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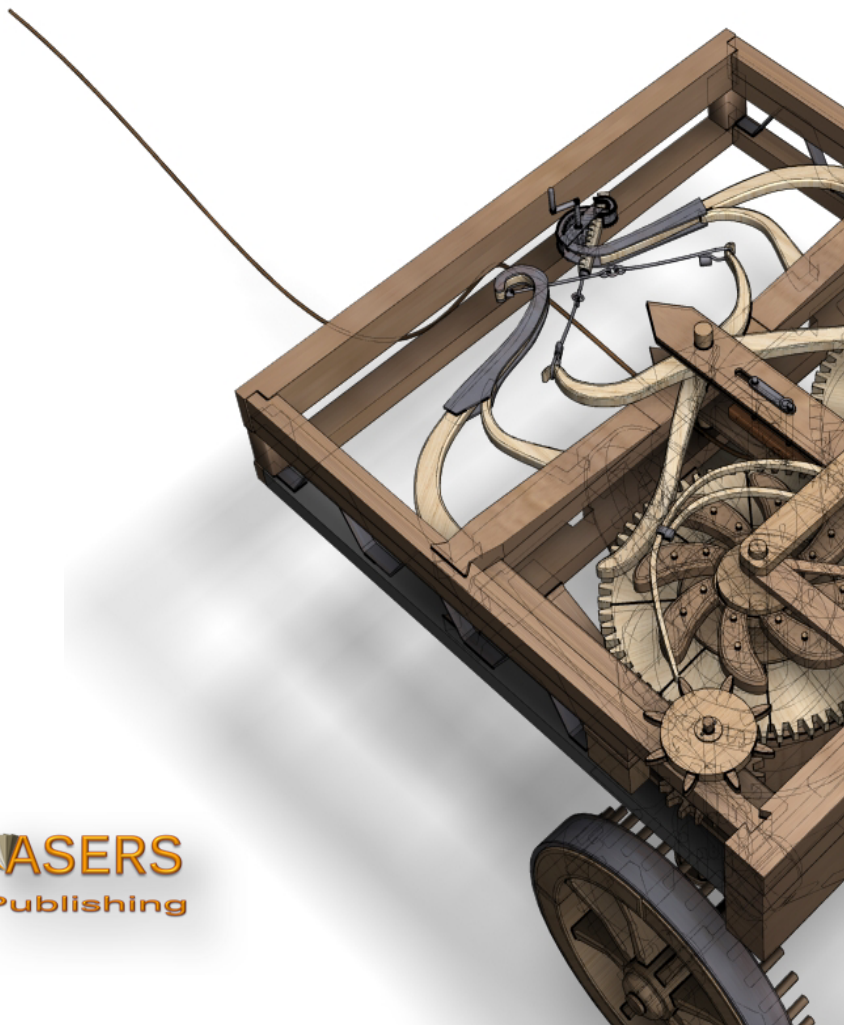

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Visitor Perception of the Degradation of Bar Reef Kalpitiya Sri Lanka

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Abstract: Bar Reef is a complex marine ecosystem with over 120 coral species living in the reef and over 300 fish species reported from the surrounding sea. It was declared a marine sanctuary in 1992. Despite efforts for conservation, the Bar Reef ecosystem is at risk of degradation due to overexploitation of extractive uses, namely, edible fish, other seafood species, and aquarium fish. In addition, destructive fishing practices are also responsible for damaging the reef ecosystem. The designation of Kalpitiya as a significant tourism promotion area has created additional pressure on the system. Further, the worldwide incidence of coral bleaching in 1998 has severely affected a major part of the Bar Reef. However, the amount of degradation persistent in the bar reef has not been valued so far. This research has attempted to value the extent of degradation prevailing in the Bar Reef from the perception of the visitors. It has used Choice Experiment Method to assess the visitors' perception of the degradation. Randomly selected 250 visitors were interviewed and the conditional logit model has been used to investigate the visitor preferences towards the habitat quality and analyze the significance of their preferences. According to the results obtained reduction of plastic and polythene by 50%, reducing the crowding in the beach area by 15%, and paying Rs. 1000 has become significant. Hence it is expected by this research to provide a signal to the relevant stakeholders on the extent of degradation prevailing and the importance of protecting this habitat.

Keywords: marine ecosystem**;** conditional logit; choice experiment; degradation of bar reef; perception.

JEL Classification: Q57; Q01; Z32; R11.

Introduction

Bar Reef is one of the largest coral reefs in Sri Lanka and is situated a few kilometers away from the shores of Kalpitiya, Puttlam District. It is enriched with high biodiversity, including rare coral species, seagrass beds, and associated ecosystems with over 120 coral species and over 300 fish species reported from the surrounding area (Coast Conservation Department, 2007; Rajasooriya *et al.* 1995). Recognizing the importance of biodiversity in the Bar Reef area, it was declared a marine sanctuary in 1992. Although declared as a marine sanctuary, the management of the reef is at the primary level.

Not only is Bar Reef important as a biodiversity destination, but it also continues to provide livelihood opportunities for many local users. Fishing is the major occupation in the Kalpitiya area. These fishers live in the coral reef area either along the continental shelf, in the Kalpitiya lagoon, or offshore areas beyond the Bar Reef. In addition to fishers who permanently reside in the villages, some migrants stay temporarily in the area during the peak fishing period. Usually, the southwest monsoon period (May - September) is considered a lean season for fishing in the area.

1. The Problem and the Objectives

Mere declaration of the Bar Reef as a protected area has yet to create an effective deterrent against harmful extractive practices, and the process of ecosystem degradation seems to be continuing. Rising demand for edible fish and other seafood species, aquarium fish, and products such as chanks has led to increasing extraction of those products from the Bar Reef area (Coast Conservation Department, 2007; Rajasooriya *et al.* 1995). Most intensive fishing can be observed during the period from February to June. In addition to overexploitation, destructive fishing practices also damage the Bar Reef and associated ecosystems. Among the destructive practices reported from the area are blast fishing and illegal fishing gear (*e.g.*, Laila nets, encircling nets, bottom set nets, and Moxy nets). An increase in the local population, a growing number of migrant fishers, especially after the conclusion of the war in the North, increasing poverty levels of local residents, and lack of other economic opportunities seem to encourage overexploitation and the use of destructive practices.

Further, booming tourism activities in the area have created additional pressure on the system in terms of the increased number of visitors, an extended number of recreation services, and associated damages to the system due to congestion and the accumulation of non-biodegradable waste. More visitors have also increased the demand for local products causing indirect pressure on local resources.

Not only the anthropogenic factors, but the Bar Reef is also susceptible to natural causes of degradation too (Coast Conservation Department, 2021, 2007; Ohmen *et al.* 1998; Rajasuriya *et al.* 1995). The worldwide incidence of coral bleaching in 1998 has severely affected a major part of the Bar Reef. Some estimates suggest that over 90% of coral died due to bleaching, and experts reported that the system's biodiversity has reduced after the mass bleaching (Rajasuriya and Karunarathna, 2000; Rajasuriya 2002). However, there are signs of recovery and new colonies growing on top of dead colonies (Department of Wildlife Conservation, 2020). Even before the incidence of bleaching, the Bar Reef underwent a severe attack of invasive crown-of-thorns starfish (COT) in the 1970s (Rajasuriya *et al.* 1995). The Department of Fisheries and Aquatic Resources (DFAR) had to make a major effort to destroy COT, and the reef recovered gradually since then. These incidents of natural disasters suggest that the Bar Reef is a fragile system, and excessive exposure to harmful anthropogenic activities could set the system on a rapid path of degradation.

Therefore, the objectives of this study are to value the amount of degradation persistent in the Bar Reef from the perception of visitors. Valuation of the extent of degradation may be useful to inform policymakers about the importance of this destination. Hence it is expected by this research to provide a signal to the relevant stakeholders on the extent of degradation prevailing and the importance of protecting this habitat.

2. Literature Review

The coral reef ecosystem is a pristine environment that represents a resource of primary importance to many economies. However, fragile developing economies which depend on natural resources to a greater extent and are burdened with poverty, demographic pressure, and low human capital capacity (Leisher *et al.* 2007; Pollnac *et al.* 2000, Laurans *et al.* 2013) seem to have created unfavorable consequences on this important ecosystem. Coral reefs are threatened by various negative pressures such as acidification of the oceans, climate change, excessive tourism, pollution, and sedimentation (Mumby and Steneck 2008, Laurans *et al.* 2013, Lee *et al.* 2019). Due to the said reasons, coral reefs are the core focus of many conservation organizations. According to the findings of the scientists, many coral reefs in the world, especially those found in the Indian Ocean will cease providing their basic functionalities very soon (Wilkinson, 2008; Bryant *et al.* 2011, Laurans *et al.* 2013).

To examine the extent of the degradation of corals and their impacts, various methods have been used by economists (Spurgeon 1992; Dixon, 1998). Cesar (2000), Ahmed *et al.* (2004), and Brander *et al.* (2007) have provided with meta-analysis of coral-associated ecosystems. Costanza *et al.* (1997) have estimated a global value for coral ecosystems.

The economic value of coral degradation is a standard topic nowadays though it was initially described by the end of the 1980s (Hodgson and Dixon (1988) and Hundloe *et al.* (1987)). In their study on tourism in Palawan, the authors (Pet-Soede *et al.* 1999) have attempted to compare the social cost and private benefits that have adversely affected the coral reefs. In Indonesia, the economic cost of blast fishing to society has been estimated to be several times higher than the total net private benefits. This is mainly because blast fishing damages coral habitats on which other fish depend (Pet-Soede *et al.* 1999). Other means of destructive practices are cyanide fishing (Mous *et al.* 2000) coral mining (Ohman and Cesar 2000), and tourism (Van Beukering and Cesar 2004).

Many authors have highlighted the benefits of conservation and management of natural resources over conversion effects. Mangroves and coral reefs of Olango Island in the Philippines generate net benefits of US$1.53 to 2.54 million per year. However, the cost of conservation of this environment is only US$100,000 per

year (White *et al.* 2000). In determining the importance of criteria in the management of wetlands in Sri Lanka, Wattage and Mardle (2005), considered two key issues: that is whether they should be conserved for environmental benefits, or whether they should be used for development activities.

Lane *et al.* (2013) have used the benefit transfer approach to calculate the economic values of changes in coral cover especially when greenhouse gas emissions are increased.

Coral reefs are non-market goods and hence their benefits need to be measured using an assessment method. Hence Contingent Valuation Method (CVM) and Choice Experiment Method (CEM) are used to measure the values of non-market goods like coral reefs (Lee *et al.* 2019). Persons and Thur (2008) have used a CE Survey to estimate the value of changes in the coral ecosystem to scuba divers. Lee *et al.* (2019) have valued the ecological conservation of the Kenting Coral Reef using CEM. This study used CEM to construct a random utility model for the conservation of coral ecology. It has also investigated the coral conservation preferences and willingness to pay the value of tourists.

Lara *et al.* (2021) have also valued the reef attributes of Cozumel Island using CEM. This study has attempted to investigate the link between the local economy and the management of the park using CEM to examine the economic values visitors assign to underwater visibility, biodiversity, and visitor congestion in reef areas.

Pakalniete *et al.* (2021) have used CEM to evaluate benefits from Ecosystem Services (ES) and welfare losses to people due to restrictions on economic activities from establishing new offshore Marine Protected Areas. Shen *et al.* (2019) have used CEM to estimate the social cost of marine litter in China. They have conducted surveys at ten different beaches in Zhejiang province. The social cost is US$1.00 to 1.07 per visit when the CEM is applied.

Cavalletti *et al.* (2021) have used CEM to examine the preferences of a sample of visitors of human-made services vs. natural services in a marine protected area where policymakers must balance when deciding on management strategies for coastal sites. The results of the choice experiment method indicated that natural services were preferred by the visitors. Armstrong *et al.* (2019) have investigated the tradeoffs between the protection of cold-water coral reefs and economic activities such as fisheries and petroleum extraction using a CEM in Norway and Ireland. Results indicated that Norwegian respondents prefer to protect corals than the Irish and that the present governance system does not properly focus on the protection of cold-water corals.

Davis *et al.* (2019) have used Integrated Choice Experiment (ICE) to value many attributes. They have used ICE to value marine ecological and recreational features at Moreton Bay, South-East Queensland where the results of the ICE approach were compared with full profile Discrete Choice Experiment (DCE) with all eight attributes.

Contingent Valuation Method is a non-market valuation method that values users' preferences for ecosystems in a good ecological state (Spash 2000, Lee *et al.* (2019). This method is a means to value individuals' willingness to pay for the preservation of the services or willingness to accept their loss by simulating the absent market for coral reef ecosystem services by eliciting through surveys. Ahmed *et al.* (2007) have valued the recreation and conservation benefits of coral reefs in the Philippines using travel cost and CVM. The results indicate that preserving the natural environment is not an immediate priority among the people in developing countries due to socio-economic considerations. Splash (2000) also has attempted to investigate whether CVM was applicable to the valuation of the benefits of maintaining and improving coral reef biodiversity.

Moreover, another method of valuing conservation involves considering the costs and benefits of specific engagement, such as establishing marine protected areas (Dixon *et al.* 1995; Subade 2007). Rani *et al.* (2020) have mentioned that the coral reefs of Saint Martin's coral island and the associated ecosystem of Bangladesh are damaged, mainly from fishing, anchoring of boats, and waste discarded by tourists. They have calculated the net present value of all the island's resources to be US$ 545 million over 25 years and presented a socio-ecological-political, restoration, and management framework to protect the reefs.

Some studies have focused on restoring critical habitats when considering coral reef degradation. Under this approach, cost and benefits of restoring degraded ecosystems are discussed (Spurgeon and Lindahl 2000) or rehabilitating and creating habitats. Thus, conservation examines the economic opportunity created by protection measures.

Jayasekera *et al.* (2019) have estimated the optimal entrance fee for the Hikkaduwa National Park, Sri Lanka using the travel cost method and have mentioned that the main threat to this recreational site are the rapid degradation of the coral reef and beach pollution.

Since coral reef conservation and climate change are interconnected, Ngoc (2019) has calculated the loss in the economic value of coral under climate change ranges from US$ 27.78 to US$ 31.72 million for Nha Trang

Bay in Vietnam and has pointed out that this value will be useful for the policymakers to draw conclusions for climate change policy. El Niño event which occurred in 1998 has resulted in massive coral bleaching all over the world and especially in the tropical coastal regions. It has been estimated by Westmacott *et al.* (2000) that losses in tourism revenues and welfare in Sri Lanka were estimated to be US$ 2.2 million due to the coral bleaching.

Pendleton (1995) mentioned that the marine park's economic benefit is the value of avoiding reef degradation. It has also mentioned that many previous studies have erroneously measured their economic benefits since they value “the resource protected and not the protection provided”. Further, Wielgus *et al.* (2002) have attempted to measure the economic valuation of pollution damage to coral reefs using dose-response modeling. In this study, they have discussed the importance of the economic value of coral reefs and how dose-response functions can be used for the economic valuation of coral reef damage.

Accordingly, there are more studies done regarding coral degradation globally. However, visitor perception and how it should lead to the improvement of existing governance systems still need to be researched in which is the focus of the present study.

3. Research Methodology

Revealed preference data is seldom found for recreation and tourism studies hence stated preference techniques are commonly used for such valuations. Two common approaches of stated preference are the Contingent Valuation Method (CVM) and the Choice Experiment Method (CEM). Although CVM is commonly used to examine respondents’ preferences for unpriced benefits related to coastal environments, specifically for non-use values, if the resource is difficult to be imagined by the respondents’ inaccurate estimates are likely to be produced (Wattage *et al.* 2011). However, this problem can be minimized if CEM can be adopted. CEM is derived out of conjoint analysis which was mainly developed for the purpose of market research (Carson *et al.* 1994). The basic form of CEM has been developed in the 1970s and the applications have been popular in recent years (Green and Sirinivansan 1978) partly in order to overcome the drawbacks of CVM and partly due to its own development (Wattage *et al.* 2011). CEM is viewed by some as the evolution of CVM since both these methods involve surveys and both are based on the economic theory of random utility (Adamowicz *et al.* 1998). At present, there is a trend of applying CEM in environmental valuations (Mariel *et al.* 2021).

The aim of the approach is to establish the relative importance of attributes and estimate the structure of individual preferences. To achieve this, a set of attributes and their levels are presented to the respondent. The total utility that an individual obtains from that alternative is thereby decided by the utility to the individual of each attribute. The ultimate objective of the conjoint analysis-based techniques is to “(a) estimate the relative importance of individual attributes (b) the trade-offs or marginal rates of substitution that individuals are willing to make between these attributes and (c) the total satisfaction or utility scores for a different combination of attributes" (Ryan 1996). In the CEM there are attributes and their respective levels. Different choice sets can be made by changing attributes and their levels. It is commonly seen that fixed choice sets are being used. In CEM respondents are making a choice from different combinations presented as a different set of attributes and associated levels. According to Green and Sirinivansan (1978), there are certain steps needed to be followed. As the first step set of attributes needed to be chosen and the alternatives needed to be described. This involves three key components. They are understanding the problem, identifying attributes, and setting attribute measures.

Further, two methods are usually practiced for data collection. They are two factors at a time and full profile. Two-factor method is simple, reduces information accumulation, and is more suitable for a postal survey. However, there are limitations inherent to this method. Since choice-based approaches depend on personnel interviews full profile approach provides a more realistic approach. Therefore, once the number of attributes examined is high, more comparisons are needed to be made, and hence limits needed to be placed on the number of attributes that can be examined.

For example, in this study, a full factorial design of the four main attributes was identified to produce a total of 4^3 combinations or profiles. Since it is difficult to show all these combinations to the respondent simultaneously, only a fraction of the possible combinations can be used for the choice cards. This is achieved by selecting an orthogonal, fractional factorial design. An orthogonal design confirms that individual estimates of attributes and levels are independent of each other (Aas *et al.* 2000).

3.1 Econometric Analysis

The choices of the respondents depend on the Random Utility Theory and Consumer Choice Theory. According to consumer choice theory satisfaction of the consumer is derived from the attributes of the goods and not from the good itself on the utility gained. According to Random Utility Theory, consumers will choose one alternative

over another once the utility derived from that alternative is higher. The utility of a choice can be mathematically represented as follows;

$$U_{ab} = V_{ab}(X_{ab}, S_a) + \in_{ab} \quad (1)$$

In the above equation, U denotes the utility of the a[th] respondent will obtain from choosing alternative b. V_{ab} is the systematic term, which is a function of X_{ab}, the vector that includes the attributes, and the respondent's characteristics are represented by S_a. Further, the random error is represented by $\in_{ab}$.The error term is inclusive of the effects of omitted variables. It also includes the case-specific factors that affect utility.

A respondent would choose alternative "c" over alternative "b" only when the satisfaction obtained is higher, *i.e.*, $U_{ac} > U_{ab}$ whereas U represent utility. So that the probability of the a[th] respondent choosing c[th] alternative over b, from the choice set c, is given as

$$P_{ac} = Prob\ (U_{ac} > U_{ab}\ ) \text{ for all b in c, b≠c} \quad (2)$$

$$P_{ac} = Prob\ (V_{ac} + \in_{ac} > V_{ab}\ + \in_{ab}) \text{ for all b in c, b≠c} \quad (3)$$

When considering the b[th] alternative, V_b is known as representative component utility and it includes the observed and measured attributes for the individual. The marginal utility of each attribute is explained by the weights attached to them. It is shown in the following equation.

$$V_b = \beta_{ob} + \beta_{1b} f(X_{1b}) + \beta_{2b} f(X_{2b}) + + \beta_{cb} f(X_{cb}) \ldots\ldots\ldots\ldots\ldots \quad (4)$$

It is mandatory to satisfy the condition of Independence of Irrelevant Alternatives (IIA) to calculate selection probabilities in a choice model. According to Can and Alp (2012), IIA condition states that "the presence or absence of an additional alternative does not affect the ratio of the probabilities of choosing one alternative over another when all alternatives having a non-zero probability of choice are considered."

IIA assumption ultimately means that error terms are independently and identically distributed. An assumption on the distribution of the error term is vital to getting a meaningful expression for probabilities. Further, error terms have a Gumbell, Weibull, or double exponential distribution. It can be represented as

$$P_{ab} = \frac{\exp\ (V_{ab})}{\sum c{=}1\ \exp(Vac)} \quad (5)$$

It is known as conditional logit model or multinomial logit model.

$$P_{ab} = \frac{\exp\ (V_{ab})}{\sum_{c=1} exp(V_{ac})} \quad (5)$$

3.2 Calculating a Willingness to Pay Value

Given one attribute is measured in monetary terms; Willingness to Pay (WTP) can be interpreted as a ratio of two parameters provided that all others held are constant. It is a mandatory requirement that both the attributes are statistically significant. Attribute measured as the monetary term should be used in the denominator in the equation. The WTP is the ratio of the coefficient of the attribute of interest and price coefficient (Birol and Koundouri, 2008).

$$WTP = \beta_C^{-1} ln \left| \frac{\varepsilon_a \exp\ (v_a^1)}{\varepsilon_a \exp\ (v_a^0)} \right| \quad (6)$$

Letting β_k represent the coefficient of any attribute from the above-mentioned equation, WTP can be stated as

$$WTP = -\frac{\beta_K}{\beta_C} \quad (7)$$

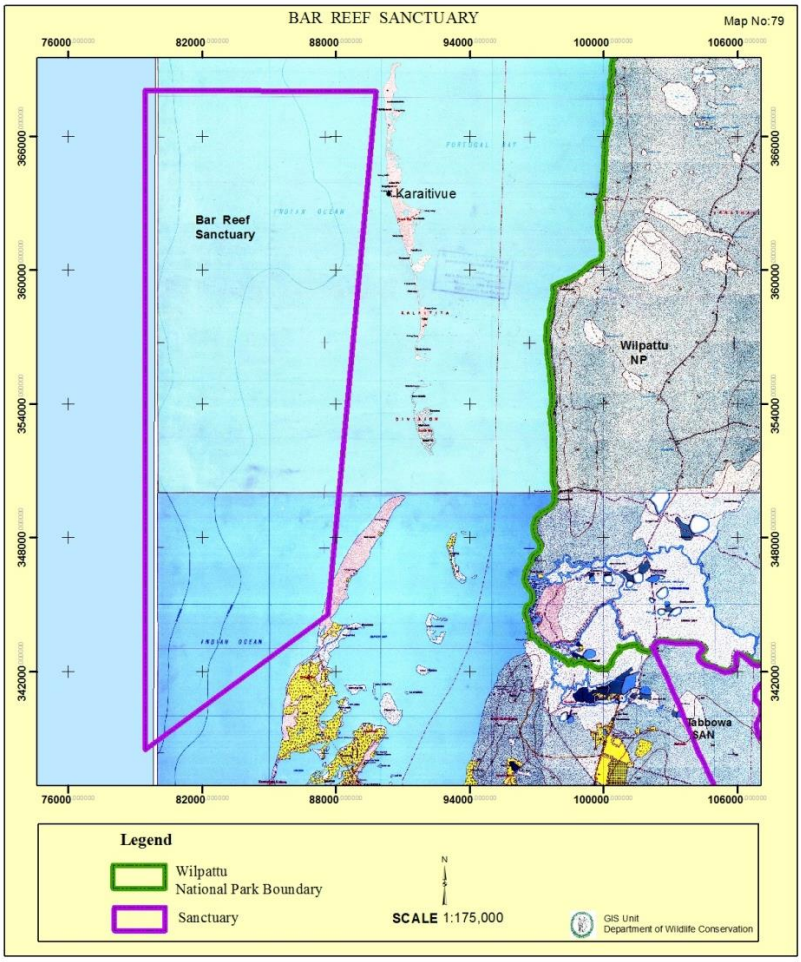
3.3 Main user Categories of the Bar Reef

The Bar Reef is fast becoming a tourism attraction and number of visitors to the area is increasing. Hence, a sample of visitors who traveled to the area for recreation during the study period was the focus of this study. Since fishing is the main occupation in the area, the main type of local resource users were fishers. Fishers are a user category whose livelihood is closely associated with the Bar Reef and also represents a significant share of the local population. Comparatively, other local users, such as divers and collectors, are few. Tourism is fast becoming an alternative source of income for residents in the area and there are around 25 hotels and guest houses in the area. In addition, there are unregistered free-lance boat operators and guides who offer services to the visitors.

3.4 Study Area

Bar Reef is found few kilometers away from the shores of Kalpitiya. It is a complex marine ecosystem consisted of near shore coral reefs, sea grass beds and associated ecosystem rich in biodiversity. There are 31 Grama Niladhari (GN) divisions (smallest administrative unit) in Kalpitiya Divisional Secretariat (DS). Only some of the GN divisions in the Kalpitiya DS area are equally dependent on the Bar Reef. Department of Wild Life Conservation charges LKR 20 for a local adult and US$20 for a foreign adult who wishes to enter the Marine Sanctuary. The map of Bar Reef Marine Sanctuary is presented in figure 1 below.

Figure 1. Map of Bar Reef Marine Sanctuary (Source: Department of Wildlife Conservation)



3.5 Data Sources

Primary data was the key source of information for the study. Visitors, the main user category of the recreation resources, were the target population. A sample of 250 visitors was selected using a random sampling method, and they were interviewed visiting local hotels, resorts, and beach areas. The other two main user groups, fishers and hotel owners were mainly included in the Key Informant Interviews and the focus group discussions. In addition, secondary data available from official sources (*e.g.*, Kalpitiya DS office, Department of Wildlife Conservation Regional office) and official documents (*e.g.*, Bar Reef Special Management Plan, Environmental Profile of Kalpitiya, Tourism Development Program for Kalpitiya area) and scientific literature on the Bar Reef and surrounding ecosystems were also consulted.

3.6 Data Collection Methods

Grama Niladhari divisions that are dependent on the Bar Reef were identified for data collection with the consultation of local stakeholders. Few key informant discussions were also held with a few local users of the Bar Reef that included fishers, hotel owners, boat operators and aquarium fish collectors. The data collection strategy was identified based on the information gathered from these interactions, and the survey was designed accordingly. Focus group discussions also were conducted in selected villages in the Kalpitiya peninsula. Since

the Choice Experiment Method was used in this study, the first step was to identify different attributes. In order to identify the attributes more precisely focus group discussions and Key Informative Interviews (KII) were held. KIIs were also held to gather qualitative information with local users that including fishers, hotel owners, boat operators, aquarium fish collectors, and local officers. Further, several field visits were conducted to identify the attributes more accurately. Thereafter pilot test was conducted to ensure the attributes selected were the most appropriate ones. Selected attributes and their levels are depicted in table 1.

Table 1. Different attributes and their levels

Attribute	Level I	Level II	Level III
Level of plastic and polythene accumulated	50% reduced plastic and polythene	25% reduced plastic and polythene	Current level of plastic and polythene
Use of illegal fishing nets	50% reduced illegal fishing nets	25% reduced illegal fishing nets	Current level of illegal fishing nets
Level of crowding in the beach	30% fewer people	15% fewer people	Usual number of people
Monetary contribution	LKR 1000	LKR 500	No additional contribution

Since there are four attributes and three levels, mathematically 4^3 or 64 combinations of different choice scenarios are possible. To perform this task more conveniently, an orthogonal main effect design was generated using SPSS 21 software, and then 9 choice cards were prepared, each having 4 different attributes. The number of random alternatives in each choice task was set to two, with a third fixed alternative corresponding to the status quo.

Several field tests and reviews were done to make sure the questions were clear and understandable. Additionally, the survey included different sections to collect socio economic information, on their perception on preservation issues, and on the choices made during the Discrete Choice Experiment section. An example of a choice set is presented in table 2.

Table 2. An example of the choice set used in the survey.

Attribute 1	Attribute 2	Attribute 3	Attribute 4	Choice
50 % reduced use of plastic	25% reduced use of illegal fishing nets	30% fewer people	No additional fee	1
50 % reduced use of plastic	50% reduced use of illegal fishing nets	Usual number of people	LKR 500 additional fee	2
25 % reduced use of plastic	Continue to use current illegal fishing nets	30% fewer people	LKR 500 additional fee	3
25 % reduced use of plastic	50% reduced use of illegal fishing nets	15% fewer people	No additional fee	4
25 % reduced use of plastic	25% reduced use of illegal fishing nets	Usual no of people	LKR 1000 additional fee	5
Current level plastic use	50% reduced use of illegal fishing nets	30% fewer people	LKR 1000 additional fee	6
Current level plastic use	Continue to use current illegal fishing nets	Usual no of people	No additional fee	7
50 % reduced use of plastic	Continue to use current illegal fishing nets	15% fewer people	LKR 1000 additional fee	8
Current level plastic use	25% reduced use of illegal fishing nets	15% fewer people	LKR 500 additional fee	9

Target population to the study was the visitors who come to the Bar Reef and data collection was done from January to August 2021. Random sampling was done, and 250 visitors were interviewed using a standard questionnaire.

4. Results

A value for each attribute was estimated using SPSS 21 software. The chi-squared estimated value for likelihood ratio implies that the model is significant at α 0.01. Also this model implies that null hypothesis which states that

there is no relationship between choice and the attributes can be rejected. The maximum likelihood estimates of parameter values and relevant statistics are mentioned in Table 3

Table 3. Results of conditional logit regression analysis

Parameter Variable	Estimate	S.E	*X2*	Pr>*X2*
Reduce plastic by 50%	0.651	0.173	14.253	0.000
Reduce plastic by 25%	0.266	0.181	2.158	0.142
Reduce Illegal nets by 50%	-0.04	0.174	0.001	0.982
Reduce Illegal nets by 25%	0.212	0.168	1.600	0.206
Reduce crowding by 30%	-0.068	0.156	0.193	0.661
Reduce crowding by 15%	-0.598	0.174	11.782	0.001
Pay Rs. 1000	-0.552	0.172	10.314	0.001
Pay Rs.500	-0.234	0.160	2.145	0.143

According to the above table, some parameter values are significant, and some are insignificant at α =0.01 level. Considering the reduction of plastic and polythene accumulation in the beach and the sea, reduction of plastic and polythene by 50% is significant at α = 0.01. However, reduction of plastic by 25% is not significant at the given probability level. Reduction of illegal fishing nets in fishery activities by 50% or 25% has not become a significant variable at the α = 0.01. Reducing the crowding in the beach area by 15% has become significant, whereas reducing the crowding by 30% in the beach area has not become a significant variable. Finally paying LKR 1000 has become a significant variable and paying LKR 500 has not become a significant variable.

According to the conditional logistic results depicted in the above table, regression equation can be presented as

Choice = -.552+ 0.651 reduce plastic by 50% - 0.598 reduce crowding by 15%

Marginal Willingness to Pay (MWTP) for reducing plastic by 50% is given by the negative value of the proportion between the coefficient of the attribute and the coefficient of the contribution.

MWTP = -(0.651/-0.552)
=LKR 1.179

Marginal Willingness to Pay value states that visitors are willing to visit this place if availability of plastic and polythene in the beach and sea can be reduced by 50%.

Similarly, MWTP can be calculated for crowding as well. Marginal Willingness to Pay for reducing the crowding of the beach by 15% is given by the negative value of the proportion between the coefficient of the attribute and the coefficient of the contribution.

MWTP = -(-0.598/-.552)
=LKR-1.083

Marginal Willingness to Pay value states that visitors are willing to visit this place if the crowding of the beach can be reduced by 15%.

5. Discussion and Recommendations

CEM is a flexible and practical method to evaluate complex tradeoffs between attributes. This paper aimed to scrutinize the robustness of the CEM approach to evaluate the visitor perception of the degradation of the Bar Reef Kalpitiya, Sri Lanka.

Further, reducing crowding by 15% has become a significant variable in this study, and the Marginal Willingness to Pay value for reducing crowding by 15% is LKR 1.083. According to the results of Lee *et al.* (2019), "restricting the daily number of visitors to 75% of the status quo will significantly improve the utility of the respondents". It ultimately depicts that both these studies, which are based on coral ecosystems have similar attributes in terms of significance.

Moreover, the paying LKR 1000 is positive and significant at ∞=0.01. This result is also similar to the results obtained by Lee *et al.* (2019) in the Kenting coral ecosystem, *i.e.*, the t value of "coral reefs conservation

fund" is negative and significant at the 1% level. It indicated that the visitors would gain less utility from the coral ecosystem if the contribution increased.

Ecosystem degradation, as evident in Bar Reef Marine Sanctuary, is common in many protected areas in other countries as well. According to Can and Alp (2012), the Göcek Bay area in Turkey although declared a protected area is polluted due to excessive boat tourism and a lack of efficient policies. Authors have used a CEM study to investigate the amounts that local residents and tourists are willing to pay for improved water quality and improvement in marine life.

Wattage *et al.* (2005) has mentioned that increasing sustainable yields, maintaining regional employment, and reducing conflict between fishers using towed and fixed gear are the most common attributes in evaluating the importance of fisheries management objectives. Kalpitiya being an important fishing destination has to be managed sustainably and in order to achieve this task, proper awareness must be made to protect the reef. Sea cucumbers, Lobsters, and Chanks were said to be drastically reduced due to over-harvesting.

Wattage *et al.* (2011) have examined the value held by the Irish public to protect deep-sea corals using CEM, and have arrived at a result to ban trawling in a Marine Protected Area, protect all areas with corals, and pay a tax of € 1per annum. In Sri Lankan context as a developing country, although people are not willing to pay taxes, they have expressed the view to ban Laila nets which creates similar problems to trawling.

Species conservation should be a priority in any marine protected area. Hence turtle conservation, which is practiced at present but not promoted as a conservation activity, needs to be promoted with immediate effect to protect valuable species. Proper awareness campaigns should be conducted to minimize waste disposal by visitors.

Norochcholei thermal power plant which is located 41.1 km away has created some negative effects on the environment. Mainly when unloading coal, it contaminates seawater. No research has been done to estimate the impact. Further, coal dust has created a severe impact on the people who are engaged in agricultural activities. Therefore, it is recommended to conduct research to examine the impact of the coal power plant on the associated ecosystem.

The coral reef has been significantly damaged and bleached. Further, there is accumulated garbage on the reef mainly plastic. Plastic water bottles carried into the sea by the fisherman have been minimized by the department by imposing a rule so that they cannot carry water containers less than 5 liters. Moreover, some beach areas are severely polluted by polythene and plastic so that it is strongly recommended to conduct reef cleaning programs to protect these valuable resources.

Mangroves are a part of the Bar Reef ecosystem and hence there is a need to protect mangroves as well in order to create a sustainably managed Bar Reef Marine Sanctuary. However, mangrove destruction is still present in this area for fencing, prawn farming, and illegal trespassing. Therefore, it is strongly recommended to closely monitor to avoid the above-mentioned activities.

Conclusion

This research has attempted to investigate the reasons for the degradation of the Bar Reef Marine Sanctuary due to natural and anthropogenic reasons. The main attributes used in this study were reducing plastic and polythene, reducing illegal fishing nets, and reducing crowding in the beach areas, pay LKR 500 and 1000. It was evident from the results that significant variables at $\alpha = 0.01$ were reduce plastic by 50%, reduce crowding by 15% and pay LKR 1000. It was evident from the MWTP values that visitors are willing to visit this place if availability of plastic and polythene in the beach and sea can be reduced by 50% and reduce the crowding of the beach by 15%. The results of this study will be important to the policy makers so that they can bring more rules and regulations to reduce the accumulation of plastic and improve sustainable management. It is also needful to consider that visitors prefer a less crowded beach than what they see at present.

Other attribute although was not significant the illegal fishing nets is a major problem and needed to be addressed by the policy makers. If the sample size could be increased the variable might be significant. However, the results of the model that was employed in this analysis depicts that it is a successive effort.

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Credit Authorship Contribution Statement

Chamathi Tharanga Jayaratne: Conceptualization and writing: original draft
Premachandra Wattage: Supervising and guiding original draft.

Prasanthi Gunawardena: Supervising and guiding original draft.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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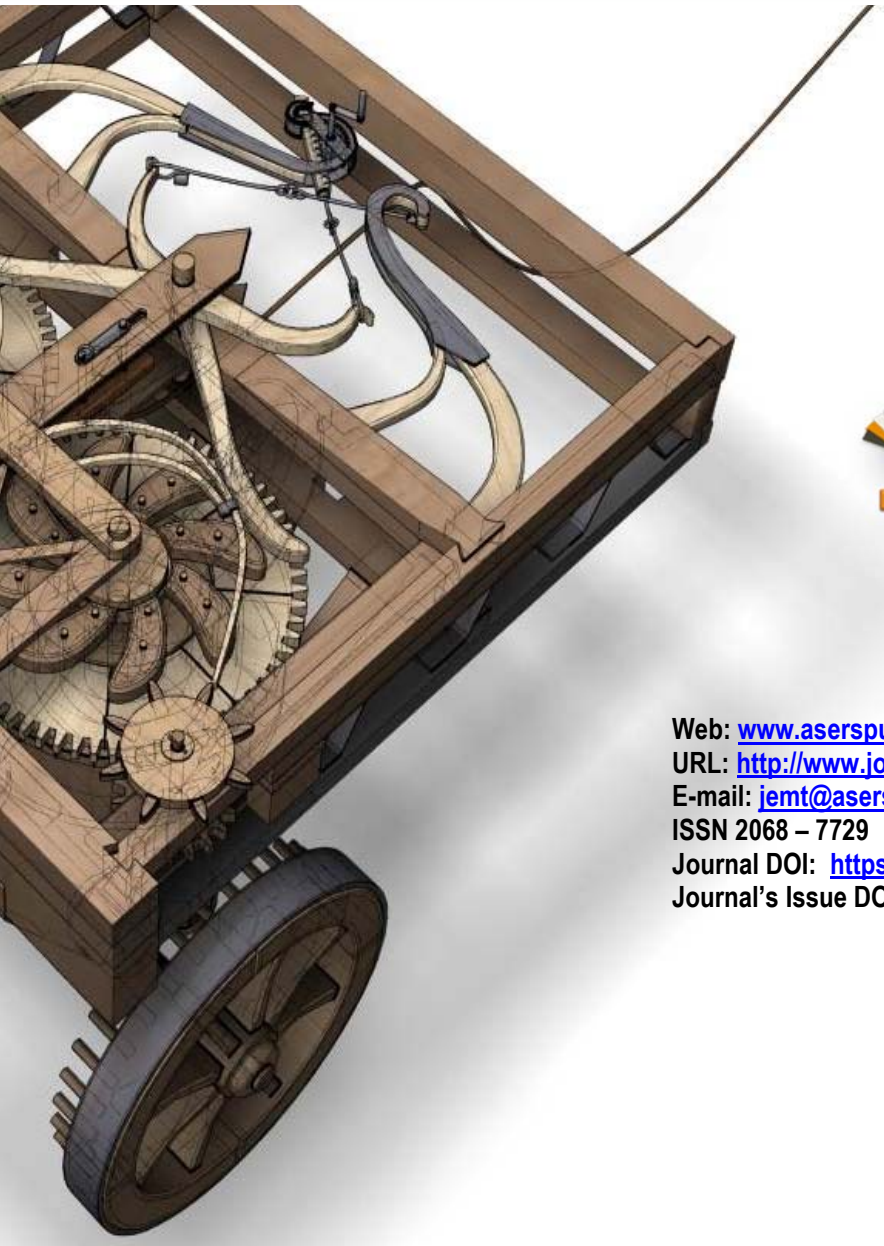

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