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The amenity value of Abu Dhabi's coastal and marine resources to its beach visitors

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ABSTRACT

Abu Dhabi, marketed as a centre of economic development in its geographic area during the post-oil era, is renowned for being a choice destination of high value individuals and tourists, due to its rich coastal and marine resources as well as the high quality of services. Outbreaks of harmful algae blooms (HAB) (red tides) due to increased eutrophication as a result of a decline in water quality, however, is posing a serious threat to the amenity values the tourist can appreciate. The amenity values include beach and ocean views, recreation and sport opportunities and facilities, as attractions, among others. To investigate the amenity value of the coastal and marine resources of Abu Dhabi to the beach visitors, we use a contingent valuation assessment after collecting data from a sample of 103 beach visitors. We conducted an econometric analysis to examine factors that potentially affect their behaviour. We determined firstly if the respondents were willing to accept compensation for visiting another beach in the event of an outbreak of HAB and its amount; or in another scenario if they would be willing to pay an annual fee, and its amount, for restoration and mitigation of the beach pollution.

The results show that the beach amenity value, therefore, is estimated at between US$8.3million/ha and US $13.8million/ha based on the beach size. Factors such as the travel time from place of current residence the beach, the residence status, the number of beach visits and household size and income have affected the willingness-to-accept (WTA) of the respondents.

1. Introduction

Coastal and marine resources offer a range of ecosystem goods and services to its users. These include water quality maintenance, visual amenity, beach recreation and shipping channel maintenance. Using one service, however, may reduce the levels of another service. For example, dredging to open waterways for oil tankers can increase sediment movement that inhibits coral growth and in turn reduces the recreation options (Burt et al., 2011; Burt, 2014). The Abu Dhabi authorities actively market the city as a preferred destination for high value individuals and corporations and, in the process, commit to maintain and provide a well-functioning marine and coastal ecosystem to deliver a range of quality ecosystem goods and services. It is especially the amenity value of the coastal and marine resources that is accentuated in marketing the city.

Empirical studies in the recent literature estimate the value of public good (such as the coastal and marine resources in our case) by conducting surveys illustrating the consumers' maximum willingness to pay to acquire the good in question (Zhao and Kling, 2004). More specifically, to evaluate the preferences for environmental quality (as a public good), the contingent valuation method (CVM) is often used in literature (Ahleim and Buchholtz, 2000). In this method, one can ask for the participants' willingness to pay (WTP) for an improved product (better environmental quality) or for their willingness to accept (WTA) compensation for abandoning expectations for improvement.

In this analysis we are interested in the amenity values beach users derive from the Abu Dhabi city beaches and the supporting marine ecology. This is an important consideration given that the city is being marketed as a preferred destination for the global traveller and business person, with beach and ocean views, recreation and sport opportunities as attractions (Abu Dhabi Urban Planning Council, 2013, 2014a, 2014b; Environment Agency – Abu Dhabi, 2014). The consequences of urban growth, however, include an increase in eutrophication and the number of red algae blooms as discussed above (see also AGEDI, 2008; Al Shehhi et al., 2014; Burt et al., 2011; Burt, 2014; Cheung et al., 2012; Foster and Foster, 2013; Ghaffour et al., 2013; Grandcourt et al., 2011; Sheppard et al., 2010; Zhao and Ghedira, 2014).

By marketing the city as a preferred destination with good quality coastal and marine resources as incentives for the global traveller, investors and travellers have an expectation or perceived

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entitlement to the direct and indirect benefits of these 'free' non-marketed good-quality ecosystem services supplied by the ocean, as communicated in the planning documents.

Current developments, as will be discussed below, has the potential to jeopardise these values. Because of the need to manage the environment prudently, based among others on the words of the Late Sheikh Zayed Al Nahyan (see below), we embarked on estimating the economic value of Abu Dhabi's coastal amenity values to its beach visitors using both a WTA compensation for a deterioration in quality of coastal amenity values, and a WTP to contribute to a hypothetical restoration fund to avoid a loss in these amenity values, followed by an econometric estimation of the factors affecting the respondents WTA and WTP for the improvement of the beaches.

The paper is structured as follows. The next section presents the specific case of Abu Dhabi with regards to its coastal and marine resources. The following section explains the theoretical background of the methodology, the specific details of the contingent valuation method and the econometric method to be used. Next, we present the results of the survey, the estimation of the WTA and WTP and the empirical findings of the econometric model; while the last section concludes.

2. Background: Abu Dhabi

The Abu Dhabi Emirate is currently home to about 1.4 million people of which close to 50% are located within the city (Statistics Centre – Abu Dhabi (SCAD), 2014). In their aspiration to become a regional leader in environmental performance and sustainability, multiple interlinked policy agendas have been prepared for the Emirate including the Abu Dhabi Environment Policy Agenda, UAE green Growth Strategy and UAE Vision 2021. These plans were prepared through cross-sectoral stakeholder engagement including water and electricity, oil and gas, dredging, nuclear authorities, NGOs and academia, among others. The Emirate, however, is in a period of rapid growth, given its rapidly growing population, contributing to elevated pressures to its coastline where urban growth is primarily focused. The oil industry is also largely focused on the marine environment. Consequently, there is an intensive use of the marine environment for economic inputs such as oil, shipping routes, water for desalination, fish harvesting, recreation and general coastal amenity services linked to culture, marketing and relaxation. The marine ecosystems are also recipients of the outputs of the developments, waste water discharge, thermal cooling water discharge, brine discharge, dredging spoil, ballast discharge and accidental petro-chemicals pollution (Burt, 2014).

As a result, urban settlement, inshore canalisation, oil extraction and shipping, there has been an increase in surface water temperatures, salinity, nutrient levels, sediment, resource harvesting and chemical pollution in recent years (AGEDI, 2008; Al Shehhi et al., 2014; Burt et al., 2011, 2014; Cheung et al., 2012; Foster and Foster, 2013; Ghaffour et al., 2013; Grandcourt et al., 2011; Sheppard et al., 2010; Zhao and Ghedira, 2014). The state of marine ecological assets has declined due to these pressures and recent indicators of these declines are, for example, the following:

- Coral reefs have declined by 40% in recent years (Burt et al. 2011; Sheppard et al. 2010)
- Socotra cormorant (*Phalacrocorax nigrogularis*) colonies have declined in number to only 30% of 1980 levels (BirdLife International, 2014)

One of the ecological responses to declining marine functionality has been an increase in intensity, frequency and duration of harmful algal blooms (HAB) and inshore eutrophication (Environment Agency – Abu Dhabi, 2014). HAB events, also known as red tides lead to toxic water conditions and large scale fish die-offs, resulting in poor water quality, odour and beach conditions, which unsafe and unsuitable for recreation and general use of the coastline. As part of a systematic biodiversity conservation assessment, mapping of condition took place within the Emirate to identify ecological integrity of ecosystems, including where ecosystems have been lost or degraded. This data established for the Emirate a basis for determining areas of conservation opportunity as well as highlighting conflict with other land and marine use activities.

The declining marine functionality and associated increase in disservices of poor water quality, is in conflict with the Capital 2030 vision of a world class city, which states (Abu Dhabi Urban Planning Council, 2014a):

> A Unique Environment – Planning for careful, sensitive growth is prudent so that we preserve the critical natural environment that makes Abu Dhabi unique. It is important to identify and conserve these distinct environmental and cultural amenities first and then determine where new development might best be located, striking a balance between conservation and development. Protected areas can always be sensibly developed at a later date, but it is very difficult to reclaim a damaged environment.

Current development trends and changes in the near-shore water conditions place this vision at considerable risk.

The need to develop a motivation for elevated marine conservation has given rise to the question of the economic value of the coastal and marine amenities in Abu Dhabi. This study investigates this question using the double-bound continuous choice contingent valuation method and considers both the willingness to accept (WTA) compensation for any value loss in amenity as a result of a decline in the quality of the coastal and marine resources, and the willingness to pay (WTP) to avoid future damages by contributing to a hypothetical restoration fund.

3. Methodology

In this section, we present the specific tools and methods we use to achieve the paper's purpose: theoretical aspects of the contingent valuation method, the survey and the econometric methods.

3.1. Contingent valuation

Although numerous valuation techniques have been proposed in the literature (Dixon et al., 1994), the method preferred by many when seeking to estimate the direct and indirect values of non-marketed commodities is contingent valuation (Bowers, 1997; Callan and Thomas, 1996; Kahn, 1997; Rao, 2000). Contingent valuation provides a stated preference by the interviewee as to his/her perceived value of a resource and/or the change in value given a specific scenario. Two types of contingent valuation studies are used, namely the willingness to pay (WTP) for a service, and/or the willingness to accept (WTA) compensation for the loss of and/or deterioration in a service.

The contingent valuation method has been successfully applied to estimate the economic value of coastal and marine resources in the past within different countries and continents, such as Japan (Zhai and Suzuki, 2009), Mexico, (Barr and Mourato, 2009) China (Huang et al., 2013), Sweden (Östberg et al., 2012), the UK (Georgiou et al., 2004) and the United States (Petrolia et al., 2010), as well as smaller islands like the Azores with great access to ocean and marine resources (Ressurreição et al., 2011). As discussed by

Huang et al. (2013), Zhai and Suzuki (2009), the WTA and WTP estimates of the same study and/or scenario should, according to neo-classical economics, render the same value. In practice, however, that is never the case (Ebert, 2013; Flachaire et al., 2013, Tuncel and Hammit, 2014, Zhao and Kling, 2004). Empirical evidence indicates that the WTP values are considerably lower than the WTA values.

Given the natural tendency of the WTA method to render upper-bound estimates of the economic value of a resource and/or amenity, WTP is generally favoured as it is a more conservative estimate (Arrow et al., 1993). The magnitude of the difference between WTA and WTP is impacted by substitution effects so that various non-expected phenomena can be discussed and estimated through standard utility theory. So, from a theoretical point of view, the difference between WTP and WTA is expected since no direct substitutes goods are easily available.

From a psychological point of reasoning, the reaction of people to pay or accept is not symmetric for an environmental improvement. The WTA-case shows that they have already accepted the promise for improvement and now are asked to value its loss while in WTP-case they bid for an improvement. So, various studies (Boyce et al., 1992; Knetsch, 1994; Morisson, 1997) have suggested that respondents are inclined to rather not accept a change for the worse and hence, request higher remuneration for any deterioration of their status quo. According to Morisson (1997) and Shogren and Hayes (1997), this effect is purely asymmetric since the respondents' value losses more than benefits: the WTP for betterment is lower than the WTA remuneration for utility/satisfaction reduction.

Flachaire et al., (2013) have suggested another way of interpreting the difference between WTP and WTA values. Market-friendly respondents finding the market exchanges acceptable tend to value the paying or accepting of the specific project in a market-value manner and hence, no endowment effect is observed (ratio between WTA and WTP close to 1). On contrary, a market-reluctant person might protest his preference to the specific project by overstating his WTA and understate WTP.

All in all, the choice of WTA or WTP as welfare/utility measure should rely on the framework of a specific project with regards to the socioeconomic and political background of the application.

As is in the cases of China (Huang et al., 2013) and Japan (Zhai and Suzuki, 2009), it can be argued that the beach users in Abu Dhabi have a high expectation that could be considered a right to the amenity values of the coastal and marine resources. This is since Abu Dhabi is marketed to prospective residents and tourists as having accessible, high-quality coastal and marine resources. For example, it is clearly demonstrated in, among others, the following statement on the historic role of Abu Dhabi's natural resources and continued commitment to its future protection and state (Environment Agency – Abu Dhabi, 2014):

> ‘We cherish our environment because it is an integral part of our country, our history and our heritage. On land and in the sea, our forefathers lived and survived in this environment. They were able to do so only because they recognised the need to conserve it, to take from it only what they needed to live and to preserve it for succeeding generations. We are responsible for taking care of our environment & wildlife, protect it and preserve it not only for the sake of our current generation, but also for the sake of our children and grandchildren. It is our duty to be loyal to our ancestors as well as our successors. With God's will, we shall continue to work to protect our environment and our wildlife, as did our forefathers before us. It is a duty, and, if we fail, our children, rightly, will reproach us for squandering an essential part of their inheritance, and of our heritage.’
>
> *The Late Sheikh Zayed bin Sultan Al Nahyan, Founding father of the United Arab Emirates (February 1998, on the occasion of the Annual Environment Day).*

Based on this statement, and many other similar declarations with respect to the role of the natural environment in the past and the continued importance and support thereof in the future, we embarked on estimating the economic value of Abu Dhabi's coastal amenity values to its beach visitors using both a WTA compensation for a deterioration in quality of coastal amenity values, and a WTP to contribute to a hypothetical restoration fund to avoid a loss in these amenity values (see also Barr and Mourato, 2009), but focussing on the former.

3.2. Survey

A survey was conducted using a double-bound continuous choice contingent valuation method with voting cards considering both the willingness to accept (WTA) compensation for any value loss in amenity and the willingness to pay (WTP) to avoid future damages by contributing to a hypothetical restoration fund. The survey method was influenced by other studies (Zhai and Suzuki, 2009; Barr and Mourato, 2009; Huang et al., 2013, Östberg et al., 2012, and Georgiou et al., 2004). The questionnaire started with a general introduction about the current state of the coastal and marine ecology, marketing material, the government's vision, and examples of real and recent pollution in the form of HAB (a proxy of a decline in water quality) – all supported with photos. The general introduction was followed first by a section of questions enquiring about demographics and then by the contingent valuation survey seeking to determine the willingness to accept (WTA) compensation for a loss in amenity services. Interviewees were provided with the following hypothetical situation:

> There are two beaches, beach A and B; they are identical in terms of size and in terms of amenity services. Beach A is the beach you are at now. Because of on-going local and regional economic development and a change in environmental conditions this beach becomes covered with algae and experiences a red tide that are often associated with dis-amenities, such as being unattractive, toxic and odorous, which necessitates the complete avoidance. Your only alternative is an algae-free beach, Beach B, situated an hour away.

The interviewees were asked whether they will visit beach B. If “yes”, an offset compensation value was determined, using a series of voting cards increasing in value. This was followed by a question on the desired level of compensation if beach B was also covered by red tide (i.e. there were no beach options available). Interviewees who answered “no” to the option of visiting beach B were also asked what their compensatory value for the loss in services on beach A would be. In both cases the voting was done in an increasing sequence, and once the interviewee voted “no” to the number on the card, the interviewer went back to the “yes” response and sought the actual stated preference between the “yes” and the “no” votes.

Following the determination of the willingness to accept compensation, a hypothetical restoration scenario was sketched and the interviewees were asked whether they would be willing to pay an annual fee to a restoration fund that would mitigate the pollution and ensure a constant supply of amenity services. If they answered “yes”, a similar referendum style, double-bound, continuous choice method using voting cards was used to determine the level of contribution they would make. In all cases, once the upper-bound of the voting cards was reached, it was followed by an open-ended question as to the interviewees' preference.

Beach visitors, both residents and tourists, were targeted as they value a high-quality coastal environment for leisure time. The questionnaire was piloted with a sample of seven individuals on 1–2 October 2014. The pilot survey permitted refinement of the questionnaire, especially to improve and clarify some questions as well as rehearse the phrasing of the script. The actual survey was conducted by four experienced researchers with a combined professional career of over 40 years. The survey was conducted between 16 October and 13 November 2014. All surveys were conducted on "normal" days, i.e. not part of a holiday, or a special festival. While it was difficult to assign a survey rule to the sampling of beach visitors, the surveyors selected individuals by walking up and down along a transect on the beach, and engaging with all individuals or groups that were sitting up and active at the time, either alone or in a group. There was no targeting of a specific age class or gender, or any other demographic distinction. The surveyors engaged either with the head of the household or individual. In the cases where the surveyors approached a group of individuals they sought engagement from one or sometimes more than one member of the group. Surveyors worked either in teams of two or, in some rare occasions, alone. Very few beach visitors declined to be interviewed, estimated to be less than 5%, but this number was not recorded. Those who did declined did so because they were not fluent in either English or Arabic. The number of participants declining to be interviewed was not recorded by the surveying teams. A small number of interviews were conducted in Arabic, and this data was recorded and translated into English.

The interviews were conducted at the four principal paid beaches located on the coast of Abu Dhabi city. There are no other formal public or pay beaches; the remainder are hotel, private or informal beaches. The four formal beaches are:

1. Al Bateen Public Beach and Ladies Pay Beach – managed by the Municipality of Abu Dhabi City (ADM) and SERCO, approximately 46,934 m^2 in size
2. Corniche Public and Pay Beaches – managed by ADM and SERCO, approximately 427,200 m^2 in size
3. Saadiyat Island Pay Beach – managed by BAKE, approximately 64,646 m^2 in size
4. Yas Island Pay Beach – managed by Ventura Entertainment, approximately 18,228 m^2 in size

For each beach, access permissions were sought from the relevant beach management agency (listed above). All the beaches provided access and none of the beach management agencies refused permission to access to their beach for the survey. The total combined beach size of these four main beaches is 557,008 m^2 or 55.7 ha. A total of 103 beach visitor questionnaires were completed.

3.3. Model

For the econometric part of this study, a statistical model, the Tobit model, is adopted following Huang et al., (2013) who examined the public demand for ecosystem improvement at Hongze Lake in China. Their study evaluated the respondents' WTP for a hypothetical improvement in water quality of the lake and the respondents' WTA certain compensation if certain improvements were not carried out. The Tobit estimation was also employed by numerous other studies on environmental issues. Barr and Mourato (2009) used a Tobit model to investigate the factors influencing the respondents' WTP and WTA for marine protection in the Espiritu Santo Marine Park in Mexico. Similarly, Petrolia and Kim (2011) estimated various welfare measures to prevent future coastal wetland loses in Louisiana, USA by using both WTP and WTA compensation for improvements.

The Tobit model is chosen here to evaluate the integrated representation of the effects of WTP and WTA for two reasons: i) it can combine the best features of the linear regression, and ii) it is appropriate when a large number of observations on the dependent variable hover around zero (Flachaire et al., 2013; Huang et al., 2013; Zhai and Ikeda, 2006). Pearce (2002) in his report to the Environment Agency Bristol, argues that it is not easy to agree on which concept (WTP or WTA) is preferable for valuation purposes. "In the context of an improvement, one could think of a WTP to secure the improvement and a WTA compensation to forego the improvement. Economic theory suggested that these would not differ much" (Pearce, 2002). However, in practice, it became clear that this theoretical prediction was not true. Hence, it is argued that the disparity between WTA-WTP matters.

For the traditional Tobit model, the dependent variables are the price data of WTP (WTP ≥ 0) and WTA (WTA ≥ 0) obtained from the survey results, and the independent variables are age, household size, average household income, residence status, number of beach visits, and travel time (see Table 1). The full Tobit model is as follows:

$$\begin{aligned} WTP_i orWTA_i = \beta_0 + \beta_1 age_i + \beta_2 householdsize_i \\ + \beta_3 averagehouseholdincome_i + \beta_4 residencestatus_i \\ + \beta_5 beachvisits_i + \beta_6 traveltime_i + \varepsilon_\iota \end{aligned}$$

where ε is the error component assumed to be normally distributed and independent.

As Huang et al. (2013) suggest based on Petrolia et al. (2010): *Because we observed both WTP and WTA from each respondent, they were likely to have correlated error terms, so we assumed cross-equation correlation across the error terms of the two Tobit models and tried to get the adjusted standard errors by adopting the post-estimation procedure of Seemingly Unrelated Estimation (SUEST) in Stata 10.*

Table 1
Description of the variables used in the 2 equations.

Variables	Description
WTA	Continuous variable representing either the willingness to accept to offset the inconvenience caused by the need to move beaches or the willingness to accept to offset the loss of access to these beaches or the willingness to accept to offset the inconvenience of not being able to go to the beach
WTP	Continuous variable representing the willingness to pay value of the respondents to contribute to a restoration fund
Age	Categorical variable, representing the age category of the respondent
Household size	Continuous variable, representing the number of individuals in the household
Average household income	Categorical variable, representing the bracket of the average household income
Residence status	Categorical variable, representing whether the respondent is a resident or a visitor
Beach visits	Continuous variable, representing the number of visits to the beach per year
Travel time	Continuous variable, representing the time from the current residence to the beach in minutes

4. Results

4.1. Estimates of the willingness to accept and the willingness to pay

The profile of the interviewees is provided in Table 2 and Fig. 1 below. A total of 86 of the 130 questionnaires completed were by residents, 70 thereof by the three middle-income categories varying from US$817–US$16,350 per month. Interviewees between the ages of 20 and 40 years dominated the sample at all of the beaches. This implies a focus on the middle cohort both in terms of age and income. The younger generation is also earning less income than the older, as can be seen by the declining trend of the blue bar in Fig. 1.

The cosmopolitan nature of the city of Abu Dhabi and the success of the marketing drive of the authorities to solicit investment and entice people from across the globe to Abu Dhabi is reflected in the diverse set of passport holders interviewed, namely:

Tourists from:

1. Algeria, Belgium, Denmark, Egypt, India, Ireland, Italy, Latvia, Lebanon, Palestine, Serbia, Slovakia, Slovenia, Spain and UK. Residents from:
2. Algeria, Argentina, Australia, Canada, Egypt, France, Germany, India, Ireland, Italy, Japan, Jordan, Lebanon, Montenegro, Morocco, Nepal, The Netherlands, New Zealand, Philippines, Portugal, Romania, Serbia, Spain, Syria, Tunisia, UAE, Uganda, UK, Ukraine, USA and Venezuela.

There is a high intensity of beach use with an average of between 50 and 105 visits per year by the residents and between five and 20 visits per year by the tourists. The average travel time varies between 20 and 60 min, but it could be as low as 5 and 10 min (see Table 3 for details regarding the intensity of the use of the beaches).

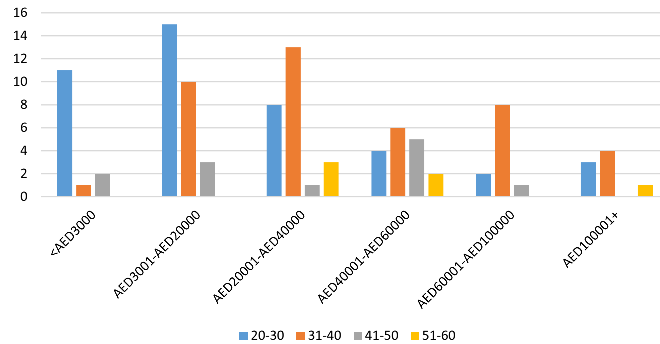

Fig. 1. Age and income profile of beach visitors surveyed. (For interpretation of the references to color in this figure, the reader is referred to the web version of this article.)

Table 3
Beach use intensity.

	Age	Beach visits/year			Travel time to beach (in min)		
		Min	Max	Ave	Min	Max	Ave
Residents	20–30	1	365	65.3	5.0	150.0	29.5
	31–40	2	365	71.8	5.0	90.0	23.5
	41–50	6	300	105.4	10.0	40.0	24.3
	51–60	25	100	53.0	5.0	240.0	56.6
Tourists	20–30	5	20	9.8	10.0	15.0	11.3
	31–40	2	24	10.9	5.0	40.0	16.3
	41–50	1	7	4.0	30.0	30.0	30.0
	51–60	1	5	3.0	10.0	60.0	35.0

A summary of the results of the valuation study is presented in Table 4 and Fig. 2.

From Table 4, it is clear that 78% (67 of 86) of the residents

Table 2
Profile of surveyed beach visitors.

Beach name	No. of residents	No. of tourists	Age	Income						Total no.
				< AED3 000 (< US$817)	AED3 001 – 20,000 (US$818 –5 450)	AED20 001 – 40,000 (US$5 451 – 10,900)	AED40 001 – 60,000 (US$10 901 – 16,350)	AED60 001 – 100,000 (US$16 351 – 27,250)	> AED100001 (> US$27 251)	
Al Bateen Beach	11	0	20–30	1	3		1		1	6
			31–40		1	2	1			4
			50–60				1			1
			Total	1	4	2	3		1	11
Al Bateen Ladies Beach	2	0	20–30		1	1				2
Al Raha Beach	1	0	31–40		1					1
Bahraini Island	1	0	41–50				1			1
Corniche Beach	15	8	20–30	2	3	3	2		1	11
			31–40		1	3		2		6
			41–50	1	2	1				4
			51–60				1		1	2
			Total	3	6	7	3	2	2	23
Maha Island	1	0	30–40						1	1
Saadiyat Beach	44	5	20–30	8	4	1	1	2	1	17
			31–40	1	4	5	5	5	3	23
			41–50	1	1		4	1		7
			51–60			2				2
			Total	10	9	8	10	8	4	49
Sir Bani Yas	1	0	30–40					1		1
Yas Beach	10	4	20–30		4	3				7
			31–40		3	3				6
			50–60			1				1
			Total		7	7				14
Grand total	86	17		14	28	25	17	11	8	103

Table 4
Beach visitors' willingness to accept compensation.

Interviewee type		Visit beach B = yes: Value of off-set voucher			Visit beach B = yes: Beach B not available: Cost of red tide			Visit beach B = no: Cost of red tide		
Residents	Number of 'yes' (n=86)	67						19		
Tourists	Number of 'yes' (n=17)	13						4		
	Annual income	**Min**	**Max**	**Ave**	**Min**	**Max**	**Ave**	**Min**	**Max**	**Ave**
Residents	< AED3 000 (< $817)	10	500	229.0	20	2000	702.0	100	150	125.0
	AED3 001 – 20 000 ($818 – 5 450)	10	2 000	249.7	100	5000	802.9	50	750	300.0
	AED20 001 – 40 000 ($5 451 – 10 900)	-	500	191.0	100	5000	827.8		500	74.4
	AED40 001 – 60 000 ($10 901 – 16 350)	20	500	179.5	50	5000	1245.0		100	33.3
	AED60 001 – 100 000 ($16 351 – 27 2500)	50	500	225.0	500	5000	3125.0			
	> AED100 001 (> $27 251)		150	60.0		2500	545.0			
Tourists	< AED3 000 (< $817)	280	280	280.0	500	500	500.0			
	AED3 001 – 20 000 ($818 – 5 450)	50	300	196.7	-	9000	2208.3			
	AED20 001 – 40 000 ($5 451 – 10 900)	50	100	83.3	1 000	10,000	5333.3			
	AED40 001 – 60 000 ($10 901 – 16 350)							250	250	250.0
	AED60 001 – 100 000 ($16 351 – 27 250)	250	250	250.0	5 000	5000	5000.0			
	> AED100 001 (> $27 251)	150	200	175.0	300	2000	1150.0			

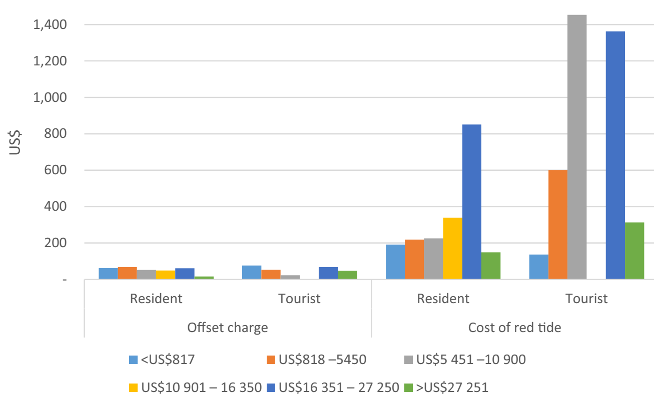

Fig. 2. Beach visitors' stated ranges of willingness to accept compensation.

indicated that they would be willing to accept compensation to go to beach B in the event of their preferred beach not being available for recreation purposes due to red tide. A very similar number of tourists, 76% (13 out of 17), indicated the same. Those willing to go the beach B would have required compensation to offset their cost by between, on average, AED60 and AED250 (US$16,3–US$68,1) per visit for the residents. The poorer households indicated that they will require more compensation, pointing to their greater inability to cover the additional expense. The comparable range for the tourists is AED80–AED280 (US$21,8–US$76,3), which is marginally higher. Interestingly enough, the poorer households again required the higher compensation.

In the event of a complete loss of services, those among the residents who would have been willing to travel to beach B would have required compensation between AED550 and AED3 125 (US $149,9–US$ 851,5) per visit, this time the more affluent households demanding higher compensation. This indicates that the sense of the value of money is quite different among the income groups. Among the tourists this number is, on average, AED1 150 and AED5 300 (US$313,4–US$ 1444,1) per visit – considerably higher than that of the residents. Those who would not consider going to go to beach B estimated their loss much lower, approximately AED30–AED300 (US$8,2–US$ 81,7) per visit.

Fig. 2 provides a graphical summary of the compensation required by beach visitors by income category for the prevalence of excessive harmful algal blooms (HAB) or red tide affecting their ability to access and enjoy the beach for their choice of either:

1. an offset charge for having to go to Beach B as an alternative; or
2. accepting a complete loss of amenity services.

The results can be summarised as follows:

Residents

a. For the 67 residents that said that they would go to beach B:
   1. The total offset cost is estimated as AED801 800 (US$218 474) per year
   2. The total value of compensation required should there be no alternative, is estimated as AED4 1800 (US$1 090 408) per year

b. For the 13 residents that said that they would not go to beach B:
   - The compensation required should there be no alternative, is estimated as AED104 250 (US$28 406).

Tourists:

c. For the 13 tourists that said that they would go to beach B:
   1. The total offset cost is estimated as AED17 900 (US$4 877) per year
   2. The total value of compensation required should there be no alternative, is estimated as AED438 000 (US$119 346)

d. For the 4 tourists that said that they would not go to beach B:
   - The compensation required should there be no alternative, is estimated as AED154 000 (US$41 962), with one person indicating the value to be AED150 000 (US$40 872).

The aggregate (city-wide) results can be determined as follows:

multiply the number of visits by the actual stated compensatory values for the three categories proportionately

It should be noted that the residents of Abu Dhabi have little alternative options for recreation, as also reflected in the high number of beach visits per year per person. The fact that the amenity services offered by the marine and coastal ecosystems are highly treasured is also shown by the percentage compensation required relative to annual income received (see Fig. 3). The offset-cost requirement for the poorer households equates to 62% of their annual income, which is the compensation required to visit beach B in the event of red tide at their favourite beach. This number declines as the annual income increases. Similarly, the declining pattern with an increase in income is repeated when considering the loss in utility when there is no access to the beach as a result of red tide. The total loss in amenity services will be as high as 190% of annual income for the poorer households, declining to 4% for the most affluent households.

The loss of the amenity services provided by the beaches to beach visitors in the event of HAB are likely to be extremely high due to the use of the resource and the way and intensity in which people interact with it.

In order to scale-up the value of the plausible loss in amenity value, and hence loss in household utility at city-level, it is necessary to determine the total number of beach visits a year. Thereafter, the total number has to be stratified according to income and whether they are tourists or residents, to follow the same pattern or profile as that of the survey respondents. The value each category has assigned to the amenity services is then multiplied with the corresponding number of total beach visits. An estimate of the total number of beach visits is provided in Table 5. It should be noted that, to err on the conservative side, the total number of beach visits for four formal beaches only have been estimated. While the sample size might seem small, it is representative of the demographic profile of Abu Dhabi and, as noted above, the Abu Dhabi visitor has very little alternative options for outdoor-based recreation. The city-wide numbers should be treated as indicative though rather than being and exact estimate.

After apportioning the estimated number of beach visits of 2359,855 according to the profile of the survey respondents (i.e. allowing for a differentiation between being a resident or tourist as well as income levels), the city-wide losses in utility to households due to HAB can be estimated (see Table 6).

It is indicated that the cost residents would require to mitigate the impact of having to go to beach B varies between US

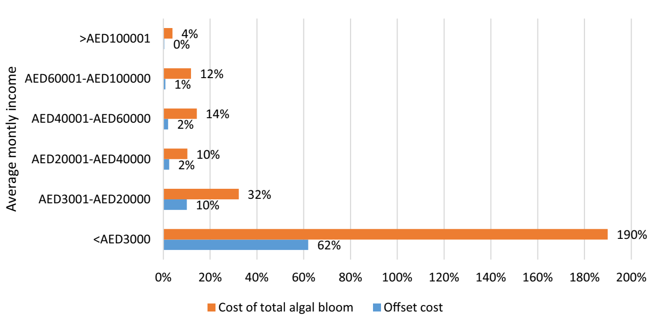

Fig. 3. Cost of HAB and offset-cost requirement.

$92.5million and US$154million if allowance is made for a 25% deviation from the estimated value. This declines to between US $2million and US$3,4million for tourists. It is, however, the loss in the total amenity value as a result of all the beaches being affected with HAB, which is noteworthy. This ranges between US$461million and US$770million for residents, and US$50.5million and US $84million for tourists; a total estimated impact of approximately US$682.9million. This does not include the impact of any possible knock-on effect due to a reduction in visitor numbers and/or level of economic activity. This translates to a value for the beaches (55.7 ha in size) offering the resident beach user an amenity service of between US$8.3million/ha and US$13.8million/ha. It should be noted that the associated ecosystems (including the mangroves, sea grass, intertidal zone, coral reefs, etc.) need to function properly in order for the beaches to be able to offer quality services. This value, therefore, has to be ascribed to the working of the larger system, approximately 30,000 ha, giving rise to a unit value of US$22,763/ha – comparable with the De Groot et al. (2010) estimate of the mean value for sea grass, shallow seas, continental shelves, shores & beaches, and intertidal zone of US$22,732/ha. The beach visitor, however, may be ignorant of their recreation dependence on the functioning of the greater system.

Lastly, the interviewees were asked whether they would be willing to contribute to a restoration fund. In total, 19 of the 86 residents (22.1%) and 10 of the 17 tourists (58.8%) said no, they will not contribute to such a fund. This implies that a considerably larger percentage of the tourists refuse to contribute to a restoration fund, and those that did agree to such a contribution, offered a much lower rate than that of the residents. The results are indicated in Table 7.

The aggregate results are indicated below, estimated by multiplying the number of visits with the stated value of their contribution to a restoration fund:

1. The residents would be willing to contribute AED197,750 (US $53,882) to a restoration compensation fund. On a city-wide level, assuming 2.3million visits per year as estimated above, this would imply AED90.8million (US$24.7million), or 4% of the loss in total amenity services.
2. The tourists would be willing to contribute AED1 630 (US$444) to a restoration compensation fund. On a city-wide level this would imply AED1.8million (US$490,000), or 1% of the loss in total amenity services

4.2. Model results

In Table 8, the results of the Tobit estimations are summarised, for WTP and WTA with non-zero responses. For each estimation, the first column presents the coefficients while the second column the robust standard errors between WTA or WTP and each variable in the regression.

Table 5
Estimate number of beach visits for 2013/2014*.

Beaches	No. of visits	Percentage share of all beach visits (%)	Notes
Bateen beach, incl. Ladies Beach from June 2014	693,153	29.4	Based on numbers provided for Jan–Nov, with a 5% adjustment for Dec
Yas beach	112,158	4.8	Based on numbers provided for Jan–Nov, with a 5% adjustment for Dec
Corniche	1386,307	58.7	Assumed twice the size of Bateen beach
Saadiyat	168,237	7.1	Assumed 1.5 times the size of Yas beach
Total	**2 359,855**	**100**	**The total number of visits equates to 4.2% of Abu Dhabi's residents visiting the beaches at the same frequency as the respondents**

* Refers to the financial year, April to March.

Table 6
Beach visitors: estimate of city-wide WTA compensation.

	Offset costs			Cost of algal bloom		
	−25%	Estimated value	+25%	−25%	Estimated value	+25%
Residents						
- AED	339,493,911	452,658,548	565,823,185	1,694,456,669	2,259,275,559	2,824,094,448
- US$	92,505,153	123,340,204	154,175,255	461,704,814	615,606,419	769,508,024
- US$/ha	1,660,775	2,214,366	2,767,958	8,289,135	11,052,180	13,815,225
Tourists						
- AED	7,576,377	10,101,835	12,627,294	185,436,333	2,47,248,444	309,060,555
- US$	264,408	2,752,544	3,440,680	50,527,611	67,370,148	84,212,685
- US$/ha	37,063	49,417	61,772	907,138	1,209,518	1,511,897
Total						
- AED	347,070,287	462,760,383	578,450,479	1,879,893,002	2,506,524,003	3,133,155,004
- US$	94,569,561	126,092,747	157,615,934	512,232,426	6,82,976,568	853,720,709
- US$/ha	1,697,838	2,263,784	2,829,730	9,196,273	12,261,698	15,327,122

Table 7
Beach visitors: willingness to pay contribution to mitigate the effects HAB.

	Contribute to restoration fund		Of those saying yes: WTP amount per visit:			State of the beaches
	Yes	No	Min	Max	Ave	Ave score out 5
Residents	67	19	5	500	39.6	3.8
Tourists	7	10	10	100	27.2	3.9

The same explanatory factors are used for both the WTP and WTA models for comparison purposes. In estimating the factors that affect the WTP, none of the independent variables are statistically significant. In other words, none of the variables used in the estimation can be used within a modelling framework to estimate the amount that the respondents are willing to pay (WTP). This implies that the underlying factors on which the WTP estimates are based are very random. This is in stark contrast with respect to the WTA.

In the second estimation (WTA – offset cost), the travel time from place of current residence to this beach is proven to have a statistical significant coefficient in explaining the respondents' willingness to accept compensation to offset the inconvenience caused by the need to move beaches. The positive sign of the coefficient shows that the higher the travel time is for the respondents, the higher their willingness to offset the inconvenience.

When it comes to the respondents' willingness to accept compensation to offset the loss of access to all beaches, there are three statistically significant factors: the residence status of the respondent (higher WTA on average for the tourist than for the resident, among the respondents), the number of beach visits (the more the respondent visits the beach the less their WTA) and the travel time from place of current residence to this beach (positive impact).

Among the respondents that would not choose to go to beach B (WTA_not_going), travel time from place of current residence to this beach, household size and average household income are factors that significantly affect their WTA. In other words, the longer it takes for a respondent to reach the beach the lower their WTA; the bigger the household size the higher their WTA; and finally, the higher the income bracket the household belongs to, the lower their WTA.

From the above it is clear that much more confidence can be placed in the results from the WTA estimates, than in the WTP. It also reflect the sense of entitlement visitors have with respect to visiting the beaches and the amenity services they derive from it.

These findings seem to be much higher than the ones been reported by Huang et al. (2013): the mean values of WTP and WTA were $1981,56 and $9696,96, respectively. The respondents in that study had to evaluate their WTA and WTP for an improvement in the quality of water. Our understanding is that the public places more value on better quality beaches and this can be a decisive factor for potential development of a tourist area as well as further economic growth of the area through an increased number of tourists. However, the two studies agree that the willingness to

Table 8
Coefficient estimates and standard errors of Tobit models.

	Results of the Tobit model							
	WTP		WTA (offset cost)		WTA (true value)		WTA (not going to beach B)	
Variables	Coefficients	Robust s.e.	Coefficients	Robust s.e.	Coefficients	Robust s.e.	Coefficients	Robust s.e.
Age	12.220	19.877	−5.324	28.450	−140.471	343.115	−360.032	407.649
Household size	0.569	0.695	0.172	3.832	−14.787	42.851	905.852*	295.265
Average household income	−2.253	5.367	−14.018	14.739	215.692	237.823	−1244.015*	395.778
Residence status	−16.624	15.871	52.027	52.027	1998.693**	1115.337	53.278	709.976
Beach visits	−0.007	0.032	0.255	0.255	−2.593**	1.414	−1.609	1.563
Travel time	−0.416	0.432	0.773*	0.773	22.677**	12.887	−36.536**	21.031
Constant	52.521	19.816	168.879	168.879	−1759.577	1603.334	4787.065**	2287.033
Log likelihood	−405.64102		−507.17306		−636.1004		−107.78503	

Note: *** Statistical significance of 5% level.

* Statistical significance of 1% level.

** Statistical significance of 10% level.

accept has a higher value than the willingness to pay for both cases, showing that respondents are relatively more passive in taking actions. The same conclusion was reached by Zhai and Suzuki (2008), who investigated a project more similar to this study by evaluating the economic value of coastal waterfront in Tokyo Bay. Also, their numerical results are closer to this study's, possibly due to the similarity of the project. With regards to factors that have affected the answers of the respondents, it is quite clear that the household (or individual's) income is a repeating factor in all three studies while some household (individual) characteristics, such as size in our study or education in Huang et al. (2013), also played a role.Management Implications and Applications: The national affinity for the environment, despite multiple threats to the environment is incorporated within multiple planning documents for the Emirate and the UAE. The provision of additional layers of data have added value to these discussions by creating cross dialogue between hoteliers, developers, recreational service providers and government through project-related workshops and meetings. Dialogue towards the protection of coastal systems as an essential part of economic diversification, in fact integral towards it.

The Environment Agency – Abu Dhabi is exploring the use of the data towards strengthened discussions around compensation and Environmental Impact Assessments while the Ministry of Climate Change and Environment is exploring the findings towards its National Natural Capital Mapping efforts being planned. The data is currently also being utilised used as part of strengthening dialogue and influencing regional planning and reporting including the ROPME Ecosystem Based Management Strategy and the Global Environmental Outlook (GEO) 6 report for West Asia.

5. Conclusion

Abu Dhabi is a fast growing and young metropolis attracting people from all over the world to live, work and play within the city. As a result, the continued protection of the amenity value of its beaches, one of the main points of attraction when marketing the city, is of the utmost importance. It is estimated that this amenity value ranges between US$4900 (tourists) and US$218 500 (residents) per year in the event that an alternative is available. In the event that no alternative is available the annual amenity value is estimated to be US$ 119,330 for tourists and $1 090 500 for residents. These values translate to a city-wide amenity values that ranges between US$461million and US$770million for residents, and US$50.5million and US$84million for tourists. Interpreting the results in terms of beach size, it implies that the beach amenity value is estimated at between US$8.3million and US$13.8million/ha. It should be noted that the associated ecosystems, (including the mangroves, sea grass, intertidal zone, coral reefs, etc.) need to function properly in order for the beaches to be able to offer quality services. This value, therefore, has to be ascribed to the working of the larger system, approximately 30,000 ha, resulting in a unit value of US$22 763/ha.

These values are of such importance with high political significance. The disparities observed between the WTA and WTP of the participants can be particularly attributed to the policies and tax regimes (or lack thereof) in the Abu Dhabi case. All in all, the results suggest that the coastal and marine ecosystems should be protected in their entirety. Such protective actions could include the mitigation of the pollution load impacting on the ecosystem and thereby reducing the threat of harmful algae bloom outbreaks, as well as restoration-based activities to augment the capacity of the ecosystem to deal with such events.

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