

# GUJARATI FISHERFOLK'S VALUATION OF MARINE RESTORATION

by

Sameera Gujarathi-Talati

(Under the Direction of Susana Ferreira)

## ABSTRACT

Marine restoration using artificial reef modules can contribute to fisheries sustainability but needs community support. We used contingent valuation (CV) to assess the acceptance of artificial reef modules among the fisheries of Gujarat state in India. We surveyed 205 fisherfolk, assessing willingness to pay (WTP) and willingness to commit time (WTCT) to support the restoration project. The hurdle regression findings show that more respondents were willing to commit time to the project than money and the monetized value of time was more than stated value in money. We recorded 33% protest responses, primarily from higher income, experienced boat owners who argued that the government should bear the costs while younger experienced skippers operating mechanized crafts were main advocates. Results suggested that WTP and WTCT were related to experience, perception of fisheries providing enough income, the concern for future generations, and the perception of folks outside fisheries. By assessing both time and money contributions, managers can explore the barriers and facilitators of conservation programs, identify target groups, assess cost-benefits of such a project and increase community engagement.

INDEX WORDS: Artificial reef modules, Contingent valuation (CV), Fisheries, Gujarat, India, Hurdle Regression, Willingness to Commit Time (WTCT), Willingness to Pay (WTP)

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**SAMEERA GUJARATHI-TALATI**

**B.E., The M.S. University of Baroda, India, 1999**

**M.B.A, The National University of Singapore, Singapore, 2004**

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SAMEERA GUJARATHI-TALATI

Major Professor: Susana Ferreira

Committee: Seth Wenger

Mateusz Filipski

Electronic Version Approved:

Ron Walcott

Vice Provost for Graduate Education and Dean of the Graduate School

The University of Georgia

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## Table of Contents

	Page
Acknowledgements.....	iv
List of Tables .....	vi
List of Figures .....	vii
Introduction .....	1
Methodology.....	5
Study area and Sampling strategy .....	5
Survey.....	6
Description of variables .....	9
Econometric Model.....	15
Results.....	18
Descriptive Statistics .....	18
Acceptance of Valuation Scenario .....	22
Protest responses .....	24
Comparing WTP and WTCT valuation .....	26
Aggregate Benefit of the project .....	27
Drivers of WTP and WTCT .....	27
Discussion.....	36
Conclusion.....	46
References .....	48
Appendix .....	52

## List of Tables

Table 1 Hypothesized relationship between predicted and predictor variables.....	12
Table 2 Respondent Demographic Profile .....	18
Table 3 Fisherfolk responses.....	20
Table 4 Summary statistics for WTP Rs. per month.....	23
Table 5 Summary statistics for WTCT, hours per month .....	24
Table 6 Explanation for Refusal to Pay .....	25
Table 7 Difference between Protest and Non-Protest group .....	26
Table 8 Monetizing WTCT .....	26
Table 9 Aggregate Benefit of Artificial Reef Modules to fisherfolk .....	27
Table 10 Variables associated with participation and contribution of WTP .....	29
Table 11 Variables that are associated with participation and contribution of WTCT.....	33
Table 12 Active Fisherfolk, CMFRI 2010 Census .....	52
Table 13 Payment elicitation ladder .....	52
Table 14 Time elicitation ladder .....	52
Table 15 Mann Whitney test for differences in protest and non-protest groups .....	53

## List of Figures

Figure 1 Artificial Reef modules, CMFRI, Veraval .....	2
Figure 2 India and location of Gujarat .....	8
Figure 3 Study Sites-Districts & Talukas.....	8
Figure 4 Study Sites-Villages & Survey locations .....	8
Figure 5 Acceptance of Money and Time contribution .....	23
Figure 6 Frequency distribution of WTP for Reef conservation project .....	23
Figure 7 Frequency distribution of WTCT for Reef conservation project .....	24

## Introduction

Gujarat state on the western coast of India is endowed with physical features congenial to the development of fisheries and accounts for almost twenty percent of India's marine fish catch. The marine fisheries sector contributes to the local economy and provides livelihood to over 300,00 fisherfolk (Statistics 2013) . However, Gujarat fisheries face multiple challenges, including overfishing, over capitalization, declining fish stocks and poor economic returns. This has prompted calls for marine ecosystem restoration actions to allow fish stocks to recover and to restore the economic health of the fishery (Sharma, Swain, and Kalamkar 2018; Statistics 2020). For restoration and conservation measures to be effective, communities must be engaged through devolution and participatory resource management (Berkes 2010; Pomeroy 2001; Meinzen-Dick and Knox 1999). It is particularly critical to engage fisherfolk, as they are both resource exploiters and resource conservationists. Support from the fishing community for the enforcement of fisheries management regulations or new conservation measures is essential for effectiveness of conservation efforts (Chaigneau and Daw 2014).

Recently, marine scientists at the Central Marine Fisheries Research Institute (CMFRI) in Veraval, Gujarat have proposed the installation of artificial reef modules off Gujarat's Saurashtra Sea coast as a conservation measure. Artificial reefs, built of human-made materials such as steel, fiberglass and concrete, have been widely deployed in response to degraded habitat and declining fisheries (Seaman 2019). These structures create refuge for marine life by providing a surface for the attachment of encrusting and fouling organisms which attracts other foraging

invertebrates and fish. A study conducted in the Gulf of Mannar in the southeast part of India monitored colonization of coral colonies on ferro-cement artificial reefs from 2002 until 2017 (Kasparraj, Mathews, and Jasper 2020), and reported a significant increase in the overall density and diversity of corals. The use of artificial reefs has gained popularity in various parts of the world to enhance seafood supply, protect sensitive habitats against trawling and support recreational fishing. The artificial reef modules proposed by CMFRI (Figure 1 ) are intended to provide refuge and reproduction sites for fish to enhance the fishery and restore biodiversity. In addition to installing reef modules, CMFRI has proposed a suspension of trawling operations in the targeted near-coastal region, and regular monitoring of marine assemblages and coral colony attachments to the modules.



Figure 1 Artificial Reef modules, CMFRI, Veraval

We performed a contingent valuation (CV) study to assess fisherfolks' assessment of the value of ecosystem restoration using artificial reef modules. Contingent valuation is a stated preference method frequently used to assess willingness to pay for environmental goods and services for which there are no available market data (Mitchell and Carson 1989), and to assess the potential for local participation in management of public goods (Swallow and Woudyalew

1994). It is an interactive exchange between the researchers and the respondent where the researcher's objective is to obtain a set of responses that reflect the individual's true value of the public goods or services in the questionnaire (Zhongmin et al. 2002).

Most CV studies use money as a numeraire and rely on monetary means as a mode of contribution and measure of willingness to pay (WTP). However, in low income, developing and rural economies, cash constraints, imperfect labor markets and low disposable incomes can restrict a respondent's ability to contribute monetarily to conservation programs even if they value such efforts. A meta-analysis of CV studies conducted in least developed countries revealed that cost recovery from user demand was infeasible in most cases and rural areas were unable to pay enough to finance conservation projects (Abramson et al. 2011). Other studies have found that non-cash numeraires such as special taxes, tax reallocations, donations, direct taxation, microfinance or the option of paying in labor and time instead of cash could better assess respondents' demand for non-market goods and services; they further found that cash may not be the only currency of value where bartering or other social transactions predominate (Abramson et al. 2011; Vondolia et al. 2014; Casiwan-Launio, Shinbo, and Morooka 2011). Under such conditions, CV using non-monetary forms of contribution (e.g., willingness to contribute labor or time) can provide a more accurate assessment of preferences.

In the current study, we employed CV using both time and money elicitation mechanisms to evaluate the demand for artificial reef modules among fisherfolk belonging to fishing villages off the Saurashtra coast in the state of Gujarat in Western India. The objectives of our study were

to evaluate support for the proposed reef conservation project, understand differences between supporters and non-supporters, and to investigate and compare the drivers of the WTP versus the willingness to contribute time (WTCT). Research on the willingness of local stakeholders to support the installation of the proposed artificial reef modules, and how they value such a proposal can suggest potential conservation and participatory resource management strategies.

This paper is divided in five sections. The next section describes the methodology of the study, followed by the econometric model used for analysis, the results of our inquiry and finally a discussion of the findings and conclusions.

## Methodology

### Study area and Sampling strategy

The fishing harbor town of Veraval in the Saurashtra region of Gujarat contributes to 35% of Gujarat's marine fish catch (Vase, Ramani, and Jayasankar 2017). Our study sites included four fishing villages - Bhidiya, Old Light house and Jaleshwar, in Veraval *taluka*<sup>1</sup> and Chorwad in neighboring Maliya Hatina *taluka* (Figure 2, Figure 3, Figure 4). The survey was fielded in July 2019. This period coincided with the monsoon ban<sup>2</sup> on fishing and was chosen intentionally to increase the probability of meeting fisherfolk. We carried out both unstructured and structured interviews with key stakeholders in the industry including fishing boat owners, boat captains (called skippers or colloquially known as *tandels*), boat laborers (colloquially known as *khalasis*), fisherfolk belonging to different religious and caste groups, fishers with different kinds of fishing crafts and varying in degrees of mechanization and scale of operations, industry suppliers, distributors, sea-food processors, government officials, fisheries scientists, academicians, environmentalists, and community leaders. We targeted a sample size of 200 and recorded a total of 217 interviews.<sup>3</sup>

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<sup>1</sup> Taluka is an administrative subdivision comprising an Indian revenue district

<sup>2</sup> The Department of Fisheries, Government of India implements a fishing ban during the monsoon period in the Indian Exclusive Economic Zone (EEZ) beyond territorial waters (12 nautical miles) for conservation and effective management of fishery resources and for sea safety reasons. The uniform fishing ban is implemented for a period of 61 days from 15th April to 14th June on the East coast and from 1st June to 31st July on the West coast. Traditional non-motorized fishing vessels are exempted from this ban.

<sup>3</sup> 205 structured interviews and 12 unstructured interviews.

This study used subjective sampling to focus on characteristics of the fisherfolk population that were of interest to answer our research questions; convenience sampling, by interviewing fishers by ease of access and willingness to participate; snowballing techniques; and opportunistic sampling. We employed non-probabilistic techniques to maximize response rates and achieve a good representation of different stakeholders of the fishing community in our study system.<sup>4</sup>

## Survey

The survey questionnaire was guided by secondary research on Gujarat fisheries and literature review of CV studies of natural resources in developing countries. The Institutional Review Board's Human Research Protection program at the University of Georgia granted approval for research involving humans. The questionnaire was verified by scientists and practitioners from Gujarat Ecology Society, Central Marine Fisheries Research Institute (CMFRI), Central Institute of Fisheries Technology (CIFT) and the College of Fisheries in Veraval. A pilot survey was administered to twenty fishers. The final version of the survey was translated from English into Gujarati with help from Gujarat Ecology Society.

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<sup>4</sup> Such research methods are not uncommon in quantitative as well as qualitative social research where researchers often select information-rich cases (Daoutopoulos and Pyrovetsi 1990; Glain, Kotomatas, and Adamantopoulou 2001; Arjunan et al. 2006). They are especially useful when randomization is impossible like when the population is very large, when the researcher has limited resources and also when the research does not aim to generate results that will be used to create generalizations pertaining to the entire population (Ilker, Abubakar, and Sunusi 2016). The use of opportunistic sampling has been documented in several fishers' surveys (Slater, Napigkit, and Stead 2013; Coralie et al. 2014). In many surveys, the authors have disclosed that participants were chosen on the basis of the order in which they were met as the interviewer walked through the study site (Tomićević, Shannon, and Milovanović 2010). In other studies, fishermen were approached during their arrivals and departures from the port (Heitor et al. 2017). Several have used snow-balling techniques in social research, and especially in fishery surveys to garner better response rates (Glain, Kotomatas, and Adamantopoulou 2001; Hoehn and Thapa 2009; Braga and Schiavetti 2013) as well as purposive sampling to gain depth of knowledge (Parappurathu et al. 2017; Rajib, Derek, and Fikret 2017; Song 2018).

The questionnaire was divided into seven sections (A-G) designed to assess the respondent's socio-demographic information, knowledge about marine biodiversity, attitudes towards environmental conservation, and social wellbeing. The last section was the contingent valuation (CV) exercise itself.

### Contingent Valuation

Respondents were shown the picture of the reef module (Figure 1). They were told that these reef modules, developed by CMFRI in collaboration with the Department of Fisheries and Government of Gujarat, would be placed in the ocean bed in near-coastal areas of 5 sq km each to provide habitat for spawning and rearing of marine species. No trawling would be permitted in these areas for the next 5 years. This would likely hamper fishing by single day-trip fishers (specifically trawlers), but would not impact others fishing crafts like dol-netters, gillnetters, liners, etc. Restrictions would be lifted after 5 years, at which time the marine environment was projected to recover, although modules would remain in place. At this stage, the interviewer verified that respondents understood the scenario. Next, the interviewer presented to the respondent the possibility for the community to contribute in terms of money, time, or both. The respondents were reminded of the tradeoffs of loss of income today and sustainable fishing income in the future and of other demands on their time and money. They were then asked questions related to the two payment vehicles.



Figure 2 India and location of Gujarat

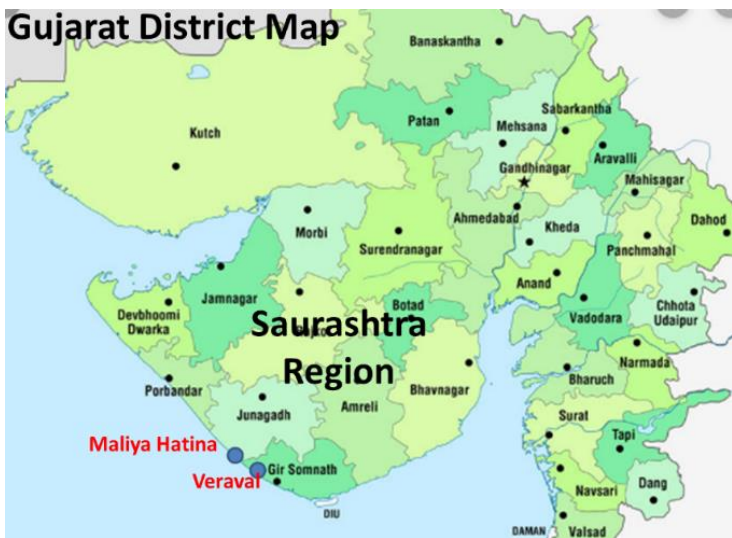


Figure 3 Study Sites-Districts & Talukas

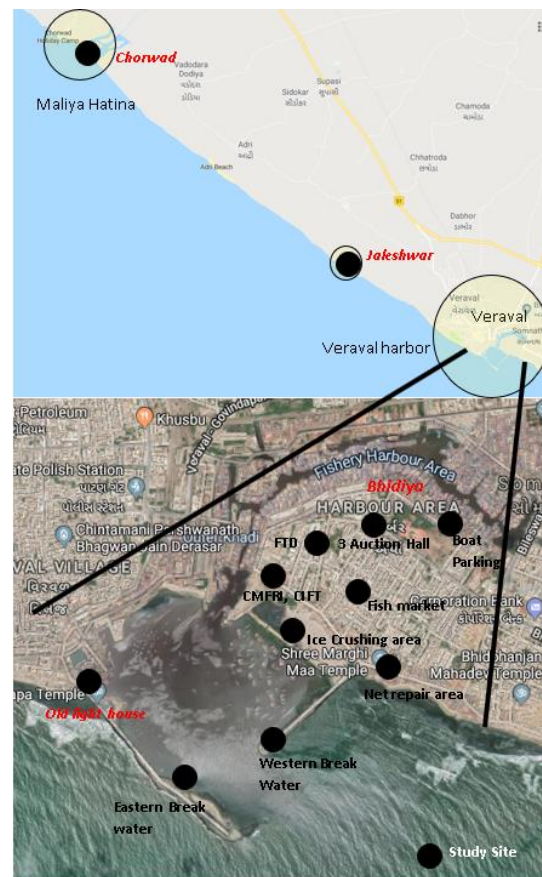


Figure 4 Study Sites-Villages & Survey locations

Figures are not to scale.

AN

## Description of variables

### Response Variables

Approximately half of the respondents were first asked about their willingness to contribute time towards this project. This binary Yes/No response variable reflected the respondent's acceptance of the time contribution scenario. Respondents were told how their time would be used (for site identification, module installation and reef monitoring). Those who said yes were asked for amount of time they were willing to contribute per week (WTCT) using a payment ladder elicitation format whereby respondents were shown a ladder containing an array of numbers and asked to choose the number of hours on the ladder which best represented their maximum willingness to contribute. A payment card method removes the influence of a starting bid and eliminates the large "don't know" responses that are typical of single open-ended questions. It provides more information about the respondent's willingness to pay compared to a referendum style format. It also further introduces uncertainty over the cost of providing the good which can encourage more truthful preference revelation (Carson and Hanemann 2005).<sup>5</sup> The time elicitation ladder we used consisted of a series of time contributions starting at zero and

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<sup>5</sup> The CV instrument was not referendum style (in which respondent is asked to respond "yes" or "no" to a proposal at a specified price/ tax instead of identifying and announcing their maximum WTP). Researchers believe that referendum style questioning is incentive compatible as it makes the respondent believe that the referendum result will influence real-world policy choice, avoids warm-glow effects and confusion over market-extent of the instrument. However, several studies have been conducted comparing WTP estimated from referendum CV with open-ended WTP and the typical conclusion has been that the referendum generates somewhat higher estimates of WTP (Alan 1997). Additionally, the NOAA panel also acknowledged that the respondent in a CV referendum also does realize that the referendum is hypothetical; there is no implication that the tax will be levied, and the damage repaired or avoided. And although payment card does not satisfy the conditions of incentive compatibility, it provides more information than the single-bounded binary choice elicitation format and also seems to induce a desirable level of uncertainty over the expected cost of providing an environmental good which may encourage more truthful responses (Vossler and Holladay 2018).

increasing in increments of 0.5 – 1 hour up to 10 hours/week (Table 14).<sup>6</sup> For those few who stated greater than 10 hours to express their higher valuation, we extrapolated their value based on the Pareto curve (Hout 2004) and this right-censored value was recorded as 12 hours.<sup>7</sup> This was done so that these few demonstratively high values were incorporated in the analysis with minimal bias (Frey and Pirscher 2018). Those who said “no” were asked an open-ended question about why they were not willing to contribute time.

Subsequently, the group who was first asked about contributing their time was asked if they would be willing to contribute money towards this conservation project. This binary Yes/No response variable, named reflected the respondent’s acceptance of the money contribution scenario. They were told that this contribution would be used to conduct field studies on the regeneration of the reef. Those who said “yes” were asked for their willingness to pay per month (WTP) using a payment ladder with monetary values starting at Rs. 100 and increasing in increments of 50-100 up to Rs. 1,000/ month for a year (Table 13).<sup>8</sup> Like the high elicitation for time, high elicitation for money (greater than Rs 1000) were extrapolated based on the Pareto curve and estimated at Rs 1,180. Those who said “no” were asked a multiple-choice question about why they were not willing to contribute money. These included choices that were either related to the inability to pay or skepticism related to project implementation (Table 6). To the other group of respondents, the time-money contribution question order was reversed, i.e., they

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<sup>6</sup> The pilot surveys helped finalize the range of time and payment allocations in the CV instrument.

<sup>7</sup> The formula is:  $M_{top} = L_{top} (V / V - 1)$  where  $V = (\ln(f_{top-1} + f_{top}) - \ln(f_{top})) / (\ln(L_{top}) - \ln(L_{top-1}))$ ,  $L_{top}$  is the lower limit of the top category,  $L_{top-1}$  is the lower limit of the category before the top one,  $f_{top}$  is the frequency in the top category, and  $f_{top-1}$  is the frequency in the category before the top one.

<sup>8</sup> 1 USD = Indian Rs. 68.85 in July 2019. Source: [Exchangerates.org.uk](http://Exchangerates.org.uk)

were first asked about contributing money followed by contributing time. This was done to detect and control for potential question-ordering effects.

### Explanatory Variables

We developed several hypotheses to explain the drivers of acceptance of time scenario, willingness to contribute time, acceptance of money scenario and willingness to contribute money. The hypothesized relationships were organized into the categories of demographic, economic, environmental knowledge, environmental values, perceived behavioral control and social well-being.

The inclusion of the first few categories such as demographic and economic factors, and environmental knowledge and values is common in environmental non-market valuation research (Dunlap et al. 2000; Ignatow 2006; Zhongmin et al. 2002; Anoop and Suryaprakash 2008; Masud et al. 2014). We also drew from the field of environmental psychology and included factors that reflected the respondent's perceived behavioral control – the degree to which a person perceives they have control over a situation, which is indicative of the perceived difficulty of executing a behavior (Klöckner 2013). Additionally, we also asked questions regarding the respondent's social well-being, which refers to an individual's sense of belonging to a community, feelings of internal satisfaction and connection to a wider social environment.

Finally, we included a variable for question order to capture whether the respondent was asked the time or money contribution question first. [Table 1](#) describes these categories with the predictor variables under each group, the variable type, its description, and its hypothesized relationship with the predicted variables.

Table 1 Hypothesized relationship between predicted and predictor variables

Category	Variable Name	Var type	Variable Description & Categories	Hypothesized Response for WTP/ContriMoney & WTCT/ContriTime
Question Order	Timefirst/MoneyFirst	Binary	Whether the time contribution or the money contribution question was asked first	+ / -
	Occupation (Occu)	Categorical	<i>Boat owner</i> (reference) Skipper/laborer Others-Traders, Distributors, Processors, Government officials, Academics, Fisher wives	Skipper/laborer: - Others: -
Demographic	Age	Continuous	Age of respondent	-
	Age <sup>2</sup> (squared)			+
	Education (Edu)	Categorical	No formal education <i>Primary</i> (reference) Secondary (<10 <sup>th</sup> grade) SSC Pass (10 <sup>th</sup> grade) and above	No formal education - Secondary + SSC Pass & above +
	Caste	Categorical	<i>Kharva</i> (reference) Koli Others	Koli + / - Others + / -
	Household Size (HHSize)	Continuous	Household size	-
	Household Size <sup>2</sup> (HHSize squared)	Continuous		-
Economic	Income	Continuous	Annual income	+ for money, - for time
	Enough Income (EnoughInc)	Ordinal	Does fishing provide you enough income to meet your livelihood needs (1: Not enough - 3: Enough)	+ for money, - for time
	Economic Situation (EconSit)	Ordinal	How has your economic situation changed in last 5 years (1: Weakened - 3: Improved)	+ for money, - for time
Fisheries Outlook	Years Fishing (YrsFishing)	Continuous	Years in Fishing profession	+
	Years Fishing <sup>2</sup> (YrsFishing squared)			+/-
	Boat Type (Base:2)	Categorical	Non-boat owners Non-motorized <i>Motorized</i> (Reference)	Non-boat owners + Non-motorized +

			Mechanized	Mechanized -
<b>Environmental Values</b>	Children Fishing (ChildFishing)	Binary	Like children to join fishing? (0/1=Yes)	+
	Quality of Marine habitat (QualityNow)	Ordinal	What is your perception of the quality of Marine habitat now (1: Poor - 5: Excellent)	-
		Binary	Perception that quality of marine habitat is neither excellent nor very poor 0: extreme, 1: Average)	+
	Human Activities (HumAct)	Binary	Have human activities worsened coastal ecology (0/1= Yes)	+
	Costs Money to protect (CostMoney)	Ordinal	Tradeoff-Protect marine environment even if costs money (1: Strongly disagree - 5: Strongly agree)	+
	Use Motive for protecting marine resources (UseMot)	Ordinal	Value the marine resources because my household depends on food for it (1: Strongly disagree - 5: Strongly agree)	+
	Bequest Motive for protect marine resources (BeqMot)	Ordinal	Even if my household did not use the marine resources, we have a responsibility to protect the marine environment for future generations (1: Strongly disagree - 5: Strongly agree)	+
	Responsibility of Management (RespMgmt)	Categorical	Who is responsible for conservation of marine resources <i>Government</i> (Reference) All Fishers	All (+) Fishers (+)
	Intergenerational tradeoff (FutOrCurr)	Ordinal	More important to preserve fishing stocks for future generations or make a living through fishing today (1: livelihood today, 5: Future generation)	+
	<b>Perceived Behavioral Control</b>	Government Efficacy (GovEffi)	Ordinal	Efficacy of government bodies in regulating, monitoring, enforcing, knowledge transfer (1: Poor, 3: Good)
Conservation Impact (ConsDeclmp)		Ordinal	Impact of conservation decisions on your life (1: No effect at all, 5: Affect drastically)	+/-
		Binary	Moderate impact of conservation decisions (0: extreme, 1: Average)	+/-

	Government Environmental Efficacy (GovRoleENV)	Ordinal	Government doing enough for -Environment (1: Too little, 5: A lot)	+/-
		Binary	Government doing adequate for the environment (0: extreme, 1: Average)	+/-
	Own Influence on Regulations (InflReg)	Ordinal	Your influence on laws and regulations (1: None, 4: Significant Influence)	+/-
<b>Social Well Being</b>	Outsiders Perception (OutPer)	Binary	Perception of outsiders i.e., people outside the fishing industry (0/1=Yes?)	+
	Health	Ordinal	General Health (1: Poor, 5: Excellent)	+
	Attachment to place (Attch)	Ordinal	Attachment to place (1: Not attached, 5: very attached)	+
	Satisfaction Government (RelGov)	Ordinal	Satisfaction with relationship- government (1: Not at all satisfied, 5: Very satisfied)	+
	Satisfaction non-Government (RelNonGov)	Ordinal	Satisfaction with relationship- non-government officials (NGOs, research institutes, academic institutes) (1: Not at all satisfied, 5: Very satisfied)	+
	Pride	Ordinal	Sense of pride to be in fishing (1: None, 3: Immense)	+

## Econometric Model

### Protest responses

Protest responses are zero valuations to a contingent valuation that are motivated because the respondent rejects some aspect of the hypothetical market scenario despite their true valuation of the project being different from zero. A standard procedure in CV studies requires identification of protest responses and dropping them from analysis as they may not reflect the true economic value of the good (Jorgensen et al. 1999; Frey and Pirscher 2018; Rankin and Robinson 2018). However, removing protest responses can introduce biases and may result in the under-representation of the population that is associated with having a higher probability of protesting. Hence, we tested for differences between the protest group and the non-protest group (comprising of positive WTP and true zero responses) using Mann Whitney non-parametric test to evaluate if the characteristics of protesters were significantly different from non-protesters and if protest responses should be retained in further analysis (Rankin and Robinson 2018). Subsequently, we analyzed our data using hurdle regression, which has been recommended as an appropriate tool for datasets with potential protest responses because it separates the behavior of respondents into two parts: the decision to participate and the amount of participation (Rankin and Robinson 2018).

### Monetizing time

To compare the stated WTCT to WTP, we monetized WTCT using three different approaches: (1) the wage rate, (2) the leisure rate and (3) the rate derived from income.

For the wage rate we used an average of the fisherfolk hourly rate in India, Rs139 (ERI 2021b), and the average pay for a captain of a fishing vessel, Rs 394 / hour (ERI 2021a). Since our sampled population comprised fisherfolk who were captains, skippers, and laborers, and some who fell outside these categories, we used a simple mean of these two hourly wage rates (Rs 266.5). We multiplied this wage rate with the individual WTCT of each respondent to arrive at the monetary conversion of time.

$$\text{Monetized wage rate } WTCT_i = \frac{1}{n} \sum (WTCT_i \times \text{wage rate})$$

For the leisure rate we assumed a value of 1/3<sup>rd</sup> the wage rate, following other published studies (Arbiol et al. 2013; O'Garra 2009; Casiwan-Launio, Shinbo, and Morooka 2011).

$$\text{Monetized leisure rate } WTCT_i = \frac{1}{n} \sum (WTCT_i \times \left(\frac{\text{wage rate}}{3}\right))$$

For the third measure we accounted for individual incomes of our sampled population instead of using an average wage rate. The monetized WTCT in this case was equal to the product of mean WTCT and the individual income rate.

$$\text{Monetized Income derived rate } WTCT_i = \frac{1}{n} \sum (WTCT_i \times \text{Hourly}^9 \text{ Income}_i)$$

### Aggregate Benefit of the project

To estimate the total benefit of installing the artificial reefs, the stated WTP and the estimated opportunity cost of time using the wage rate, leisure rate and income rate were multiplied with the reported number of fisherfolk living in the Veraval and Maliya Hatina region.

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<sup>9</sup> Annual working hours for fisheries were derived from [www.eri.com](http://www.eri.com), estimated at an average of 2080 hours/year

## Hurdle Regression

We assessed the drivers of a respondent's WTP and WTCT using two-part hurdle modelling. This model decomposes the behavior of individuals in the decision-making process into two parts: first, whether to participate or not in the contingent market offered (participation equation: first hurdle), and second, the decision on the amount to consume, that is how much to pay (consumption equation: second hurdle) (Havet et al. 2012)

Thus, the participation equation is:

$$P_i = 1 \text{ if } WTP^* \text{ (or } WTCT^*) = \alpha X_i + u_i > 0 \text{ ("Yes" to participate)}$$

OR

$$P_i = 0 \text{ ("No" to participate)}$$

Where  $P_i$  is equal to one if individual  $i$  participates in the proposal and zero otherwise,  $X_i$  is the set of independent variables that influences the decision to participate.

And the consumption equation is:

$$WTP \text{ (or } WTCT) = WTP^* \text{ (or } WTCT^*) \text{ if } WTP^* \text{ (or } WTCT^*) > 0 \text{ and } P_i = 1$$

OR

$$WTP \text{ (or } WTCT) = 0 \text{ if } P_i = 0 \text{ or if } P_i = 1 \text{ and } WTP^* \text{ (or } WTCT^*) = 0$$

This model specifies the probability to observe the amount of  $WTP^*$  (or  $WTCT^*$ ), conditional on the expression of a positive WTP (or WTCT). We used general to specific modeling strategy with a selection criteria of  $p < 0.1$  (Campos, Ericsson, and Hendry 2005).

## Results

### Descriptive Statistics

The average respondent in our sample was a Hindu *kharva* male boat owner, 44 years old, with a primary education level, living in a household of six, from Bhidiya fishing village, with about twenty years of experience in the fishing industry and an average estimated income of Rs. 7 lakhs<sup>10</sup> per annum (Table 2).

Table 2 Respondent Demographic Profile

Description	Category	% Of sample
Location of interview	Bhidiya	68%
	Old Harbor	8%
	Chorwad	22%
	Other places	2%
Gender	Male	98%
Religion	Hindu	93%
	Muslim	7%
Caste	<i>Kharva</i>	79%
	<i>Koli</i>	18%
	Others	3%
Occupation	Boat owners	53%

<sup>10</sup> Lakhs in Indian numbering system is equal to one hundred thousand. 1 lakh= Rs 100,000. Rs. 68.85= 1 USD in July 2019. Source: [Exchangerates.org.uk](http://Exchangerates.org.uk)

	Skippers & Laborers (( <i>Khalasi /Tandel</i> ))	38%	
	Others (traders, academic, government)	9%	
Boat type	Non-motorized	5%	
	Motorized	47%	
	Mechanized	41%	
	No boat	7%	
Education	No formal education	14%	
	Primary education (8 <sup>th</sup> grade)	40%	
	Secondary education (12 <sup>th</sup> grade)	14%	
	Higher education (College or more)	32%	
<b>Description</b>	<b>Mean</b>	<b>Standard Deviation</b>	<b>Range</b>
Age	44	9.8	21-65
Household size	6	2.35	1-20
Years Fishing	20	10.35	2-50
Income(estimated), '000 INR	713	798	0-6000

Seventy four percent of our respondents reported that their economic situation had weakened in the last five years; yet 87 percent stated that fishing still provided enough income to meet their livelihood needs (Table 3). Fifty three percent wanted their children to continue in the fishing profession, with the main reason being to continue the family tradition. Almost all the respondents said they were attached to where they lived and almost eighty percent said they felt immense pride in their profession. However, a majority, almost two-thirds, felt that their industry was viewed negatively by outsiders.

Table 3 Fisherfolk responses

INDICATOR	CATEGORY	Frequency	%
1. Enough Income (EnoughInc)	Not enough	13	6
	Just enough	13	6
	Enough	179	87
2. Economic Situation (EconSit)	Weakened	152	74
	No change	12	6
	Improved	36	18
3. Child Fishing (ChildFishing)	Yes	108	53
	No	97	47
4. Quality of marine habitat Now (QualityNow)	Poor	55	27
	Not so good	71	35
	Average	50	24
	Good	20	10
	Excellent	3	1
	Do not know/ No response	6	3
5. Human Activities negative (HumAct)	Yes	188	92
	No	11	5
6. Protect environment even if costs money (CostMoney)	Strongly disagree	43	21
	Disagree	45	22
	Neither agree nor disagree	17	8
	Agree	35	17
	Strongly agree	58	28
7. Value because need (UseMotive)	Strongly disagree	3	1
	Disagree	16	8
	Neither agree nor disagree	30	15
	Agree	18	9
	Strongly agree	126	61
8. Value for future generations (BeqMot)	Strongly disagree	5	2
	Disagree	19	9

	Neither agree nor disagree	18	9
	Agree	28	14
	Strongly agree	124	5
7. Responsibility of Management (RespMgmt)	Government	20	10
	All	176	86
	Fishers	9	4
8. Use today or preserve for future (FutOrCurr)	Livelihood today	6	3
	Both	45	22
	Future generations	143	70
9. Government Efficacy (GovEffi)	Poor	57	28
	Average	109	53
	Good	39	19
10. Conservation Decision Impact (ConsDeclmp)	Not affect at all	28	14
	Affect somewhat	0	0
	Will affect	27	13
	Affect quite a bit	1	0
	Affect drastically	149	73
11. Government doing enough for environment (GovRoleEnv)	Too little	77	38
	Some	68	33
	Adequate	38	19
	Quite a lot	10	5
	A lot	3	1
12. Influence over regulations (InflReg)	None	143	70
	Very little	17	8
	Some	27	13
	Significant	3	1
13. Outsiders Perception (OutPerception)	Negative	133	65
	Positive	72	35
14. Health	Poor	0	0
	Not so good	0	0
	Average	32	16
	Quite good	51	25
	Excellent	117	57
15. Place Attachment (Attch)	Not attached	1	0
	Somewhat attached	1	0
	Neutral	14	7
	Attached	28	14
	Very attached	159	78
16. Relations with Government (RelGov)	Not at all satisfied	11	5
	Somewhat satisfied	7	3
	Neither satisfied nor dissatisfied	27	13
	Satisfied	30	15
	Very satisfied	130	63
17. Relations with Non-Government officials (RelNonGov)	Not at all satisfied	5	2
	Somewhat satisfied	14	7
	Neither satisfied nor dissatisfied	37	18
	Satisfied	29	14
	Very satisfied	120	59
18. Pride	None	5	2

Somewhat	26	13
Immense	162	79

Two-thirds of our survey respondents deemed the quality of the marine habitat to be deteriorating and over ninety percent blamed human activities for the worsening of the coastal ecology (Table 3). Fisherfolk valued the coastal resources because they depended on it for sustenance as well as for preserving it for future generations and almost 75 percent of them said that conservation decisions would impact them drastically. Despite this, only about half were willing to incur costs to protect the marine environment.

This could partly be because our sampled fisherfolk felt that the responsibility of conservation needed to be jointly shared with the government. Though more than 70 percent asserted that they were satisfied with their relationships with government and non-government officials, the majority (about 81 percent) also mentioned that efficacy of government bodies in regulating, monitoring, enforcing, and knowledge transfer was mediocre to poor, and seventy one percent believed that the government was not doing enough for environmental protection.

### Acceptance of Valuation Scenario

More respondents were willing to contribute time than money. Fifty eight percent (118 out of 205) of the sampled fisherfolk expressed willingness to pay for the reef conservation project and 82% (168 out of 205) agreed to contribute time to the project. While only 2% (5 out of 205) were willing to contribute money but no time, 27% (55 out of 205) were willing to contribute time but no money. Fifty five percent (113) were willing to contribute both, while 16% refused participation in both (Figure 5).

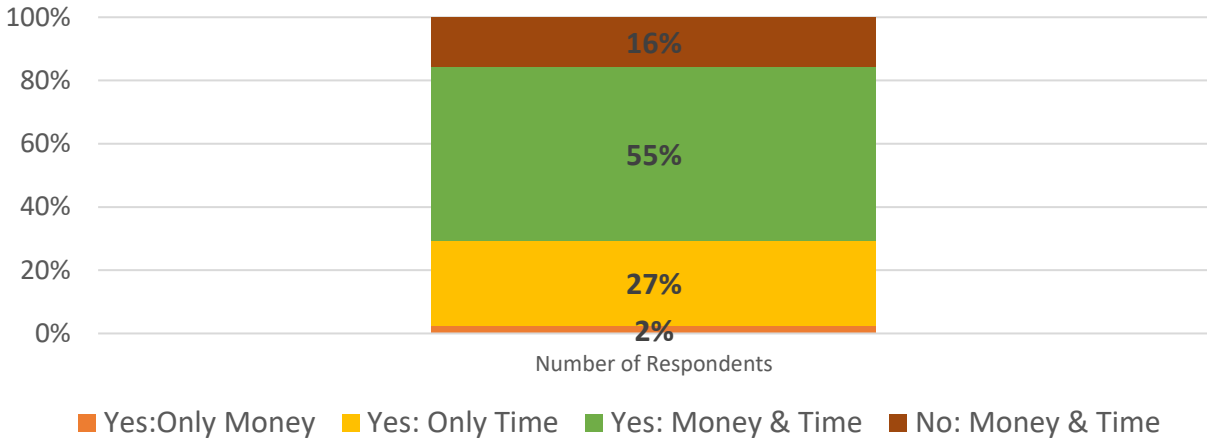


Figure 5 Acceptance of Money and Time contribution

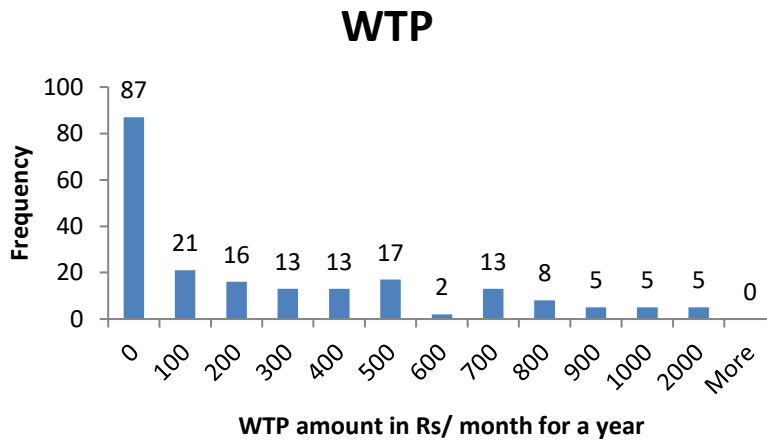


Figure 6 Frequency distribution of WTP for Reef conservation project

Stated Willingness to Pay

Table 4 Summary statistics for WTP Rs. per month

WTP > 0	118
WTP = 0	87
Mean WTP	Rs. 270.24
Median WTP	Rs. 100
Mode WTP	Rs. 0
Standard Deviation	350.62
Min	Rs. 0
Max	Rs. 1120 (right censored value)

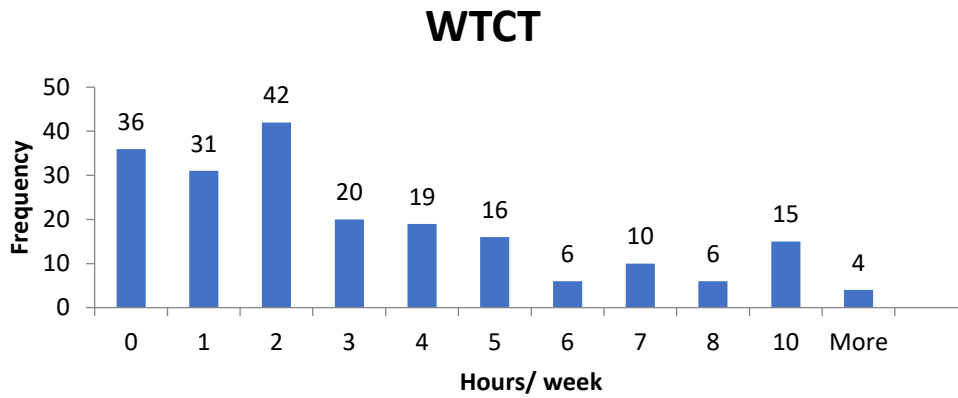


Figure 7 Frequency distribution of WTCT for Reef conservation project  
Stated Willingness to Contribute Time

Table 5 Summary statistics for WTCT, hours per month

WTCT > 0	169
WTCT = 0	36
Mean WTCT	3.32 hrs
Median WTCT	2 hrs
Mode WTCT	0 hrs
Standard deviation	3.26
Min	0
Max	12 (Right censored)

### Protest responses

Forty two percent of respondents gave a zero valuation to the project in terms of the money contribution instrument (Table 4). Respondents who refused to contribute money to the project were asked to choose a reason for their refusal. Table 6 shows various reasons offered and the frequency of each selection.

Table 6 Explanation for Refusal to Pay

#	Explanation for Refusal to pay	# Of respondents
1	Current status of sea good enough	0
2	Cannot afford to pay	20
3	Do not believe revival of sea is possible	5
4	Do not care about health of the sea	0
5	Do not believe project will be successfully implemented	10
6	Do not believe money will be used for this purpose	11
7	Think that government should bear the cost	32
8	No Response	9
Total Protest Responses (Reason # 3,5,6,7)		<b>67</b>
True Zeros (Reason # 1,2,4)		<b>20</b>

We classified the 20 responses of “cannot afford to pay” as true zeros, and the other 67 responses as protest votes, because their reasons for refusing to pay indicated a lack of confidence in the program, disagreement over who should pay for the project, or disagreement with the payment vehicle. Nevertheless, we based our inferences on the full responses, including protest votes, because the protest group had distinctive demographic characteristics: the protest group was mostly boat owners (67% compared to 46% for the non-protest group) with a higher average income than the non-protest group (Rs 857,403 vs Rs 643,598-Table 7, Mann Whitney  $p$ -value 0.03- Table 15) and more years spent in the industry (23 years vs 19 years- Table 7, Mann Whitney  $p$ -value 0.01- Table 15). Removing this group of respondents who were unwilling to contribute would lead to a biased estimate of the average WTP and WTCT.

table 7 Difference between Protest and Non-Protest group

Group	N	Mean WTP Rs/month	Occupation (% boat owners)	Avg Annual Income, Rs	Avg Fishing Experience, yrs.
All (N=205)	205	270.24	52%	713,476	20.35
Non-Protest group	138	401.45	46%	643,598	18.85
Protest group	67	0	67%	857,403	23.45

### Comparing WTP and WTCT valuation

We found that regardless of the calculation method used, the value of the mean stated time contribution (3.31 hours per week) far exceeded the mean financial contribution (Table 8). Whereas the mean WTP was Rs 270/month, the value of committed time was at least Rs 1,178 / month (using the leisure rate) or as much as Rs 4,548 (using the income rate).

Table 8 Monetizing WTCT

<b>Payment Vehicle</b>			
<b>A. Stated Time contribution: Mean WTCT:</b>		3.31 Hours/ Week	
Monetizing WTCT:	Rs/hour	Rs/Week	Rs/Month
1. Wage rate	266.5	883	<b>3533</b>
2. Leisure rate	88.8	294	<b>1178</b>
3. Income rate	343.02	1137	<b>4548</b>
<b>B. Stated Money contributed: Mean WTP:</b>			<b>270</b>
<b>As a reference, average monthly income for our sampled fisherfolk =</b>			<b>Rs 59,456</b>

## Aggregate Benefit of the project

Based on the mean value of stated contributions and the total number of fisherfolk in the study region, the aggregate benefit of the artificial reefs was Rs 20 *lakhs*<sup>11</sup> to Rs 3.5 *crores*<sup>12</sup> depending on whether the wage rate, leisure rate or income rate is used (Table 9).

Table 9 Aggregate Benefit of Artificial Reef Modules to fisherfolk

Method of Valuation	WTP Rs/Month	Aggregate* Benefit Rs/ month
Median WTP	100	755,900
Mean WTP	270	2,043,314
Monetized WTCT using Wage rate	3533	26,716,037
Monetized WTCT using Leisure rate	1178	8,905,346
Monetized WTCT using Income rate	4573	34,578,808

\*Based on 7561 fishers (see appendix Table 12) in our study area

## Drivers of WTP and WTCT

### What influences WTP

Among the various socio-economic factors, the respondent's occupation, age, and perception of fishing providing enough income to meet livelihood needs had significant associations with the WTP (Table 10). Occupation had a sizeable correlation with WTP contribution. Contrary to our hypothesis that a skipper or laborer would have a lower propensity to contribute monetarily to the project than a boat owner, this category expressed a contribution of Rs. 2,367 more to the reef conservation project than a boat owner. Age correlated with WTP contribution negatively, with older respondents offering lower contributions. The effect of income was statistically significant but small. The perception of enough income increased the probability of participating in the monetary contribution by 21%.

<sup>11</sup> Lakhs in Indian numbering system is equal to one hundred thousand.

<sup>12</sup> A crore denotes ten million and is equal to 100 lakhs

We found that experience played a key role in engagement in the program, increasing the contribution amount by Rs. 92 with each additional year spent in the fishing industry. Furthermore, as the perception of quality of marine resources worsened, the willingness to participate in the monetary contribution increased by 17% and the actual contribution increased by Rs. 4,416. We also found that when respondents' perception of the quality of marine resources was average, their propensity to participate increased by 26% and the actual donation increased by Rs 7,719 compared to those whose perception of quality was either poor or excellent. The perception of quality had the most sizeable association with both the participation and contribution decisions for WTP.

Fisherfolk who believed that it was their responsibility to protect the marine environment had a 38% higher probability to participate and tended to contribute Rs 6,541 more to the project than those who thought this was the government's sole responsibility. Similarly, respondents who considered it more important to preserve fishing stocks for future generations than to make a living through fishing today had a higher monetary contribution by Rs 2,623.

We included the category of perceived behavioral control to evaluate the degree of control the respondent felt on their ability to affect conservation decisions. Our analysis revealed that a strong predictor of both participation and contribution to the monetary aspect of the project was the belief that the respondent had significant influence on laws and regulations. Fisherfolk who believed they had some degree of influence on laws and regulations showed a 18% higher probability of participation and Rs 1,374 higher WTP contribution. We also saw that when our respondents believed that the government was either doing too little or making

significant efforts towards environmental protection, they showed a higher probability (13%) of agreeing to contribute money.

Our social wellbeing category included indicators of how a respondent felt about their reputation, their health, their attachment to their profession, their relationships with government and non-government bodies and their pride in their profession. We found that respondents who perceived that outsiders looked upon them negatively, tended to contribute Rs 2,159 more to the project than those whose perception was positive.

Table 10 Variables associated with participation and contribution of WTP

Predictor	Hypothesized response	Participation Probability (Probit)	Contribution (Truncated Regression)
<b>Question Order</b>			
Time question first	+/-	0.26 (.06)**	
<b>Demographic</b>			
Occupation (Ref: Boat owner)	Skipper/laborer - Others -		+2367 (1180) * -3532 (3637)
Age	+		-123 (63) *
Age <sup>2</sup> (squared)	+		
Education (Edu) (Ref: Primary)	No education - Secondary + SSC Pass & above +	-0.16 (.1) +0.02(.08) +0.02(.07)	
Caste (Ref: Kharvas)	Kolis + / - Others + / -	.13 (.07) * -0.08	
Household Size (HHSize)	-	+0.13 (.07)	+304 (346)
Household Size <sup>2</sup> (HHsize squared)	-		-91(58)
<b>Economic</b>			
Income	+	-5xe-08 (4xe-08)	+0.002 (0) **

Enough Income (EnoughInc)		+	+ .21 (.07) **	
Economic Situation (EconSit)		+		
<hr/> <b>Fisheries Outlook</b>				
Years Fishing (YrsFishing)		+/-	+ .03 (.01) **	+92 (58)
Years Fishing <sup>2</sup> (YrsFishing squared)		+/-	- .0005 (.0) *	
Boat Type (Ref: Motorized)	Non-boat owners	+	+ .09 (.1)	+2316 (3985)
	Non-motorized	+	- .06 (.13)	-2826 (1645)
	Mechanized	-	- .11 (.07)	+584 (1223)
Children Fishing (ChildFishing)		+		
Quality of Marine habitat (QualityNow)		-	- .17 (.04) **	-4416 (1140) **
Quality of Marine habitat (Extreme/Avg)		+	+ .26 (.09) **	+7719 (2209) **
<hr/> <b>Environmental Values</b>				
Human Activities (HumAct)		+		
Costs Money to protect (CostMoney)		+		
Use Motive for protecting marine resources (UseMot)		+		
Bequest Motive for protect marine resources (BeqMot)		+		-593 (371) *
Responsibility of Management (RespMgmt) (Ref: Government)	All (+)		+ .05 (.1)	+873 (1747)
	Fishers (+)		+ .38 (.12) **	+6541 (2380) **
Intergenerational tradeoff (FutOrCurr)		+		+2623 (724) **
<hr/> <b>Perceived Behavioral Control</b>				
Government Efficacy (GovEffi)		+	+ .08 (.04)	-732 (740)
Conservation Impact (ConsDeclmp)		+/-		
Conservation Impact (Extreme/Avg)		+/-		
Government Environmental Efficacy (GovRoleENV)		+/-		
Government Environmental Efficacy (Extreme/Avg)		+/-	- .13 (.06) *	
Own Influence on Regulations (InflReg)		+/-	+ .18 (.04) **	+1374 (508) **

<b><i>Social Well Being</i></b>		
Outsiders Perception (OutPer)	+	-2159 (866) *
Health	+	
Attachment to place (Attch)	+	+855 (614)
Satisfaction Government (RelGov)	+	
Satisfaction non-Government (RelNonGov)	+	
Pride	+	
<i>Sample Size</i>		205                      118
Note: Values denote Coefficient (Standard error)		
* Significant at 0.05 level, ** Significant at 0.01 level		
Variables with no values indicate that they were not included in the reduced model		

### What influences WTCT

Though occupation of the respondent was correlated with monetary contribution, neither occupation nor any other demographic factors correlated with respondent's time participation or contribution decision. However, the perception of fishing providing enough income to meet livelihood needs showed association with the time contribution, with every step increase increasing WTCT contribution by 2.4 hours (Table 11).

Among characteristics related to the fisheries outlook, we observed that experience in the fishing profession had a statistically significant association, increasing time contribution by 0.4 hours. We had anticipated that the respondent's boat type would affect their acceptance of a conservation project given the limited access to near shore fishing by trawlers, and indeed found that ownership of mechanized craft reduced the probability of acceptance by 10%. Interestingly, however, we found that mechanized craft owners who overcame the barrier of participation were willing to contribute 3.5 hours more than motorized boat owners. We

hypothesized that respondents who wanted their children to join fishing would be more participative in this restoration project, and indeed found evidence for that hypothesis; those who answered this question positively were 11% more likely to participate in the project and contributed 2.1 hours more.

Several indicators of environmental values correlated with time participation and contribution decision. Fisherfolk who believed that human actions were responsible for ecological damage had a 21% higher probability of wanting to contribute time to the project. Those who accepted that protecting the marine environment was important even if it cost money were less willing to contribute time- with every step increase in this view, the time contribution reduced by 0.55 hrs. Fisherfolk who considered it to everybody's responsibility to take care of marine resources were averse to participate in the program. Respondents who considered it more important to preserve fishing stocks for future generations than to make a living through fishing today were more likely to contribute time; answering positively to this question increased the probability of participation in the time contribution by 7% and increased the time contribution by 1.8 hours.

In terms of the category of perceived behavioral control, a better perception of government's efficacy in regulating, monitoring, enforcing, and knowledge transfer led to lower interest in participating in the project. Respondents who felt that conservation decisions impacted them in an extreme manner showed higher time contribution- with their time contribution increasing by 5 hours if they felt that these decisions would make a significant positive or negative impact on their lives.

Among indicators in the social wellbeing category, a positive perception of outsiders increased willingness to contribute time by 8%. Similarly, respondents who considered themselves healthy were 5% more likely to join the program. However, respondents who reported dissatisfaction with their relationship with NGOs, research and academic organizations had an increased propensity to contribute time.

Table 11 Variables that are associated with participation and contribution of WTCT

<b>Predictor</b>	<b>Hypothesized response</b>	<b>Participation Probability (Probit)</b>	<b>Contribution (Truncated Regression)</b>
<b>Question Order</b>			
Time question first	+/-	+0.14 (.05) *	
<b>Demographic</b>			
Occupation (Ref: Boat owner)	Skipper/laborer - Others -		
Age	+		
Age <sup>2</sup> (squared)	+	+0.0003 (0)	
Education (Edu) (Ref: Primary)	No education - Secondary + SSC Pass & above +		
Caste (Ref: Kharvas)	Kolis + / - Others + / -		
Household Size (HHSize)	-		
Household Size <sup>2</sup> (HHsize squared)	-	+0.0007 (0)	
<b>Economic</b>			
Income	+	+4e-08(2.7e-08)	+3e-07(7e-07)
Enough Income (EnoughInc)	+		+2.4 (1.2) *
Economic Situation (EconSit)	+		
<b>Fisheries Outlook</b>			

Years Fishing (YrsFishing)	+/-		+4 (.2) *
Years Fishing <sup>2</sup> (YrsFishing squared)	+/-	-.000(0) *	-.007 (.004)
Boat Type (Ref: Motorized)	Non-boat owners +	-.09 (.09)	+1.03 (2.6)
	Non-motorized +	-.12 (.11)	+3.37 (1.9)
	Mechanized -	-.10(.05) *	+3.5 (1) **
Children Fishing (ChildFishing)	+	+.11(.05) *	+2.11 (0.9) *
Quality of Marine habitat (QualityNow)	-		
Quality of Marine habitat (Extreme/Avg)	+		

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***Environmental Values***

Human Activities (HumAct)	+	+.21 (.07) **	
Costs Money to protect (CostMoney)	+	-.04 (.01) *	-.55 (.3) *
Use Motive for protecting marine resources (UseMot)	+		
Bequest Motive for protect marine resources (BeqMot)	+		
Responsibility of Management (RespMgmt) (Ref: Government)	All (+) Fishers (+)	-.09 (.05) ** .005 (.07)	
Intergenerational tradeoff (FutOrCurr)	+	+.07 (.01) **	+1.8 (.55) **

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***Perceived Behavioral Control***

Government Efficacy (GovEffi)	+	-.06 (.03) *	
Conservation Impact (ConsDeclImp)	+/-		
Conservation Impact (Extreme/Avg)	+/-		-5.3 (2.2) *
Government Environmental Efficacy (GovRoleENV)	+/-		
Government Environmental Efficacy (Extreme/Avg)	+/-		
Own Influence on Regulations (InflReg)	+/-		

***Social Well Being***

Outsiders Perception (OutPer)	+	+.09 (.04) *	
Health	+	+.04 (.03)	

Attachment to place (Attch)	+		
Satisfaction Government (RelGov)	+		
Satisfaction non-Government (RelNonGov)	+		-1.2 (.4) **
Pride	+		
<hr/>			
<i>Sample Size</i>		205	169

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Note: Values denote Coefficient (Standard error),  
\* Significant at 0.05 level, \*\* Significant at 0.01 level  
Variables with no values indicate that they were not included in the reduced model

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### Question order effects

Question order affected the participation questions: those who were asked the time contribution question first tended to be more likely to commit money as well as time to the project. However, if they were asked the money contribution question first, they were more likely to refuse both time and money participation ( Table 10 & Table 11). For those who did show willingness to participate, the question order did not affect the actual monetary or time contribution.

## Discussion

We conducted a contingent valuation study to evaluate the acceptance of artificial reef modules among fisherfolk in the Saurashtra sea coast of Gujarat in Western India and their willingness to pay and willingness to contribute time to deploy them. We found that time (labor) was the preferred mode of contributing to the project. Fifty five percent of the sampled respondents were agreeable to contributing both money and time, 27% were ready to contribute only time, and only 5% agreed to contribute only money. The monetized value of time contribution was 4-14 times greater than the stated contribution in cash. We found that experience in the fishing industry, the perception of fishing providing enough income, the outlook of forgoing current needs for future sustainability and perception of outsiders affected engagement in monetary and time contribution to the reef project. The most influential driver for money contribution was the understanding of responsibility for conservation while the perception of impact of conservation actions drove the time contribution the most.

Our finding that more respondents were willing to contribute time than money is consistent with past studies. In a study on mitigation of invasive species in Nepal, the authors used contingent valuation applying money in form of membership fee and labor in terms of volunteering days as payment vehicles and concluded that allowing respondent to express their willingness to contribute labor increased their participation in environmental decision-making processes (Rai and Scarborough 2012). In another study to determine the economic burden of

leptospirosis, respondents were asked about their willingness to contribute labor for the prevention of the disease and found similar results (Arbiol et al. 2013). CV studies conducted in Ethiopia for various environmental services such as tsetse control (Swallow and Woudyalew 1994), lake restoration (Girma et al. 2021) and water hyacinth management (Sewunet et al. 2022) found that when money was used as a payment vehicle, acceptance was 12%, 29% and 32%, respectively but when time/labor was offered as the payment vehicle, for the same studies, acceptance was 26%, 63% and 39%, respectively. In Kandal province in Cambodia, researchers conducted a study using money and labor contributions as payment vehicles for improved drinking water quality (Gibson et al. 2016). They found little differences between the payment vehicles where there were functioning labor markets, but recommended the use of non-monetary instruments in cases where labor markets were missing, or not functioning (Gibson et al. 2016).

Time as a preferred participation mechanism, especially in developing countries, can be attributed to liquidity constraints, which can force respondents to pay more in terms of labor than cash; market imperfections that may restrict substitution among different resource endowments (Vondolia et al. 2014); missing or incomplete labor markets that can decrease the opportunity cost of time; endowment effects that imply that it is psychologically less painful to forego income (in form of time/ labor) than to surrender earned income (in the form of WTP payment); and loss aversion that can manifest as a disutility of giving up money greater than the utility associated with saving money in terms of time (Daniel, Jack, and Richard 1991). While each of these explanations can expound why time was the choice participatory instrument of our fisherfolk, the timing of our survey may also be a factor for consideration. Our survey was

conducted during the monsoon ban season when fishing ceases; labor markets behave differently during the fishing season and the off-season when most labor is unemployed. Excess supply of labor could coincide with a low marginal value of time. Almost two-thirds of our respondents mentioned that they did not have more opportunities in the industrial sector. Lack of substitution of fishing labor with other professions means low opportunity cost of time during the off season. This combined with liquidity constraints being a credit driven industry, and a general apprehension of parting with cash can explain why a majority of the sampled fisherfolk were willing to contribute their time instead of money to the project.

We also found quite different estimates of the opportunity cost of time depending on whether we used the wage rate, the leisure rate, or income. Though some studies have found that using per capita income rather than market wage rates led to a better convergence in response asymmetry of labor and cash payment vehicles (Tilahun et al. 2013), our study did not yield this result. Instead, we found that labor time contribution valued at the leisure rate was the closest to WTP.

While the zero-response rate for money contribution in our study (42%) fell in the typical range (24-60% in CV surveys (Arbiol et al. 2013)), the zero response rate for time was low- only 18%. We examined if the low zero response rate was because the CV scenario was not taken seriously and if the closure of near shore fisheries for the near term was not considered a grave issue. However, during our survey interviews, we documented that fishing trips were extending beyond single day to multiday trips and fisherfolk were increasingly going deeper into the ocean to remain profitable. The region of the ocean where the artificial reefs are proposed to be

installed is likely not the main fishing ground of many of our surveyed fisherfolk. Consequently, they may have accepted the need for such a project despite the closure and cost associated with it, which might explain the lower than expected zero response rate for the time-based instrument. For the money-based instrument, a majority refused because they thought the government should bear the cost of such a program. Had we only used money as a participation instrument, the positive valuation of over a fourth of our surveyed sample would potentially have been missed because they were unwilling to contribute money despite supporting the project which was expressed in terms of their readiness to contribute their time.

We found substantial differences between protest, true zero and positive WTP groups (the last two together comprise the non-protest group). Authors in previous studies have described this as the difference between not willing to pay versus not able to pay (Whittington 1998). Most of the protest group in our research consisted of boat owners with higher income and more experience in the fishing industry. In contrast, the positive WTP group is equally divided between boat owners and skipper/laborers while the true-zero group is mainly skippers/laborers. Both the latter groups have less experience in the industry. There is significant difference of wealth between the protest and non-protest WTP group- the protest group has higher income. There are significant differences between these groups on certain environmental behavior measures (Table 15)-the non-protest WTP group believes more strongly that they have a responsibility to protect the marine environment for future generations and that it is more important to preserve fishing stocks for future than make a living today. This group also perceives a greater influence on how regulation, laws etc. are formulated and enacted. So, we can infer that the difference in the valuation of the protest WTP and true zero group is income and

experience driven- the true zero group comprises mainly of skippers and laborers who are not as well off as boat owners, are price sensitive and may be relatively new to the industry, which explains their zero valuation for the project. In contrast, for the protest WTP and positive WTP group, the zero bids may be an expression of protest based on moral values or other perceived controls. It may be that the more experienced boat owners of the protest group are skeptical about the viability or successful implementation of such a project, need more information, or believe that they are not responsible for the payment.

Finally, for those respondents who agreed to contribute to the reef restoration project, we analyzed the drivers of the positive responses. We discovered certain common factors that drove the fishing community's participation in the proposed project in terms of both money and time. These were the respondent's experience, their perception of fishing providing enough income to meet livelihood needs, an outlook that supported trading off current livelihood needs for future resource availability and the perception of outsiders. The perception of fishing providing enough income to meet livelihood needs had a positive effect on WTP participation and WTCT contribution- as perception of fishing being a viable profession improved, so did the willingness to engage in conservation efforts. In our study, actual income did not influence WTP or WTCT. The role of income has been equivocal, insignificant in many studies (Vincent et al. 2014), substantial in others (Agismass and Mekonnen 2011). In instances like our study system where income is not a significant driver, one must consider the context of communities that depend on the environment as their source of livelihood. These communities are often on the side of preservation of nature regardless of their wealth and this behavior is consistent with their interests and values (Martinez-Alier 2013). Further, despite the conventional view that agrarian

communities are often too poor to think about conservation, our study shows otherwise. Seventy percent of our respondents believed that it was more important to preserve stocks for the future and this factor drove positive participation and contribution of both WTP and WTCT.

We included demographic factors such as occupation, age, education and household size because of theoretical and empirical evidence concerning their role in conservation decision making (Masud et al. 2014) (Dunlap et al. 2000; Ignatow 2006) (Zhongmin et al. 2002; Anoop and Suryaprakash 2008; Ignatow 2006). Studies have found age to be a negative predictor (Richard T. Carson, Leanne Wilks, and David Imber 1994), and education a positive predictor (Zheng, Mu, and Zhao 2018). Our study confirmed the negative effect of age on WTP contribution. While increasing age reduced the propensity of engagement in the proposed program, more experience had the opposite effect. Younger fisherfolk who had spent more time in this profession expressed more confidence in this project. Similarly, people who wanted their children to join the profession were understandably more vested in the project. We also found that occupation influenced time contribution- a skipper or boat laborer who was willing to contribute monetarily to the project contributed more than boat owners or other professions in our sample. This may signal the sense of need or urgency for such a restoration project among fisherfolk who are at sea because they have experienced declining catches and increased length and distance of fishing trips. In keeping with our expectation, mechanized craft owners had a lower probability of accepting the project, presumably because it would limit their access to the near-shore fishery because of the restrictions of the project. However, the very same group, if they agreed to participate, did tend to show a positive contribution of labor.

In terms of local ecological knowledge, the respondents' perception of the marine environment had the largest impact on the willingness to contribute money. Fisherfolk who perceived the current quality of their marine environment to be deteriorating were 17% more likely to participate in the program- and if they did, this poor perception led to increasing the WTP by Rs. 5,249. Respondents who perceived the state of the sea to be average instead of either extremely poor or excellent tended to participate and donate more- implying that those at the margins either felt no hope of their efforts improving the health of the sea or felt no need for doing so. While two-thirds of our sampled fisherfolk deemed the condition of the marine environment to be below average, one-third felt otherwise. This finding drives the point home that "health" of an ecosystem can mean different things to different people. While conservation scientists may be concerned with the ecological viability or resilience of the system, fishers may associate health with higher catch volumes and increased profitability. This finding can provide insight to marine conservation and policy programs to raise awareness of the linkages between long term ecological and economic sustainability of fisheries.

Our study provided an affirmation of the linkages between environmental values and environmental behavior (Gifford and Nilsson 2014; Steg et al. 2014; Steg, de Groot, and Thøgersen 2018). We found that fisherfolk who stated that human actions impacted coastal ecology had a higher probability to contribute their time to conservation efforts. In addition, respondents who considered it their responsibility to protect their natural resources tended to state a higher monetary contribution to the restoration efforts. Our study also asserted the connection between impact and readiness to make a change- fisherfolk who felt that they are

severely affected by the loss of marine resources are also projected to contribute more time to their protection.

The role of governance is pivotal in conservation programs. Our analysis showed that the perception of fisherfolk towards the government, their efficiency, their relationships, and their control also contributed to their own engagement in such community driven restoration project. Fisherfolk who felt that they had a say in the laws and regulations that governed their industry felt more confident to invest money in the reef conservation project. On the other hand, the perception of an efficient government and having good ties with NGOs and such bodies was detrimental to our respondent's contribution of labor, reasoning for which we were not sure. Also, we found that the perception our fisherfolk held about how outsiders valued them and their profession affected their engagement in the program- confirming that social norms can exert powerful influence on environmental behavior (Keizer and Schultz 2019).

Our research opens other areas of further investigation. While we were able to estimate the total valuation of the project based on the WTP and the monetized value of time, the costs of such a project remain to be accounted for. These would include costs related to planning, installation, monitoring and surveillance; they must also include the opportunity cost of foregone fishing grounds especially for traditional fishers and single-day trawlers.

We acknowledge that the use of multiple payment vehicles simultaneously can increase the complexity of the results analysis. Respondents considered two modes of contributions and inherently made trade-offs between the two, so an unconscious bias of one answer on the other may occur. There is also the influence of sequencing. An alternative approach could have been

to a split sample survey where each group is only offered one form of payment choice as done in some studies (Rai and Scarborough 2014; Casiwan-Launio, Shinbo, and Morooka 2011; Gibson et al. 2016). However, this poses other issue of using independent samples questioning the comparison of the samples. To mitigate this, we accounted for the effects of question order in our analysis.

In our study, the demographic profile was dominated by Hindu male *Kharva* boat owners. Resource constraints placed limits on a more exhaustive sampling frame with wider temporal and spatial coverage. Timing of the survey precluded presence of migrant skippers and boat laborers, as well as local fishers who use the monsoon-ban period to travel or attend social commitments. Face-to-face structured interviews were time consuming and posed a challenge for participation of women in our survey though they constitute about 60% of fish processing activity (Pushp, Vala, and Verma 2017); we recommend more observational learning methods to engage women in research studies. Fisherfolk belonging to Muslim communities were underrepresented, predominantly because of their skepticism to engage with academic researchers. Also, fishing practices in Saurashtra region differ from those in Kutch, South Gujarat and other parts of Gujarat and India. Generalizability is often a challenge in social research and a further extensive study involving these varied groups and regions will enable drawing broader conclusions.

Finally, while the results from the CV study indicate a positive support to the project, we acknowledge that it is a stated preference method, and a hypothetical bias can arise from what fisherfolk say they will do versus what they will actually do. However, we argue that the hypothetical scenario presented in our study was realistic- the fisheries is in distress, the fishers

do see the need for marine recovery, the proposed reef modules are present on the CMFRI campus in Veraval and such reef modules have been implemented in other parts of India; these factors mitigate these biases and contribute to rational elicitation.

## Conclusion

With this study, our objective was to use CV as a participatory methodology to enable expression of participation, preferences, and pricing of the reef restoration project in Gujarat. Our results showed that younger skippers, fisherfolk who used mechanized boats and had higher years of experience would be willing to participate in this program more readily. On the other hand, we also discovered that skeptics were mostly experienced boat owners. Based on these results from our sampled population, our recommendation to agencies like CMFRI that are engaged in implementation of these programs is to safeguard the support of the group that has shown readiness to participate and assess and allay the wariness of the group that is unsure. Our study also offers areas of intervention in terms of changing the understanding of marine ecosystem resilience, marine quality, and marine sustainability.

A healthy marine ecosystem benefits not just coastal communities by supporting the local economy but also has far reaching advantages to the society at large by attracting tourism, promoting food security, providing feed for livestock, and serving as a natural defense against coastal erosion and inundation. Our study provides monetary estimate for aggregate benefits of reef restoration expressed in terms of WTP or WTCT of the fisherfolk of our study area. Future work should consider expanding this research to other coastal communities as well as communities away from the coast who nevertheless accrue positive externalities of a healthy marine ecosystem. Finally, this study attempts to add to the limited empirical literature on

contingent valuation studies that have been conducted in developing countries and especially in India (Ekka and Pandit 2012; Anoop and Suryaprakash 2008; Zhongmin et al. 2002; Imandoust and Gadam 2007; Gurluk 2005; Stone et al. 2008). This is a first study of its kind focusing on the coastal state of Gujarat.

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## Appendix

Table 12 Active Fisherfolk, CMFRI 2010 Census

<u>District</u>	<u>Taluka</u>	<u>Municipality/ Fishing Village</u>	<u>Number of fishers (Full-time &amp; part time)</u>
Gir-Somnath	Veraval	Bhidiya	2548
		Old Light house	4193
		Jaleshwar	287
Junagadh	Maliya Hatina	Chorwad	533
Total			7561

Table 13 Payment elicitation ladder

Contribution/ month for a year	
Rs 100	Rs 450
Rs 150	Rs 500
Rs 200	Rs 600
Rs 250	Rs 700
Rs 300	Rs 800
Rs 350	Rs 900
Rs 400	Rs 1000
	> Rs 1000

Table 14 Time elicitation ladder

Contribution/ week for a year	
½ hour	5 hours
1 hour	6 hours
1 ½ hour	7 hours
2 hours	8 hours
3 hours	9 hours
4 hours	>=10 hours

Table 15 Mann Whitney test for differences in protest and non-protest groups

Group	Positive WTP	Protest WTP	True Zeros	Non-Protest Group	Protest Group
N	118	67	20	138	67
Age	0.45		0.14		0.3
Edu	0.23		0.2		0.17
HH Size	0.15		0.96		0.2
YrsFishing	<b>0.04</b>		<b>0</b>		<b>0.01</b>
Income	0.14		<b>0</b>		<b>0.03</b>
CostMon	0.10		0.91		0.15
UseMot	<b>0.01</b>		0.19		<b>0.01</b>
BeqMot	<b>0</b>		0.2		<b>0</b>
FutOrCurr	<b>0</b>		0.08		<b>0</b>
RespMgmt	0.11		0.09		0.44
InflReg	<b>0</b>		0.65		<b>0</b>
GovEffi	0.23		0.08		0.14
QltyNow	0.11		0.23		0.08

Figures in green show significant differences in means between groups. Comparison is between Positive WTP and Protest WTP groups and Protest WTP and True Zero groups.