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A comparison of the values of water inflows into selected South African estuaries: The Heuningnes, Kleinmond, Klein, Palmiet, Cefane, Kwelera and Haga-Haga

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ABSTRACT

The functionality of estuaries is threatened by widespread and rapid transformation as a result of the significant reduction in the rate at which freshwater flows into them. We present standardized methods that combine freshwater abstraction and estuary functionality to estimate recreational values of freshwater inflow to households located in proximity to the seven selected South African estuaries while testing for the convergent validity of the contingent valuation method (CVM), zonal travel cost method (ZTCM) and the individual travel cost method (ITCM). Given that the dependent variable is the log transform, our dependent variable is not censored, so we use an OLS model for the regression, and model separately our zero values using a spike model. When running our regressions, we pool all observations from the seven estuaries and use dummy fixed effects for each estuary, and use interactions to model different effects of the covariates in each estuary. For travel costs analyses, we estimate truncated count data models of recreational demand taking into account the fact that the number of visitation trips taken is a non-negative integer. The CVM generated values per m^3 of freshwater inflow into the estuary ranges from R0.0022 to R0.0546 whereas the ZTCM values ranges from R0.0035 to R0.0499, while the ITCM generated value per m^3 of freshwater inflow is R0.003. The findings in this study are that some convergence of results is achieved.

1. Introduction

Estuaries are described as bodies of water along the sea that are formed when salty seawater mixes with freshwater drained from inland. Estuaries are ecologically important because they are habitats for birds, fish and plants and they are valuable because they provide human beings with food (fish) and recreational pleasure in the form of unique views, bird watching, photograph scenery, and opportunities for swimming and boating if managed well. Furthermore, they also act as barriers against damaging storm waves and floods. It is in this context that they also have economic, recreational, aesthetic and cultural value. The provision of these services is dependent on the inflow of freshwater into estuaries.

Estuarine and coastal ecosystems are some of the most over-used and threatened natural systems in the world [26,41,49]. Their deterioration mainly due to human activities is intense and increasing, 50% of salt marshes, 35% of mangroves, 30% of coral reefs, and 29% of sea grasses are either lost or degraded globally [21,39,42,47,50].

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Estuaries are open access public goods in the sense that it is difficult to exclude people from accessing and using them, and that the marginal cost of this use is low. The problem with estuarine freshwater demand is that estuaries are the 'last in line', literally and perhaps figuratively - in the typical prioritisation of human wants by government.

The abstraction of freshwater from estuaries increases the period of mouth closure [29]. South African estuaries have in the past mainly been managed on a piecemeal basis-sometimes in the interest of fishermen, sometimes property development owners and sometimes other local interest groups. This situation changed with the National Water Act of 1998. One of its objectives was to address the mismanagement and inadequate research about water inflow impacts on estuaries [1].

Such widespread and rapid transformation of estuaries as a result of the significant reduction in the rate at which freshwater flows into estuaries implies that it is vital to better understand what is at stake in terms of critical benefits and values.

Policy makers are increasingly becoming more reliant on non-market valuations (i.e. stated preference method and revealed methods) to address environmental problems. It is well documented in the literature that these commonly used methods generate different values to the same resource, which is problematic. In light of this increasing reliance on these approaches, being able to consistently monitor the consistency and reliability of these valuations is vital. The validation of values generated by different non-market techniques has been commonly ignored in previous or related research. The aim of this study is to estimate the recreational value of freshwater inflow to households located in proximity to the seven selected South African estuaries while testing for the convergent validity (i.e. whether they are consistent with each other) of the contingent valuation method (CVM), zonal travel cost method (ZTCM) and the individual travel cost method (ITCM). It is an important question and the use of CVM, ZTCM and ITCM is appropriate. Thus, our study contributes toward the validation of values derived from these methods in the context of recreational water by applying the most advanced and rigorous models.

The paper is structured as follows. The global issues facing estuaries are discussed in Section 2 and literature reviewed in Section 3. The study site is presented in Section 4, while the methodology is discussed in Section 5. Sections 6 and 7 discuss the survey and presents the survey findings. The fitting of willingness to pay (WTP) functions-generating a predictive model are presented in Section 7. Validity tests and comparison of CVM, ZTCM and ITCM estimates are presented in Sections 8 and 9 respectively. Section 10 concludes.

2. A global perspective about estuaries

The problems faced by South African estuaries are not unique. All over the world there is pressure on estuaries. The magnitudes of these problems are even greater in other parts of the world, because their estuaries are bigger than those of South Africa.

In comparison to the rest of the world, the commercialization of South African estuaries is small in scale. According to De Villiers and Hodgson [18] the penaeid prawns of KwaZulu-Natal support both offshore fishery, as well as estuarine fisheries, in the two main estuarine nursery grounds of St Lucia and Richards Bay. Both fisheries are of a small scale by International standards. They only yield a total of 20 tonnes per year. The retail value of this production was US$100,000 in 1998.

The prawn fisheries operations have a long history, going back to the 1930s, although data is only available for the last 25 years. The future of both estuarine prawn fisheries has been complicated by many factors, including reduced freshwater inflow and harbour developments [18]. The two estuaries mentioned above are examples of estuaries in South Africa that are used for commercial purposes. An overwhelming majority of South African estuaries are only used for subsistence fishing and recreational purposes.

Due to their great significance for commercial and recreational reasons, the coastal population often overuses estuaries. About 60% of the world population lives by the coast in close proximity to estuaries [23]. An array of estuarine impacts is predicted to accompany coastal watersheds development during the next 25 years. Among the most severe impact will be the loss on habitats and alteration associated with large scale modifications of coastal watersheds, estuaries shorelines and basins [33].

Climate change is accelerating coastal erosion and the high tides are causing abnormal coastal erosion in places like Durban. In estuaries higher tides will cause more sea water to flow into the estuaries and this may be detrimental to the species in need of habitats with lower salinity concentrations. This problem has already occurred in St. Lucia. The St. Lucia estuary was recently flooded by salty seawater, negatively affecting several species of fish in that estuary.

The global warming phenomenon is going to negatively affect estuaries (see [17,48]) and put more pressure on the availability of freshwater inflows into estuaries, as well as the availability of drinking water. Global warming will lead to Africa becoming hotter and receiving less rainfall, possibly causing the problem of reduced freshwater inflow into estuaries to worsen. One of the undesirable effects to estuaries of reduced freshwater inflows is the depletion of fishing stocks.

Extensive research has established that there is a positive correlation between freshwater inflow and estuary productivity [19]. The challenge for society will be to balance the ever growing demands for freshwater for different needs. Freshwater is demanded for direct human consumption, agriculture, forestry and industry. Freshwater inflow into estuaries is another such demand. This study recognises that different estuaries are affected by freshwater reduction differently depending on the different characteristics of those estuaries and their location.

There is an emerging worldwide consensus that effective and efficient management of water resources include, among other things, management of water as an economic resource. The Dublin Statement of the International Conference on Water and the Environment, stated that water has an economic value in all its competing uses and should be recognized as an economic good [6].

3. Literature review

Coastal tourism and recreation, combined, is one of the fastest growing segments in the United States economy [12]. According

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