How much is a clean beach worth? The impact of litter on beach users in the Cape Peninsula, South Africa

A. Ballancea, P.G. Ryanb and J.K. Turpieb

Stranded and discarded litter detracts from the aesthetic quality of beaches, and the quantities of litter on South African beaches continue to increase. We estimate the deterrent effect this has on beach users, and the consequent effect on the regional economy. An interview survey was used to determine the importance of beach cleanliness to local and non-local beach users. Cleanliness was stated as the most important factor in influencing choice of beach, especially by foreign tourists. Almost half of the respondents from the Cape Metropolitan Region are prepared to spend more than seven times the average trip cost to visit clean beaches. Furthermore, up to 97% of the value of these beaches could be lost by a drop in standards of cleanliness. Litter densities of more than 10 large items per metre of beach would deter 40% of foreign tourists, and 60% of domestic tourists interviewed, from returning to Cape Town. The impact of this on the regional economy could be a loss of billions of rands each year. A Travel Cost approach estimated the total annual recreational value of selected beaches in the Cape Peninsula, South Africa, at between R3 million and R23 million. The large variation is due to a number of assumptions inherent to the Travel Cost Method, and extrapolations from the limited data available. Beach cleaning within the Cape Metropolitan Region is clearly necessary, however, expenditure during the study period (R3 million in 1994–95) is high in relation to the recreational value, and alternative methods of reducing debris at source are required to improve beach cleanliness.

Marine and beach pollution is an environmental problem worldwide, threatening wildlife and resulting in a loss of aesthetic quality of the coastline. The recent increase in density of large debris items found on South African beaches is a cause for concern. Plastic makes up 90% of all large debris stranded on South African beaches and is particularly troublesome because it disperses easily and degrades slowly. The costs of marine and beach debris are now receiving more attention, to provide incentives to reduce pollution. Degradation of beaches affects their aesthetic value to users, and loss of this attraction may affect the regional economy by deterring visitors, particularly tourists. This was demonstrated by an oil spill in June 1994, which polluted some of Cape Town’s most popular beaches.

Tourism is extremely important to the South African economy. In 1994, it generated revenue of R12 billion (R7 billion from international tourism), and, directly and indirectly, supported 14 million jobs. It is also a sector of the economy that has great potential for growth and employment, and hence is a target for public and private investment. Knowledge of the impact of beach litter on the regional economy is therefore important. This paper assesses the value of clean beaches to users and the socioeconomic impacts of beach litter on the region. We hope this will encourage improved legislation or the development of alternative strategies for preventing pollution at source, thus reducing the environmental and aesthetic effect of litter.

Methods and study area

The study was conducted around the Cape Peninsula (33°S, 26°E) because of the opportunities for estimating beach value to tourists and residents. Cape Town attracts 49% of international tourists visiting South Africa as well as 20% of domestic tourists, and many of the 3.1 million local residents use the beaches for recreational purposes (walking, swimming, tanning, surfing, etc.). The beaches of the Peninsula differ in a number of attributes important to visitors, such as water temperature, exposure to wind, facilities and ease of access. Ten study beaches were selected across the range of these features (Fig. 1) to assess attitudes towards cleanliness of a wide range of visitors. All estimates are 1996 values, to compare with the estimates of income generated by tourism and expenditure on beach cleaning, during the period 1994–96.

A questionnaire survey using one-to-one interviews gauged attitudes among one thousand visitors to the sample beaches. The interviews were conducted randomly with respect to age, gender, nationality, and activity of the respondent, time of day and day of the week, to minimize biases towards particular user groups, and to represent the proportion of both residents and tourists using the beaches. Tourists were defined as people from outside of the Cape Metropolitan Region (CMR) or those from within the region who were staying overnight away from home. Attempts were made to standardize the number of interviews at beaches surveyed, although differing weather conditions (and hence number of visitors) at the beaches did not always permit this. To compensate for small sample sizes, the responses from visitors to Strandfontein were combined with those from Muizenberg, and the responses from visitors to Milnerton were combined with those from Blouberg. In both cases the beaches have similar physical characteristics and visitor profiles.

Questionnaires were designed to establish the number of visits to a particular site, the cost of the trip, and the respondents’ opinions towards the standard of cleanliness of the beaches. Beach activity and anticipated length of stay on the beach were also sought, in search for relationships with the perceived level of cleanliness. A profile was constructed of different user groups according to their personal details and opinions (for instance, residential area, household income, length of stay, activity, perceptions of cleanliness), across all beaches.
The Travel Cost Method was used to estimate the recreational value of sample beaches. This method is widely used in the evaluation of natural resources with recreational appeal, and records the actual travel cost associated with visiting a resource as a proxy for its value to the visitor. It was selected for this study over other techniques as it uses actual values, which can be summed across a wide range of users to compute a nominal total recreational demand value, it is restricted to direct, non-consumptive use valuation, and it is easy to administer. (For a detailed appraisal of alternative techniques see ref. 9.) The return trip cost was estimated for each respondent using either public transport fares or the Automobile Association’s cost of 35.5 cents per kilometre (1995 rates). The annual recreational value of all beaches to each respondent was calculated using the number of visits per year and the cost per visit. The total annual recreational value of each beach was determined using the mean trip cost per visitor, and the number of visitors per year (obtained from extrapolations from aerial photographs, courtesy of Cape Metropolitan Council). A full description of the application of the travel cost method is given in ref. 10.

The Travel Cost Method estimates the total value of beaches to users, but says nothing about the value of individual beach attributes, such as cleanliness. To establish the relative importance of selected attributes, visitors were asked to rank them from 1 to 5, with 1 being the most important. The absolute importance of beach cleanliness was determined by questioning residents how far they would be prepared to travel for different levels of cleanliness, and by asking tourists how covered in debris the beaches would have to be for them to stop visiting. Three levels of beach cleanliness were used, based on the results of a survey of 84 beaches across the country. The levels were more than 10 large items of litter per square metre of beach, between two and 10 items per metre, and less than two items per square metre. Photographs of each of these levels were shown to elicit the reaction sought. The proportion of tourists who stated they would not visit Cape Town according to the extent of beach litter was used to estimate the tourism revenue potentially lost by not maintaining levels of cleanliness of beaches in the Cape Peninsula. Expenditure on cleaning beaches was obtained from local authorities.11,12

### What the survey revealed

Most respondents were residents of the Cape Metropolitan Region (65%). Twenty-one percent of the people surveyed were domestic tourists, and 14% were foreign tourists. Perceived standards of cleanliness of Cape beaches were high, particularly among tourists. Tourists also spent significantly longer on beaches they considered to be ‘clean’ or ‘acceptable’ than on those they saw as ‘too dirty’ (ANOVA, F_{3,23} = 5.576, P < 0.005; ‘clean’ > ‘too dirty’ and ‘acceptable’: Newman-Keuls test).

Cleanliness was most frequently ranked as the most important of the beach attributes investigated, and foreign tourists ranked cleanliness as relatively more important than either domestic tourists or residents (Table 1). Furthermore, 44% of residents claimed they would travel 50 km or more to visit a clean beach. The average trip distance for residents was 14 km (cost approximately R4.90) and for tourists 12 km (nominal cost R4.20), probably because many of the popular tourist hotels are located close to the beaches. Residents made approximately 70 trips to the beach each year on average (annual travel cost R348), whereas tourists made 10 trips (annual cost R42). A trip of 50 km to visit a clean beach has a minimum trip cost of R35.50, more than seven times greater than the cost of a trip for residents interviewed. However, beach users derive value from a variety of beach attributes, and often these features mutually influence the decision of which beach to visit.

The extrapolations from the summer and winter beach attendance data gave a total of 1.871 million visitors per year. Because these are extrapolations, and given the large variation in the data available for determining beach attendance, figures have been rounded to the nearest thousand visitors. Extrapolation of the mean trip cost across the total number of beach visitors yielded an estimated combined annual recreational value for the sample beaches of R8 million, although there was considerable variation between values for individual beaches (Table 2). Assuming similar mean trip costs, and similar combined number of visitors per year for all other beaches in the Cape Peninsula, the annual recreational use value of all beaches in the region was estimated at R18 million.

The figures should be treated as underestimates of the actual value. Several estimations were made, as not all required data were available or accurate, and there are several assumptions inherent to the Travel Cost Method. A sensitivity analysis, which estimated the cumulative impact of these variations, showed that the total annual recreational value for sample beaches was R3–23 million.24 Using the same estimation criteria, the value for all the beaches in the Cape Peninsula is likely to lie between R9–50 million per year.

The survey indicated that 85% of both tourists and residents would not visit beaches if they had more than two items of debris per metre. This would reduce the average annual recreational value of the sample beaches from R1 million to R150,000. The total annual expenditure on travel to sample beaches would be reduced from R8 million to R1 million. The annual expenditure on travel for all beaches in the Cape Peninsula would be reduced from R18 million to R15 million. The survey also showed that if these were extrapolations, the total recreational value to R300,000 per year. Such reduced annual expenditure on travel represents a reduction in the regional economy of R8 million.

Given the importance of tourism to the national and regional economy, the

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**Table 1. Mean scores for relative importance of various beach attributes as perceived by beach users around the Cape Peninsula. Lower scores indicate greater importance of attribute.**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Mean score from residents</th>
<th>Mean score from domestic tourists</th>
<th>Mean score from foreign tourists</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cleanliness</td>
<td>2.5</td>
<td>2.3</td>
<td>2.2</td>
</tr>
<tr>
<td>Facilities</td>
<td>3.9</td>
<td>4.4</td>
<td>4.1</td>
</tr>
<tr>
<td>Number and type of people</td>
<td>4.0</td>
<td>4.4</td>
<td>4.2</td>
</tr>
<tr>
<td>Proximity to home/hotel</td>
<td>4.2</td>
<td>3.7</td>
<td>4.5</td>
</tr>
<tr>
<td>Water temperature/surf quality</td>
<td>3.6</td>
<td>3.9</td>
<td>4.1</td>
</tr>
<tr>
<td>Wind direction and force</td>
<td>2.8</td>
<td>2.9</td>
<td>3.5</td>
</tr>
</tbody>
</table>

*Sixty-two respondents named an additional attraction, of which safety and scenic beauty were cited most frequently (30 and 23 times, respectively).
Table 2. Estimated total annual recreational use value of sample beaches on the Cape Peninsula.

<table>
<thead>
<tr>
<th>Beach</th>
<th>Number of residents visiting per year</th>
<th>Mean trip cost for residents (rands)</th>
<th>Number of tourists visiting per year</th>
<th>Mean trip cost for tourists (rands)</th>
<th>Total annual value (R million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blouberg and Milnerton</td>
<td>93 000</td>
<td>4.2</td>
<td>54 000</td>
<td>4.8</td>
<td>0.6</td>
</tr>
<tr>
<td>Sea Point</td>
<td>113 000</td>
<td>3.6</td>
<td>51 000</td>
<td>1.2</td>
<td>0.4</td>
</tr>
<tr>
<td>Clifton</td>
<td>73 000</td>
<td>6.7</td>
<td>80 000</td>
<td>5.3</td>
<td>0.9</td>
</tr>
<tr>
<td>Camps Bay</td>
<td>129 000</td>
<td>5.5</td>
<td>86 000</td>
<td>4.2</td>
<td>1.0</td>
</tr>
<tr>
<td>Llandudno</td>
<td>24 000</td>
<td>6.3</td>
<td>32 000</td>
<td>4.3</td>
<td>0.2</td>
</tr>
<tr>
<td>Fish Hoek</td>
<td>115 000</td>
<td>3.1</td>
<td>28 000</td>
<td>4.0</td>
<td>0.4</td>
</tr>
<tr>
<td>Muizenberg</td>
<td>175 000</td>
<td>5.5</td>
<td>109 000</td>
<td>6.8</td>
<td>1.7</td>
</tr>
<tr>
<td>Muurbosibi and Strandfontein</td>
<td>667 000</td>
<td>4.5</td>
<td>42 000</td>
<td>2.6</td>
<td>3.1</td>
</tr>
<tr>
<td>Total</td>
<td>1389 000</td>
<td>4.9</td>
<td>482 000</td>
<td>4.2</td>
<td>8.6</td>
</tr>
</tbody>
</table>

*The total annual value of R8.5 million is not the same as the sum of the values in that column due to rounding errors.

Potential loss in number of tourists due to a drop in standards of beach cleanliness that this study reports (up to 40% of foreign and 60% of domestic tourists) is significant (up to 52% of the revenue from tourism).

Coastal areas are important in terms of economic, scientific, recreational, ecological and educational services. Reliable estimates of beach value are therefore important for planning facilities, determining access and transport capacity, estimating potential for new business development, and for coastline protection and pollution control. The estimated value of beaches and beach cleanliness should be reflected in an appropriate budget for cleansing. Furthermore, estimation of the impact of environmental quality on tourism potential is far from trivial. The relative and absolute importance of cleanliness to beach users shown in this study provides a strong incentive for pollution control.

Expenditure on beach cleansing in the Cape Metropolitan area was approximately R3.5 million in 1994-95; and beach cleaning efforts have increased during the last five years. Given that Cape Town attracts a significant proportion of the tourist market, it is reasonable to assume that the increased expenditure (relative to the rest of the country) is, at least partially, a result of greater importance placed on the aesthetic quality of beaches. This study estimates that the regional economy could suffer a potential loss of over half the tourism revenue from a reduction in beach cleanliness. Keeping beaches clean is therefore necessary. As only 44% of people surveyed perceived the beach they were on as 'clean', current methods of cleaning debris appear to be insufficient to tackle the problem.

A survey of pollution on South African beaches in 1994 showed four of the ten dirtiest beaches are within the Cape Metropolitan Region. However, the Cape Town Municipality Cleansing Department reported a 37% decrease in the volume of litter generated on beaches under its control between 1994-95 and 1995-96. This may be attributable to more efficient cleaning operations, or reduced amounts of litter entering the marine environment. As clean-up operations are expensive in relation to the number of tourists, it is necessary to consider alternative methods of reducing beach debris. Legislation, improved efficiency of cleansing services, recycling, reduction at source, and education are possible options.

Most beach debris is generated by beach users or is washed or blown onto beaches from the land. Plastics, especially packaging materials, constitute over 90% of all beach debris. These items are very durable, which increases the risk of entanglement or ingestion by marine wildlife. Lack of waste collection and disposal services in many urban coastal settlements contributes to the accumulation of waste on beaches, as it is blown or washed away from unprotected, informal waste dumps. Furthermore, the increasing population and influx of people to coastal urban centres intensifies the pressure of waste generation on the beach resources.

Much attention has been focused recently on methods of reducing plastic packaging. One suggestion is to produce less durable plastics, which break down faster by means of biological, chemical, photochemical or physical actions. Another option is to promote recycling, which requires the creation of markets for recycled material. Further efforts to reduce plastic packaging have centred on charging for packaging.

Perhaps the biggest hurdle to overcome is the mindset of today's 'throw-away' society. Education of the public to the problem of litter in the environment would go a long way to increase levels of responsibility, and thus to reduce the volume of litter in the environment.

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Widening access to tertiary science study: the ‘augmented’ model

J. Parkinson*

The four-year B.Sc. degree course at the University of Natal, Durban, is unusual in providing access to tertiary science through ‘augmentation’ rather than the more usual foundation course. The augmentation involves students registering for a reduced load of ordinary first-year courses, which are supplemented by extra tutorials and practicals. This article describes the augmented approach to science study. It examines the development of the B.Sc.-4 curriculum during the 10 years it has been operating and describes some of its successes and failures during this period.

The present under-representation of black students in tertiary education, particularly science and applied science, is well documented as are the roots of this under-representation in apartheid policy. Only 19% of mathematics teachers and 16% of science teachers in the country have completed one or more years of the subject at university level. This has led to the current situation where few black students match the criteria for direct entry into tertiary science studies. During the 1990s, less than 10% of admissions into the Science Faculty at the University of Natal in Durban (UND) have been black students who meet the entrance requirements. The four-year B.Sc. curriculum described below has allowed the faculty to more than double its intake of black students during this period, by enabling admission of students who do not meet the usual entrance requirements.

To increase enrolment and graduation rates of black students, historically white universities have, in the last 15 years, introduced four-year science curricula of a variety of types. Some add an initial foundation year, after which students embark on first year. Others have an initial two-year programme combining foundation and first-level courses. Since 1991, UND has had a four-year B.Sc. curriculum in which students are admitted directly into first-year courses. These differ from the usual first-year courses in having an almost double load of tutorials, lectures and practicals. This model of academic development has been rejected by many institutions because the pool of black students who can cope with a curriculum where students start first-level courses immediately is relatively small. Foundation programmes are able to draw on a larger, less-prepared group of students because more time can be spent on pre-first-year material.

Structure of the B.Sc.-4

Students who enter the four-year B.Sc. curriculum at UND take two double-load ‘augmented’ level 1 courses in their first year. For example, in physics they have nine contact periods per week for lectures and tutorials and two practical sessions, instead of the five periods for lectures and tutorials and single practical session of the regular first-year physics course. Typically, courses taken are mathematics and either computer science, physics or chemistry, or, for a biology student, chemistry and biology. Students also take an accredited science writing course.

Six of the level 1 courses in the faculty are offered as double-load ‘augmented’ courses: cell biology, chemistry, computer science, environmental biology, mathematics and physics. Some of these double-load courses (cell biology, environmental biology, computer science and mathematics) are ‘augmented’ in that the students attend the usual lectures and practicals plus an additional load of tutorials and practicals in groups of about 30 students. In these additional tutorials, tutors can address problems with the lecture material as well as dealing with some pre-first-year material.

Other level 1 courses (physics and chemistry), although covering the same content as the usual first-year courses, are entirely separate from it. This enables the lecturer to go more slowly and integrate pre-first-year material into the course. Some of the contact time is lecture mode but, given the small group size (30 students or fewer), there is opportunity for questions and other interactions with students. Other contact time is devoted to small group work, and problem solving, depending on the demands of the material.

Individual departments design courses and decide whether their double-load courses are separate from the usual lecture course or ‘augmented’ with additional tutorials and practicals. Different subjects lend themselves to different models. Initial poor student performance, both in first-level and later level chemistry courses, led to a change from the lectures plus extra tutorials model to the separate course model. It is not clear why the lectures plus tutorials model works (in terms of student performance) in some disciplines but not others. A factor to be considered is the extent to which the first-year course in each discipline assumes and builds on prior knowledge. In disciplines where a good deal of prior knowledge is assumed such as in chemistry, mathematics and physics, (but far less in biology and computer science), it makes educationally better sense to build teaching of the prior knowledge into a separately taught level 1 course. In mathematics, however, student results have been good using the lectures plus tutorials model, and the course has proved more successful in dealing with the prior knowledge in tutorials before the lectures than was the case in chemistry.

An element of difference between mathematics on the one hand and physics and chemistry on the other, is the difficulty that B.Sc.-4 students had with the lecture mode in chemistry and physics, especially in the first semester. In most disciplines it seems to be the case that sitting through lectures in which material is presented rapidly and in a possibly unfamiliar accent is not an ideal learning environment for students entering the four-year degree. This appears to be particularly true in chemistry and physics, where students report great difficulty in

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