

Environment, urban development & crime - establishing the value of a freshwater lake in an urban setting: the case of Zeekoevlei

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Abstract

Most local governments in South Africa grapple with the pressing needs of their communities. But, at the same time there is pressure on government to care for environmental concerns. The environment often has public good characteristics. For this reason, it is difficult to value it in the market. Usually, the provision thereof is left in the hands of the government and they are generally less prioritized by local governments.

This study aims to show that public environmental goods are beneficial to society and should receive due consideration in the spending activities of local governments. The focus is on Zeekoevlei lake, situated on the Cape Flats near Cape Town. The lake is an important regional recreational venue but is highly polluted.

The environmental value of Zeekoevlei is estimated using the contingent valuation method (CVM). The study is unique in that the lake is situated within an urban area surrounded by residential dwellings. The study faces some methodological challenges as this area is characterized by very different use (and non-use) options and the impact of security problems due to crime can also influence these values. The questionnaire is set up in such a manner to obtain the values for those people living at the lake, and those who visit the lake. The study finds that the communities within the immediate vicinity of the lake do feel they benefit from the lake.

The preliminary calculation of the mean willingness to pay for improved water quality is estimated at R38.31 (per month), and the mean willingness to pay for improved recreational facilities is an entrance fee of R9.44 per person per visit. The willingness to pay varies with socioeconomic variables like income, household size and education.

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1 Introduction

Water resources are a vital part of human activity. They are utilized for consumption and production activities. While the main water use is the current flow to residential areas or production, it also includes consumption of the services from the water stock, like using water bodies for the purpose of recreation and the enjoyment of its aesthetic beauty. Water management therefore does not only comprise looking after the volume of the resource, but also its quality. At the same time, urban settlements have experienced an influx of people into cities, especially from rural areas in the search for employment. This has placed increased pressure on resources of local governments to provide basic and other public services such as improving environmental quality. This implies less emphasis on improving the water quality of lakes utilized for recreational purposes.

South Africa has many wetlands and water bodies that are used for the purpose of recreation. One such water body is Zeekoevlei in the Western Cape. It is the largest freshwater lake (256 hectares) in South Africa (World Lakes Database, n.d.). The lake is situated on the Cape Flats² and is surrounded by suburbs with varying economic and social characteristics. Some residents live on the edge of the lake while others are within walking distance. The lake is utilized for recreational purposes, and sailing and fishing activities are some of the more frequent activities on the lake.

Zeekoevlei is heavily polluted with high levels of phosphorous (World Lakes Database, n.d.). A study conducted by Southern Waters Ecological Research and Consulting (2000), identifies three sources of pollution, namely pollution runoff from the rivers feeding into the lake; the sediment in the lake itself; and the wastewater treatment plant situated adjacent to the lake. The increased pollution has impacted on the recreational use of the lake and it has implications for the preservation of natural wetlands on the Cape Flats.

This study wants to establish the value of the lake to the surrounding communities. It investigates the factors that influence the willingness to pay for the environmental water qualities. The focus is on both the recreational and the non-use value of the lake. The primary goal is to establish the importance of the lake as an environmental good which can be an important benefit to local communities. This will support the viability of the clean-up and restoration of Zeekoevlei. Determining the economic value of the lake is especially relevant since cleaning it up will be costly and the current focus of the local government is primarily the provision of basic goods and services. Special attention is given to the influence of crime on the valuation of the lake. This part of the Cape Flats is well known for a high rate of crime and the use of the lake for recreational purposes is probably influenced by both pollution and crime.

² The Cape Flats is a flat low-lying area which is situated to the southeast of central Cape Town.

Since there is no ready market where these values can be established, the valuation method will rely on the “stated preference”/ direct valuation method of contingent valuation. Huszar, et. al. (n.d.) state that the contingent valuation method (CVM) is a widely used survey method to determine the willingness to pay for use, existence and bequest values for environmental resources.

The paper starts with a theoretical exposition of the case for government involvement in the provision of environmental goods. It explains why environmental goods are classified as public goods and the difficulty in obtaining values for these goods. The next section briefly elaborates on the budgetary trade-offs faced by the local government of Cape Town given the pressing needs in its jurisdiction. Urban development patterns in the Western Cape are one of the underlying reasons for the increased demand for local government services. This section outlines the implications of these budgetary allocations on the provision of environmental goods. This is followed by a background section on Zeekoevlei and the communities in surrounding suburbs. Section four outlines the data collection process and methodology. It provides specific information on the design of the survey. Section five discusses the results of the econometric analysis. The last section concludes with a general summary of the paper.

2 Theoretical Exposition on provision of Environmental Goods

2.1 Environmental goods as public goods

Graves (2002) indicates that environment goods are usually classified as a subset of public goods. The latter exists due to two properties: the first one is non-excludability in consumption (which implies that no individual can be excluded from the benefit of the environmental good, e.g. swimming in a river). The second property stems from the non-rivalrousness in consumption (which implies when one person consumes the good, there is not less left for the next person to consume). Environmental goods often has either (or both) of these properties and provision thereof does not usually take place in markets. Mishra (n.d.) states that only certain environmental goods have markets and only a few therefore have prices. However, in most cases, no markets exist and therefore no prices and costs are available to the consumer. This is especially the case when one deals with the existence of non-use values. Hanley, et. al (2001) indicate that an environmental good can have both direct and indirect benefits. The preservation of a wetland, for example, can have direct benefits which include use values such as bird watching and non-use or existence values such as people knowing that the wetland is preserved. Indirect benefits can emanate from the pollution cost that will be saved if the wetland is preserved. Most environmental benefits from the use of wetlands are non-consumptive; they do not exhaust the water body.

2.2 *Environmental valuation and some empirical applications*

Many environmental services are offered with no markets present and standard methods of consumer surplus cannot be used to reveal market information via the price system. A different approach is required to obtain the economic values for these goods and services. A standard textbook approach like Hanley, et. al (1997) is to distinguish between direct and indirect valuation methods. The former involves directly obtaining the values from individuals (also referred to as the stated preference methods), whereas the latter attempts to establish these values by observing the behaviour of individuals in related markets.

In the case of stated preference methods, Grafton, et. al (2004: 229) argue that this entails "... 'conversations' with individuals through structured surveys." These methods involve asking the respondents to the surveys what they would be willing to pay for changes in environmental quality. The Contingent Valuation Method (CVM) is the most common stated preference method and involves creating a hypothetical market in which the respondent is offered a good and is asked to indicate whether he/she is willing to purchase the good. O'Doherty (1993: 1) states that where a policy change will cause an environmental effect, those who benefit (or suffer a disbenefit) are encouraged to reveal their willingness to pay for the policy change (or to avoid it).

A vast literature exists on CVM (which will not be surveyed here); see however, Arrow et al (1993) for the classical article on CVM. The CVM has been utilised in a number of studies in developing countries. Kohlin (2001) applied the method to establish the value of a social forestry project in India. The respondents were asked how much they were willing to pay for a new plantation (which could then be compared with the plantation costs). The study highlighted certain issues one has to take into account when conducting studies in developing countries, for example the population may not all be literate (especially in rural areas) and this would affect the type of questions asked to elicit the willingness to pay value.

Another study in developing countries is that of Carlsson, et. al (2003). This study focused on community plantations in Ethiopia and attempted to draw both methodological and policy conclusions using the CVM method. The study specifically asked respondents what their willingness to pay would be to share in a community plantation. One of the findings was that the application of the closed-ended elicitation in the context of community based scenarios could lead to yea-saying.

2.3 *Budgetary trade-offs for local governments – implications for environmental goods*

Spatial development patterns in South Africa are of such a nature that rural areas have experienced little development over the past years, both economically and socially. This has resulted in a migration of people into urban areas in the search for better opportunities. This is

also the case for the Western Cape. There has been an influx of workers to city centres especially from neighbouring provinces (Eastern Cape and Northern Cape) where fewer economic opportunities are available. This has placed a burden on the local government as there has been an increase in the demand for basic services such as water and sanitation services.

The local government of Cape Town (known as the City of Cape Town, CCT) has experienced an influx of workers from rural areas and other parts of the country. For the period 1996 to 2006 the CCT experienced an annual average growth rate of 3% in population (CCT, 2007).³ The driving force behind these movements is primarily economic. Many people cannot find work in rural areas and are then forced to migrate to urban centres. This normally leads to the development of informal settlements in the urban centres. According to the State of Cape Town report (2006: 32) "Cape Town grew by 40% in developed land area in the period 1985-2005." This leads to higher population densities, especially in the lower-income areas, which leads to overcrowding and therefore health problems. According to the CCT (2007), from 1993 to 2006, the number of households in informal settlements grew from 23000 to 115000.

Urban population growth places increased pressure on local governments to provide social and economic services. One can therefore expect that the greater proportion of local government budgets is spent on the provision of basic services. This is illustrated in table 1 below which reflects the major spending categories of the CCT.

Table 1. Major spending categories for the City of Cape Town: 2007 Budget

Category	Capital Expenditure R'000	Operating Expenditure R'000	Total Expenditure (TE) R'000	TE as % of Total Budget
Utility Services	1325230	7141299	8466529	49.38
Transport	722927	1089083	1812010	10.57
Environmental Resource Management	7906	46667	54573	0.32

Source: The City of Cape Town Budget for 2007/2008 to 2009/2010.

Table 1 indicates less than 1% of the total budget is spent on environmental resource management as compared to almost 50% on utility services. This clearly indicates the focus of the CCT on the provision of basic goods and services.

3 An overview of Zeekoevlei and the surrounding suburbs

Zeekoevlei is situated on the Cape Flats amidst an urban residential area. It is surrounded by primarily the (traditionally called) coloured suburbs of Grassy Park, Lotus River, Pelican Park

³ There has been a downward trend in population growth, with the population growth rate slowing to 1.61% by 2006 (CCT, 2007).

and Zeekoevlei. A section of Zeekoevlei is also referred to as the Peninsula as it is a part of the suburb of Zeekoevlei that is isolated (in the sense that residential plots are located on a piece of land surrounded by the lake with only one access road). The residents living on the Peninsula is relatively more affluent (and racially mixed) than the other suburbs.

3.1 Factors impacting on the value of Zeekoevlei

Zeekoevlei is an area open to the public and it is utilised for recreational purposes. The lake is itself an area that makes many different recreational activities possible. It is in principle a possible area for swimming, although water pollution may not always allow such direct contact. Therefore, it seems more reasonable to study the values of boating, fishing and bird watching, as well as picnics or relaxing along the shores of the lake. It also has value in terms of the nature of the area. A user assessment survey conducted by Quick and Johansson (1992) strengthens this by indicating the activities mentioned as being the most popular amongst users of Zeekoevlei.

Zeekoevlei is the largest water body on the Cape Flats and is fed by two rivers, the Big and Little Lotus Rivers. Zeekoevlei has experienced increased pollution levels as the areas surrounding the lake became more urbanized and industrialized. Southern Waters (2000) has identified the causes of the high nutrient loading (phosphorous) as emanating primarily from the following sources: runoff into the Big Lotus River and the Little Lotus River (agricultural runoff from farming and horticultural activities), seepages from the wastewater treatment plant (adjacent to the lake), and stock-based sediments in the lake itself. This flow pollution has accumulated in the lake over the years and at present around 25% of the pollution is generated by internal loading from the volume of organically-rich sediments.⁴ These sources constitute a negative externality to the lake and adversely affect its recreational functioning.

The value of the lake for human use is also influenced by the crime of the area. The surrounding residential areas experience high levels of criminal activity.⁵ Remote areas (such as the lake) are especially exposed to these criminal activities and the lake area is subsequently a place people tend to avoid due to the higher risk of exposure to crime. In a survey completed by the CCT on the Environment and Tourism, it was found that crime and fear for personal safety are the most common reasons for stopping or limiting visits to protected natural areas, especially amongst people from the Cape Flats (CCT, 2001). Pollution and crime therefore work as complements to constitute the negative external effects on the use of Zeekoevlei.

⁴ This section draws heavily on a report completed by Southern Waters Ecological Research and Consulting, who completed a rehabilitation study on Zeekoevlei and Rondevlei in November 2000.

⁵ In its 2006 Sustainability Report, the CCT (2007) refers to statistics on criminal activities in Cape Town. Drug-related criminal activity has increased from 2004/05 to 2005/06 and the number of murders (per 100000 population) increased from 54.6 to 57.3.

3.2 *The suburbs surrounding Zeekoevlei*

Zeekoevlei is almost completely surrounded by urban residential dwellings. There are four suburbs within the immediate vicinity of the lake. This section provides a brief overview of these suburbs, providing a brief socio-economic analysis. The four suburbs are Grassy Park, Lotus River, Pelican Park and Zeekoevlei. The data is based on the Census of 2001.

Table 2. Socio-economic information on Suburbs

Category / Suburb	Grassy Park	Lotus River	Pelican Park	Zeekoevlei
Number of households	5090	7701	1535	908
Females (%)	53.02	52.25	51.68	50.96
Black African (%)	2.76	1.34	6.61	3.08
Coloured (%)	94.03	97.42	58.51	78.78
Indian/Asian (%)	2.40	0.81	33.99	4.91
White (%)	0.80	0.43	0.90	13.22
Age 18 and above (%)	69.59	66.93	63.36	64.37
Matriculated and higher education (%)	42.34	28.17	39.12	57.02
Monthly income above R25 600 (%)	1.03	0.13	1.07	1.61

Source: City of Cape Town. Census 2001

The information reflects that coloureds are the main racial group in the suburbs. Pelican Park and Zeekoevlei, however, seem to be more racially mixed. The proportion of females compared to males is generally the same for all suburbs, ranging around an average of 52%. The statistics also reflect that around two thirds of the population in each suburb is above 18 years old. If one compares the level of education across suburbs, Zeekoevlei is clearly different to the other suburbs with 57% of the suburb's population having obtained matric and higher education. Lotus River is especially low (compared to the other suburbs), with only 28% having obtained matric and higher education. It is also evident from the statistics that Zeekoevlei is the more affluent suburb, with 1.61% of its population earning a monthly income above R25 600. This fact is reinforced by this study's survey data (see more details on the survey later on). Table 3 shows the distribution of questionnaires completed in the suburbs, by income group.

Table 3. Percentage distribution of questionnaires completed by suburb and income group:

Income Group	Grassy Park	Lotus River	Pelican Park	Zeekoevlei	Peninsula	Total
1) 0-1000	2.42	6.61	4.82	0.00	0.00	3.91
2) 1001-5000	32.26	33.88	14.46	21.05	5.41	25.78
3) 5001- 10000	31.45	32.23	37.35	26.32	10.81	30.73
4) 10001-20000	25.00	19.83	33.73	47.37	43.24	28.13
5) > 20000	8.87	7.44	9.64	5.26	40.54	11.46
	100.00	100.00	100.00	100.00	100.00	100.00

The majority of the lower income groups (1 to 3), amounting to more than 60% of all households, live in the (traditionally) coloured suburbs of Grassy Park, Lotus River and Pelican Park. In Zeekoevlei, more than 50% of the respondents to the survey earn above R10 000. For households living on the Peninsula, about 40% earn above R20 000. This clearly reflects the economic differences between the suburbs.⁶

3.3 Determining the value of Zeekoevlei lake

Even without environmental externalities such as pollution, the value of the lake must be influenced by the safety of using it. The opposite argument also applies: in determining the value of the lake in a situation with security enforced, it must be influenced by the presence of environmental externalities. A polluted lake gives a low recreational value even if it is policed well; and a clean lake gives a low recreational value if the area is ridden by crime. Hence, it is not possible to completely separate the two effects (pollution and crime); they are complementary negative externalities.

Crime and pollution are both factors negatively influencing the value of the lake. This study focuses on the environmental value of the lake and also attempts to establish the impact of crime on how people value the lake (this is done by adding a question in the survey on whether policing of the area are essential to determine the environmental value of the lake). It is obviously not a unique situation. Access to an area with human activity and traffic close by are all outside factors that can overshadow pollution. In fact, in a study of the Zandvlei⁷, the value of wetlands was influenced by its potential effect acting as a buffer to surrounding crime-infected suburbs, (see van Zyl & Leiman, 2002).

The recreational area has different qualities. Zeekoevlei lake is a potentially unique nature reserve with different stock values like birds, views, fish, etc. It is also a recreational area for water activities and for onshore recreation. Most of these qualities people would like to enjoy, and they are all parts of the utility function of the households in the area. It seems reasonable that the demand for the good will differ with income, and that culture must have an influence.

⁶ One has to be careful about the accuracy of survey data on income. Respondents tend to be wary to reveal their income. However, the correlation of the survey data with the census 2001 statistics makes it more reliable.

⁷ Zandvlei is also a natural wetlands on the Cape Flats, situated quite close to Zeekoevlei.

The typical nature conservationist attitude may not be shared by all people in the area. The households' distance from the lake is also probably an important factor influencing its value to them. In the suburb of Zeekoevlei, some households have direct access to the vlei (for example on the Peninsula, most houses have access to the shore directly from their backyards). It seems like people living on the Peninsula constitutes a local community that is very different from the rest of the surrounding area. It makes sense to assume that their cultural background and income will bring about quite a different attitude towards the environmental value of the lake. Pelican Park is within walking distance to the lake, but it is an area where security is a more pressing issue. Lotus River and Grassy Park are further away, but some households are not living far from the lake. From observation and discussions in the focus groups it was also established that many households use the close by Zandvlei for recreation. This can be seen as a substitute for using Zeekoevlei as a recreational value. From these discussions it is apparent that Zandvlei provides better recreational facilities and people generally feel safer to take their families there for an outing.

4 Methodology & Data collection

4.1 Methodology

This study uses the contingent valuation method (CVM) to establish the value of Zeekoevlei lake to its surrounding communities. The CVM is especially applied when no market exists for goods and its value cannot easily be determined. Jennings & Curtis (2002, 1) argue that the CVM "...has been extensively used to assess the use and non-use value of environmental amenities, and continues to be developed as a tool for this purpose."

The CVM is a hypothetical method that directly asks the respondents' valuation of a particular environmental good. Jacobsson and Dragun (1996: 93) state that the development of CVM has enabled the measurement of non-market values. This is especially the case for option or existence values. The focus is on estimating the willingness to pay for an environmental good. This way the method aims to reveal the valuation of the lake in a way that makes it possible to use standard welfare analysis like consumer surplus. This provides an estimate of the welfare changes experienced by the respondent, since, if provided truthfully, it will provide a measure of compensating surplus.⁸ According to FAO (2000), the objective of the CVM is to ascertain the compensating variation for a particular good, where the latter is used as a measure where the person needs to buy an improvement in environmental quality. The respondent can therefore be asked what his/her WTP would be to obtain this good.

Freeman (1999: 170) identified 3 important aspects to focus on in the survey instrument:

- i) there must be a description of the choice setting within which the respondent will find him or

⁸ Compensating surplus is a monetary measure of the utility change associated with a change in environmental quantity or quality (Perman, et. al, 1999: 385).

herself; ii) the choice questions from which environmental values will be inferred (to establish an economic value expressed in money) and, iii) questions on the respondents to get information on their demographic and socioeconomic background that may influence their utility from the goods. The questionnaire for this paper commences with an introductory section that provides information on Zeekoevlei, the pollution of the vlei, and elaborates on the recreational activities at the vlei. The subsequent sections focus on obtaining demographic and socio-economic information on the respondent. Two sections contained the willingness to pay questions a final section provides some information on how the respondents rated the questions in terms of the levels of understanding and difficulty.

4.2 Survey design and Data Collection

4.2.1 Survey design

The design of the survey is based on an overview of existing literature on empirical studies completed using the CVM. Various contingent valuation studies provided examples of different types of elicitation formats and its advantages and disadvantages. Some of the more prominent studies utilised in this study is Carlsson, et. al. (2004), and Loomis et. al. (2000). Two focus group meetings and a small pilot survey were conducted before the main survey. The first focus group meeting took place in Grassy Park, with mostly residents from this suburb participating. The second focus group meeting was arranged via the Zeekoevlei Residents' Association and included mostly residents living in the suburb of Zeekoevlei. The meetings were generally informative about how prospective respondents would react to the survey questions. The participants in the focus group meetings were excluded from the main survey.

The questionnaire is set up to collect the background information on the social, economic and cultural characteristics of the households, as well as their attitudes towards the use of Zeekoevlei. This includes questions on their existing use of the lake. Questions on the willingness to pay are divided into two sections: one section focuses specifically on the use value of Zeekoevlei (asking hypothetical questions on the recreational facilities at the lake). The second section focuses on the environmental value (use and non-use), assuming hypothetical changes in the water quality. The reason for this two-pronged approach is that some households live next to the lake and would not utilise recreational facilities at the lake. Their responses on value already embed both use and non-use values since they have made an explicit choice to buy property next to the lake. For households in suburbs surrounding the lake (but not adjacent to the lake), there would be a possible risk that some value would not be captured, especially if they do not visit the lake. The questionnaires used for these households therefore consist of two sections, one focusing on the recreational facilities at the lake and the second focusing on the environmental value (specifically the water quality).

The question format in both questionnaires is referendum-type (dichotomous choice questions). Referendum questions basically ask the respondent whether he or she would be willing to pay a specified amount for a particular (environmental) change to occur (Freeman, 1999). A positive response to the question indicates the willingness to pay that is equal or higher than the amount specified. A refusal to the bid indicates that the specified amount can be taken as the upper bound on the true willingness to pay for the respondent concerned. An advantage of the referendum type question is that it allows a more simple revelation of the willingness to pay and is likened to a market transaction where the consumer can decide to say yes or no to a price. However, we still face other methodological problems like strategic answers.

For the environmental quality closed-ended question, individuals were asked whether they would be willing to pay a monthly clean-up fee, which would be added to their monthly municipality bill.⁹ In the case of the entrance fee, the respondents were asked whether they would be willing to pay an entrance fee.¹⁰

4.2.2 Data Collection

Data were collected by students from the University of the Western Cape. Five students were appointed to participate in the data collection process. All students selected were Economics majors with some currently completing postgraduate qualifications. Most of them had completed a course in Public Economics and were familiar with environmental externalities. All students were familiar with the study areas since most of the students were born or lived on the Cape Flats (which comprised the suburbs surrounding Zeekoevlei). The research assistants were given substantial training in the method used. Since environmental valuation is not necessarily a part of the Public Economics course, students attended a half-day session where the basics of environmental externalities and valuation techniques were discussed. The presentation specifically focused on Contingent Valuation (the method utilised in the empirical analysis).

Training was also provided on the questionnaire itself and the field work process. Students were advised about the relevance of every question in the questionnaire, especially how to approach the hypothetical scenario for the WTP questions. Students received detailed explanations about the importance of not influencing the responses of respondents, when to use the appropriate photographs that accompanied the questionnaire, and also what information to provide to the respondents about the study.

⁹ The questionnaire used four different monthly fees as possible prices for the change in environmental quality: R10, R20, R30 and R50. These amounts were chosen based on the information gathered from the focus groups and the pilot study. Each respondent was offered one of these amounts. The distribution of the bid amounts was determined beforehand through the packaging of the questionnaires and was not influenced by the research assistant.

¹⁰ The entrance fee used four different amounts as possible entrance fees: R2, R3, R5 and R10. These were indicated as being paid per person per visit. The fees were based on amounts emanating from discussions in focus groups, as well as comparative fees used in existing national parks and other lakes (where an access fee is charged).

The survey area consisted of four suburbs: Grassy Park (GP), Lotus River (LR), Pelican Park (PP), Zeekoevlei (Z) and those living on the Peninsula (P) in Zeekoevlei. The total number of questionnaires completed in each suburb, by each assistant, is given below:

Table 4. Distribution of questionnaires completed in different suburbs, by research assistant:

Assistant	GP	LR	PP	Z	P	Total
1	76	0	0	0	0	76
2	2	63	2	6	21	94
3	4	0	15	2	0	21
4	6	58	2	9	10	85
5	36	0	64	2	6	108
	124	121	83	19	37	384

4.2.3 Descriptive Statistics

The WTP questions were combined with questions pertaining to information about the households, such as age, household size, income, education, as well as questions around the usage and existence value of Zeekoevlei. There were also some questions pertaining to whether crime had any significant impact in the household's decision to visit or use the lake. This was done by asking the individual whether effective policing would influence the way they feel about the lake.

Table 5: Distribution of responses to closed-ended question (for improved water quality)

1) Bid (Prices for environmental good)	2) Total no. of households	3) Yes responses ¹¹	4) No responses
R10	100	64 (64%)	36
R20	89	46 (52%)	43
R30	96	48 (50%)	48
R50	99	42 (42%)	57
Total	384	200	184

Table 5 indicates the proportion of yes responses to the closed-ended question on improvements in water quality. Column 3 in the table specifically indicates a decrease in the proportion of yes responses as the bid amount increases. This decrease is similar to what Carlsson, et. al (2004) found in a study on examining the determinants of the willingness to pay for community woodlots. In this case, however, the share of yes responses is relatively close to each other, given the bid amounts, showing that perhaps higher bid amounts should have been included in the survey.

¹¹ The percentages in brackets are the proportions of yes responses as a percentage of the total number of questionnaires for each bid.

5 Regression Analysis

The total number of questionnaires completed amounted to 384. These consisted of 26 questionnaires to households living adjacent to the lake and 358 questionnaires to households living in within the vicinity of lake.

5.1 Econometric Model

The econometric analysis for referendum questions entails estimating the probability that a respondent would pay (Loomis, et. al, 2000). The basic relationship (assuming a logistic distribution) is given by:

$$\text{Probability (Yes)} = 1 - [1 + \exp(b_i X_i)]^{-1}^{12}$$

where b_i are the coefficients to be estimated and X_i are the explanatory variables (including the Bid as the rand amount the respondent was asked to pay).

The mean willingness to pay (WTP) is then calculated from the following formula

$$E(\text{WTP}) = \frac{1}{b_1} \ln \left[\frac{1 + e^{b_0^*}}{1 + e^{b_0^* - b_1 * \text{Bidmax}}} \right]^{13}$$

Amirnejad, et. al. (2006: 670) refer to this as the truncated mean WTP, where the expected value of WTP is calculated by numerical integration, ranging from 0 to the maximum bid. They state that that this method is the most preferable as "...it satisfies consistency with theoretical constraints, statistical efficiency and ability to be aggregated." (Duffield and Patterson (1991), in Amirnejad, et. al., 2006: 670). Since stratified sampling was used to ensure that all suburbs are represented, the mean willingness to pay calculations has to be weighted. This is done by giving each suburb a weight according to the number of actual households in that suburb.¹⁴

The regressions discussed in this section focuses entirely on estimating the determinants influencing the willingness to pay for an improvement in the water quality of Zeekoevlei, i.e. a reduction in the pollution levels. The estimates are thus for both use and non-use values. The variables in the regression analysis are given in table 6.

¹² For further details on the estimation of the logit model, see Loomis, et. al. (2000).

¹³ See Hanemann (1989) for complete details on welfare evaluations in Contingent Valuation. In the formula provided here, b_1 is the coefficient for the bid amount, b_0^* is the grand constant (including the constant plus the other X variables times their respective sample means) and Bidmax is the maximum bid amount.

¹⁴ The regression results for the whole sample are used to calculate a mean willingness to pay for each suburb, using the formula indicated in the text. This is then weighted to find the mean willingness to pay for the area.

Table 6. The variables included in the regression analysis

Variable	Description
wtp	Willingness to Pay – binary variable (yes or no on closed ended question)
y1 – y4	Income dummies, y1: 0-5000, y2: 5001-10000, y3: 10001-20000, y4:>20000
bid (price)	Bid amounts for monthly environmental fee ranging from R10 to R50
dlr, dgp, dpp, dp, dz	Dummies for suburbs dlr – Lotus River, dgp – Grassy Park, dpp-Pelican Park, dp – those households living on Peninsula, dz – Zeekoevlei
vu	Dummy: yes – visit/use the lake, otherwise 0
age	age of respondent
hhsiz	size of household
otherlake	Dummy: yes – visits other lakes, otherwise 0
edu1– edu3	Dummy: education categorical variables: edu1: no schooling, primary + secondary school, excluding matric; edu 2: matric; edu3: matric + higher education
policing	Dummy: yes – policing important, otherwise 0

Using a logit model, the regression equation estimated is as follows: ¹⁵

$$[\log(Yes)/(1-Yes)] = f(\text{bid}, y2-y4, \text{dgp}, \text{dpp}, \text{dp}, \text{dz}, \text{vu}, \text{age}, \text{edu2}, \text{edu3}, \text{hhsiz}, \text{policing}, \text{other-lake})$$

Table 7. Logit model: estimating the willingness to pay for an improvement in the water quality of Zeekoevlei

Variable	Coefficient	Standard Error	Z-value	P>z	Variable	Coefficient	Standard Error	Z-value	P>z
bid	-0.023	.0076001	-2.97	0.003	age	-0.006	0.0080859	-0.70	0.484
y2	0.177	0.2956179	0.60	0.549	hhsiz	0.131	0.065786	2.00	0.046
y3	0.220	0.3279822	0.67	0.503	policing	-0.140	0.3892368	-0.36	0.719
y4	-1.149	0.4647352	-2.47	0.013	edu2	0.605	0.3018944	2.01	0.045
dgp	-0.224	0.2713894	-0.83	0.409	edu3	0.083	0.2992936	0.28	0.781
dpp	-1.086	0.326561	-3.33	0.001	other-lake	0.380	0.241453	1.57	0.116
dp	1.186	0.5293424	2.24	0.025	vu	0.122	0.2439201	0.50	0.616
dz	0.739	0.5838437	1.27	0.206	constant	0.260	0.6896014	0.38	0.706

Notes: Number of observations = 382. The LR chi2 (15) = 60.24, with Prob > chi2 = 0.0000. Pseudo R² = 0.1139.

The results reflect that the bid function has a negative and significant effect. This is an important result since it illustrates there is a downward-sloping demand curve for the good in question. Thus, the higher the bid value (price), the lower respondents' willingness to pay for an improvement in the environmental quality of the lake. Household size seems to be important. The positive sign indicates the bigger the household, the higher the willingness to pay. This can possibly be explained by the hypothesis that households with larger families (especially where children are present), are more likely to spend time at the lake and would therefore be more

¹⁵ The base group is those living in Lotus River, households in the Y1 income category with an education level up to secondary schooling (excluding matric). The number of observations reduces to 382 respondents (from the total of 384, due to missing observations for the variable other-lake). The regression analysis used STATA9.

willing to pay for improvements in environmental quality. The weighted mean willingness to pay is estimated at R38.31.

Substitutes to Zeekoevlei (such as Rondevlei, Princess Lake and Zandvlei) were considered as alternative recreational venues for households and therefore used in the analysis as substitute products. The 'other-lake' variable has a positive sign. This indicates the importance of alternative recreational venues and the sign may possibly be interpreted as indicating that those who visit other lakes do value these recreational spots and would be willing to pay for Zeekoevlei's clean-up. The coefficient, though, is not significant. The policing variable has a negative coefficient but it is not statistically significant.

The coefficients of the education variables both have positive signs (as compared to the base group – edu1). This is a reasonable outcome as it is often argued that more educated people will care more for the environment. Only edu2, though, has a significant coefficient.¹⁶ The suburb dummies provide some interesting insights into the differences between communities living around the lake. The dummy for Grassy Park is not significantly different from the base suburb (Lotus River). Pelican Park is significantly different from the base suburb and the negative coefficient indicates less willingness to pay compared to Lotus River. The reason for this may be that Pelican Park is much closer to the Zeekoevlei lake, within walking distance. The suburb of Zeekoevlei (and the Peninsula) is positive and significantly different to Lotus River.

The income dummies are all positive (although not significant) except for the income dummy y4. This means that as income increases for y2 and y3, as compared to y1, respondents' willingness to pay increases. For income group y4 though, the result is a negative coefficient. This reflects that people in this income category are willing to pay less (as compared to the base group). This is a strange result (and it is significant) since one normally expects that higher-income earners will be more willing to contribute to a cleaner environment.¹⁷

Some investigation into the characteristics of the respondents in this category revealed the following information:

- 44 of the 384 respondents fall into the highest income category (earning more than R20 000 per month).
- Most of these respondents have a university degree.
- Very few have time over weekends to spend on activities that may involve the lake.
- When asked whether they actively use the lake, 28 of the 44 respondents indicated positively.

¹⁶ A test of joint significance for edu2 and edu3 reveal a $\chi^2(2) = 4.53$ and $\text{Prob} > \chi^2 = 0.1039$. Thus we can only reject at the 10% level that these coefficients are not jointly significant.

¹⁷ A test of joint significance for y2, y3 and y4 reveal a $\chi^2(3) = 10.98$ and $\text{Prob} > \chi^2 = 0.0119$. Thus we can reject at the 5% level that these coefficients are not jointly significant.

- Activities such as water sports, angling, and bird watching are not regarded as important on their activity list.
- 39 of these respondents indicated they value the lake as environmental good.
- Households living at the Peninsula are over-represented in the high income group. In the total sample the Peninsula has 10% of the households, while for this income group 38% live at the Peninsula.

When we remove respondents in this group who reside in Zeekoevlei, only 28 respondents remain (residing in Lotus River, Grassy Park or Pelican Park). However, the investigation into the characteristics of these 28 respondents appears to be no different. A possible (but unknown) argument may be that the highest income group in the sample has other options for recreation available making their interest in Zeekoevlei less dominant. The high-income earners have the ability to move out of the area more easily and afford other recreational activities, which may make the lake an inferior good for them.

5.2 *Estimating the willingness to pay for improved recreational facilities at Zeekoevlei*

In this section, the use value of the lake is established, focusing specifically on recreational activities at the lake. As explained in section 4.2, these values were estimated separately since not all respondents would utilise these facilities and it would therefore not be practical to ask them how much they value improved recreational facilities. The payment vehicle used is an entrance fee (per person, per visit). Although most of the respondents included in this section reside in the suburbs of Grassy Park, Lotus River, Pelican Park and Zeekoevlei, 14 respondents on the Peninsula also completed this questionnaire as they do not have direct access to the lake.

Most variables are the same as used in the previous regression analysis (see table 6) with the exception of the dependent variable, indicating willingness to pay an entrance fee (wtp-fee) and the bid amounts (bid-entrance). The former is a binary variable, corresponding to the closed-ended question asked in this section. The latter is a distribution of the entrance fee bid amounts, which forms part of the valuation question.

The regression equation is as follows:

$$[\log(Yes)/(1-Yes)] = f(\text{bid-entrance}, y2-y4, dgp, dpp, dp, dz, vu, age, edu2, edu3, hbsize, policing, other-lake)$$

Table 8. Logit model- estimating the WTP for an improvement in the recreational facilities at Zeekoevlei

Variable	Coefficient	Standard Error	Z-value	P>z	Variable	Coefficient	Standard Error	Z-value	P>z
bid-entrance	-0.143	0.0429124	-3.33	0.001	age	-0.010	0.0101144	-1.101	0.313
y2	0.587	0.3724523	1.58	0.115	hhszise	-0.026	0.0817473	-0.31	0.755
y3	0.480	0.4180896	1.15	0.251	policing	0.309	0.4911362	0.63	0.530
y4	0.028	0.5509109	0.05	0.959	edu2	0.492	0.3950161	1.25	0.213
dgp	0.253	0.3665583	0.69	0.491	edu3	0.011	0.3814502	0.03	0.977
dpp	-1.192	0.3688294	-3.23	0.001	other-lake	0.343	0.3100023	1.10	0.269
dp	-0.407	0.7973256	-0.51	0.610	vu	0.614	0.3191644	1.92	0.054
dz	0.099	0.8392953	0.12	0.906	constant	1.855	0.8661861	2.14	0.032

Notes: Number of observations = 356. The LR chi2 (15) = 46.52, with Prob > chi2 = 0.0000. Pseudo R² = 0.1251.

The bid-entrance fee is significant, reflecting a negative relationship between the bid cost and the willingness to pay for improved recreational facilities, i.e. a negatively-sloping demand curve. From the suburbs dummies, it is only the Pelican Park dummy that is significantly different to the base suburb of Lotus River. (Pelican Park is situated very close to the lake, within walking distance). The negative coefficient perhaps reflects that these residents will be less willing to pay since they live so close to the lake and feel they should have free access. The weighted mean willingness to pay in this case is estimated at R9.44.

The income dummies are all positive (here none of the dummies are significantly different than the base group of y1). This can be interpreted as showing that income matters in the willingness to pay an entrance fee. The negative effect of household size probably reflects that large households are facing a higher total fee to visit the lake than smaller households. This is opposite to the situation for the environmental qualities, where the fee is part of the rates and it does not increase with the household size. The strange result here is that policing is positive (although insignificant), even though one would expect that it should play a bigger role in willingness to pay for visiting the lake. This is contrary to information obtained from the survey questionnaire, where most of the respondents indicated that proper policing would matter in their decision to visit the lake. One possible reason for this outcome may be that the respondents feel that an entrance fee will constitute some way of policing the area.

6 Concluding remarks

Environmental goods such as wetlands and lake are valuable to human society and the preservation thereof must receive careful attention in environmental management strategies. Since these goods are public goods, when they become polluted or run-down, it is generally the government's responsibility to care for these negative externalities. However, local governments

often have more pressing needs such as providing and maintaining infrastructure and utility services. There are fewer resources available for the provision of improved environmental services. This study set out to show that improving the environmental quality and recreational facilities of Zeekoevlei will be of benefit to local communities surrounding the lake. Its primary goal was to indicate that these communities do attach a positive value to the lake and will derive a benefit from its clean-up. The hypothetical improvements suggested in the questionnaire emanated from the use of the CVM to establish these values. The most significant result in both cases was the establishment of a negative slope for the bid functions. This shows a downward-sloping demand for both goods, namely an improvement in environmental quality (through improved water quality) and improved recreational facilities. Most of the other explanatory variables were, however, not significant in explaining what affected willingness to pay.

The calculation of the weighted mean willingness is estimated at R38.31 for improved environmental quality and R9.44 for improved recreational facilities. This clearly indicates that there is a positive value for the lake and it would be a worthwhile endeavour to care for it.

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