

The fishing sector in Sri Lanka greatly contributes to the country's economy, providing livelihoods for coastal communities and supporting domestic and export markets. Sea cucumbers are the commercially most valuable seafood. In the face of socioeconomic and climatic challenges encountered by the traditional fisheries sector, sea cucumber production has emerged as an alternative source of income to support the livelihoods of artisanal fishermen in developing countries. Although sea cucumber farming has been practiced since time immemorial, it has become as a lucrative business venture during the last few decades along with the support of public institutions and other international organizations (Purcell et al., 2023). Moreover, there is huge demand for sea cucumber as it consists high nutritional and medicinal values that can satisfy the dietary requirements and ensure the food security of the local people. Sea cucumber is considered a cost-effective and protein-rich animal food. Sea cucumber contains essential amino acids with lower lipid content, which makes it one of the healthiest seafoods in the world. Moreover, sea cucumber-derived food products such as "Trepang" and "Beche-de-mer" are considered excellent nutritional supplements and are in high demand in the export market (Rahman et al., 2020).

Sea cucumbers also play an important role in maintaining the stability of marine environment through nutrient recycling, decaying of excess organic matters present in the

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sea, hindering the excess algal blooming, reducing ocean acidification, and maintaining the biodiversity of marine ecosystem. Currently, sea cucumber farming is practiced in more than 90 countries all around the world. Average annual catch of sea cucumber is estimated as 100,000 tons covering 66 sea cucumber species (Nishanthan et al., 2019). South-East Asian countries such as Philippines, Indonesia, Papua New Guinea, Cambodia, Vietnam, and Malaysia are mainly engaged in global sea cucumber farming where the production is mainly targeted for the export market. Moreover, the production has also been rapidly expanded to Indian sub-continent and East African countries due to the conducive environmental conditions that exist in those regions. Hong Kong and Mainland China are the largest importers and consumers of sea cucumbers and sea cucumber-derived products in the world. Other East-Asian countries like South Korea, Taiwan, and Japan are also consumed sea cucumbers but in a relatively lower amount (Rahman et al., 2020).

On one hand, because of the huge market demand for sea cucumber, there have been various initiatives and projects carried out to promote sea cucumber farming and processing activities across the globe. On the other hand, the rising demand for sea cucumbers has exerted a tremendous pressure on the harvest of marketable sea cucumber species and led to continuous depletion of natural stock of sea cucumbers in the marine ecosystem. Despite all the potentials and benefits of sea cucumber production, over production of sea cucumbers without observing the regulatory standards produce adverse effects on the environment such as pollution, depletion of wild fish stocks, damage of natural habitats in the marine ecosystem and thereby pose an extreme threat on traditional fishing activities and the livelihoods of the local fishermen. Therefore, it is imperative to implement effective policies and regulations to achieve sustainable harvesting of sea cucumbers and thereby maintain the stability of the marine environment and support the livelihoods of coastal communities.

As an island nation, Sri Lanka has a long history of engaging in sea cucumber farming and the trade. Traditional fishing methods are widely used in the production and processing of sea cucumbers in Sri Lanka (Dissanayake et al., 2010). The commercial sea cucumber fishery in Sri Lanka predominantly consists of species belonging to the genera *Holothuria* and *Bohadschia*. Since there is no tradition of consuming sea cucumbers locally, sea cucumber production in Sri Lanka is mainly targeted for the export market. The major export destinations for sea cucumbers are China, Hong Kong, Taiwan, and Singapore. Approximately, more than 10,000 small-scale fishing families, mainly from the north-western and north-eastern part of the country are dependent on sea cucumber production as their livelihoods (Dissanayake and Stefansson, 2010). They are mainly engaged in the production of processed sea cucumber, i.e., Beche-de-mer. Basically, Beche-de-mer is the cooked and dried body wall of sea cucumbers. According to Nishanthan et al. (2019), the entire harvest of Beche-de-mer with the worth of USD 2.55 million was exported from Sri Lanka in 2016 (Nishanthan et al., 2019). In 2020, nearly 326 tons of sea cucumbers were exported from the country and earned nearly LKR 1.5 billion as foreign exchange (Daily Mirror, 2022). As per the statistics from Department of Fisheries and Aquatic Resources, the total production and the export value of sea cucumber in Sri Lanka show an increasing trend. Although the sea cucumber farming is traditionally practiced in Sri Lanka for more than a Millenium, commercialization of sea cucumbers was not given a priority until recent years. However, in line with the rising demand for processed sea cucumbers in the world market, the government of Sri Lanka has put more efforts to develop the large-scale sea cucumber farming activities in the

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coastal regions of Sri Lanka. Commercialization of sea cucumber production has a huge potential to improve the fishing industry to meet with the global demands and improve the socioeconomic status of the local fishermen. To promote commercial sea cucumber production, hatcheries are established in the coastal areas with the support of other government investments and the donations other international agencies. The government of Sri Lanka has already granted permission to establish large-scale commercial sea cucumber hatcheries and export villages to the extent of more than 5000 acres in the northern and north-eastern regions of Sri Lanka (Earth Journalism Network, 2022). According to the recent studies, the principal sea cucumber species cultivated in the region are *Holothuria atra, Holothuria edulis,* and *Holothuria scabra* (Dissanayake et al., 2010; Dissanayake and Stefansson, 2010). Furthermore, the public institutions that come under the Ministry of Fisheries such as Department of Fisheries and Aquatic Resources, and National Aquaculture Development Authority (NAQDA) are actively involved in providing technical support for the expansion of commercial sea cucumber production activities in the country.

In contrast to the expected gains, development of commercial sea cucumber farming does not always guarantee the positive outcomes. In the absence of regulations and proper management methods, Sri Lanka is witnessed that the expansion of intensive commercial sea cucumber production activities has resulted in environmental pollution and eutrophication, destruction of the natural habitats of wild fish, and depletion of marine biodiversity. Generally, commercial sea cucumber production may take up more space on the sea floor and compete with the proliferation and growth of wild fish stock, leading to depletion of the fish stock in the area. This can exert an extreme pressure on the traditional fishing activities. Since only a small proportion of the fishing community are engaged in sea cucumber farming, the loss of wild fish catch may result in financial hardships, social unrest, and resentment among the local fishing communities and affect the livelihoods of the local fishermen. Even though sea cucumber farming brings the foreign exchange to this country, it affects the traditional fishing industry. Due to these issues, it is vital to identify the appropriate policy for sustainable development of sea cucumber farms in Jaffna lagoon area, therefore, developing suitable payment mechanism are known to be the appropriate policy instrument. The accurate estimation of willingness to accept compensation for establishing commercial sea cucumber farms in Jaffna lagoon will help policymakers to develop a fair and effective compensation policies, which can reduce potential conflicts between traditional fishing communities and commercial sea cucumber farms. Hence, this study not only aims to calculate the local fishermen's willingness to accept (WTA) compensation to establish the commercial sea cucumber farms in Jaffna lagoon but also analyze the fishermen's preferences for sustainable lagoon management practices. To best of our knowledge, this is the first study analyzing the fishermen preferences of establishing commercial sea cucumber farms.

Materials and methods

Methodology

Stated preference techniques have been widely used to elicit preferences for non-market goods and services. Flexibility is a strength of the SP techniques, whilst their hypothetical nature is their major weakness (Whitehead et al., 2008). Among SP techniques, the contingent valuation method (CVM) and choice experiment (CE) techniques are often used by researchers to elicit individuals' preferences (Bostan et al.,

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2020). CVM is considered as a direct method to elicit willingness to pay (WTP) from individuals (i.e., individuals are asked directly to state their WTP) (Whitehead et al., 2008). On the contrary, the CE is known as the indirect method to estimate WTP. Moreover, CVM does not provide any information regarding the different attributes of a good, which is considered as the important difference between CM and the CVM. CVM is used to elicit WTP when it is challenging to generate choice sets for goods or services, and there is a limited interview time. In CE, respondents are provided with different options with varying attribute values) to rank, to rate or to choose the most preferred alternative. Also, price/cost/payment is included (with varying levels) as one of the attributes, and it assists in the indirect estimation of WTP based on the respondents' choice, rank, or rate (Hanley et al., 2001). CE techniques are known as an alternative to CVM (Bong et al., 2012), and have several advantages over CVM. In CM, respondents get multiple chances to express their preferences for a valued good or service over a range of cost/price/payment than CVM. However, a notable drawback is the cognitive burden placed on respondents due to multiple choices with many attributes and levels (Veldwijk et al., 2023). Also, CE has a problem of overestimation because of its hypothetical scenarios. Although some studies exhibit a slight variation between the estimated WTP from CE and the actual one, CE techniques are more appropriate to measure WTP for different attributes of a good or service.

Study area and data collection

Figure 1 shows the location of the Jaffna Lagoon. Jaffna Lagoon is located between the Jaffna and the Kilinochchi Districts in northern Sri Lanka. It is situated between latitudes 9°30N and 9°50N and longitudes 79°54E and 80°20E. In 2022, there were 25,780 active fishers in Jaffna District and 4930 in Kilinochchi District, according to the Ministry of Fisheries. Given that Jaffna District records a comparatively higher number of active fishers, it was selected as the study area. Within the district, three Divisional Secretariat (DS) divisions were randomly selected to ensure representativeness. The study area comprised the Velanai, Jaffna, and Nallur DS divisions in the Jaffna District of Sri Lanka. Johnson et al. (2007) proposed a method for estimating an appropriate sample size for the CE method.

$$N = 500\frac{NLEV}{NALT*NREP} \quad \text{(Eq.1)}$$

Here, N denotes the respondent sample size, *NREP* represents the number of choice questions answered by each respondent, *NALT* refers to the number of alternatives per choice set (excluding status quo), and *NLEV* indicates the maximum number of levels observed in any attribute. According to the above-mentioned equation, the minimum sample size required for the study is 125. For this study, 164 local fishermen were randomly selected from the three DS divisions. Data were gathered from May to July 2023 through face-to-face interviews with participants using a structured questionnaire.

Choice experimental design

The objective of the experimental design is to generate the choice sets (i.e., combinations of attribute levels) that are presented to respondents. Focus group discussion with local fishermen provides the inputs of key attributes and their corresponding levels for a choice experiment. The attributes and levels were chosen after

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discussions with experts and local fishermen. A pilot study was conducted in April 2024 among 30 randomly selected fishermen to obtain the prior values[1] for the attributes needed to create an efficient design. Five attributes were selected for this study: sea cucumber farms, breeding sites for fishes and crustaceans, tourist facilities, mangroves, and cost. The attributes and its corresponding levels are displayed in the *Table 1*. All attributes, except for the cost attribute, have two levels and are effect coded. The cost attribute was included in our study to estimate the marginal willingness to accept/pay for other attributes. Ngene software was used to generate the D-efficient design and the lowest D-error was selected for the experiment (Mzek et al., 2022; Khan et al., 2021). A total of eight choice sets were developed using an efficient design. *Figure 2* displays the sample choice set used in this study. We clearly explained the attributes and levels to the respondents during the choice experiment survey and asked them to choose their true preference for alternatives to avoid hypothetical bias. We gathered information on the socio-demographic characteristics of local fishermen in addition to the choice experiment.

Analytical framework

The random utility theory (McFadden, 1974) and the characteristics theory of value (Lancaster, 1966) are the foundations of the choice experiment framework. Lancaster depicts utility for individuals is derived from the attributes or characteristics associated with a good, rather than the good itself (Pan et al., 2016; Rahmati et al., 2023). This study asks fishermen to choose the most preferred alternative from choice sets. Each choice set is defined by varying attributes and levels. In each choice set, one alternative represents the current scenario, while the other two depict hypothetical scenarios in which the attribute levels are modified concerning the current situation.

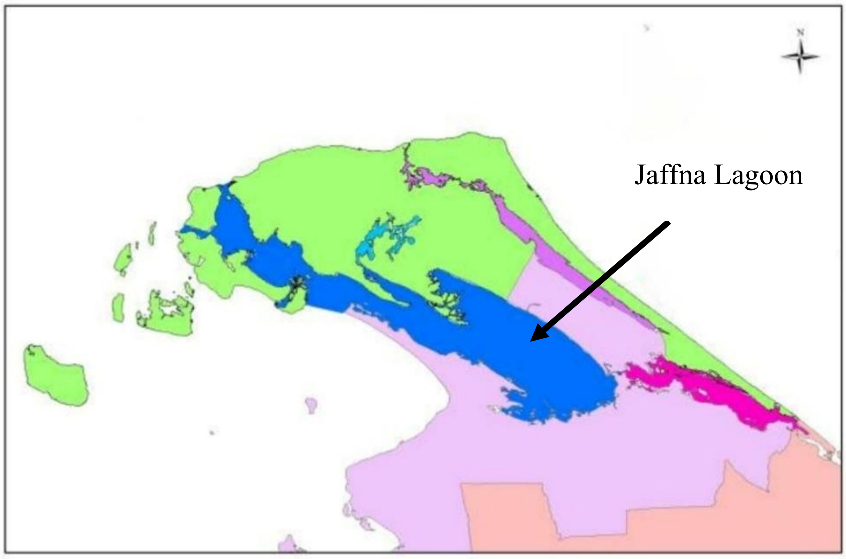

Figure 1. *Map of showing Jaffna Lagoon*

[1] An efficient design requires prior values for the attributes, which can be obtained in several methods, such as pilot study, expert opinions, and literature. We estimated the prior values from the pilot study using the conditional logit model. According to the literature, efficient designs have been shown to lead to lower standard errors than orthogonal designs, mainly when the sample size is small.

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Table 1. *Definition of attributes and their levels*

Attribute	Levels	Definitions
Sea cucumber rearing area	Sea cucumber farms	Establishing rearing area for sea cucumber farm
	No sea cucumber farms	Not establishing rearing area for sea cucumber
Breeding site for fishes and crustaceans	Improvement	Improving the breeding sites for fish and crustaceans
	No change	No change in the breeding sites
Tourist facilities	Improvement	Improving the facilities for tourist
	No change	Keep the existing tourist facilities
Mangroves	Planting mangroves	Increase the number of mangroves
	No change	The number of mangroves in the fishing area remains unchanged
Cost (LKR)	0, 1000, 2000, & 3000	Annual payment to local government authority

Attributes	Alternative A	Alternative B	Status quo
Rearing area	No sea cucumber farm	Sea cucumber farm	No sea cucumber farm
Breeding site	Improve	Improve	No change
Tourist facilities	No change	Improve	No change
Mangroves	No change	Planting	No change
Cost (in LKR)	Rs.3000	Rs.1000	Rs.0
I choose	☐	☐	☐

Figure 2. *A Sample choice set example*

According to random utility model (RUM), the utility is modelled with two components such as deterministic component (observable component) (V_{nit}) and a random component (ε_{nit}) representing an error term. The error term includes all non-observable factors that affect respondents' decisions but are not observable by the researcher.

Therefore, the utility (U_{nit}) for the alternative *i* can be written as:

$$U_{nit} = V_{nit} + \varepsilon_{nit} \quad \text{(Eq.2)}$$

Therefore, fisherman *n* will select alternative *i* if $U_{nit} > U_{njt} \; \forall j \neq i$. Then, the probability fisherman *n* choosing the i^{th} is given by:

$$\begin{aligned} P_{nit} &= \text{Prob}\left(V_{nit} + \varepsilon_{nit} > V_{njt} + \varepsilon_{njt} \,:\, \forall j \in C, \forall j \neq i\right) \\ &= \text{Prob}\left(V_{nit} - V_{njt} > \varepsilon_{nit} - \varepsilon_{njt} : \forall j \in C, \forall j \neq i\right) \end{aligned} \quad \text{(Eq.3)}$$

If the ε_{nit} is independent and identically distributed (i.i.d) with extreme value distribution, and Independence of Irrelevant alternative (IIA) assumption is valid, then the conditional logit model (CLM) can be applied. Therefore, the probability of fisherman *n* choosing i^{th} alternative being chosen can then be expressed as follows:

$$P_{nit} = \frac{exp(V_{nit})}{\sum_j exp(V_{nit})} \quad \text{(Eq.4)}$$

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The CLM may yield biased estimates if there is heterogeneity in fishermen's tastes. In cases where the preferences among fishermen vary significantly, estimating CLM may lead to inaccurate results. However, the random parameter logit (RPL) model is more flexible than CLM and widely used in choice experiments. The RPL model relaxed the limitations of independent and identically distribution and IIA assumption while capturing preference heterogeneity (Revelt and Train, 1998; Mu et al., 2023). Therefore, we used RPL model in this study to identify fishermen's preferences.

In the RPL model, the probability of fisherman *n* choosing i^{th} alternative then becomes:

$$P_{nit}=\int \frac{exp(V_{nit})}{\sum_j exp(V_{nit})} f(\beta \mid \theta) d\beta \quad \text{(Eq.5)}$$

where $f(\beta \mid \theta)$ denotes the probability density function of parameter β.

The RPL model accounts for preference heterogeneity by allowing the taste parameters to vary among respondents; however, it does not explain the sources of preference heterogeneity (Boxall and Adamowicz, 2002). Allowing interactions between the socio-economic characteristics of fishermen and choice-specific attributes and/or an alternative-specific constant (ASC) in the utility function is one way to identify the sources of heterogeneity (Pan, 2016). The definitions of the respondents' specific variables employed to account for preference heterogeneity are given in *Table 2*. We include an ASC which represents the status quo/current situation. Including a status quo alternative in each choice set enables fishermen to select the status quo option if none of the alternatives (aside from the status quo) is preferred. The indirect utility function, U_{nit} is expressed as follows:

$$V_{nit} = \beta_0 ASC + \sum \beta_m X_m \quad \text{(Eq.6)}$$

where β_0 is the coefficient of ASC, and β denotes the parameter of each attribute. Welfare measures can be calculated by estimating the marginal rate of substitution (MRS) between the considered attribute and cost, which can be expressed as marginal WTP/WTA. Here, utility is modelled as linear functions of the attributes. Therefore, the MRS is determined by calculating the ratio between the attribute and the cost attribute and multiplied by 2 since we used effects coding in this study (Lusk et al., 2003; Wang et al., 2018; Ortega et al., 2011; Zhou et al., 2017; Yin et al., 2018).

The marginal WTP/WTA for attribute *k* a will be:

$$WTP_k/WTA_k = -2 \frac{\beta_k}{\beta_{cost}} \quad \text{(Eq.7)}$$

β_k denotes the coefficient for the *k*th attribute and β_{cost} is the coefficient for the price attribute.

Table 2. *Respondents' specific variables used to explain preference heterogeneity*

Variables	Description
Age	Dummy variable 1 if the respondents' age is above 45 and 0 otherwise
Experience	Dummy variable 1 if the respondent has experience above 25 years and 0 otherwise
Education	Dummy variable 1 if the respondent has education qualification above grade 8 and 0 otherwise
Income	Dummy variable 1 if the household monthly income is above 30,000 LKR and 0 otherwise

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Results and discussion

Descriptive statics

Table 3 presents the descriptive statistics of the final sample of 164 fishermen. The fishermen's ages range from 21 to 75, with an average of 45.28 years, and their average fishing experience is 24.86 years. The average monthly income is LKR 32,378.05. The average education is 8.03.

Table 3. *Sociodemographic profiles of the surveyed respondents*

Variables	Mean	Standard deviation	Minimum	Maximum
Age	45.28	11.49	21	75
Experience	24.86	12.45	1	52
Education	8.03	2.6	2	13
Income	32,378.05 (USD 107.61)	6660.04	15,000	40,000

An exchange rate of USD 1 equals LKR 300.89 in 2025 (Source: Central Bank of Sri Lanka, 2025)

Estimation of CLM and RPL

We present the CLM and RPL results in *Tables 4* and *5*. The estimates of the CLM are shown in Models 1 and 2. Model 3, 4 and 5 reports the results of the RPL model with and without considering interactions with fishermen's socioeconomic characteristics: Model 3 includes the RPL model with main effects only, Model 4 includes the RPL model with interaction between ASC and fishermen's socioeconomic characteristics, Model 5 includes RPL model with interaction between attributes and fishermen socioeconomic characteristics. All the models were estimated using maximum simulated likelihood procedures in NLOGIT software version 6.0, and the RPL model was estimated using 1000 Halton draws. The Akaike Information Criteria (AIC) suggests that incorporating the respondents' sociodemographic characteristics into the RPL model best fits the data than other models. Also, inclusion of interaction terms in the RPL model has increased the model fit.

The coefficient for ASC is positive and statistically significant at the 1% level, indicating that fishermen prefer to select alternatives other than the status quo. This in turn meant that any changes relative to status quo had a positive impact of utility. The coefficient for cost attribute in all RPL and CLM models is negative and statistically significant at the 1%, indicating that the likelihood of choosing an alternative fall as the cost rises. The coefficients for "breeding sites," "tourist facilities," and "mangroves" are positive and statistically significant at the 1% level in all models, indicating that fishermen are willing to pay for these attributes. However, a negative coefficient was found for the "rearing area" attribute, indicating that fishermen are willing to accept compensation for commercial sea cucumber farms. In other words, fishermen may be open to receiving compensation if commercial sea cucumber farms are present. In the RPL models, the estimated standard deviation for rearing area and breeding site attributes are significant, indicating the existence of unobserved preference heterogeneity.

The sociodemographic characteristics of respondents are incorporated into the model (Model 4) by interacting them with the ASC, allowing for an examination of the impact of each characteristic on respondents' choices. The results suggest that the interaction between ASC and education is positive and statistically significant at the 1% level. It reveals that, on average, respondents with an education qualification above Grade 8 are less likely to

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choose the status quo alternative. Also, the interactions between attributes and respondents’ socioeconomic characters are presented in model 5. Interactions between breeding sites and education and breeding sites and income are positive and statistically significant at the 1% level. It indicates that respondents with an education qualification above Grade 8 and a monthly household income above LKR 30,000 are more willing to pay for improvement in the breeding sites. The interaction terms for education with tourist facilities and mangroves are positive and statistically significant at the 1% and 5% levels, respectively. It suggests that respondents with an education level above Grade 8 are more willing to pay for improvement in tourist facilities and mangroves.

Table 4. *Estimates of conditional logit model and random parameters logit model*

Variable	Model 1 CLM	Model 2 CLM with interactions	Model 3 RPL without interactions		Model 4 RPL with interactions	
	Coefficient	Coefficient	Coefficient	St. Deviation	Coefficient	St. Deviation
ASC	0.5525*** (0.1410)	0.1505 (0.2291)	0.6452*** (0.1935)	-	0.0013 (0.3200)	-
Cost	-0.0007*** (0.5428D-04)	-0.0007*** (0.5474D-04)	-0.0016*** (0.00013)	-	-0.0016*** (0.00013)	-
Rearing area	-0.7213*** (0.0578)	-0.7353*** (0.0583)	-1.9366*** (0.3257)	3.3850*** (0.4368)	-1.8614*** (0.3092)	3.3196*** (0.4202)
Breeding sites	1.0648*** (0.0627)	1.0790*** (0.0633)	1.9602*** (0.1488)	0.5217*** (0.1124)	1.9454*** (0.1435)	0.4791*** (0.1144)
Tourist facilities	0.5958*** (0.0409)	0.6040*** (0.0413)	1.2772*** (0.1078)	0.1488 (0.1834)	1.2582*** (0.1031)	0.1263 (0.1724)
Mangroves	0.2502*** (0.0377)	0.2551*** (0.0378)	0.8396*** (0.0904)	0.2026 (0.1373)	0.8309*** (0.0871)	0.1462 (0.1517)
Interactions of respondents’ sociodemographic characteristics with ASC						
ASC × age	-	-0.0070 (0.2327)	-		0.44631 (0.32569	
ASC × experience	-	-0.2508 (0.2264)	-		-0.2056 (0.3088)	
ASC × education	-	0.3283* (0.1760)	-		0.6950*** (0.2508)	
ASC × income	-	0.5136*** (0.1657)	-		0.1917 (0.2280)	
Log likelihood	-1169.22	-1156.52	-847.63		-842.24	
AIC	2350.40	2333.0	1715.3		1712.5	
Pseudo R2			0.411		0.415	
Sample size	164	164	164		164	

*** denotes significance at 1%, ** at 5%, * at 10% level. Standard errors are presented in parentheses

Table 5. *Estimates of the random parameter logit model with interactions of attribute levels with respondents’ sociodemographic characteristics*

Variable	Model 5			
	Coefficient	S.E	St. Deviation	S.E
ASC	0.7420***	(0.1932)		
Cost	-0.0016***	(0.00013)		
Rearing area	-1.4738**	(0.6365)	3.2597***	(0.4091)
Breeding sites	1.2980***	(0.1946)	0.3534**	(0.1459)
Tourist facilities	1.0180***	(0.1531)	0.162	(0.1463)
Mangroves	0.5604***	(0.1456)	0.1476	(0.1398)

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Interactions between attribute levels and sociodemographic characteristics		
Rearing area × age	-0.8666	(0.9311)
Rearing area × education	-0.7019	(0.6217)
Rearing area × experience	-0.1445	(0.9068)
Rearing area × income	0.7638	(0.5913)
Breeding sites × age	0.2205	(0.2059)
Breeding sites × education	0.4225***	(0.1586)
Breeding sites × experience	-0.1512	(0.2008)
Breeding sites × income	0.5584***	(0.1472)
Tourist facilities × age	0.1807	(0.1599)
Tourist facilities × education	0.3837***	(0.1234)
Tourist facilities × experience	-0.1473	(0.1519)
Tourist facilities × income	-0.0179	(0.1123)
Mangroves × age	0.0279	(0.1495)
Mangroves × education	0.2451**	(0.1158)
Mangroves × experience	0.0708	(0.1439)
Mangroves × income	0.1051	(0.1094)
Log likelihood	-821.75	
AIC	1695.50	
Pseudo R2	0.429	
Sample size	164	

*** denotes significance at 1%, ** at 5%, * at 10% level. Standard errors are presented in parenthesis

The mean willingness to pay and willingness to accept for each attribute are estimated using *Equation 6* and presented in *Table 6*. It shows that fishermen are willing to pay for improvements in breeding sites and tourist facilities, as well as for the planting of mangroves. However, they are willing to accept compensation for commercial sea cucumber farms. The estimated mean WTP for improving breeding sites is LKR 1619.95 (USD 5.38), for developing tourist facilities is LKR 1270.50 (USD 4.22), and for planting mangroves is LKR 699.38 (USD 2.32), while the mean WTA compensation for commercial sea cucumber farm is LKR 1839.39 (USD 6.11). The selected attributes in this study indicate that fishermen place a higher value on improving breeding sites compared to other attributes. This clearly shows that fishermen prioritize improving breeding sites because such improvements directly benefit them by enhancing the quality and quantity of fish and crustaceans. Also, the findings indicate that fishermen are seeking compensation for establishing sea cucumber farms. This may be due to fishermen perceiving that sea cucumber farming can significantly impact wild fish stocks, leading to a decrease in the number of fish in the area, which may affect their livelihoods. The mean WTP of interaction of attributes with social characteristics are presented in *Table 6*. Fishermen with an education level above grade 8 and a monthly income above LKR 30000 are willing to pay LKR 528.16 (USD 1.76) and LKR 697.96 (USD2.32), respectively, for improving the breeding sites of fishes and crustaceans compared to those with an education level below grade 8 and an income of LKR 30000. Additionally, fishermen with an education level above grade 8 are willing to pay LKR 479.66 (USD 1.59) and LKR 306.33 (USD 1.02), respectively, for improving tourist facilities and planting mangroves, compared to those with an education level below grade 8. The significant interactions observed between attributes such as breeding sites, tourist facilities, and mangroves and respondents' education levels indicate that more educated fishermen tend to show stronger preferences for implementing improvements in the Jaffna Lagoon. This shows that education plays a crucial role in shaping fishermen's preferences, and acceptance of conservation-oriented and livelihood-improving initiatives in the Jaffna Lagoon. This is consistent with previous studies in Sri Lanka by Krishnapillai et al. (2020) and Nesha Dushani et al. (2023). Nesha Dushani et al. (2023) found that education significantly increased households' willingness to pay for mangrove restoration in the Rekawa coastal wetland. Similarly, Krishnapillai et al. (2020) reported that fishermen with higher education levels expressed greater willingness to support mangrove expansion and tourist facility improvements in the Jaffna Lagoon.

Table 6. *Mean willingness to pay and willingness to accept*

Attributes	Mean WTP/WTA	
	(in LKR)	(in USD)
Rearing area	-1839.39**	-6.11**
Breeding sites	1619.95***	5.38***
Tourist facilities	1270.50***	4.22***
Mangroves	699.38***	2.32***
Mean WTP for attributes interaction with various social characteristic		
Breeding sites × education	528.16***	1.76***
Breeding sites × income	697.96***	2.32***
Tourist facilities × education	479.66***	1.59***
Mangroves × education	306.33**	1.02***

*** denotes significance at 1%, ** at 5%, * at 10% level. Standard errors are presented in parenthesis
An exchange rate of USD 1 equals LKR 300.89 in 2025 (Source: Central Bank of Sri Lanka, 2025)

Conclusion

A clear understanding of the local fishermen's preference for sea cucumber farms and their WTA compensation for establishing them in the Jaffna lagoon will help in developing appropriate policies. We used the choice experiment approach to estimate the local fishermen's WTA compensation for establishing sea cucumber farms in the Jaffna lagoon. The findings of this study reveal that local fishermen are willing to accept compensation for establishing sea cucumber farms, while they are willing to pay for improvements in breeding sites, tourist facilities, and increased mangroves. We further identify that the fishermen's socioeconomic characteristics significantly influence their preferences. Notably, socioeconomic characteristics of fishermen, such as their education and income levels, have a significant influence on their willingness to pay for the attributes selected in this study. The estimated values will help policymakers allocate resources efficiently based on the fishermen's priorities. The marginal WTA values estimated in this study will assist local authorities in establishing suitable compensation schemes for establishing sea cucumber farms. Additionally, the mean willingness to pay (WTP) estimated in this study will offer valuable insights to policymakers regarding local fishermen's preferences for changes in breeding sites, tourism, and mangroves. These values will assist local authorities in determining the suitable funding levels for managing breeding sites, developing tourist facilities, and planting mangroves. Overall, the findings

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will assist local authorities in designing more effective and balanced strategies that promote sustainable development in the Jaffna Lagoon, which will benefit the local communities and the environment. This study combined various investment types, such as rearing areas, breeding sites, tourist facilities, and mangroves, into a single choice experiment. This approach limits our ability to understand fishermen's preferences for each type in detail. Therefore, future researchers should consider these investment types separately to provide more targeted and effective policy interventions.

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