

# **The Potential for using Cost Benefit Analysis in Developing Optimal Water Management Strategies for Project Development on the Berg River**

**Author: Horn, A.M., University of Cape Town**

*The decisions we make about ecosystems imply valuations (although not necessarily expressed in monetary terms). We can choose to make these valuations explicit or not; we can do them with an explicit acknowledgement of the huge uncertainties involved or not; but as long as we are forced to make choices we are going through the process of valuation (Constanza, et al., 1997).*

## *Abstract*

*The concern with financial cost benefit analysis (CBA) is that this process does not take into account the degradation of natural resources within the geographic area or impact on society in which a project is situated. The question is raised as to whether even an environmental CBA is the appropriate way of making a decision as to a project which further impacts the sewerage systems, where the agricultural export market is sensitive to suggestion that polluted water might be used for irrigation.*

*The methodology of what these hidden costs might be that need to be added as the external costs, in the particular example of a unidirectional river, where pollution affects downstream users, draws on research done on the Berg River, Western Cape, South Africa. Assessment of costs has involved in depth analysis of current and pending wastewater treatment works, and purification treatment works, based on the bulk infrastructure spend and operation expenditure within the budget developed by the municipality of Drakenstein.*

The Berg River is one of the major rivers of South Africa, situated in the Western Cape, beginning in the mountains above Franschhoek and ending on the West Coast at Port Owen. Economically it is of importance to the Cape Town metropolitan area as it is the major source of water for both domestic and industrial use. The demands on this water will continue to increase with economic growth for South Africa reported at 3.8% in 2010 by the Organisation for Economic and Cooperative Development (OECD), where the Western Cape is usually reported as 1% above the national figure.

There has also been a trend towards increasing urbanisation and continued influx of people from the rural areas into metropolitan Cape Town. From 1985 to 2005, with the relaxing and subsequent lifting of internal migration strategies, urban populations grew by 9.9% in South Africa (Hassan et al, 2008). Economists have also tended to value water for urban use more highly than water for agricultural use as urban areas have a higher revealed willingness to pay. This may tend to influence the allocation of water, with a bias towards the urban area. There will be a pressure from society to extract more water from the Berg River in the future, although there is an instream minimum flow requirement under the most recent Water Act that will provide for the most basic ecological needs. Any additional withdrawal of water will lessen its dilution capacity, hence, *ceteris paribus*, pollution per unit volume of water will increase and the impact of pollution in the Berg River will increase. This concern is already evident in the popular media, such as Farmer's Weekly, (August 2010) and the television programme, 50/50 (October 2010). The significance of this increased exposure is that the values of externalities are frequently based on public perceptions. The damage done by a belief that the river water is badly contaminated may be little different to that done if the pollution is real.

## Polluted water threatens export markets

“In December 2004 an investigation into Berg River water found it was so polluted it was unsuitable for irrigation,” said Prof Louw. “The press picked up the story and by 2005 the EU was threatening to place an embargo on all fruit from that area.”

Prof Louw said South Africa will lose around R570 million if an embargo stops the export of at least 60% of the Berg River region's fruit. “. Loss of export markets will also jeopardise the land-reform process and there will be more devastation in areas ravaged by unemployment,” he noted. “But any perceived threat has an impact on the consumer and the market.” he said. – *Lindi van Rooven*

The particular concerns in the Berg River have centered around the *E. coli* spikes that been linked with higher levels of rainfall in the winter months, when untreated sewage flows into the river water from the Waste Water Treatment Works (WWTW), notably at Paarl, Wellington and Franschhoek. There is debate as to whether the levels of *E. coli* in the Berg River are a real health threat, as the roots of the fruit trees and vines take up the water from drip irrigation. But whilst there might be no physiological consequences, there remains the possibility that pollution could cost local farmers their share of the European Union market.

Events of May 2011 have shown that it is not only possible to stop the agricultural produce export from a region but from an entire country. Vegetables in Germany, contaminated with enterohaemorrhagic *E. coli*, led to 16 deaths through haemolytic effects on the kidney and the Robert Koch Institute of national disease reported 1150 cases of illness. The German authorities found *E.coli*, although it was not even of the same subspecies, on Spanish cucumbers and quickly erroneously announced this to the media, as the source of the problem. All vegetable imports from Spain were stopped, with BBC world news, 31 May, reporting this as a loss of \$200m per week to

the Spanish agricultural exporters. The effects of this have been that the agricultural growers have been leaving vegetables to rot and there has been a loss of work for migrant labour. CNN, 1 June, sourcing data from Fepex, outlined the Spanish market size in 2010, as \$11 billion in revenue overall in 2010 of which a quarter went to Germany.

Whilst the literature deals extensively with potential externalities and their economic effects on the market, there is little literature dealing with real externalities. The experience that is taken from Spain in May 2011, shows that the lesson for the Berg River is that there can be no perceived threat of *E.coli* contamination. In the month following their loss of agricultural export market Spain rejected a proposed payout by the Economic Commission of 150 million Euros to the farmers affected by the crisis, demanding more ([www.guardian.co.uk](http://www.guardian.co.uk)). In the case of South Africa, should there be a loss of market there is no organisation to guarantee such compensation.

What would the loss of export market in a season, owing to irrational or real risk perception of health threats spread by the media, mean financially to the Berg River agricultural sector? In the short term, within the season, it would be difficult to find replacement markets and so there is a strong possibility that fruit and olives would be left to rot as happened to the vegetables in Spain.

The agricultural export value in the Berg Valley calculated in 2008, in an unpublished report to the Berg Irrigation Board, in a year was R950 300 000. This figure is based on value per ton of planted hectares per crop type, and 400 farmers were interviewed to establish this. This value represents the type of loss that could occur in a season. Export markets account for 73% of production in the Berg River, and given a health scare domestic markets could also be affected. Agriculture labour is vulnerable in the face of market loss. The 13 000 fixed and 15 500 casual labour employed in the agricultural export market in the Berg River, collectively are paid R 319 000 000, although this represents an overlap of their services, to the domestic market. Of the agricultural export sales figure 23% of the value is for the labour cost alone,

so any loss of this market would detrimentally affect the most economically disadvantaged sector of this community.

The Waste Water Treatment plants on the Berg River are being extensively upgraded. Figures collated from the Water Services Development Plan for the Drakenstein Municipality, 2011, show that the total costing required for bulk water sanitation for Paarl is R 263 463 000, for Wellington it is R78 350 000 and for the Drakenstein Municipality R344 973 000. The operations expenditure for wastewater treatment, as recorded for 2009/2010 for the Drakenstein municipality was R45 167 927. This future spend on waste water treatment infrastructure is necessary to ensure that *E coli* levels remain within the recommended standards for irrigation purposes.

In the past additional projects in the hospitality sector have been put on hold in the Franschhoek area as it has been considered that the wastewater treatment plant needed to be upgraded to accommodate them first.

What would be the appropriate economic instrument to assess whether a hospitality project should proceed? If one considers a purely financial Cost Benefit Analysis (CBA) approach then the financial costs are balanced against the benefits, without considering such factors as the inter-generational transfer of costs and benefits or even current environmental externalities. Requena and Sáeza, 2007, indicate particularly that where the environmental impacts extend through long periods of time the financial CBA is obsolete. However in a world of incomplete and asymmetric information, is CBA, even given the inclusion of environmental and social impacts, the appropriate tool? How do we deal with the pricing of externalities?

In constructing a CBA there is the assumption that one is working with rational consumers and producers, whose utility functions are well behaved, and whose production functions are convex. It is also assumed that the market can work out the probabilities of risky events; but in the case of the threat of loss of agricultural market under the perception of a health hazard, one is dealing with uncertainty rather than risk. Fair and rational are not relevant

aspects here, just as the contamination of vegetables in Germany was blamed on Spain. This externality was not tangible and so could not be measured or anticipated. The conventional option to CBA, multi criteria decision analysis (MCDA), which asks stakeholders to weight attributes linked to a project, could also not cope with this kind of unfortunate event. This is not just an assessment of sewage levels in river water, in relation to expected standards but perceptions in the fruit export market.

The question being raised is one of whether a project, such as an additional hotel, should be set up in an agricultural export dominated valley, which will put further pressure on an overloaded sewage cleansing system. The basic hypothesis to consider is what would be the best outcome for the agricultural market of the Berg River in a world of competition – to continue with the development or not? The common economic view that two projects can only be compared if they are both Pareto improving is an unrealistic one and has been replaced by the Hicks Kaldor compensation principle requiring that the beneficiaries of a project be able to compensate the losers. In this case does development offer enough financial gain to allow developers to adequately compensate agriculturalists should the *E.coli* levels in irrigation water be seen as a threat to the health of fruit eaters. Is the decision to continue with the development a sustainable one or will an action be taken today which has an impact in the future? Can economic tools such as CBA deal with these economic and environmental aspects?

It becomes difficult to use CBA when one is not working with a defined time line. If excess pollution continues to infiltrate the river, without clearly understanding the carrying capacity of the flowing river, then current and future generations will suffer, as there will be a perception that the agricultural areas around the Berg are polluted. Markets may be affected for a long time after the physical problem has disappeared. They can be compensated but as the Scitovsky reversal principle (1941) states, people's tastes change as their incomes rise, so that they may prefer the pre- project(s) situation. These possibly more affluent people may have environmental ideals, which lead

them to prefer a more pristine river and CBA cannot deal with a situation where the wishes of future generations are not known.

There is an externality, which is the possible loss of the export market. This could follow the overflow of sewage after high rainfall. Such an externality is difficult to cost. If the market is able to recover after only one season then the worst case scenario would quantify it as the loss of a season's crops. Can we ask farmers in the Berg River what they would be willing to pay to clean up the water through technologically improved and enlarged Waste Water Treatment Works? At present farmers are still selling fruit. Farmers' threats of lawsuits against government in the Berg River show that they do recognise this externality but probably not the full extent or probability of the total loss of the export market. Similarly water for domestic use is of a reasonable standard, as it is treated and drawn from taps. Yet the potential for epidemics for water drawn from the river, even though it has been treated, remains. Once the assimilative capacity of the river is exceeded, the externality of a threat to clean drinking water cannot be defined as zero.

Economics can be seen as a self-actualising philosophy. In the market place we are dealing with the imagination or perceptions. The Berg River farming area needs to show that it draws clean water from the river for irrigation, such that its produce poses no threat to the buyer. The consequences of even a suggestion by an authority in the European media, can mean total and not partial collapse of an export market, reaching right across the country, certainly for that season. Is this simply exaggeration? The Spanish example of vegetable market loss from May 2011, with the suggestion of a lack of hygiene, in even a single type of product, namely cucumbers, suggests not.

### **Setting up an Environmental CBA**

If government intervenes to make a decision as to whether a certain project should be implemented, and a CBA is to be used in the process, then government should ensure that it also values certain goods, such as potential

environmental damage or distributional objectives leading to social equity, where market failure often occurs (The Green Book – Appraisal and Evaluation in Central Government, HM Treasury, London, downloaded 2011). In South Africa, in the setting up of an Environmental Impact Assessment (EIA), it is not required that a CBA be included, although a purely financial CBA, without flow on effect for environmental or social costs and benefits is usually required to obtain bank funding.

### **Application of the Methodology to Assessing a Project with Waste Water Treatment Costs on the Berg River, South Africa**

The wastewater treatment process has significant associated environmental benefits, Molinos-Senante et al 2010. As the benefits do not have a defined market value, they often remain uncalculated. This paper suggests using the concept of shadow price to quantify the environmental benefits from wastewater treatment. So the market price of treated water is equated to the benefit of the removal of pollutants, such as organic matter, nitrogen and phosphorus. The environmental benefits of wastewater treatment plants (WWTPs) need to be assessed and the economic costs of the treatment processes are known. The impact of any project on the plant can be considered as part of the decision-making to implement the project.

So what is the optimal way of assessing the implementation of a project on the Berg River?

All development should be considered in the light of the Integrated Development Plan (IDP), which sets out planning and development for a local authority for a five year period. The framework for the IDP is outlined in the White Paper on Local Government for 1998. Sowman and Brown, 2006, note that the South African Constitution Act of 1996 mandates local government to promote social and economic development and yet to promote a safe and healthy government. The National Environmental Management Act (NEMA) of 1998 outlines the polluter pays principle, which holds the protagonist

responsible for this action; the precautionary principle which indicates that where there is limited understanding of the consequences of a development for the environment, precaution should prevail; and that decisions should take into account needs, both now and in the future.

Sustainability decisions on projects need to be made such that the needs of future generations are not unduly diminished by our decisions today and so that the impact on the environment of any project is considered. Importantly the following questions should be considered. What key resource must be protected during development? What approach should government take in project development to maintain water quality, and avoid the possibility of risk of loss of agricultural market in the Berg River Valley? An environmental cost benefit analysis may be used as part of the decision making to implement a project but this needs to be done with due consideration of the limitations of this economic tool, in a situation where the agricultural market can behave in an irrational way.

## Bibliography

Almansa C. and Martinez-Paz J.M., 2011. What weight should be assigned to future environmental impacts? A probabilistic cost benefit analysis using recent advances on discounting, *Science of the Total Environment* 409: 1305 – 1314

BBC News <http://www.bbc.co.uk/news/world-europe-13605910>  
31 May 2011 [29/07/2011]

Birol, E., Koundouri, P., Kountouris, Y., Assessing the Economic Viability of Alternative Water Resources in Water-Scarce Regions: Combining Economic Valuation, Cost-Benefit Analysis and Discounting, *Ecological Economics*, 69 (2010): 839-847

CNN News *Warning lifted against Spanish cucumbers suspected in E. coli outbreak*  
<http://www.cnn.com/2011/WORLD/europe/06/01/spain.germany.e.coli/index.html>  
[29/07/2011]

Constanza, R., D'Arge, R., de Groot, R., Farber, S., Grasso, M., Hannon, B., Limburg, K., Naeem, S, O'Neill, R., Paruelo, J., Raskin, R., Sutton, P. and van der Belt, M., 1997, "The Value of the World's Ecosystems Services and Natural Capital", *Nature*, 387, 255.

DEAT (2004) Cost Benefit Analysis, Integrated Environmental Management, Information Series 8, Department of Environmental Affairs and Tourism (DEAT), Pretoria. (Leiman T., Tuomi K.)

Guardian. *Spain rejects €150m payout offer for farms hit by E coli fears.*  
<http://www.guardian.co.uk/world/2011/jun/07/e-coli-spain-france-farmers>  
[29/07/2011]

Hanley N. and Spash C., 1993, *Cost-Benefit Analysis and the Environment*, Edward Elgar Publishing.

Hansjürgens, B., 2004, Economic valuation through cost-benefit analysis – possibilities and limitations, *Toxicology* 205: 241 – 252

Kuosmanen, T., Kortelainen, M., Valuing Environmental Factors in Cost-benefit Analysis Using Data Envelopment Analysis (DEA), *Ecological Economics* 62 (2007): 56 – 65

Molinos-Senante, M., Hernandez-Sanch, F., Sala-Garrido, R. Economic feasibility for waste water treatment: A cost-benefit analysis, *Science of the Total Environment* 408 (2010) 4396-4402

Organisation for Economic Cooperation and Development (OECD). 2008. *Economic Assessment of South Africa 2008*. <http://www.oecd.org/document> [6 September 2010]

Pearce, D.W., Turner, R.K. 1990. *Economics of natural resources and the environment*. New York: Harvester Wheatsheaf.

Requena J.C., Sáeza C.A., 2007, Reconciling Sustainability and Discounting in Cost–Benefit Analysis: A methodological proposal, *Ecological Economics* 60, 712–725

South Africa. DWAf. 2004. *Berg Water Management Area, Internal Strategic Perspective Report*. PWMA 19/000/00/0304. Pretoria: DWAf

Sowman M., Brown A. L., 2006, Mainstreaming Environmental Sustainability into South Africa’s Integrated Development Planning Process, *Journal of Environmental Planning and Management*, Vol. 49, No. 5

The Green Book – Appraisal and Evaluation in Central Government, HM Treasury, London; downloaded 18/02/2011; [www.hm-treasury.gov.uk/greenbook](http://www.hm-treasury.gov.uk/greenbook)

Ward F.A., 2009, Economics in integrated water management, *Environmental Modeling and Software* 24, 948-958

Water Services Development Plan for the Drakenstein Municipality, 2011, modules 2 and 3

Williams, B., 2008, Cost-benefit Analysis: Methods Explained, *Economic and Labour Market Review*, 2(12), 67 - 70