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RECREATIONAL VALUE OF COASTAL AND MARINE ECOSYSTEMS IN INDIA: A MACRO APPROACH

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Coastal and marine ecosystems offer a large number of services for human well-being, including recreation, which is evidenced by people's willingness to spend on leisure. Traditional categories of national income accounting such as income from service sectors like "Hotels and Restaurants" do not capture the net welfare (consumers' surplus) from recreation that can be attributed to the existence of the ecosystem. This article presents the first estimates of a country-wide recreational value regarding the consumers' surplus generated by coastal and marine ecosystems in India using the Zonal Travel Cost Method. We found that the recreational value from nine coastal states in India generated consumers' surplus to the extent of 0.9% of India's gross domestic product at market prices [Rs93,888.76 billion or US$5,863 billion purchasing power parities (PPP)] in 2012–2013 for domestic and foreign tourist (at 2012–2013 current prices). The consumers' surplus generated for visitors of domestic origin is estimated at Rs295 billion (US$18.4 billion) and for visitors from the rest of the world is Rs562 billion (US$35 billion). This highlights the importance of ecosystems and provides a framework to estimate recreational demand functions. It also provides a mechanism to create suitable state-specific tariffs on recreational services for financing coastal and marine conservation.

Key words: Coastal and marine ecosystems; Recreational value in India; Consumers' surplus; Zonal Travel Cost Method

Introduction

The global "adventure" tourism market was valued at US$445 billion in 2016 and projected to grow at 17% per annum on a cumulative basis. Nature-based tourism (NBT) is considered as the fastest growing segment of the tourism industry, which itself is said to be the largest industry in the world (Kuenzi & McNeely, 2008). Unregulated growth of NBT could become counterproductive and cause irreversible damages that would affect the long-term sustainability not only of incomes but also the resource (Balmford et al., 2009).

Ecosystem approaches to tourism management have been suggested as a sustainable way forward. As a first step, it would involve the estimation of

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ecosystem services (Arkema et al., 2015). This article attempts to estimate the recreational value of coastal and marine ecosystems in India. According to the Millennium Ecosystem Assessment (MA, 2005), coastal systems begin from the inland areas that are within 100 km or of 50-m elevation from the coastline (whichever is closer), to less than 50-m water depth. Marine systems are waters from the depth of 50 m to the high seas (MA, 2005). Coastal and marine ecosystems are also categorized as (i) marine fisheries systems and inshore coastal systems, and (ii) coastal communities.

India's coastal and marine ecosystems are an integral part of the economy, society, culture, and religion. About 275 million people live in the coastal districts of nine maritime states (Andhra Pradesh including Telangana, Goa, Gujarat, Karnataka, Kerala, Maharashtra, Odisha, Tamil Nadu and West Bengal), and four Union Territories (two in the mainland: Daman & Diu and Puducherry, and two islands groups: Lakshadweep and Andaman & Nicobar archipelagos). According to the Central Marine Fisheries Research Institute's (CMFRI) Marine Fisheries Census 2010, India has 3,288 marine fishing villages and 1,511 marine fish landing centers across the country. India's coastline is 8,118 km long with the Bay of Bengal in the East, the Indian Ocean in the South, and the Arabian Sea in the West. The coastal zone includes wetlands covering 40,230 km^2, 97 estuaries, 34 lagoons, 31 mangrove areas, and 5 coral reef areas (Yadava, Mukhopadhyay, & Bhatt, 2015).

The economic importance of coastal zones lies in their ability to provide livelihood support to fishers, and benefits of commerce, navigation, and recreation. In India, coastal and marine fishing produced 3.32 million tonnes, and inland fishing contributed 5.72 million tonnes of fish catch, together contributing to the tune of Rs780.53 billion (US$48.7 billion) to India's gross domestic product (GDP at current prices) during 2012–2013 (Government of India [GoI], 2017). In the MA classification, ecosystems provide provisioning, regulating, cultural, recreational, and supporting services. Provisioning services include what people receive as direct livelihood support such as food, energy resources, and medicinal resources. Regulating services include protection from storms and floods through mangroves, shoreline stabilization, climate regulation, hydrological services, and carbon sequestration, among others. Supporting services are those that provide habitat and soil formation services. Cultural and recreational services include aesthetic, spiritual, and religious values, and tourism and recreation (UN Environmental Programme World Conservation Monitoring Centre [UNEP-WCMC], 2011). Coastal and marine ecosystems provide numerous benefits, some of which have "use values" and some have "non-use values" that are received by society either directly or indirectly for its well-being. One of the significant components of "use values" can be captured from information on tourism market. This article focuses on the estimation of the benefits from recreation services of coastal ecosystems in India measured by the consumers' surplus (CS) it generates.

There is an ethical debate on whether nature and its resources can and should be "valued" (Daily et al., 2000). However, there is a sizable section of researchers and policymakers who feel that valuation helps in decision making in a logically justifiable manner (Dasgupta, 2008). Careful estimation of monetary benefits could help in resolving disputes on resource use and allow for rational allocation of resources to manage them (Krutilla & Fisher, 1975). To make management decisions, the economist's toolkit relies on the cost–benefit analysis or some variant of it. However, this implies that we need a full physical and monetary accounting of the costs and the benefits of resource use.

The first step in this exercise is to estimate the physical flows and stocks. The next step is to place a monetary value to these resources. It is here that problems arise because (a) many natural resources may not have a direct market price and (b) when these prices exist, they may not reflect the true social value. There are several exhaustive reviews on valuation, and numerous alternative methods have been relied on to value ecosystem services (UNEP-WCMC, 2011). The literature on valuation of recreation suggests two commonly used variants of the travel cost method (TCM): the Individual and Zonal.

Much of the existing literature using the TCM have relied on primary data-based microstudies extending up to a landscape level. The monetary value of natural resources and ecosystem services crucially depends on the location-specific availability of complementary man-made resources, local demands, and local prices. If these estimates are spatially scaled up, they may lead to significant errors. However, when we examine policy issues at the regional or national scale, there is a need for scaling up. The global effort at natural capital valuation, green accounting, and building of the System of Environmental-Economic Accounting (SEEA) at the country level clearly shows the need for macrolevel valuation studies (GoI, 2013; Mukhopadhyay & Shyamsundar, 2015). National green accounting efforts are a step in this direction, but they are still at an early stage. They remain uncommon and controversial not only because they are difficult to carry out but also because the data requirements could be intensive, and the methodological issues are not yet resolved (Dayal, 2014).

An early and much-discussed effort placed the annual value of global ecosystem services (over and above what was accounted for in the national income accounts) at US$33 trillion per year when the global GDP was US$18 trillion in 1997 at 1994 US$ prices (Costanza et al., 1997). In a similar assessment undertaken in 2014, the value of the annual flow of ecosystem services was found to have increased to US$145 trillion per year in comparison to global GDP of US$75.2 trillion per year in 2011 at 2007 US$ prices (Costanza et al., 2014). Interestingly, a significant part of this value was contributed by the coastal and marine ecosystems: US$20.9 trillion per year (excluding wetlands) in the 1997 assessment and US$60.5 trillion per year in the 2014 assessment. These findings received a mixed response, but it triggered increased research efforts to understand ecosystem values (Toman, 1998).

The global literature on ecosystems services is quite large (Barbier et al., 2009; de Groot et al., 2012; Nunes, Ding, & Markandya, 2009). Studies related to the valuation of ecosystem services have been listed and compiled in the Ecosystem Services Valuation Database (ESVD) (van der Ploeg & de Groot, 2010). Of the 1,310 peer-reviewed studies listed there, only 62 were from South Asia and 24 from India. In this database, coastal and marine ecosystems cover the following subcategories: coastal and marine, open oceans, swamps/marshes, tidal marshes, mangroves, coral reefs, continental shelf sea, estuaries, seagrass and algae beds, shores, and saltwater wetlands. India accounts for only 9 of the 518 coastal and marine ecosystem studies on this list (Parikh et al., 2012; World Bank, 2013).

This gap in the literature on valuation of coastal and marine ecosystem services establishes a clear need for more studies in this area in India (Yadava et al., 2015). There are some location-specific studies (Chopra, Kumar, & Kapuria, 2010; Guha & Ghosh, 2011), but to the best of our knowledge there are no national-level estimates available in India for the value of coastal and marine ecosystems services. Despite the methodological challenges such macrolevel exercises pose, a careful and systematic attempt to arrive at a country-wide estimate is an essential pursuit as it would lead to more informed decision-making. This article presumably provides the first national estimates of net benefits from recreational services of coastal and marine ecosystems in India. It also provides a methodological pathway to estimating the recreational value at the national level using the Zonal Travel Cost Method (ZTCM).

The rest of the article is organized as follows. The next section discusses the methodology and data used. Section 3 presents the results and section 4 provides an analytical discussion of these results. The article concludes in section 5 with a discussion on the implications for policy-making.

Method

The Total Economic Value (TEV) of ecosystem services is a widely accepted framework for valuation. It anticipates that ecosystems deliver multiple benefits. If the values of all these benefits could be added up, then we would arrive at a comprehensive value (Krutilla & Fisher, 1975; Pearce & Turner, 1990). In the common demand–supply analytical framework of welfare estimation, the net gain to society is the sum of the CS and producers' surplus (PS—net rent in case of natural resources). In practice, the estimation of welfare is constrained by data availability. In their global TEV estimation, Costanza et al. (1997) used two additional methods as proxy measures depending on the availability of data (apart from the textbook CS + PS measure). These were (a) only producer surplus and (b) the price–quantity product.

This study uses the value per hectare of recreational benefits from coastal ecosystems ($903/ha/year at 2011 prices) from Costanza et al. (2014).

Table 1
Net State Domestic Product (NSDP) and Projected Recreational Value (Based on Global Averages) in Coastal States

Name of State (A)	NSDP at Current Prices in 2012–2013 (Billion Rs) (B)	Coastal Ecosystem Area (Net of Habitation (km^2) (C)	Benefit Transfer Measure: Recreational Values of Coastal Area (Net of Habitation) in 2012–2013 (Billion Rs) (D)	Benefit Transfer Measure: Recreational Values of Coastal Area (Net of Habitation) in 2012–2013 (Billion $ PPP) (E)
Andhra Pradesh	6718	14751	21.3	1.3
Goa	341	2995	4.3	0.3
Gujarat	6027	32021	46.3	2.9
Karnataka	4650	12952	18.7	1.2
Kerala	3174	3726	5.4	0.3
Maharashtra	12391	4134	6.0	0.4
Odisha	1769	10067	14.6	0.9
Tamil Nadu	6005	22759	32.9	2.1
West Bengal	4871	14969	21.6	1.4
Total		**118374**	**171.2**	**10.7**

Note. Column B: Reserve Bank of India (RBI, 2019). Column C: Authors' calculations based on Indian Space Research Organisation (ISRO, 2012). Columns D and E: Authors' calculations based on Costanza et al. (2014) ISRO (2012), OECD (2019).

Further, all international values are adjusted for 2012–2013 prices in Indian rupees at an exchange rate of Rs16.013 for US$1 PPP as per Organisation for Economic Co-operation and Development (OECD, 2019). When this per hectare value is multiplied to the area under coastal zone (net of the area under habitation) for each state in India, it totals Rs171 billion ($10.7 billion) (Table 1, columns D and E, respectively). This is a simple value transfer application to obtain a back of the envelope estimate of recreation value for the coastal and marine ecosystem in India (de Groot et al., 2012). This value provides a useful benchmark for estimates derived from this study presented below.

Travel Cost Method

The recreational value of a tourist destination is generally estimated by the well-accepted Travel Cost Method (TCM). Originally this method was developed for a specific recreational site receiving visitors originating from different locations and distances (Hotelling, 1949). The literature anticipates a positive linear relationship between distance traveled and the associated travel cost. The theory of demand tells us that visitation rate during a certain period to the site by an individual tourist would be inversely related to the distance (and therefore travel cost) he/she needs to travel. It assumes that the amount of money a visitor pays for a recreational trip is the floor value of the recreational benefits received by the visitor from the site. The recreational demand can then be estimated using a function relating travel cost with the visitation rate after controlling for other socioeconomic factors. Any change in the entry fee (if any) is expected to have a similar effect as a change in travel cost might have on the visitation rate.

This functional relationship is estimated as a trip-generating function (TGF) with an appropriate regression model after controlling for other individual characteristics like visitor's age, sex educational qualification, occupation, social class, and other covariates when such data are available. Estimation of such a TGF invariably requires the individual visitor's details, which can be obtained typically by a primary survey of a carefully selected sample of visitors to the site. This is considered as the demand function of the visitors for that site, and it can be used to calculate the aggregate CS that has accrued to all visitors to the site within a specified period. The CS can be considered as the value of the services generated by the existence and quality of the recreational site. Valuation studies help focus on trade-offs that inform public policy decisions.

This appealing and straightforward theory is easier to apply for sites that are frequented by neighborhood visitors as a weekend destination (Barbier, 2012). Tourists from nearby places are supposed to visit that destination many times within a period (say 1 year) as they have to incur less travel cost (price). In contrast, visitors from a distant origin are expected to visit a lesser number of times within the same period because they have to incur a higher cost per visit. This phenomenon, if true, ensures sufficient variation in the visitation rate across visitors from different distances, which is essential for robust econometric estimation of the TGF. Unfortunately, this may not be the case for travel destinations in poorer countries like India and also for more iconic destinations (e.g., climbing Mt. Everest). Such places are associated with large recreational values. However, a TGF (demand function) for those sites cannot be estimated by using the method mentioned above, as it is hard to find the same tourist visiting that site multiple times within a reasonable period. This lack of variation in the conventional "visitation rate" calls for redefining it, so that enough variation can be ensured in the "modified visitation rate" for an econometrically viable TGF estimation.

This estimation problem led to the development of another variant of TCM—called the ZTCM. Variation in cost of visitation arises out of differential travel costs from different zones, which increases with the distance of visitors' originating (hereafter also called origin) zone from the destination site.

The variation in visitation rate is ensured by considering the number of visitors originating from a particular geographical area (zone), in contrast to the number of times one individual visits the site. It is expected that the "average travel cost" of visitors originating from a particular zone would show a monotonically increasing pattern with the "average distance" from the origin zone. The "average travel cost" and "zonal visitation rate" (calculated as the number of visitors from that zone normalized by the population in that zone) can be used to estimate the TGF. The reliability of the ZTCM estimates requires an adequate number of zones to ensure acceptable degrees of freedom depending on the number of regressors used in the estimation process. The travel cost (including the opportunity cost of time) represents the lower bound of what people are willing to pay for a recreational site.

The ZTCM differs from the Individual Travel Cost Method (ITCM) in its commonly used regressors. At the zonal level variables such as literacy rate, the percentage of urban population, and the female/male ratio (FMR) of the origin zone are expected to influence the visitation rate from that zone (Ahmed, Umali, Chong, Rull, & García, 2007; Kline & Swallow, 1998; Tobias & Mendelsohn, 1991).

In most of the existing ZTCM studies, the application of the travel cost method is confined to a specific site. The average zonal travel cost and visitation rate are usually obtained through a carefully designed primary survey of visitors (Fletcher, Adamowicz, & Graham-Tomasi, 1990). The typical methodological challenges in ZTCM are the choice of an optimum number of zones and dealing with multisite tourists, especially foreign tourists. Visitors may go to more than one destination, and it becomes difficult to apportion the cost of travel to the destination of interest. Then there could be other econometric estimation issues like an appropriate functional form for TGF (and dealing with heteroscedasticity). This study accommodates some of these issues by treating one state as a single zone (site) and is therefore able to control for multiple site visits as long as they are in the same state.

Zonal Travel Cost Method

In a typical ZTCM, if N_i is the estimated number of visitors from zone *i*, where P_i is its total population, then visitation rate for zone *i* is defined as:

$$V_i = (N_i/P_i) \tag{1}$$

The average travel cost from each zone is calculated based on the data available. If data were generated using a primary survey, then the travel cost information from each originating zone would be collected from the sample of visitors being interviewed. The travel cost is calculated "per visitor" and would include all actual expenses of the visitor from the origin site, entry fee (if any), as well as his/her opportunity cost of time. If T_i is the average travel cost from zone *i*, then visitation rate from zone *i* (V_i) would be represented as:

$$V_i = f(T_i, Z_i) \tag{2}$$

where Z_i is a vector of other zonal characteristics that could affect V_i.

The relationship between V, T, and Z is known as the TGF (equation 2). The demand function for each zone would be obtained by putting the corresponding value of Z_i in the estimated TGF. The aggregate recreational demand for a site would then be obtained as the sum of such demand for all originating zones. The net value of the recreational services offered by the site is the aggregate CS calculated from all such zonal demand schedules.

For each of the zones, CS was estimated as the area under the corresponding demand curve but above the priceline, which represents the visitor's actual average travel cost. Every zone is expected to have a "choke price," which represents the maximum demand price when the visitation from that zone reduces to zero. If T^a is the average (actual) price paid by visitors and T^c is the choke price for a zone, then the zonal CS would be:

$$\mathrm{CS} = \int_{\mathrm{T^a}}^{\mathrm{T^c}} \mathrm{VdT} \tag{3}$$

The sum of all such zonal CS was considered as the recreational value of the site (equation 3).

Data

This study relies on secondary data from multiple sources available in the public domain—like the Ministry of Tourism (MoT), Government of India, Reserve Bank of India, World Bank, and Office of the Registrar General & Census Commissioner (Appendix A1 provides details for each variable and its source). India has a vast coastline of more than 7,500 km dotted with numerous recreational sites of varying importance. Nine states are identified as "coastal states" as they contain significant coastal area within their administrative boundary. These are Andhra Pradesh, Goa, Gujarat, Karnataka, Kerala, Maharashtra, Orissa, Tamil Nadu, and West Bengal. Our analysis excludes the small Union Territories of Puducherry, Andaman & Nicobar, Lakshadweep, and Daman & Diu due to nonavailability of the required data. The Indian coastline has unique ecological sites and biodiversity hotspots like the Sundarbans (West Bengal), Bhitarkanika (Odisha), and the Rann of Kutch (Gujarat), which are iconic tourist attractions. There are also important religious sites like Puri (Odisha), Rameswaram (Tamil Nadu), and Somnath (Gujarat). Since all coastal states have multiple recreational sites, this study has treated the entire coastline of a state as a single recreational site for that state.

In these destination states, tourists arrive from all over India and abroad and may visit coasts as well as interior parts for recreation. The state is the lowest subnational level at which tourism data are available. Visitors are classified by purpose of visit under different categories of which "recreation" (or "leisure") is one. Nonleisure visitors can be separated as they are classified under other categories (such as "business"). In this article, the terms recreational visitors and tourists are interchangeably used.

The data on the number of tourists to a destination state are available from the Ministry of Tourism (GoI, 2014). One data limitation that researchers face is that there are no site-specific data on tourist visitations within a destination state. The data gap was overcome by existing studies like Neumann, Vafeidis, and Zimmermann (2015) by using a uniform population to visitor ratio. Recent studies in tourism have begun to use a Tourism Density Index (TDI), which measures the tourist arrivals as a proportion of the local population (Intrepid, 2018). The value of the density separates destinations with "overtourism" and "undertourism." Iconic destinations seem to fall in the former category while politically unstable destinations fall in the latter category. This study, like Neumann et al. (2015), assumes that the TDI is homogenous within each state, although it differs for individual sites at the district level.

There are two categories of tourists according to their point of origin. In this study, domestic visitors are those whose point of origin is India (either in that state or in any other state). The data source does not distinguish between those who are usually resident and those who are citizens in a particular place and may include both. Visitors from the rest of the world (foreigners) are those whose travel origin is from other countries and who have arrived on a tourist visa. The data on foreigners are independently obtained from a separate source as indicated in Appendix A1.

There is a second level of classificaiton for two broad types of tourists: those who tread the mass tourism circuit and those who look for non-mass tourism destinations. The latter are fewer in number and move away from "commercial" routes and seek less populated zones either as elite tourists or backpackers (Bramwell, 2003; Vainikka, 2013). The former group lead to the creation of infrastructure and expansion of the carrying capacity of the host population in a demand-driven dynamic market. Therefore, it is not unreasonable to anticipate that both types of tourism are likely to mirror the size of the host population share in coastal areas. The larger group of mass tourists will congregate in larger host populated zones, and elite and backpacking tourists will move to less populated zones in the district. Such data bridging methods are increasingly used in macrostudies in order to overcome spatial and temporal limitations of data (Wood, Guerry, Silver, & Lacayo, 2013). Demographic data are available from Office of the Registrar General & Census Commissioner (2011), which was upwardly projected for the year 2012–2013 for this study.

The origin state's total population was then used to calculate the "visitation rate per thousand people" (from the origin state) to the destination state. There are 9 destination zones (states) and 34 origin zones [including 33 Indian states and rest of the world (RoW)]. In this study, "zones" are identified with "states" (and RoW), and the terms are used interchangeably in this article. The state-level variables were used as control variables in the estimation of TGF. Each of these 34 origin zones spins off one observation for each of the 9 destination zones replicating a 34 × 9 matrix. The special nature of this arrangement resembles a "panel data" structure where origin states are like cross-sectional observations, and destination states are like different times points, across which the cross-sectional entities (origin states) show variability regarding their travel cost and visitation rate. This represents a methodological innovation of this study in estimating TGF as a panel estimation.

Empirical Model

In order to estimate the actual travel cost per visitor, three broad categories of expenses were computed: expenditure on travel, accommodation and food, and the opportunity cost of spending time on recreation. These three were then added to arrive at the total travel cost from different zones to a particular destination zone (see Appendix A2 for details). In ZTCM, the visitation rate is treated as being continuous, and the estimation is usually done using a multivariate least square regression model where the double log form is found suitable (Guha & Ghosh, 2011).

Panel regression estimation techniques are known to overcome problems of bias and inefficiency that cross-section ordinary least squares (OLS) regression estimates may have (Hsiao, 2007). Equation 4 is a generic panel data model:

$$Y_{ij} = \beta_0 + \beta_1 X_{ij} + \psi_{ij} + \varepsilon_i \tag{4}$$

where Y_{ij} is the dependent variable, X_{ij} represents the vector of independent variables, and ψ_{ij} and ε_i are the error terms. It is assumed that ψ_{ij} (the idiosyncratic error) is uncorrelated to the X_{ij}s and ε_i is unobserved heterogeneity (Wooldridge, 2013). A visitor's choice of travel destination would depend on individual characteristics like income, age, sex, education, and so on, apart from the cost of travel. Also, in the Indian context, the application of ZTCM had shown that interstate recreational visitors represent a well-to-do section of the society and they are invariably urban (Guha & Ghosh, 2011). Therefore, "percentage of urban population" in each origin state is used as a regressor. India has significant wealth and consumption/income inequality as evidenced by large sample studies of the National Sample Survey Office (NSSO, 2013). Ability to pay for recreation would therefore be influenced by the level of inequality in each origin state and "poverty rate" has been used as a control variable.

A few other socioeconomic state-level characteristics are expected to influence the visitation rates. These are:

- female/Male ratio (FMR) of the origin state (as a proxy of gender inequality),
- state's "own tax as a ratio of the gross state domestic product" (as a proxy for the distortions in relative market prices across states due to state-specific indirect taxes),

- beach area in the origin state (in square kilometers, as a proxy for the availability of coastal recreation sites),
- coast length—this is the length of the coastline in the origin state (as a proxy for the supply of coastal recreational area, in kilometers).

Table 2 provides the summary statistics for the variables used in the estimation of TGF. In the first instance, a Hausman test was used to choose between the random effects and fixed effects model to estimate the TGF. The Hausman test suggested that the null hypothesis of random effects model estimates is to be accepted. The TGF was then estimated using a random effects maximum likelihood estimator (MLE) model as well as the generalized least squares (GLS) model, and the estimates were similar (see Table 3 for results, thus only MLE results are reported).

Two separate specifications for TGF were estimated to check for robustness. The difference between equation 5 and 6 is that in the former, the "area of the beach in the origin state" (regressor: *Beach*) is used. In equation 6, the "length of coastline in the origin state" (regressor: *Coastlength*) was used. This was done to check whether the results were sensitive to the choice of an indicator of the recreational resource in the origin state. Interestingly, the key variables are not sensitive to the use of either variable. However, in this article, the *Beach* variable is used for CS estimation because it is more meaningful than *Coastlength* as recreational facilities are concentrated in the area around a beach. The regression equations used for estimation are:

Table 2
Summary Statistics

Variable	Mean	*SD*	Min	Max
ln_VisitRate	−0.48	2.27	−5.76	5.73
ln_TravelCost	9.63	0.45	8.42	10.6
Urban (Rate)	38.33	21.04	10.03	97.5
Poverty (Rate)	24.67	12.83	2	47.9
Coastlength	217.32	406.36	0	1600
Beach	10.83	22.24	0	85.57
Own tax_GSDP	6.07	2.6	0	11.4
Female/male ratio (FMR)[a]	946.52	45.49	867.96	1,084.31

Note. Number of observations = 299. [a]Number of females per 1,000 males.

Table 3
Regression Results—Dependent Variable: ln_VisitRate

Independent Variables	Model 1	Model 2
ln_TravelCost	−1.29***	−1.29***
Urban (Rate)	0.024***	0.023***
Poverty (Rate)	−0.017*	−0.016
OwnTax_GSDP	−0.096*	−0.095*
FMR	0.0059**	0.0054*
Beach	0.01*	
Coastlength		0.00063*
Constant	6.32	9.2***
Observations	299	299
Number of origin states	34	34
Wald (χ^2)	45.55	45.64
df	6	6
Prob > χ^2	0.000	0.000

**p* < 0.10, ***p* < 0.05, ****p* < 0.01.

$$\begin{aligned}\text{ln\_VisitRate}_{ij} = \beta_0 + \beta_1\text{ln\_TravelCost}_{ij} + \beta_2\text{Urban}_i \\ + \beta_3\text{Poverty}_i + \beta_4\text{Beach}_i \\ + \beta_5\text{OwnTax\_GSDP}_i \\ + \beta_6\text{FMR}_i + \psi_{ij} + \varepsilon_i\end{aligned} \quad (5)$$

$$\begin{aligned}\text{ln\_VisitRate}_{ij} = \beta_0 + \beta_1\text{ln\_TravelCost}_{ij} \\ + \beta_2\text{Urban}_i + \beta_3\text{Poverty}_i \\ + \beta_4\text{Coastlength}_i \\ + \beta_5\text{OwnTax\_GSDP}_i \\ + \beta_6\text{FMR}_i + \psi_{ij} + \varepsilon_i\end{aligned} \quad (6)$$

where:

ψ and ε represent the error terms as discussed earlier,

i = origin zone (state) of the visitor,

j = destination zone (state) of the visitor,

ln_VisitRate = natural log of the number of visitors per 1,000 population,

ln_TravelCost = natural log of the cost of travel including expense on travel, accommodation and opportunity cost of time,

Urban = urbanization rate (proportion of people living in urban areas),

Poverty = poverty rate (proportion of people living under the poverty line),

Beach = area of the beach (in square kilometers),

Coastlength = length of coast in the state (in kilometers),

OwnTax_GSDP = own tax revenue of the state as the ratio of gross state domestic product,

FMR = mumber of females per 1,000 males.

Results

The estimates show that travel cost strongly and inversely affects visitation rate as anticipated (Table 3). A highly urbanized origin state has a larger visitation rate from that state to coastal destinations, which is as per expectation. A higher poverty rate in the origin state means lower visitation rate from that state, also as anticipated. A higher FMR in origin state could imply a more socially equitable and progressive society and this would have a positive influence on the visitation rate from that state. A negative sign for the coefficient of OwnTax_GSDP suggests that higher tax rates in origin states lead to lower visitation rates might be resulting from lower disposable income.

The recreational demand function for each destination state was estimated using the coefficients derived from the TGF. The state-specific values of all regressors from origin states were used to predict the demand function. The recreational value of destination sites was then derived by estimating aggregate CS using a choke price—a cost at which demand falls to near zero. In a double-log form equation as used in this study, the estimated number of visitors would never truly be zero as the demand curve is asymptotic to the vertical axis. The choke price was predicted by simulating the travel cost successively until the estimated number of visitors for every destination zone was *rounded off* to the smallest integer (unity). The CS estimates were then multiplied by the total population (measured in 1,000s) of the origin state to obtain the aggregate CS for each destination state. The recreational value of coastal and marine ecosystems was obtained by summing the CS for all nine coastal destination states for both visitors from within India (domestic tourists) as well as the rest of the world.

The above results suggest that the CS generated from the recreational value of coastal zones was about Rs875 billion ($53.5 billion) in 2012–2013. These are net benefits over and above what is recorded in the national income accounts. Since there are no other studies against which to benchmark these estimates, we are unable to comment whether these estimates are high or low at this juncture. These results suggest that CS generated was 0.9% of India's gross domestic product at market prices (Rs93,888.76 billion or $5,863 billion) in 2012–2013. Interestingly, the contribution from "Hotels and Restaurants" to India's GDP at market prices was Rs1,360.8 billion ($84.9 billion). This was about 1.4% of India's GDP. While this sector does not allow the estimation of recreational value directly, it at least provides a neighborhood value for validation of estimates.

Analysis

The state-wise CS for all nine coastal states is presented in Table 4 (column D to I). The estimated CS for visitors from domestic origin and visitors from the rest of the world are presented separately. The CS generated for visitors of domestic origin is estimated at Rs295 billion ($18.4 billion) in 2012–2013. The CS generated for visitors from RoW is estimated at Rs562 billion ($35 billion) in 2012–2013. The extent of CS generated for visitors from the RoW is almost 1.8 times (in aggregate) in comparison to CS generated for visitors of domestic origins.

Odisha was able to generate the maximum CS followed closely by Tamil Nadu. Karnataka had the lowest CS, a little less than Goa. Among domestic visitors, Kerala generated the highest CS, followed by Tamil Nadu. Odisha generated the highest CS, followed by West Bengal from the category of visitors coming from the rest of the world.

Kerala as a destination state is estimated to have the highest average travel cost per visitor (Rs33,838, $2,113) followed by Goa (Rs23,178, $1,447), while the lowest was for West Bengal Rs12,923 ($807) (Table 4, Column B to C). The scatter plot of visitation rate (log) against travel cost (log) exhibits the inverse relationship as anticipated (see Fig. 1).

The states differ in terms of the CS they generate, their size, and population. Due to this reason, the absolute CS would not be an accurate indicator of the relative importance of recreation and tourism to the state's economy. One way to address this is to examine the ratio of CS to the state's net state domestic product (NSDP) (Table 4, column J). In the eight states (except Goa), the total CS as a ratio of NSDP ranges between 0.8% in Maharashtra to 5.6% in Odisha. Goa is an outlier with this ratio being nearly 26%. However, if one examines the tourist density in Goa, measured as a ratio of tourist inflow into Goa to the size of the resident

Table 4
Estimated Consumer's Surplus From Coastal and Marine Recreation for Visitors in 2012–2013

Name of Destination State (A)	Estimated Travel Cost (in Rs) (B)	Estimated Travel Cost (in US $ PPP) (C)	Estimated CS for Visitors With Domestic Origin (Billion Rs) (D)	Estimated CS for Visitors With Domestic Origin (Billion $ PPP) (E)	Estimated CS for Visitors From Rest of the World (Billion Rs) (F)	Estimated CS for Visitors From Rest of the World (Billion $ PPP) (G)	Estimated CS for Visitors With Both Domestic Origin and the Rest of the World (Billion Rs) (H = D + F)	Estimated CS for Visitors With Both Domestic Origin and the Rest of the World (Billion $ PPP) (I = E + G)	CS as Percentage of NSDP (%) (J)
Andhra Pradesh	1,5020	938	32.41	2.02	62.07	3.88	94.47	5.90	1.4
Goa	2,3178	1,447	30.17	1.88	58.89	3.68	89.06	5.56	26.1
Gujarat	1,9009	1,187	33.52	2.09	63.62	3.97	97.14	6.07	1.6
Karnataka	1,9784	1,235	28.75	1.80	58.38	3.65	87.14	5.44	1.9
Kerala	3,3838	2,113	35.54	2.22	61.54	3.84	97.08	6.06	3.1
Maharashtra	1,3751	859	34.34	2.14	63.55	3.97	97.90	6.11	0.8
Odisha	1,9263	1,203	32.50	2.03	67.04	4.19	99.55	6.22	5.6
Tamil Nadu	1,3712	856	35.44	2.21	62.53	3.90	97.96	6.12	1.6
West Bengal	1,2923	807	32.46	2.03	64.39	4.02	96.85	6.05	2.0
Total	**1,8458**	**1,153**	**295.13**	**18.43**	**562.02**	**35.10**	**857.15**	**53.53**	

Source: Authors' calculations.

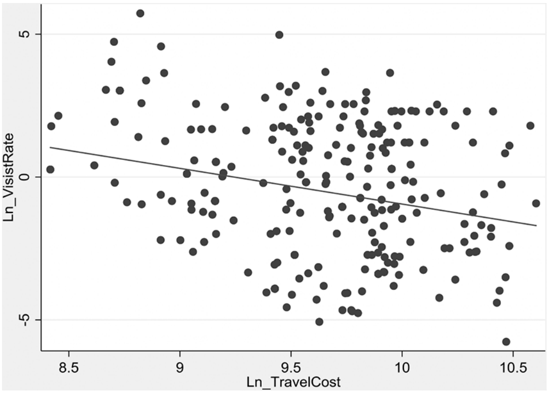

Figure 1. Visitation rate and travel cost of coastal states in India (scatter plot and fitted line).

population, this would not seem improbable. In 2012, the number of domestic visitors coming to Goa was recorded as 2.3 million and foreign visitors as 0.5 million, totaling to 2.8 million. Goa's resident population was about 1.5 million in the same year. Therefore, Goa hosted about two visitors per resident, which is much higher than any other state.

If one looks at the CS generated per square kilometer of the beach area, which is also an indicator of tourist density, Goa far outstrips all other states and is an outlier (Fig. 2). The visitation to this state may well be reaching the state's carrying capacity being a small state catering to a large tourist demand. Bigger states have the luxury of potentially being able to spread the tourism pressure on their longer coastline.

If we separate out the CS generated by two broad categories of origin—foreign and domestic—we find that foreign tourists generate more CS per square kilometre of beach than domestic tourists in all the coastal states (Table 4, columns D–I). This should not come as a surprise even though foreign visitors travel longer distances to come to India as they have higher incomes than the average domestic visitor. It is therefore expected that the CS generated would be larger for the foreign visitor since the tariff structure for visitors in the coastal zone does not distinguish between domestic and foreign visitors.

Discussion and Conclusions

Estimation of the value of a destination endowed with rich natural recreational resources helps place a monetary value on the resources that would otherwise not be captured in market transactions. While some have raised ethical concerns

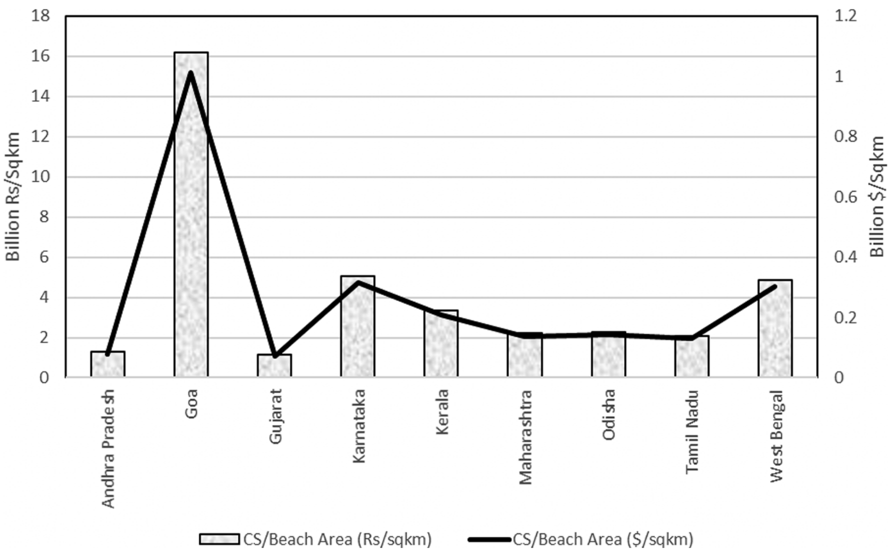

Figure 2. Ratio of consumers' surplus per square kilometer of beach area (in Rs primary axis and $ secondary axis).

about valuing resources (Daly & Townsend, 1993), others have argued that in the absence of a reference monetary value for resources, these could be suboptimally allocated resulting in non-sustainable use (Barbier et al., 2011). The value estimates provided in this article for coastal and marine ecosystems will help address at least three linked problems.

First, India is undergoing rapid land-use change, especially in the coastal zones (Menon, Kapoor, Venkataram, Kohli, & Kaur, 2015). Rules have been framed by the Indian government that regulate land use, but the anthropogenic pressures have resulted in the Coastal Regulation Zone rules being amended 34 times in 27 years (Kukreti, 2019). Coastal states need integrated management plans, and the valuation of recreational resources would allow informed choices at the planning stage. Second, apart from the direct anthropological pressures, there is a severe threat to the coastal zones from climate change (Kavi Kumar & Tholkappian, 2006; Nicholls et al., 2007). Therefore, there may be need for greater investment to shore up coastal defenses, especially in mangrove restoration and sand dune protection as these act as natural defenses during storm surges and cyclones (Das & Vincent, 2009). This would require additional funds that could be justified once the value of resources that need protection are better understood. Thirdly, ecosystem valuation would aid governments to implement green accounting in the SEEA framework. Currently, there is no mechanism to scale up values from microstudies to feed into the national accounts. The methodology proposed here could be a possible mechanism to improve national accounts within the SEEA framework. Further, the estimated state-wise recreational demand functions can enable governments to devise state-specific tariff structure for recreational services for visitors (Laarman & Gregersen, 1996). It would serve the dual purpose of regulating the flow of tourists to the destination states so that natural capital is sustainably managed and at the same time generate revenue for the government.

In a vast and developing country like India, the financial resources available for development purposes are always scarce. If different geographical zones are to be prioritized for developmental interventions, there should be an objective criterion for doing so. This study provides a rationale for allocating financial resources for protecting India's coastal zones as these regions, and the livelihoods from tourism and fishery, are vulnerable to climate change (Coombes, Jones, & Sutherland, 2008; Liquete et al., 2013; Santos-Lacueva, Clavé, & Saladié, 2017). Numerous regions have reported uncontrolled tourism expansion that has adversely affected tourism revenues in the long run (Biggs, Amar, Valdebenito, & Gelcich, 2016; Gormsen, 1997; Lakshmi & Shaji, 2016; Otrachshenko & Bosello, 2017). The exploitation of the natural capital for tourism needs to be controlled so that irreparable damage to the ecosystem can be avoided. However, while designing a tariff structure policy-makers need to be sensitive to the fact that India competes with many international tourist destinations in its neighborhood, like Sri Lanka, Malaysia, and Thailand. These are substitute recreation zones that are popular not only with international visitors but also with Indian visitors. Therefore, the tariff structure must be calibrated to balance revenue needs, resource maintenance, and consumers' surplus optimally. The findings of this article by estimating the recreational value of the ecosystem services will hopefully help in that effort.

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Appendix A1: Description of Data

The most popular destination locations identified in each state used for travel distance calculations are: Yarada beach (Andhra Pradesh), Calangute beach (in Goa), Mandvi beach (Gujarat), Dahanu beach (in Maharashtra), Gokarna beach (Karnataka), Kovalam beach (in Kerala), Aryapalli beach (Odisha) Marina beach (Tamil Nadu), and Bakkhali beach (West Bengal).

Visitor data were obtained from primary surveys commissioned by the MoT, which is available in the public domain. These primary surveys had been conducted as part of a more extensive exercise across many Indian states by the MoT. This survey data is not available for all the coastal states. Further, these were one-time exercises in each state. The surveys were not carried out in the same year and therefore reflected different years. In order to make them compatible, the suitable adjustments were undertaken to organize the whole dataset (see Appendix A2 for details).

The visitor survey of each state provided information on the proportion of day visitors and overnight visitors in each destination state and their corresponding per capita expenditure. However, there is some missing information in these datasets. For states where the data are missing, we substituted them with the value of a neighboring comparable state. The cost of accommodation and food differs between these two categories. The average expenditure by a random visitor was calculated by taking the weighted average of the costs incurred by day and day/night visitors for each destination state by origin using the proportion of these two categories as weights.

Appendix A2: Notes on Estimation

Estimation of travel expense: This value was obtained by multiplying the distance from the capital of the state of origin to the most visited recreation site of the host state by the cost per unit (kilometer) traveled. Visitors avail of different modes of transport in interstate and intrastate travels. The figure used in this study is Rs4 per kilometer, for reasons detailed below.

A survey of domestic visitors conducted by NSSO (2016) suggested that, for purposes of recreation and leisure, surveyed households used a mixed set of options: bus (65%), train (16%), and air (1%). About 18% used either their own vehicles or rented vehicles (NSSO, 2016, p. 14). The survey did not capture distance traveled by the visitor but inquired about the transport expense. On average, households spent Rs1,633 on recreational travel [the highest being by air (Rs23,967) followed by railways (Rs1,981) and lowest by road (Rs615)]. Domestic air travel cost per kilometer is taken from Directorate General of Civil Aviation (DGCA, 2015) which reports "passenger yield" (the average fare paid per passenger kilometer flown) with a median value of Rs4.67 per kilometer per passenger. Rail travel rates were taken from GoI (2015) and confirmed by Ministry of Railways (MoR, 2013) wherein the average rate per passenger kilometer for 2012–2013 was Rs0.285. The rate used for own or rented vehicles was taken from the government of India rate for travel allowance, which was Rs16 per kilometer during that period (Ministry of Finance [MoF], 2008a, 2008b). Road travel rates were taken from government-approved travel rates (for employees and approved travel agents). The rates for bus travel was taken as Rs1.5 per kilometer, which is the average of air-conditioned (AC) and non-AC buses (Parwez, 2013) and is similar to other government-approved rates like Government of Odisha (GoO, 2018) and lower than Government of Tripura (GoT, 2012).

The average cost of travel was calculated by taking a weighted average of long-distance travel by road, air, and train as per NSSO (2016) works out to Rs4 per kilometer.

Expense on accommodation and food: Data were available from the earlier discussed surveys on the number of day/night visitors spend in the destination state and how much an average visitor spends there. While for three states (Karnataka, Andhra Pradesh, and Maharashtra) data were available for 2009–2010 (ACNielsen, ORG-MARG, n.d.a, n.d.c, n.d.d), for two states (Goa and Odisha) data were available for 2005–2006 from state-level surveys (Datamation Consultants, n.d.; ACNielsen, ORG-MARG, n.d.a). We needed data for visitor's expenditures in each destination state by origin. In order to re-create the expenditures by origin state, we generated an index for each origin zone. This index was constructed as the ratio of per capita income of the origin state to the national per capita income in 2012–2013. Then we multiplied the average visitor expenditure at the destination state with the above indices to obtain the same for each origin state.

Opportunity cost of time: One of the persisting debates in the empirical estimation of travel cost has been the calculation of opportunity cost of travel, after Clawson and Knetsch (1966) raised this issue. Several approaches exist in the literature to deal with this issue and fall under two broad categories: (a) exclude opportunity cost, and (b) include opportunity cost as a fraction of the respondent's wage rate (some have used 100% of foregone wages). We have used the per capita income for 2012–2013 for each state of origin and multiplied it by the average number of days each visitor spent in the host state. This was considered as the income foregone by the visitors.

Origin and destination point: The capital of each origin state is considered to be the starting point of the visitor (from that state/zone). The destination point was chosen as the most frequently visited (the most popular) location in the coastal area of each destination state (identified using internet travel sites). We checked the most popular sites in each destination state, and these had the most extensive accommodation choices. While we are not excluding the possibility of these visitors going to multiple sites within the state, this assumption allows us to estimate the minimal travel expenditure to the most visited site by the average visitor.

Foreign visitors: Dealing with foreign visitors in a ZTCM study has always been a challenging issue, and some studies had dropped foreign visitors in their analysis if they constitute a small proportion of total visitors (Guha & Ghosh, 2011). However, in this study foreign visitors were included due to their importance in coastal tourism and dropping them from the analysis would have resulted in an underestimation of the recreational value. International visitors are typically known to be multisite visitors in India. Delhi is the best connected entry point for international visitors coming by air to India, being the capital city. In this study, the estimation of the travel cost of foreign visitors was done using Delhi as the origin. The cost of travel from Delhi to their home country was excluded in order to avoid any overestimation of travel cost.

The tourism data showed that while India received visitors from all over the world, the visitation was dominated by a few countries. In this study, the eight most popular origins of foreign visitors were selected for estimation: US, UK, Russia, Canada, Malaysia, France, Australia, and Germany. Bangladesh was also one of the major originating countries, but it was excluded from the recreational study as most of the visitors to India from Bangladesh come for business trips or medical treatments in metro cities (Ali & Medhekar, 2018; Gupta, 2008). The number of foreign visitors is the reported number of foreigners visiting a destination state estimated in 2012–2013. The visitation rate was then calculated using the population of the respective country. The per capita of income of foreign visitors has been estimated as the weighted average (by population) per capita income of the top eight origin countries of foreign visitors. While the visitor data were available from the state-level survey reports, per capita income of these countries were obtained from the World Bank database (see Appendix A3).

The sum of the three components—travel expenditure (from origin to destination and return), the opportunity cost (income foregone during the visit), and on-site local expenditure (on hotel and food)—constitutes the travel cost of a visitor in our study. All the prices and nominal values were adjusted to 2012–2013 prices.

Appendix A3: Data Management

The data on travel cost were constructed from numerous sources, as discussed above. The possibility of unusual observations (outliers) could not be ruled out a priori in the data generation process. Outlier tests were conducted using Stata 15, including, box plots, Iqr, and Hilo. Only the top and bottom five observations of the variable log (travel cost) were dropped after checking on results from all these tests. This implied exclusion of observations that were in the bottom 1% and above 99% of the variable (below 8.416574 and above 11.42816).

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