ESTIMATING WETLAND PRESERVATION VALUES: A WAKKERSTROOM CASE STUDY

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Wetland loss rates remain high as the full value of wetland services is understated. This is partly due to the benefits of wetland preservation (non-use) being unpriced, as they are not traded in markets. These benefits are reflected by option, existence and bequest demands for wetland preservation. The Contingent Valuation Method (CVM) was used to estimate peoples' willingness-to-pay (WTP) for wetland preservation, using the Wakkerstroom wetland as a case study. Median WTP for option, existence and bequest values ranged from R15.01 -R20.00 per month. Key determinants of these values were annual household income, respondent education and age, household size and membership of other environmental organizations. Well designed CVM studies can help to make the public, policy-makers and individual farmers more aware of the value of wetland preservation, leading to more informed decisions being made about wetland use.

1. Introduction

Wetland ecosystems perform vital ecological and hydrological functions (such as the provision of habitat for many bird and animal species and the purification and storage of water). Despite this, wetland loss rates continue to be high in both developed and developing nations (Turner, 1991). In Natal, over half of the wetland resource base has been altered or lost during the last 100 years (Begg, 1989). Reasons for wetland loss include conversion to intensive agriculture, aqua-culture or industrial use ('natural' resource-use conflict), a lack of awareness and appreciation of their full value, and other factors such as pollution and recreation pressure (Turner, 1988). Loss rates could be reduced by informing the public, policy-makers and farmers about the value (benefits) of wetland preservation.

Individuals can benefit from wetland resources via the utility or satisfaction gained from direct wetland use (e.g. bird-watching), and the utility gained from wetland preservation (non-use). Economic valuation in the wetland preservation context entails measuring people's preferences for or against changing the state of the wetland. Valuation is therefore of preferences held by individuals (Pearce, 1993). These preferences are reflected by the values which individuals associate with wetland preservation. Option value is the amount that individuals are willing to pay for the option to visit the wetland in the future (Walsh *et al.*, 1984). Option value is thus like an insurance premium to ensure the supply of the wetland when the individual decides to exercise the choice of using it. Existence value refers to the willingness-to-pay (WTP) for the continued existence of the wetland, even though no direct use of the wetland by individuals is contemplated (Young, 1991). Finally, bequest value is what individuals are willing to pay for the assurance that the wetland will be preserved for future generations (Pearce, 1993). Unfortunately, these non-use benefits of wetland resources are **not traded** in markets and therefore remain **unpriced**, making it extremely difficult to estimate their values (Brookshire *et al.*, 1983; Young, 1991).

This paper uses the Contingent Valuation Method (CVM) of valuing non-marketed goods (Mitchell and Carson, 1989), to estimate peoples' WTP for wetland preservation, using the Wakkerstroom wetland as a case study. Information like this for other wetlands can make the public, policy-makers and individual farmers more aware of the benefits of wetland preservation, leading to more informed decisions being made about wetland use.. The paper first discusses a conceptual model of WTP for wetland preservation. Secondly, it outlines the CVM, describes the Wakkerstroom study area and highlights the potential biases in CVM questionnaires. Thirdly, wetland preservation values given by case study respondents are reported, along with regression functions which estimate WTP for preservation using relevant variables. Implications for future wetland and other environmental resource use decisions in South Africa are then considered.

2. Conceptual model

Individual preferences for wetland preservation will compete with preferences for direct wetland use and consumption of marketed goods and services. As the individual usually has a budget constraint, option, existence and bequest value WTP will probably be positively related to annual household income. Respondents with more prior knowledge (information) or past recreational use and experience of wetlands may value preservation more highly, and so express higher WTP bids. Prior knowledge and use could have been derived from past visits, nature walks, photography, reading articles on wetlands and watching television documentaries about wetlands. The availability of environmental amenities which substitute for the wetland experience will likely lower WTP for wetland preservation (Walsh *et al.*, 1984; Whitehead, 1990; Hanley and Spash, 1993).

3. The contingent valuation method

The CVM uses survey data which are usually collected by means of a carefully constructed questionnaire. This typically contains questions about the socio-economic characteristics of the survey respondent, followed by the construction of a hypothetical market that describes the proposed policy that will affect the wetland resource. After the hypothetical market has been established, direct valuation questions are presented to survey respondents to elicit WTP bids for wetland preservation (option, existence and bequest values) (Whitehead, 1990).

3.1 Study area and questionnaire

The Wakkerstroom wetland is situated in the uppermost reaches of the Tugela catchment, west of the village of Wakkerstroom, a small town in the south-eastern Transvaal (Begg, 1989). The wetland and its immediate surroundings (650 ha in total) are managed by the

Wakkerstroom Natural Heritage Association (WNHA). The WNHA has a very diverse membership base, from farmers to academics, living throughout South Africa. Time and research fund constraints limited the study area to the Wakkerstroom wetland and the study population to WNHA members. However, as the wetland is the hub of WNHA activities, this area is suitable for a study designed to estimate people's preferences for wetland preservation.

The survey questionnaire was designed following procedures for mail surveys developed by Dillman (1978) and first pre-tested with a small group of respondents to ensure ease of answering. Data were collected on factors such as the respondents' household annual income levels, educational level, age and membership of other environmental organizations. In the WTP section, the ecological and hydrological services provided by wetlands were first explained to the respondents, after which a realistic and credible contingent market scenario was described in detail to ensure uniform perception. This scenario pointed out that increased demands on the study area's water resources, due to industrial development and population growth, could lead to the flooding of the Wakkerstroom wetland if the capacity of the Zaaihoek dam (situated directly below the Wakkerstroom wetland) was increased. The scenario also indicated the potential wetland functional losses that could be caused by flooding, and stressed that government funding to protect the wetland would probably not be available. Each respondent was then asked to make a market-like decision by stating his/her WTP into a 'special fund' (for each of option, existence and bequest value) to preserve the wetland from flooding.

Questions to elicit these bids had to be phrased to limit possible strategic, design and mental account bias (Hanley and Spash, 1993). Strategic bias occurs when respondents understate their option value WTP if they believe that those who do not pay will still have future use of the preserved wetland (the free-rider problem). Alternatively, if respondents believe that their bids are purely hypothetical, they may overstate WTP for wetland preservation, to increase the probability of preservation. These problems were reduced by stating specifically that only those who paid would have the option to visit the wetland in future, and by describing the credible flooding scenario.

Design bias can affect responses through the choice of bid 'vehicle' and/or by the bid starting point given to respondents. The bid vehicle used in all three cases was a special fund, because this relatively neutral mechanism avoids the emotional reactions or protests associated with other mechanisms such as entrance fees or sales taxes (Walsh *et al.*, 1984). Individuals may resent paying by such direct methods for something 'natural'; the payment debases the recreational experience (Hanley and Spash, 1993). To avoid the bid starting point from influencing respondent bids by suggesting what size of bid is appropriate, potential WTP bids for each non-use value were divided into small classes which began from a very low starting point (Mitchell and Carson, 1989). In all, there were twenty-one R2.50 per month interval classes, ranging from R0.01 - R2.50 per month to the last 'open ended' class of R50.01 or more per month. A starting point of as little as R0.01 was less likely to influence the final bid than a very high starting point.

Mental account bias refers to an individual bidding his/her total 'preservation' budget on one environmental good (like a wetland), even though he/she may care about preserving other environmental goods (such as forest sites), thus overstating true WTP. This possibility was limited by asking respondents to check that their bids for each of the three non-use values were affordable, given their annual household income levels.

4. Results

A useable questionnaire response rate of 54% (66 questionnaires) was obtained. This compares favourably with mail survey response rates of 8% - 69% for various CVM studies reviewed by Mitchell and Carson (1989).

4.1 Socio-economic characteristics of respondents

Median annual household income before tax (husband and wife where appropriate) was in the R80 000 - R90 000 range, whilst most respondents (78%) had tertiary education (either non-degree, bachelor's degree and/or a post-graduate degree). The median age of respondents was in the 48 - 53 years old class, the average household comprised 2.7 persons and 85% of respondents also belonged to other environmental organizations.

4.2 Reported option, existence and bequest values

Most survey respondents were willing to pay to preserve the Wakkerstroom wetland (i.e. they expressed positive option, existence and bequest values). Zero WTP was stated by 20 respondents (30.3%) for option value, 14 respondents (21.2%) for existence value and 11 respondents (16.7%) for bequest value. Positive option and existence value WTP bids ranged from R2.51 - R5.00 per month to R50.01 or more per month, whilst for bequest value, positive WTP bids ranged from R0.01 - R2.50 per month to R50.01 or more per month. The mean WTP bid could not be calculated for any of the three non-use values, because the bids were divided into classes and the last class, R50.01 or more per month, was an 'open ended' class. The median WTP class for option value was R17.51 - R20.00 per month, whilst the existence and bequest values had the same median WTP class of R15.01 - R17.50 per month. There seemed to be no evidence of strategic bias in any of the WTP distributions. The distributions did not flatten between the high and low bids, as there were a considerable number of bids in the middle range classes.

4.3 Willingness-to-pay functions (regression equations)

The conceptual model of WTP for preservation outlined in section 2 was estimated using the following explanatory variables: annual household income (INC) to reflect the budget constraint; respondent's age (AGE) and education level as proxies for past wetland knowledge and experience; household size (HOM); and membership of other environmental organizations (ENV = 1 if yes, = 0 if no) as a proxy for wetland substitutes.

The following WTP functions were obtained for option value (WTP_O), existence value (WTP_E) and bequest value (WTP_B) respectively:

$$WTP_O = 2.71 + 0.0001INC + 8.36POS + 0.46AGE - 3.14HOM - 18.21ENV + 3.97DFO \quad (1)$$
$$(0.25) \quad (2.65)^{**} \quad (1.94)^{*} \quad (2.53)^{**} \quad (-2.11)^{**} \quad (-2.75)^{***} \quad (1.70)^{*}$$

$R^2 = 0.17$ F value = 3.23^{***} n = 66

$$WTP_E = 14.33 + 0.00009INC + 0.33AGE - 3.97HOM - 18.66ENV + 2.51DWE \quad (2)$$
$$(1.36) \quad (2.14)^{**} \quad (1.86)^{*} \quad (-2.70)^{***} \quad (-2.80)^{***} \quad (1.65)^{a}$$

$R^2 = 0.14$ F value = 3.08^{**} n = 66

$$WTP_B = -57.85 + 18.33LOGINC - 3.65HOM - 8.74ENV \quad (3)$$
$$(-1.70) \quad (2.49)^{**} \quad (-2.48)^{**} \quad (-1.47)^{a}$$

$R^2 = 0.10$ F value = 3.25^{**} n = 64

where numbers in parentheses ( ) are 't'-ratios; LOGINC = log of income; and ^{a}, *, ** and *** reflect significance at the 0.15, 0.10, 0.05 and 0.01 confidence levels respectively.

Option value was positively related to INC, level of education (post-graduate degree (POS)), AGE and number of days spent participating in the forest walk (DFO), which is a complement to the wetland visit. From equation (1), every R1 000 increase in INC will increase WTP_O by an estimated R0.10 per month. The WTP_O was negatively related to HOM and ENV. As HOM rises by one member, WTP_O declines by some R3.14 per month.

The WTP_E was positively related to INC, AGE and days spent visiting the wetland (DWE), which is also a proxy for wetland experience. Equation (2) estimates that for every R1 000 increase in INC, WTP_E will rise by some R0.09 per month. Variables negatively related to WTP_E were again HOM and ENV. Membership of another environmental organization will reduce WTP_E by an average of about R18.66 per month (similar to WTP_O).

Equation (3) supports a positive log-linear relationship between WTP_B and LOGINC. A family with an income of R100 000 per annum is predicted to have a WTP_B value of R91.66 per month, *ceteris paribus*. The WTP_B was also negatively related to HOM and ENV. For each additional household member, WTP_B will decline by an estimated R3.65 per month.

All the equations had F values significant at the 0.01 or 0.05 levels of significance. The regression coefficients of all included variables were statistically significant at acceptable levels of significance (0.01 to 0.15). The number of observations differed for each estimated model, as each had a different number of missing data values. The R^2 statistics show that between 10% and 17% of the total variation in WTP preservation values was explained by the variables included in the three equations. Similar low R^2 values have been reported in other CVM studies (see literature review by Mitchell and Carson, 1989) and may be due to other socio-economic variables, omitted from the survey, being better proxies for past wetland experience; different functional forms being more appropriate; and the use of cross-sectional survey data. The signs of the statistically significant coefficients do, however, show that the included variables are theoretically valid determinants of respondents' WTP for wetland preservation.

5. Conclusion

Most survey respondents were willing to pay to preserve the Wakkerstroom wetland (they expressed positive preservation benefit values). For option value, the median WTP class ranged from R17.51 - R20.00 per month, whilst existence and bequest values had the same median WTP class range of R15.01 - R17.50 per month. The WTP bids may be upwardly biased, as time and research fund constraints limited the survey group to WNHA members -they are more likely to favour wetland preservation than non-members. This bias could, however, be less than expected, as between 17% and 30% of WNHA members gave zero WTP bids for the three types of preservation values.

The signs of coefficients estimated for the determinants of wetland preservation WTP agreed with *a priori* expectations. Option value was positively related to annual household income, respondents' level of education (post-graduate degree) and age, and number of days spent participating in the forest walk. Existence value was positively related to income, age and number of days spent visiting the wetland, while bequest value WTP had a positive log-linear relationship with income. The WTP for all three preservation values was negatively related to household size and membership of another (other) environmental organization(s). Such membership will compete with wetland preservation WTP for the household's budget, as it may substitute for the Wakkerstroom wetland experience.

The reported preservation value estimates are plausible, as potential biases associated with using the CVM were accounted for in research design as far as possible. It is recommended that the public, policy-makers and individual farmers be made more aware of preservation values associated with other wetlands, so that they can make more informed decisions about wetland use. Without such information, the value of wetland resources will be understated and wetland loss rates are likely to increase. Although this study focused on wetland preservation, the CVM principles can be used for the economic valuation of other environmental resources in South Africa. Future studies would be incomplete without some reference to the value of people's preferences for or against environmental change.

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