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Directional Heterogeneity in WTP For Multiple Attributes of Beach Recreation: An Application of Future Travel Cost Increase Method to A Labelled Discrete Choice Experiment

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ABSTRACT

This study examines directional heterogeneity in distance-decay effects on willingness-to-pay (WTP) and their significance in welfare estimates, benefits transfer, and cost-benefit analysis. We used the future travel cost (FTC) increase method in a labelled discrete choice experiment (DCE) and applied random parameter logit (RPL) models to estimate distance-decay effects in WTP for multiple attributes of beach recreation, such as coastal water quality and beach cleanliness. The results show that accounting for directional heterogeneity for multiple attributes, rather than a single attribute, yields notably different willingness-to-pay (WTP) estimates. For coastal water quality, directional effects are seen across two directions, while beach cleanliness shows directional effects in all directions. These findings highlight significant directional heterogeneity in WTP held by individual respondents for multiple attributes across different directions exist, which would help policymakers lacking financial resources to generate revenues for sustainable coastal resource management.

JEL Classification: C13, C83, O13, Q22, Q51, Q53, Q57, Q59

Keywords: Directional Heterogeneity; Discrete choice experiment; Distance-decay; Future travel cost increase; Willingness-to-pay

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INTRODUCTION

There are various studies that investigate the non-market valuation of environmental and spatial (or directional) effects[1], such as distance or travel costs, which address respondents' choices for environmental improvements at different sites under valuation located in specific regions (e.g. Pellegrini and Fotheringham, 2002; Hanley et al., 2002). For instance, Hanley et al. (2002) used an unlabelled discrete choice experiment (DCE) and included travel cost as one of the attributes to account for unidirectional (or generic) distance-decay effects in preferences of rock climbers in Scotland (the UK). Schaafsma et al. (2012), using a labelled DCE, described defined distance-decay as the spatial effect that represents a respondent's trade-off the between welfare benefits of an already undervalued site and the cost of distance, thus reinforcing the inclusion of travel cost in distance travelled by users to visit their preferred recreational site.

The above studies indicate that the distance and willingness-to-pay (WTP) relationship is negative, with lower travelling demand and higher WTP by decision-makers to lower travel costs to preferred destinations. There are other factors that can adversely impact WTP's distance-decay effect, such as the direct and indirect benefits that affect user's choice (Hanley et al., 2003). Also, information and knowledge about the site (Batemann et al., 2006) and location of available sites and their distance to users' residences (Schaafsama et al., 2013) also influence a negative relationship between distance and WTP. All these factors empirically examined in the above studies justify that preferences of users living in different directions are more heterogeneous and unbiased if distance-decay effect is accounted using travel cost of visitors travelling from various directions, such as East, west, north and south. (e.g. Schaafsma et al., 2012).

The use of distance or travel cost in the revealed preferences (RP) (e.g. Parsons et al., 2000; Bateman et al., 2006; Blakemore and Williams, 2008; Preez et al., 2011) and stated preferences (SP) studies (e.g. Oviedo et al., 2016; Penn et al., 2016; Hanley et al., 2002) revealed that distance-decay effects are largely unrecognised and do not consider users' locations across different directions, leading to unidirectional (or generic) distance-decay effects over space (Schaafsma et al., 2012). Now, a question arises as to the extent to which variations in the distance-decay effect occur if multiple sites' undervaluation is not randomly located over space. This means that the more availability of substitutes across different directions the lower is distance-decay or vice-versa. If we ignore this directional (or geographical) heterogeneity of respondents, then in that case, empirical models may generate biased or statistically insignificant distance-decay effects (Cameron, 2006).

According to Schaafsma et al. (2012), focusing solely on a distance variable in SP models (see Campos et al., 2007; Oviedo et al., 2016) may not fully capture spatial heterogeneity in WTP estimates. The literature review confirms that respondents view distance as a travel cost, particularly in SP studies in developing countries with rising fuel prices and unstable incomes. Understanding the potential increase in the future travel costs (FTC) is vital. While previous studies have addressed directional effects on WTP for single attributes, the impact on multiple attributes across substitute sites remains unexplored. This calls for further empirical investigation into the directional effect on WTP for multiple attribute improvements.

Our study is the first in the SP and discrete choice experiment (DCE) literature to incorporate FTC increase and hypothetical entrance fee, while accounting for directional heterogeneity in WTP for improvements in multiple attributes of beach recreation. In contrast, almost all RP and SP studies (e.g. Parsons et al., 2000; Blakemore and Williams, 2008; Preez et al., 2011; Mangan et al., 2013; Oviedo et al., 2016; Penn et al., 2016; Hanley et al., 2002) examined preference heterogeneity without taking into account users' residential locations across different directions, but according to our knowledge until recently, only one study conducted by Schaafsma et al. (2012) accounted for directional heterogeneity in WTP using distance and a single attribute. To fill the research gap, our study accounted for directional heterogeneity using a novel approach that includes FTC and multiple attributes rather than a single attribute.

We used DCE with eight labelled alternative beaches with various environmental improvements. Our research examines how distance-decay varies across different directions in the city, impacting WTP for multiple beach attributes, including coastal water and beach cleanliness. Comparing random parameter (RPL) models estimated in this study as under, those with directional heterogeneity outperform other models with unidirectional (or uniform) heterogeneity, leading to significant differences in preferences .

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[1] Directional or Spatial heterogeneity are interchangeable used, however, both terms refer to users' WTP, who live across different directions (i.e. East, west, north and south) from their preferred recreational sites.

REVIEW OF LITERATURE

Numerous studies have explored various beach attributes such as water quality, beach cleanliness, congestion, and travel costs in selecting beaches for recreation. These studies have examined beach users' preferences and WTP for essential beach attributes and levels, including mainly water quality and beach cleanliness in various locations around the world: Hilger and Hanemann (2006) in South California, Blackmore and Williams (2008) in Turkey, Beharry-Borg and Scarpa (2010) in Caribbean beaches, Hynes et al. (2013) for preferred beaches, Penn et al. (2016) in Hawaii, Leggett et al. (2018) in Southern California, and Mohamad et al. (2023) in Port Dickson, Malaysia.

Among these, some RP studies, including Blackmore and Williams (2008), Parsons et al. (2000), and Preez et al. (2011) included a single (or uniform) travel cost variable to capture unidirectional (or uniform) distance-decay effect in WTP for beach recreation attributes, like water quality and beach cleanliness. Besides, some earlier SP DCE studies on beach recreation, including Penn et al. (2016), and Hynes et al. (2013), included amongst others coastal water quality and beach cleanliness attributes in addition to travel cost attribute to calculate distance-decay effect (i.e. a negative relationship between distance and WTP), but without considering directional heterogeneity effect.

The above review demonstrates that the distance-decay effects in SP studies, no matter unidirectional (or without directions), have been largely ignored or investigated in somewhat simple way by adding a single uniform travel cost (or distance) variable (Schaafsma et al., 2013), which limitedly and only captures unidirectional heterogeneity, but not directional heterogeneity. However, during the last decade, directional distance-decay effects are increasingly recognised in SP studies valuing environmental goods like lakes, rivers, landscapes and so on (Khan et al., 2022; Logar and Brouwer, 2018; Lizin et al., 2016; Schaafsma et al., 2012 and 2013; Brouwer et al., 2010). Although there exists a limited research on spatial effects in WTP for coastal resources like beaches and coral reefs (e.g. Schaafsma and Brouwer, 2020; Mathews et al., 2018), many SP studies had potential to include directional (or spatial) dimensions (e.g. Penn et al., 2016; Hynes et al., 2013; Beharry-Borg and Scarpa, 2010; Song et al., 2010; Hanley et al., 2002).

The importance of including directional (or spatial dimensions) affects resource users' (or even non-users) preferences and their WTP for improvements in natural resource services (Schaafsma et al., 2012). If substitute resource sites and directions between these alternative sites and their users are overlooked, biased WTP values will likely be generated (e.g. Lizin et al., 2016; Schaafsma et al., 2013). According to our knowledge, using a novel approach to include FTC increase instead of distance as a usual practice in the previous studies (see e.g. Logar and Brouwer, 2018; Schaafsma et al., 2012) in DCE, our study examines and demonstrates differences between preferences derived from RPL models capturing distance-decay effect with unidirectional (or uniform) and directional heterogeneity in WTP for multiple attributes rather than for a single attribute, as previously addressed by Schaafsma et al. (2012).

RESEARCH METHODOLOGY

Attributes Selection

The process of identifying and selecting relevant alternatives, potential attributes, and their associated levels in the design of a labelled DCE, was based on relevant previous research studies, as mentioned above in the literature review, and focus group interviews with previous visitors having recreational experience to choose these eight alternatives beaches during the last 12 months, and stakeholders, including coastal communities and experts involved in coastal decision-making.

Only these eight beaches which are freely accessible to visitors were selected as labelled alternatives in choice cards, whereas Nathiagali and Sunehra beaches were excluded because the former is only accessible to Naval forces of Pakistan, whereas the latter is only visited by anglers. For this reason, our labelled DCE design, both in orthogonal fractional factorial design during the initial survey to generate prior values for the D-efficient design, later implemented during the final surveys, including the above mentioned labelled eight beaches as mentioned above in addition to an opt-out alternative, 'neither beach', phrased as 'do another recreation activity or stay at home (see Figure 1). The reasons behind the one we mentioned above, including these eight specific beach site alternatives, were based on respondents' observations, which revealed that they considered these eight beach substitutes when choosing the most preferred beach during focus group discussions.

Given the beach attributes mentioned below, and considering **an increase in your transportation costs, travel times to each beach next year,** and **the proposed entrance fees**, which beach would you prefer to visit?

Beach / Attributes	Clifton / Sea View	Manora Island	Sandspit / Turtle	Hawke's Bay	French	Paradise Point	Cape Mount	Mubarak Village	Neither Beach
Coastal Water Quality	Low	High	Low	High	Medium	Medium	High	Medium	I choose to remain at home OR Go for other recreation activities
Cleanliness on Beaches	No litter/ Almost clean	Modestly littered	No litter/ Almost clean	Modestly littered	Highly littered	Modestly littered	Highly littered	No litter/ Almost clean	
Congestion	Highly congested	Modestly congested	Lightly congested	Highly congested	Lightly congested	Lightly congested	Highly congested	Modestly congested	
Site Facilities	Low	Medium	High	Medium	Low	Low	Low	High	
Entrance Fee	PKR.120 per entry	PKR. 30 per entry	PKR. 70 per entry	PKR.120 per entry	No Entrance Fee PKR. 0 per entry	PKR.120 per entry	PKR. 70 per entry	PKR. 30 per entry	
Your choice	☐	☐	☐	☐	☐	☐	☐	☐	☐

Figure 1 An example of labelled DCE that includes an increased future travel cost

Based on the above previous literature review and various focus group discussions with some residents (or beach visitors who previously visited these beaches during the last year) and other stakeholders, four beach attributes, including coastal water quality, cleanliness on the beach, congestion, and site facilities, were finally selected (see Table 1). During focus group interviews, definitions of these attributes and levels with illustrations were thoroughly described and debated with the respondents to get more feedback, realising their in-depth perception of the attributes and levels to be included later in DCE design and surveys (see Table 1, Figure 1 and Annex 1).

Table 1 Selected attributes, their Levels and the Future travel cost increase variable

Attributes / Variable	Levels
Coastal water quality	High, Medium, Low*
Cleanliness on Beach	No litter (Almost clean), Modestly littered, Highly littered*
Congestion	Lightly congested (& quiet), Modestly congested, Highly congested (& noisy)*
Site facilities	High, Medium, Low*
Future travel cost (FTC) increase	Increased future transportation expenditures + Increased future (opportunity) cost of time
Entrance fee	PKR = 0 (i.e. No entrance fee)*, PKR 30 PKR 70 , PKR 120

Note: * indicates baseline (or reference) levels.

In Pakistan, coastal water quality standards still need to be improved because only one, Pakistan Environmental Protection Act (PEPA, 2012), which generally addresses water quality standards, specifically drinking water quality and fresh waters (e.g. lakes, irrigation and groundwater); however, it lacks other relevant water quality standards relating to coastal water quality. Most focus group participants found three low, medium, and high levels sufficient for evaluating water quality at eight selected beaches (see Figure 1 and Table 1). Our methodology mirrors the US National Coastal Water Quality Standards, as referenced by Parsons et al. (2003). We followed the US-EPA water quality ladder and levels proposed by Carson and Mitchell (1993) for categorizing coastal water quality based on ecological suitability. To make this system more user-friendly, we incorporated colour-coded visual aids considering various water characteristics like contamination, odour, colour, clarity, and suitability for recreational activities. Participants expressed difficulty in understanding objective indicators, so we adopted Schaafsma et al.'s (2012) approach by developing a comparable colour-coded water quality ladder. Colour-coded illustrations can enhance the interpretability of attribute coefficients for visitors (Hanley et al., 2003).

Chioce Experiment Design

Our DCE design included all eight labelled beach alternatives with their specified attributes and varying levels (see Table 1) and generated choice cards. Using three levels for four non-monetary attributes, such as water quality, cleanliness of beaches, congestion (or crowding) and beach facilities, and four levels for entrance as a monetary attribute, we initially applied a fractional orthogonal experimental design with main effects and interactions (Hensher, et al., 2005) using Ngene software (version 1.1.1; Choice Metrics, 2014) to estimate prior values to generate D-efficient fractional design for the final surveys. The number of blocks depends on the card numbers' total choice and complexity (Kuhfeld, 2010). For both mentioned experimental designs, 36 choice cards were generated and blocked into 6 specific choice cards. For all 36 choice cards (or 6 choice sets), the choice cards were then sequentially set, including the opt-out alternative, and implemented serially for each respondent during surveys.

These model results justify that our sample size of 156 respondents was sufficient for RPL model estimations using random cluster multi-stage sampling procedure. Due to the lack of a population framework of beach visitors who are residents, the sample size selection initially involved (i) selecting different clustered administrative areas (or districts) of Karachi city across different directions (i.e. east, west, north and south) and then, (ii) randomly selecting and interviewing respondents, having beach recreation experiences in during last one year, with their home locations in different areas and directions.

Case Study Description

Karachi, the capital of Sindh province in Pakistan, has over 25 million inhabitants, contributing 20% to the country's GDP at more than US$200 billion (GoP, 2023). It serves as a key urban trade hub, boasting a 70-kilometre shoreline. This has led to mounting pressure on coastal resources due to urban growth and economic activities expanding over the past 30 years. The city accommodates more than 6,000 manufacturing industries, discharging contaminants into *Layari* and *Malir* rivers yearly. Karachi faces challenges with its drainage system, allowing 330 million gallons of raw sewage to flow into the sea daily (KSDP, 2007). Agricultural chemicals further pollute marine waters (Mansoor and Mirza, 2007). Consequently, marine water pollution and waste (or litter) have harmed beach recreation and aquatic life.

Residents of Karachi city visit beaches considering water quality, cleanliness, congestion, and site facilities. They enjoy various activities like swimming, boating, and nature watching, while also accessing coastal resources like fisheries and mangrove forests. Coastal resources like water quality, seaside agriculture, coastal fisheries and mangrove products and services lack economic consideration in policymaking due to their public good characteristics. As a result, policymakers lack vital information to sustainably manage coastal development, especially in Karachi where growing population and industrial development are leading to beach pollution and waste issues.

For this study, all eight beaches were selected along the coast of Karachi city, namely Clifton and Sea View, Manora Island, Sandspit, Hawke's Bay, French, Paradise Point, Cape Mount, and Mubarak Village (see Figure 2), which are situated from east to west along the coastline, and based on personal observations, the residents of the city frequently visit these beaches. Keeping in view the non-existence of official statistics, we estimated that almost 5.85 million residents visit these beaches annually. While estimating residents' WTP for improvements in different attributes of beach recreation, our research introduces a hypothetical entrance fee to assess visitors' WTP (see Figure 2).

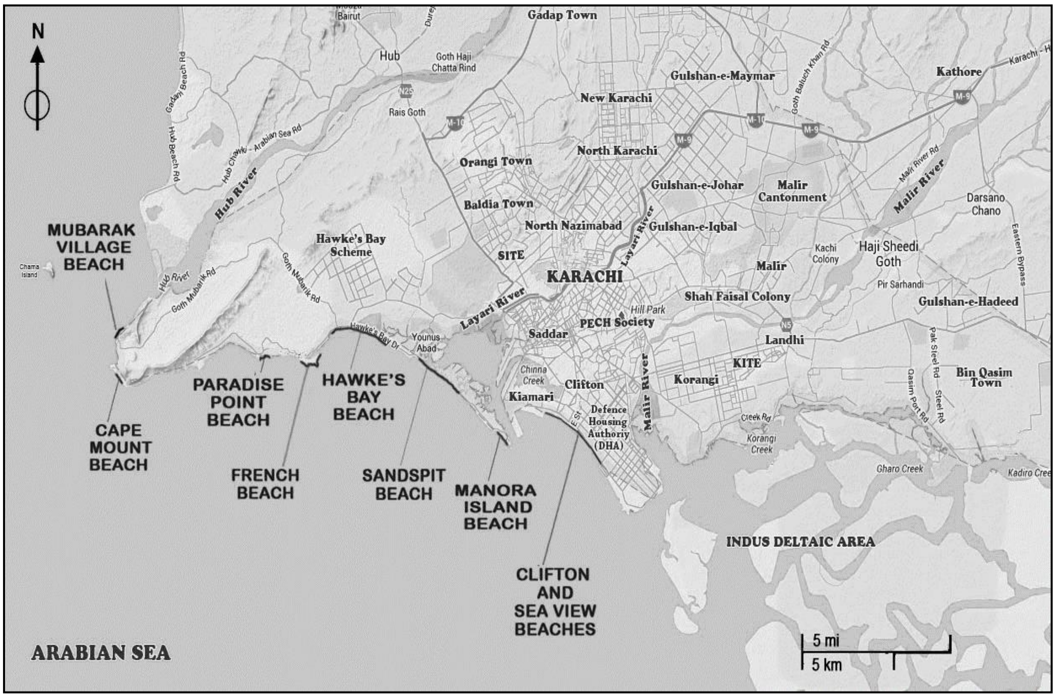

Figure 2 Locations and directions of selected eight beaches neighbouring Karachi city, Sindh province of Pakistan

Visitors to these beaches gain recreational benefits as 'free riders' paying through transportation costs and foregone time (i.e. travel cost). Besides, the recent studies (see Mohamad et al., 2023; Khan, 2011; Blackmore and Williams; 2008) also considered a hypothetical entrance fee parameter for resource managers to generate revenue from free riders. Due to this market failure (or free access), visitors get beach recreation benefits free of cost (or without paying any entrance fee). Also, coastal water quality and cleanliness of beaches situated along Kratachity city coast have been deteriorated since more than two decades in addition to increasing congestion (or crowding) of visitors. The lack of beach facilities for visitors has become another problem over the last many years. To address these problems, the Government of Pakistan (or coastal managers) has been confronting these coastal environmental issues due to inadequate financial resources.

The Government of Pakistan currently generates revenue from product sales, services, and beach activities like camel riding, boating, and parking fees at beaches along the city coast. However, if an entrance fee per adult per entry is introduced to beach visitors, then coastal managers having inadequate resources can manage coastal resources, including beaches and their associated coastal water quality and beach cleanliness, can generate additional revenues to manage these resources on financially sustainable basis.

Data Collection

Each individual was presented with one of the six choice cards in the surveys, involving initially orthogonal fractional factorial design with the main effects to generate prior values for D-efficient design. Lastly, D-efficient design was included in the final suverys based on a sample of 156 individuals. Our both orthogonal and D-efficient designs generated 36 choice cards blocked into 6 choice sets (i.e. each choice set included 6 choice cards) to be answered by each individual . In other words, we assigned 6 choice cards to each respondent to lessen their cognitive burden, and repeated this process for the entire sample. The data was collected through a questionnaire for final surveys, utilizing D-efficient design .

Considering off-site sampling method of residents (or visitors) our study involved, the data was collected from respondents after their office timings during the early evening and the weekends (i.e. Saturdays and Sundays in Pakistan), when their availability at their homes was almost ensured. We used Microsoft Excel software for data entry process and later analysed data using NLOGIT software, version 5.0. The questionnaire consisted of three sections: the first section gathered details on respondents' travel behaviour related to distances from home to desired beaches, transportation costs, visit purpose, types of activities planned at the beach, and more. A city map was provided to show the locations of the eight beaches, aiding respondents in evaluating distances from their homes to each beach.

In the second section, respondents completed a labelled DCE with six choice cards each, assessing attributes like coastal water quality, beach cleanliness, congestion, site facilities, and entrance fees as a monetary attribute. This process identified preferences for the best beach among eight alternatives and opt-out (i.e. neither beach alternative) in each choice card. The final section gathered socio-economic and household details from visitors, while investigating cognitive burden and fatigue through discussions and surveys. Respondents reported no issues with the choice cards involving eight beaches and four non-monetary attributes.

During the final surveys, personal interviews with Karachi City residents who had visited eight beaches in the past five years were conducted using an off-site sampling method via multi-stage random cluster sampling. Residents in various towns of 6 districts were selected using off-site sampling, followed by selecting respondents' homes through simple random sampling. Off-site surveys were preferred for higher response rates to avoid interviewing most frequent visitors or endogenuous stratification (e.g. Mangan et al., 2013), and to interview both male and female residents without cultural constraints. Only city residents were interviewed, excluding non-residents and non-frequent visitors from nearby cities.

Data Analysis

Theoretical framework

In DCE, respondents face a hypothetical situation to select their most preferred alternative from a choice situation of various alternatives with varying attribute levels, including an opt-out (or status-quo). Sequentially, individuals are asked to choose their most preferred alternative in the remaining choice cards that could maximize their utility.

According to Random Utility Modelling (RUM) theory, developed by McFadden (1974), researchers do not observe utility directly but estimate utility from respondents' observed choices. Therefore, the indirect utility function of individual i for alternative n (U_{in}) contains two components, shown in equation (1) as follows:

$$U_{in} = V_{in} + \varepsilon_{in} \tag{1}$$

Here, V_{in} is the systematic component of the indirect utility, including the attributes and their levels observed by the researcher, whereas ε_{in} is the random or unobserved component. An individual always selects the alternative that brings him/her the maximized level of expected utility. Hence, the decision-making process functions as a comparison of the utility of attributes' values as indicated in equation (2).

$$U_{in} = v\ (X_{in}, P_{in}, (X_{in} * FTC_{in}), Z_{in}, \varepsilon_{in}) \tag{2}$$

where X_{in} refers to attributes of an alternative *n* of an environmental good; P_{in} indicates a monetary (or price) attribute; Z_{in} refers to socio-demographic characteristics of an individual decision-maker *i*; and ε_{in} indicates an error term that varies over alternatives *n* and individuals *i*. Considering WTP (or implicit price) for improvements in coastal water quality and beach cleanliness over space, we will interact both these attributes with a future travel cost (FTC) increase (*X * FTC*) in our Model. Instead of including distance, which is usually practised as a travel cost proxy, we will incorporate the FTC increase to reach beaches (see Annex 3), respectively, to capture the distance decay effect on visitors' preferences.

A respondent (or an individual) will select an alternative *n* if $U_{in} > U_{kn}$ for all $i \neq k$ from a given choice situation (or choice card) that maximizes his/her expected utility in comparison to all other alternatives available in the choice card (or task). However, since the utilities comprise a stochastic or an observed component ε_{in}, one can only define the probability *Pn* of selecting substitute *n* as indicated in equation (3).

$$P_n = p\ (V_{in} + \varepsilon_{in} > V_{kn} + \varepsilon_{kn}\ ;\ \forall\ k \in C) \tag{3}$$

Here, *C* represents the set of all possible alternatives, including an opt-out (or status quo). The V_{in} includes attributes and varying levels of the choice situation, and there are beach alternatives, labelling all eight beaches in DCE (see Figure 2).

Empirical specification

To model the directional heterogeneity in distance decay effect on WTP values, we designed a labelled DCE with eight beach locations, allowing us to evaluate substitute accessibility across various directions in Karachi city. In empirical specification-1, as shown in Equation (4), we envisage that the utility *U* of a visitor *i* for beach *n* specifies the modelling framework to capture unidirectional heterogeneity by applying random parameter (or mixed) logit models.

Empirical specification-1: Distance decay without directional heterogeneity effect:

$$U_{in} = \alpha_i + \beta_i^x X_{in} + \beta_i^p P_{in} + \beta_{in}^{FTC}(X_{in} * FTC_{in}) + \beta_i^z Z_{in} + \varepsilon_{in} \tag{4}$$

where α_i signifies an alternative-specific constant (ASC), *X* represents the site quality attributes, such as coastal water quality, beach cleanliness, congestion and site facilities, and *P* refers to entrance fee as a monetary attribute, respectively. Considering WTP for improvements in coastal water quality and cleanliness on beaches over space, we interact both these attributes with the FTC increase (*X * FTC*) in our Model 2. Instead of including distance, our novel approach included an increase in FTC as a distance proxy by including and calculating both transportation cost and the opportunity cost of travelling time to beaches, respectively. In addition, *Z* signifies visitors' characteristics and interactions, whereas ε_{in} the error term assumes an extreme value (Gumbel) distribution associated with an *i.i.d.* property.

Subsequently, we apply the modelling specification-2 as shown in equation (7) to estimate directional (or spatial) heterogeneity in the FTC increase (distance-decay) by interacting site-specific directional effects (α_i * *Dir)** (*X * FTC*) with multiple site quality attributes. Here, α_i is an alternative-specific constant for all eight beaches, *Dir* denotes directional dummies for east, west, north and south directions, where a visitor's residence is located. The directional dummy takes the value 1 if the visitor is located from a specific beach site in Karachi city's east, west, north, or south direction. *X* represents multiple attributes, such as beach water quality and beach cleanliness, and *FTC* refers to the future travel cost increase as a distance proxy. We will compare empirical specification-1 with generic, unidirectional distance-decay effects (i.e. without directional heterogeneity) to our empirical specification-2, which incorporates site-specific directional heterogeneity effects in WTP values.

Empirical specification-2: Distance decay with directional heterogeneity effect:

$$U_{in} = \alpha_i + \beta_i^x X_{in} + \beta_i^p P_{in} + \beta_{in}^{FTC}(X_{in} * FTC_{in}) + \beta_i^z Z_{in} + \beta_{in}^{Dir}(X_{in} * FTC_{in}) \text{ x } (\alpha_i * Dir) + \varepsilon_{in} \quad (5)$$

where β_{in}^{Dir} coefficient captures the site-specific directional heterogeneity effects (e.g. East, west, north and south directions of respondents' residential locations) in visitors' preferences and WTP for multiple attributes, including coastal water quality and beach cleanliness.

RESULTS AND DISCUSSION

Beach visitors' characteristics

We applied Chi-squared and Kruskal-Wallis tests to compare differences in characteristics of beach visitors living in different directions, such as east, west, north and south directions of Karachi city (see Table 2). After obtaining information from 156 respondents of our sample during surveys and using Chi-squared and Kruskal-Wallis tests, we found statistically significant differences in all the characteristics of beach visitors living in different directions of Karachi city, including their gender, age, marriage, household size, monthly household income, distance travelled and FTC, at 1% level of significance (see Table 2).

Table 2 Comparison of Beach visitors' characteristics living in the different directions

Directions / Characteristics	North	South	East	West	Test[+] Statistic (χ^2)	Pakistan population
Gender (% Female = 1)	27.4	26.7	50.0	00.0	505.40***	52.0
Age (%)						
(18 – 39 years = 1)	72.6	70.0	81.7	75.0	96.79***	31.1
(40 – 59 years = 1)	25.8	30.0	16.7	25.0	118.43***	13.5
(≥ 60 years = 1)	1.6	00.0	1.6	00.0	27.13***	0.5
Marriage (% Married = 1)	54.8	63.3	55.0	50.0	36.59***	63.0
Household Size (Average)	6.6	4.8	6.4	4.5	413.23***	6.4
Number of children/household (Average)	2.1	1.4	2.0	1.7	174.38***	2.9
Education Level (%)						
(Primary and secondary = 1)	8.1	7.1	11.3	0.00	57.87***	74.9
(Higher: college/university =1)	90.3	92.9	85.5	0.00	98.65***	6.4
(Informal education = 1)	1.6	0.00	3.23	0.00	65.72***	0.4
Employed/Income earning (% = 1)	88.7	85.7	70.9	100	426.93***	79.0
Monthly Household Income (Average 1000 PKR) #	56.3	84.0	47.1	35.0	1117.9***	2.1
Distance travelled (Average km)	38.2	24.9	47.9	32.4	1361.2***	----
Future travel cost increase without opportunity cost of time when travelling one extra kilometer (Average 1000 PKR/visitor/day trip)	98.7	97.1	89.4	66.1	166.1***	----
Future travel cost increase with opportunity cost of time when travelling one extra kilometer (Average 1000 PKR/visitor/day trip)	107.0	105.9	99.3	72.6	178.5***	----
Number of choice cards (CC)/respondent	6					----
Sample (N = Number of respondents)	156					----
Total observations (N x CC)	936					----

Note: Asterisk *** stands for 1% level of significance at 3 degrees of freedom, asterisk + stands for types of statistical tests applied. For dummy variables, such as gender, age, marriage, etc., Chi-squared test was applied, and for non-dummy variables, such as household size, income, distance, etc., Kruskal-Wallis Chi-squared test was used. Asterisk # PKR refers to monthly average income of visitors in thousands of Pakistani Rupee (PKR).

Table 2 demonstrates that gender and age of respondents across the north, south, east and west directions of Karachi city are almost consistent with population statistics of Pakistan, however, remain statistically significant at a 1% level. Likewise, marital status, household size and number of children per household are also consistent with the national statistics, but exhibit rationally or statistically significant differences at a 1% level. Except for education and monthly household income, which included mostly highly educated, and higher-income respondents in our sample (i.e. N= 156 respondents), which are although not consistent with the national statistics, however, they vary with significant statistical differences at 1% level, including employed visitor statistic, which is consistent with statistical differences across all directions at a 1% level of significance. Besides, differences in distance travelled (on average), FTC increase, including FTC with the opportunity of cost of travelling, are explicitly and statistically significant at a 1% level.

Random parameter logit (RPL) models

In modelling specifications, despite these statistically significant differences, we controlled other variables, except education level, employed visitors, married male visitors, gender, number of children in visitors' group, water and beach activities, respondents visiting beaches with family, monthly household income and the FTC increase, to ensure that directional differences in these characteristics do not affect our model results.

Table 3 Random Parameter Logit (RPL) Models

Parameters	RPL Model-1: Uniform distance-decay without directional heterogeneity		RPL Model-2: Distance-decay with directional heterogeneity	
Beaches (ASC dummies)	*Coef. (S.E)*	*Coef. St. Dev.(S.E)*	*Coef. (S.E)*	*Coef. St. Dev. (S.E)*
Sea view and Clifton	5.734 (1.984)***		5.642 (1.983)***	
Manora Island	5.252 (1.986)***		5.643 (1.982)***	
Sandspit	5.481 (1.985)***		5.602 (1.982)***	
Hawke's Bay	5.251 (1.985)***		5.456 (1.983)***	
French beach	4.903 (1.985)**		5.121 (1.995)**	
Paradise Point	4.226 (1.989)**		4.483 (1.987)**	
Cape Mount	4.237 (1.987)**		4.734 (1.984)**	
Mubarak Village	4.244 (1.989)**		4.537 (1.987)**	
Random Parameters (Attributes)				
Medium water quality	0.850 (0.188)***	1.094 (0.261)***	0.978 (0.182)***	1.047 (0.256)***
High water quality	2.963 (0.225)***	1.357 (0.206)***	3.200 (0.250)***	1.390 (0.234)***
Modestly littered beach	0.565 (0.106)***	0.444 (0.207)**	0.524 (0.107)***	0.357 (0.228)
No litter (Almost Clean beach)	1.522 (0.105)***	0.842 (0.143)***	1.562 (0.143)***	0.703 (0.145)***
Modestly congested beach	0.486 (0.103)***	0.509 (0.123)***	0.492 (0.103)***	0.398 (0.150)**
Lightly congested (quiet) beach	0.259 (0.122)**	0.671 (0.144)***	0.233 (0.124)*	0.626 (0.134)***
Medium facilities	0.434 (0.086)***	0.193 (0.254)	0.421 (0.086)***	0.248 (0.156)
High facilities	0.045 (0.051)	0.422 (0.133)***	0.029 (0.096)	0.337 (0.185)*
WQ x FTC	– 0.152 (0.078)*	0.151 (0.078)*	–0.223 (0.076)***	0.223 (0.076)***
BC x FTC	– 0.223 (0.051)***	0.223 (0.051)***	–0.236 (0.063)***	0.236 (0.063)***
Non-Random Parameters				
Entrance fee	– 0.024 (0.003)***		–0.024 (0.003)***	
Visitor's characteristics & Interactions				
Education level	– 0.449 (0.137)***		–.457 (0.138)***	
Visitor if employed =1 (dummy)	1.578 (0.489)***		1.438 (0.510)***	
Male visitor if married =1 (dummy)	1.094 (0.559)*		1.059 (0.549)*	
Number children in visitor's group	– 0.128 (0.061)**		–0.123 (0.064)**	
Entrance fee x Water activities	0.014 (0.005)***		0.014 (0.005)***	
Entrance fee x Beach activities	0.010 (0.003)***		0.010 (0.003)***	
Entrance fee x Family visitor group	– 0.005 (0.003)*		–0.005 (0.002)**	
Entrance fee x Income	0.0002(0.35x10^{-4})***		0.0002 (0.34x10^{-4})***	
Water Quality directional dummies				
WQ x FTC x Sea View x North			0.522 (0.289)*	
WQ x FTC x Sandspit x North			0.404 (0.201)*	
WQ x FTC x Cape Mount x East			–0.605 (0.254)**	
WQ x FTC x Manora Island x West			–9.263 (3.772)**	
WQ x FTC x Mubarak Village x West			– 3.183 (1.720)*	
Beach Cleanliness directional dummies				
CL x FTC x Manora Island x North			–0.692 (0.239)***	
CL x FTC x Sea View x East			0.812 (0.394)**	
CL x FTC x Sea View x West			3.488 (1.799)**	
RPL Models Fit statistics				
Log-likelihood	– 1072.328		– 1057.505	
Adjusted–R^2	0.47		0.48	
Number of parameters	37		45	
N (Respondents x Number choice sets)	936 (156 x 6)		936 (156 x 6)	

Note: ASCs stands for alternative-specific constants, FTC future travel cost increase, WQ water quality (= moderate + high water quality), and BC beach cleanliness (= moderately littered + no litter). Stars *** (**) * represent statistical significance of coefficients at 1% (5%) 10% levels, respectively.

The results of the RPL (or Mixed Logit) model are detailed in Table 3. Our baseline RPL Model-1 captures a generic distance-decay effect. RPL Model-2 incorporates directional heterogeneity into this effect. We used normal distributions for random parameters of beach recreation attributes like WQ x FTC and BC x FTC. These variables interact with FTC increase, reflecting annual increases in distance or traveling cost and opportunity cost of traveling time. Moderate and high water quality levels and modestly littered and clean beach levels were added as dummy variables. Random coefficients for (WQ x FTC) and (BC x FTC) are highly significant, showing a generic (or uniform) preference heterogeneity. Both variables indicate a decline in WTP with increased FTC.

In addition, other non-random parameters representing respondents' characteristics, including education, employed visitors, married males, and the number of children travelling in groups, are statistically significant at 1% and 5% levels, but unexpectedly, education bears a negative sign in both RPL models (see Table 3), possibly because the education literacy rate in Pakistan is 62.3% (GoP, 2023), which is much lower as compared to the middle and high-income countries.

Several non-random interacted variables with the entrance fee, like water activities, beach activities, visitors' group size, and income, show statistical significance at 1%, 5% and 10% levels, respectively, in both RPL-1 and RPL-2 models. Specifically, entrance fees linked to water and beach activities, as well as income, have positive effects. Moreover, higher-income visitors tend to pay more for entrance fees when beach activities involve high water quality. Conversely, the variable for visitors with larger family groups has a negative effect as anticipated. This suggests that larger family groups are expected to pay higher entrance fees per person, leading to fewer beach visits.

Also, interacted variables with entrance fee, including (Entrance fee x water activities), (Entrance fee x beach activities), (Entrance fee x visitors' group travelling with family) and (Entrance fee x income) are statistically significant at in both the RPL-1 and RPL-2 models. Obviously, (Entrance fee x water activities), (Entrance fee x beach activities) and (Entrance fee x income) have positive signs as expected. This implies that higher income visitors will likely to pay higher entrance fees if they enjoy beach recreation activities involving high water quality and beach cleanliness. In contrast, a variable of visitors travelling with a larger family group bears a significantly negative sign as expected, which indicates that visitors with a larger family group are supposed to pay more entrance fee for the remaining family group; hence, it bears a negative relationship.

Effects coding (see Annex 2) instead of dummy coding, was used for estimating random parameter logit (RPL) models to address non-linear thresholds and confounding effects (Louviere et al., 2000). Various distributions (log-normal, triangular, uniform) were tested during RPL model estimation, with the best model-fit results showing normally distributed non-monetary parameters and a constant monetary parameter. Models were estimated using 100 Halton draws in NLOGIT version 5.0, as Bhat (2001) showed that 100 Halton draws in RPL models provide more accurate results than 1000 pseudo-random draws.

The RPL model results in Table 3 show positive alternative-specific constants (ASCs) values for all eight beaches, with the highest coefficients for Sea View, Clifton, Manora Island, Sandspit, Hawkes' Bay, and French beaches, indicating preferences for paying an additional visit to these beaches over choosing 'Neither beach' alternative (see, e.g. Beharry-Borg and Scarpa, 2010; Hanley et al., 2002), which represents baseline (or reference) with no reference level of any attribute for the remaining ASCs, is different from the usual academic practice, that is so-called status-quo or opt-out with baseline levels (see, e.g. Logar and Brouwer, 2018; Lizin et al., 2016).. The ASC coefficients for all eight beaches are statistically significant at 1% and 5% levels. Nearest beaches have highly significant positive constants at a 1% level, while more distant beaches are relatively less significant at a 5% level. The ASC coefficients for all eight beaches are statistically significant at 1% and 5% levels. Nearest beaches have highly significant positive constants at a 1% level, while more distant beaches are relatively less significant at a 5% level.

All the random parameters representing coastal water quality, cleanliness of beaches, and congestion are statistically highly significant, except for the high site facilities attribute, with the expected positive signs in RPL Model-1 and RPL Model-2. An entrance fee, a non-random monetary attribute, bears a negative sign, as expected. The coefficients for water quality and beach cleanliness for higher levels have significantly higher values as expected; however, this is not the case for congestion and site facilities attributes' levels (see Table 3). Congestion (or crowding) may negatively and positively affect visitors' experience (see Taylor and Longo, 2010); hence, the public prefers modestly congested beaches that few visitors visit. Regarding site facilities, respondents preoccupied idea of commonly rare facilities in Pakistan preferred medium facilities (i.e. public parking and private restaurants with toilet access) more than high facilities with toilets.

RPL model-2 in Table-3 includes directional dummies for the east, west and north directions of respondents' residential locations. Model statistics confirm that RPL Model-2 with directional heterogeneity performs better than RPL Model-1 without directional heterogeneity. Furthermore, Ben-Akiva and Swait (1986) test for non-nested discrete choice models confirms that RPL-2 Model overall performs better than RPL Model-2 at less than 1% statistical significance level, i.e. $Pr \leq \Phi$ (– 3.479) = 0.002. For RPL Model-2, a stepwise choice modelling approach was applied, starting with the model as indicated in Equation (7) and step-by-step insignificant directional heterogeneity coefficients were excluded until significant directional heterogeneity parameters remained only with south direction as a baseline. Our RPL Model-2 results remain consistent with the only previous study in this context, conducted by Schaafsama et al. (2012), however, our model results demonstrate there exists directional heterogeneity in another attribute (i.e. beach cleanliness) by applying FTC increase method in DCE, which has never been addressed before, according to our knowledge.

The main goal in estimating these RPL models is for spatial and directional mapping of WTP for multiple beach attributes, like water quality and beach cleanliness. The best fit RPL Model-2 represents the five and three directional heterogeneity effects in distance-decay on WTP for coastal water quality and beach cleanliness, which are statistically significant at 1%, 5% and 10% levels, respectively. The site-specific directional effects are found in the utility functions of five beaches, including Sea View and Clifton, Manora Island, Sandspit, and Mubarak Village beaches (see Figure 1). However, significant directional heterogeneity effects in WTP for water quality are more than the same for beach cleanliness (see Table 3), indicating that respondents living in different directions have more variation in their WTP for site-specific water improvements.

The RPL Model-2 found significant positive directional heterogeneity effects at Sea View, Clifton, and Sandspit beaches for water quality, solely for north-direction respondents at a 1% level. This suggests visitors in the north show higher WTP and lower distance-decay effects compared to others. In contrast with Schaafsama et al. (2012), our study emphasizes the influence of travel costs on respondents' preferences. Visitors from the north face nearly equal distances to Sea View and Clifton, and Sandspit beaches, underscoring the trade-off between beach attributes and FTC.

In contrast, there is a significantly negative directional heterogeneity effect for respondents living in the east and west directions, implying that visitors in east and west directions have a stronger distance effect in their WTP for improved water quality at Cape Mount, Manora Island, Mubarak Village Sea View and Clifton and Sandspit beaches than visitors in other directions. Besides, we found a significantly negative and stronger directional heterogeneity effect for respondents living in the north direction of Karachi city for beach cleanliness attribute at 1% level. However, results also show significantly positive and lower directional heterogeneity effects for respondents living in east and west directions for improvements in Clifton and Sea View Beach at a 5% level (see Table 3).

Although both RPL Model-1 and RPL Model-2 demonstrate highly significant level for beach cleanliness as compared to coastal water quality, the distance-decay parameter estimates (WQ×FTC) and (BC×FTC) in both the estimated models demonstrate that the FTC increase (or distance cost) coefficients of the these models are almost of similar magnitude. This implies that for some directions the directional heterogeneity effect in FTC increase is found to be significant, but not for all directions.

Directional heterogeneity in distance-decay effect on WTP

The minimum WTP use values for coastal water quality and beach cleanliness attributes of the eight beaches held by the beach visitors per household per year at the maximum distances from their residential locations across North, south, east and west directions are derived from RPL Model-1 and Model-2 (Table 4). For water quality, directional heterogeneity in WTP values exists only across the south and east directions (i.e., the South, Malir and Korangi districts of Karachi city), ranging from PKR. 150 to PKR. 225 per respondent per year; however, there is more directional heterogeneity in the east direction (i.e. Malir and Korangi districts) than the same in the south direction (i.e. South district) in RPL Model-2 (see Figure 3.b). This implies that individuals living in the east direction have a relatively larger distance-decay effect in their WTP for coastal water quality at the eight beaches.

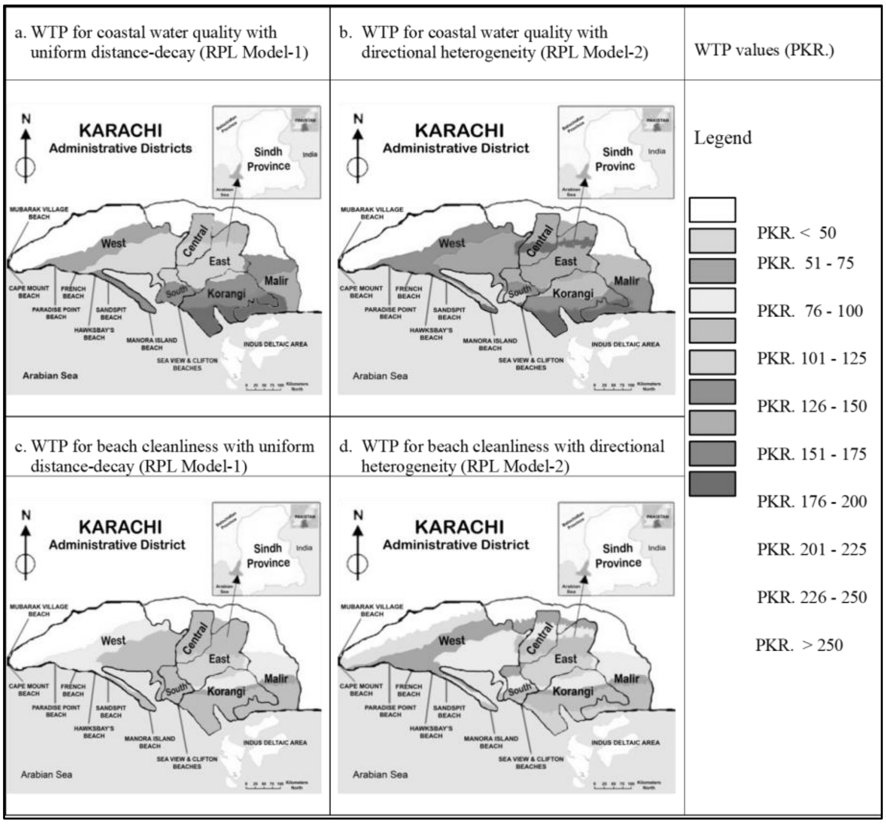

Figure 3 Spatial maps of directional heterogeneity in distance-decay effect on WTP for coastal water quality and beach cleanliness attributes

However, RPL Model-2 reveals that directional heterogeneity in distance-decay effect on WTP for beach cleanliness more or less exists for individuals living in all directions, North, south, east and west, ranging from less than PKR. 50 to PKR. 150 per visitor per year (see Figure 3.d). Overall, individuals' mean WTP for water quality is higher than for beach cleanliness in RPL Model-1 and RPL Model-2 with directional heterogeneity (Table 3). Overall, a comparison of RPL Model-1 and RPL Model-2 exhibits that accounting for directional heterogeneity in distance-decay effect results in significant differences in WTP values as distance increases across all directions in Karachi city (see Table 5 and Figure 3).

The results indicate a much stronger spatial distribution of WTP values for beach cleanliness compared to water quality across all eight beaches in RPL Model-2. Specifically, the directional effects significantly influence WTP held by individuals residing in all directions. Notably, WTP for water quality in the North direction is 4.28% higher in RPL Model-2 than in RPL Model-1, while in the West direction, it increases by 62% (Table 4). These findings show that RPL Model-2 tends to overestimate individuals' WTP values for water quality, particularly accounting for directional heterogeneity in distance-decay effects for beachgoers living in the North and West directions.

Since we accounted for directional heterogeneity in distance-decay effect on WTP values for environmental improvements in multiple attributes of beach recreation, including coastal water quality and beach cleanliness rather than a single attribute (e.g. Schaafsama et al., 2012), there is a likelihood that these differences in WTP, specifically for water quality, are higher in RPL Model-2 because individuals living in both the North and west directions possibly have stronger lexicography in their preferences for coastal water quality regardless of their residential locations in these directions.

Table 4 Comparisons of with and without directional heterogeneity effects in distance-decay on WTP for multiple attributes

Multiple Beach Attributes *Parameters*	Directions & Districts *North*	RPL Model-1 *Min. WTP* *Max. Distance*	RPL Model-2 *Min. WTP* *Max. Distance*	Differences in Min. WTP (%)
Coastal water quality	Karachi Central & Karachi East	PKR. 10.29 95 Km	PKR. 10.73 95 Km	4.28
Beach cleanliness	(= 2 districts)	PKR. 15.64	PKR. 12.54	– 19.82
	South			
Coastal water quality		PKR. 75.83 60 Km	PKR. 71.13 60 Km	– 6.20
Beach cleanliness	Karachi South (= 1 district)	PKR. 34.09	PKR. 32.77	– 3.87
	East			
Coastal water quality	Malir & Korangi (= 2 districts)	PKR. 19.19 140 Km	PKR. 14.61 140 Km	– 23.87
Beach cleanliness		PKR. 29.50	PKR. 28.23	– 4.31
	West			
Coastal water quality	Karachi West (= 1 district)	PKR. 56.86 46 Km	PKR. 92.13 46 Km	62.0
Beach cleanliness		PKR. 74.55	PKR. 71.12	– 4.60

Note: We incorporated 4 directions, north, south, east and west with a purpose of encompassing jurisdictions of 6 districts (or administrative units), Karachi central, east, south, Malir, Korangi, and west, located more or less within each direction of Karachi city. Min WTP is a visitor's minimum WTP per visit per year at the maximum distance (Max. distance) in each direction.

CONCLUSION AND RECOMMENDATIONS

This study is the first to apply the FTC increase method to assess distance-decay effects on multiple beach recreation attributes, addressing directional heterogeneity in WTP. The novelty of this paper contributes to the existing literature on how WTP for multiple attributes of beach recreation varies directionally (or spatially) due to distance-decay effects captured by a unique approach of using FTC increase from respondents' homes situated across different directions of Karachi city to their most preferred beach amongst the eight alternative beaches with environmental improvements in multiple attributes, including coastal water quality and beach cleanliness, in labelled DCE. Distance-decay directional heterogeneity effect in WTP has limitations using an unlabelled DCE, as site-specific ASCs representing each specific recreation site unlabelled location can not be included in WTP models based on an unlabelled DCE to address directional heterogeneity for WTP for site-specific attributes by visitors living across different directional locations. For instance, when sites are unlabelled, they do not represent each specific site location spatially. Hence, our study used a labelled DCE to capture the site-specific directional heterogeneity effect in WTP and, above all, for multiple attributes using the FTC increase method in a labelled DCE.

The review of previous SP studies shows that only a single study, conducted by Schaafsama et al. (2012) in the same context, addressed distance-decay effect using a generic (or uniform) and directional distance variable to capture directional heterogeneity in WTP for improvement in a single attribute of water quality of lakes in Amsterdam, the Netherlands. In contrast, our study, using the FTC increase method in a labelled DCE, explores this directional distance-decay heterogeneity effect in WTP for multiple attributes by individuals residing in different directions, making it a novel study in the existing SP research literature. In other words, this study explored distance-decay variations between the residents living in different directions of Karachi city from the eight alternative beaches (i.e. the study area) to assess the impact of directional heterogeneity in visitors' preferences for their choices of beach sites. The case study focused on eight Karachi coastal beaches, using a labelled DCE with varying scenarios and entrance fees while considering an increase in FTC for Karachi residents.

Our study utilized RPL models incorporating uniform distance-decay (without directional heterogeneity) effect derived from estimated RPL Model 1, and directional and site-specific variables with multiple attributes of beach recreation and FTC increase factors in utility functions of DCE to address distance-decay directional heterogeneity in WTP estimates for multiple attributes. The model results show a stronger directional effect in WTP values for beach cleanliness compared to water quality attributes across all eight beach locations in RPL Model 2. Overall, the directional effects significantly influence WTP for these multiple attributes held by respondents residing in all directions of the city.

Research findings highlight the importance of sampling from all directions of Karachi city to mitigate biases in WTP values. Specifically, using RPL models with directional and site-specific variables, our research demonstrates that incorporating the distance-decay effect improves the model accuracy, revealing significant directional heterogeneity site-specific effects on preferences and WTP values. Our model results show a directional distance-decay effect in visitors' preferences for multiple attributes of beach recreation.

This paper examined directional effects on WTP for multiple attributes, so our study results suggest, particularly researchers that these effects may also stem from factors like preference lexicography, lack of perfect substitute beach sites nearby and the presence of similar alternatives. In the future, it is recommended that researchers incorporate these issues when accounting for WTP for multiple attributes, for instance, two or more, of any recreation site. For further research in future, our methodology could be expanded to explore how other recreational sources in adjacent areas impact directional (or spatial) variations in distance-decay effects on WTP held by visitors. This broader analysis would help researchers clarify the importance of directional (or spatial) influences. In densely populated cities like Karachi, spatial discrepancies can lead to underestimating and overestimating average WTP for attributes like coastal water quality.

This study recommends that coastal manager (or policymakers) consider visitors' preferences and their WTP for coastal resources, such as coastal water quality and beach cleanliness, free from coastal pollution, when developing coastal management plans to ensure recreational satisfaction and environmental protection. Our study's research findings can provide information to the coastal managers, who can integrate our environmental values estimated by using our novel approach into the total economic value (TEV) for future cost-benefit analysis of any likely development project for the coastal area development and management, both financially and environmentally sustainable.

Furthermore, our research findings demonstrate that introducing a minimum entrance fee of PKR 100 and a maximum of PKR 150 per adult per day is suggested to financially support coastal managers in implementing sustainable coastal development policies across coastal areas of Sindh province in Pakistan. Our research results support the idea that coastal managers must introduce this entrance fee, which visitors' WTP rationally justifies for improved coastal water quality and beach cleanliness. Hence, this is crucial for managing coastal resources to support inadequate public financial resource allocation, specifically for beach recreation in Karachi city.

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ANNEXURES

Annex 1 Full descriptions and illustrations of multiple attribute and their levels

Coastal Water Quality and its Levels

High	**Medium**	**Low**
		
Coastal water has high clarity and is clean and clear and looks blue. Suitable for swimming, bathing, wading and playing in the water. Water has no odour, so it does not affect beach activities. (Almost) No noticeable signs of water pollution. A large stock of diverse finfish and shellfish species is found. Fish is certainly safe to eat.	Coastal water is medium clarity, so it is less clean and clear and looks somewhat blue. Only suitable for wading and playing in the water. Water has a little bad odour, which somewhat unfavourably affects beach activities - few noticeable signs of water pollution. A substantial stock of finfish and shellfish species is found. Fish is probably safe to eat.	Water has low clarity, so it is dirty, cloudy, and looks dark, not blue. Not suitable for swimming, bathing, wading and playing in the water. Water has a strong bad odour, so it unfavourably affects beach activities-noticeable signs of water pollution. Very little finfish and little variety of shellfish are found. Fish is not certainly safe to eat.

Cleanliness on Beaches and their Levels

No Liter/ Almost clean	**Modestly Littered**	**Highly Littered**
		
The beach is clean (almost) without litter. The beach contains no visible litter. If you look closer, sometimes you may find 0 – 10 units of litter per 50 meters of beach length. There is almost no risk of injury, so the beach is highly suitable for walking and other activities.	The beach is modestly littered with some litter. A substantial part of the beach contains litter, meaning 10 – 30 units per 50 meters of beach length. There is a modest risk of getting injured, so the beach is modestly suitable for walking and other activities.	The beach is highly littered. The beach contains trash or litter, visible nearly everywhere in all shapes and sizes. You may find more than 30 litter units per 50 meters of beach length. There is a high risk of getting injured, so the beach is unsuitable for walking and other activities.

Congestion and its levels

Lightly Congested (& quiet)	**Modestly Congested**	**Highly Congested (& noisy)**
		
Few visitors occupy the beach, so it is usually quiet. Highly suitable for walking, playing sports, getting relaxed and having privacy. Crowd presence is less than 20 visitors per 50 meters of beach length.	A substantial number of visitors occupy the beach, which leads mostly to some overcrowding. It is modestly suitable for walking, playing sports, relaxing and having privacy. Crowd presence is between 20 – 30 visitors per 50 meters of beach length.	The beach is occupied by many visitors, which leads almost always to overcrowding and noise. It is unsuitable for walking, playing sports, relaxing and having privacy. Crowd presence is more than 30 visitors per 50 meters of beach length.

Site Facilities and their levels

Low	**Medium**	**High**
		
The beach has only parking facilities.	The beach has parking facilities and food stores/restaurants.	The beach has parking facilities, food stores/restaurants and toilets.

Entrance fee levels

PKR 0 per entry	**PKR 30 per entry**	**PKR 70 per entry**	**PKR 120 per entry**
No entrance fee			
The beach has free access.	The beach has 30 rupees per entry. The entrance fee is for adult visitors only.	The beach has 70 rupees per entry. The entrance fee is for adult visitors only.	The beach has 120 rupees per entry. The entrance fee is for adult visitors only.
PKR 0 = No entrance fee	That is PKR 10 + PKR 20 = PKR 30	That is PKR 50 + PKR 20 = PKR 70	That is PKR 100 + PKR 20 = PKR 120

Annex 2 Effect coding procedure

The sum of the attribute with three levels is equivalent to zero, knowing that the sum of the effects codes is also equal to 0, that is $b_0 + b_1 + b_2 = 0$, which can be mathematically expressed as $b_0 = - b_1 - b_2$. For calculating WTP for improvements in the medium and the high water quality attribute levels, we applied the following formulas using the above definition of effects coding: WTP medium = $(b_1 - b_0)/b_{monetary\ attribute} = (b_1 -(- b_1 - b_2))/b_{monetary\ attribute} = (2* b_1 + b_2))/b_{monetary\ attribute}$ and WTP high = $(b_2 - b_0)/ b_{monetary\ attribute} = (b2 -(- b_1 - b_2))/ b_{monetary\ attribute} = (2* b_2 + b_1))/ b_{monetary\ attribute}$. Likewise, we applied the same procedure for the remaining attributes each with three levels.

Annex 3 The future travel cost (FTC) increase calculation procedure

As distance acts as a proxy for travel cost (Mangan et al., 2013; Hanley et al., 2002), we converted the distance into travel cost (TC) using the following formula:

$$TC \ = 2 * (Distance\ cost + Opportunity\ cost\ of\ travel\ time) \quad (6)$$

Travel costs for visiting a beach include fuel expenditures and opportunity cost of time (OCT) spent on traveling. Distance cost is calculated as round trip fuel costs paid by the household head, sometimes shared among all adults traveling together. We calculated the *OCT* by setting it at 30% of a visitor's yearly income, as commonly done in travel cost studies. Since working hours vary widely in Pakistan due to lax labour laws, we adjusted for respondents' fluctuating work hours instead of assuming a fixed weekly amount, and then determined the *OCT* using the following formula (Mangan et al., 2013):

$$OCT = (0.3 * I * 12 * E) * (RT/WH) \quad (7)$$

When referring to a visitor's monthly income *I*, employment status *E*, round-trip travel time *RT*, and varying number of working hours per year *WH*, we use specific identifiers. Employment status *E* is denoted as 1 when the visitor is employed, and 0 when not. In the latter case, *OCT* is zero, leading to travel cost determination based solely on transportation expenses. *RT* was calculated by dividing each respondent's perceived travel distance by an average speed of 60 km per hour during observations made while surveying various beaches and vehicles.

Since the last 5 years, the fuel prices increased on average by 7.6 % per month (PBS, 2015), hence, we converted a visitor’s current travel cost into a FTC increase (i.e. next year), accordingly. The present OCT in equation 3.2 is converted into its future value using a discount rate of 9.5 %. Thus, we calculated the FTC increase as the sum of the increase in future fuel expenditures and future opportunity cost of travel time.