How waterway management improves our well-being

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Background

The Australian population is currently undergoing a "sea change" as, each year, more people choose to live on the coast. Part of the attraction is the quality of the natural environment – the beaches, rivers, coastline and bays. Ironically, it is these waterways that suffer from increasing populations.

Any coastal dweller can tell you that their local waterways provide them with many benefits and most expect these assets to be protected, maintained and improved. To this end, the Commonwealth Government alone spent over $400 million on activities aimed at protecting our coasts and oceans in 2002-2003. This spending is targeted at achieving well documented environmental benefits that can be measured in terms of areas protected or rehabilitated. But what benefits do the people living on the coast get from these environmental improvements?

Coastal waterways provide important links across the catchment-coast continuum and are an important indicator of the health of a coastal catchment. My research aimed to identify and quantify the health, social and economic impacts resulting from a change in the condition of coastal waterways. This allowed the development of a general framework for assessing impacts of changes in natural resource condition on human well-being that can be applied to the management of other natural resources, leading to improved human health and well-being.

Overview

The project had six main components:

- identifying potential links between environmental condition and human well-being from literature and summarising these in a conceptual model to guide the rest of the research
- quantifying social impacts in case study areas
- quantifying health impacts in case study areas
- quantifying economic impacts in case study areas
- constructing a dynamic model incorporating all these impacts to test the effects of management scenarios on human well-being
- developing a framework for assessing impacts on human well-being that could be applied to the management of natural resources other than coastal waterways.

This paper focuses on describing the framework and its application to natural resource management issues, by incorporating the results from the other five sections to illustrate the use of the framework.

Methods and results

If a planned activity (e.g. a new development or management action) has the potential to impact a natural resource, two things are usually done to evaluate the proposal: the environmental

change expected to arise as a result of the proposal and the economic (and sometimes social) impacts of the action itself are estimated (Stanley *et al.* 2004). For example, if a management action is proposed that will improve the condition of the natural resource, the environmental benefits arising from the action and the social and economic costs of undertaking the action are assessed. However, the social and economic benefits arising as a result of the environmental improvements are usually not assessed. Similarly, if a development is proposed, the economic (and social) benefits arising from the development are assessed along with the expected environmental damage. However, the social and economic costs arising from the damage to the environment are not measured. One outcome of the failure to assess these impacts is that the needs of people and the environment are frequently seen to be in conflict. However, it is likely that, if all the impacts on human well-being are included in the assessment, an improvement in environmental condition will lead to a net improvement in human well-being.

The framework proposed here adds additional steps to the assessment process to take into account the social and economic impacts of the expected change in environmental condition. To date, this assessment has rarely, if ever, been made, as the links between environmental condition and human well-being are not well understood. For example, Rolfe *et al.* (2005) presented a thorough desktop study of the social and economic impacts of protecting environmental values of water in Queensland. Although the economic impacts were described in some detail, the analysis given to social and health impacts was limited, as they were considered too difficult to measure. The framework developed in the current study addresses these limitations. It is based on links between coastal waterway condition and human well-being that have been measured in two case study areas: Pumicestone catchment and the Douglas region, in Queensland, Australia. The framework proposes three steps in addition to previous impact assessment methods:

(a) identifying potential impacts of natural resource condition change on well-being
(b) measuring these well-being impacts
(c) modelling scenarios of environmental change.

The framework is described in more detail below, using the results from the two case studies as examples.

(a) Identifying potential well-being impacts

The first stage is to identify the potential impacts of changes to environmental condition on various aspects of well-being. A wide ranging literature review is helpful at this stage (for example, Maller *et al.* (2002) present an excellent review). The literature review undertaken for the Queensland case studies identified several potential links between human well-being and coastal waterway condition. Social, health and economic impacts were identified and are detailed in the conceptual model shown in Figure 1. Previous research supporting these links is described in (Cox *et al.* 2003).

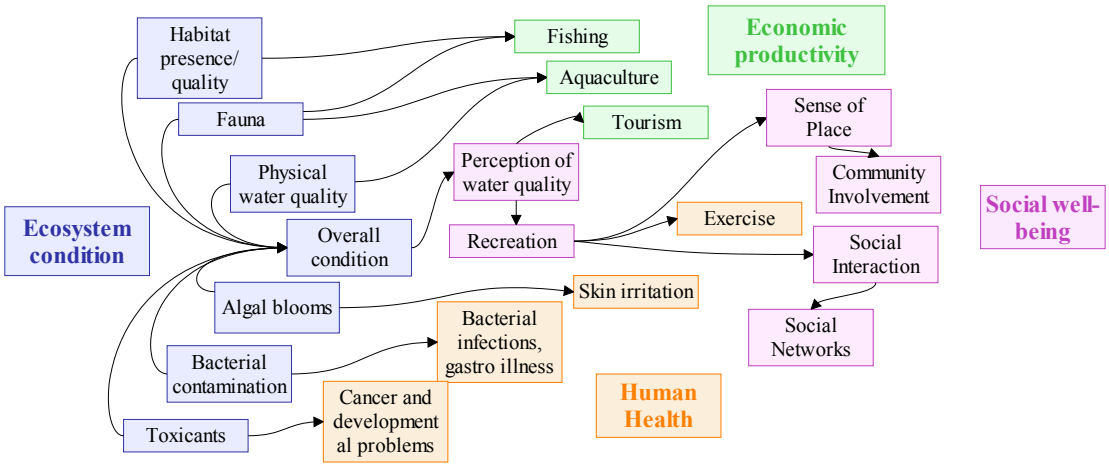

Figure 1. Potential links between coastal waterway condition and social, health and economic aspects of human well-being.

(b) Measuring well-being impacts

The second stage of the framework is to quantify the impacts on well-being. Different quantification methods are appropriate for health, social and economic impacts. In the case studies, health impacts were assessed by applying established environmental health risk assessments, social impacts by using a survey of residents, and economic impacts by using an input-output model.

Several relevant health impacts were assessed in the Pumicestone region. Elevated bacterial concentrations in recreational waters can cause gastrointestinal illness in swimmers. The bacterial concentrations at popular swimming spots were compared with guidelines (Kay *et al.* 2004) to estimate the proportion of bathers likely to fall sick following swimming. It was estimated that at most beaches, up to 5-10% of swimmers could experience gastrointestinal illness as a result of swimming. Toxicants in shellfish can cause food poisoning as well as increasing the risk of long-term health problems such as cancer. Toxicant concentrations in commercial oysters grown in Pumicestone Passage were used along with seafood consumption rates to calculate the potential long-term health risks associated with eating contaminated oysters. Toxicant concentrations complied with guidelines (World Health Organization 1996; US Environmental Protection Agency 2005) and there was no significant health risk to seafood consumers. Blooms of the toxic alga *Lyngbya majuscula* have occurred regularly in Pumicestone Passage and Deception Bay and have the potential to cause severe skin and respiratory irritation to people coming in contact with the bloom. Data on the rates of use of beaches and foreshore areas likely to be exposed to *Lyngbya* blooms were used along with rates of dermatitis (Osborne 2004) to estimate the potential number of people suffering dermatitis as a result of the blooms. Recreation at coastal waterways was found to also positively contribute to health through reducing mental stress and improving cardiac health as a result of increased exercise.

Social impacts are related to peoples' perceptions of environmental condition. In the study areas, a survey of over 800 people showed that the frequency of recreation that people undertook at coastal waterways was influenced both by the distance they lived from the waterway and by their perception of the condition of the waterway. Coastal recreation in turn had several benefits for social well-being: increased recreation led to increased social interaction and wider social networks, and to a greater sense of place. Social networks and sense of place were both important predictors of self-assessed quality of life (Cox *et al.* 2006).

Changes in the condition of coastal waterways also have economic implications for the fishing, aquaculture and tourism industries. A deterioration in waterway condition could lead a decrease in commercial fish catch, reduced ability to undertake aquaculture and a decrease in tourist visitor numbers. The flow-on effects of changes in these industries on the rest of the regional economy was assessed using an input-output model (West 1992). The model showed that changes in the tourism industry would have the largest impacts, with a decrease of 10% in the tourism production resulting in a 2-3% reduction in the gross regional product in the two study areas. This represents a significant impact.

(c) Modelling scenarios

The third stage, modelling the impacts of different management scenarios, is useful for putting all the information together to include links and feedbacks between the different aspects of well-being, assess changes over time and test the combined impacts of different management scenarios. In this study, a simple but innovative dynamic model was developed, based on the results of the data collection described in the previous section. Three management scenarios were assessed: continual environmental degradation, continual environmental improvement, and continual environmental degradation with delayed improvement, all of which are plausible in the context of the case study areas. The deterioration scenario resulted in a decrease in indicators of well-being, and the improvement scenario resulted in improvements in indicators of well-being (Cox 2005). The impacts of the delayed management scenario were more complex in that improvements to quality of life indicators did not occur even after improvements in waterway condition (Figure 2). This suggests that immediate, rather than delayed, management actions to improve waterway condition are more effective at also improving quality of life.

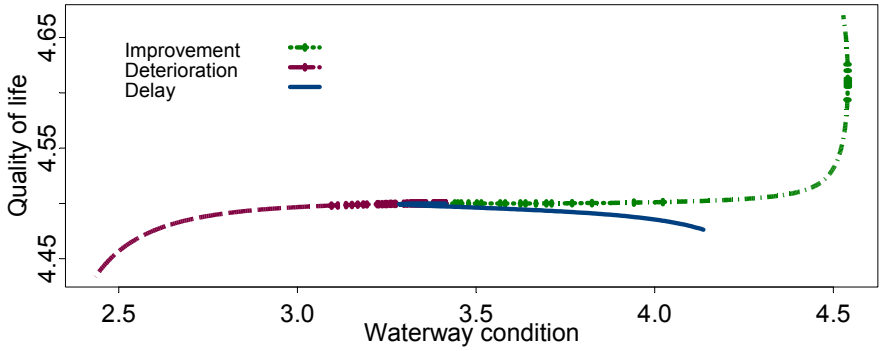

Figure 2. Quality of life and waterway condition in Pumicestone region under the three scenarios. Even though waterway condition eventually improves under the delayed scenario, quality of life continues to decline due to delays and feedbacks in the system.

Implications and applications

The framework described here is applicable to any natural resource management decision. It is a significant addition to the decision-making tools currently available to managers. It allows for the first time assessment of the well-being benefits that would flow from environmental improvements to be measured and synthesised with one management tool. Current impact assessment methodologies focus on the economic and social costs of undertaking environmental management, reinforcing the idea that outcomes for the environment and people are at odds. Robust quantification of the social and economic benefits that arise from improvements in environmental condition such as was undertaken in this study, allows for a

more equitable assessment of the costs and benefits of environmental management. This significantly improves our environmental decision-making ability. This research shows that managing waterways for environmental outcomes can also result in benefits to human well-being. It is important to better understand these benefits to ensure that we make the best use of our resources in managing our waterways for maximum environmental and well-being outcomes.

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