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Preferences and Values for Urban Waste Water Services in Small Rural Communities in Northern Victoria.

Bethany Cooper, Lin Crase and Brian Dollery

Introduction

This study aimed to make sense, and evaluate the benefits, of improved waste water treatment services in the context of small rural communities. It specifically addresses several areas of concern such as consumers' willingness to pay for improved waste water services, and the social complexities of operating in an environment of misunderstanding associated with different available technologies.

Water is both an integral component of the ecosystem and a fundamental social and economic good (Serageldin, 1996). Management of this resource is receiving unprecedented attention as demand continues to rise, approaching limits of sustainable supply in certain parts of Australia. Acknowledgement of water scarcity has sharpened resource managers' focus on what was once euphemistically referred to as 'waste' water.

The current trend of examining waste water as an alternative water resource is dominated by two approaches. Firstly, the technological and engineering facets of the reuse debate has produced an expansive literature with numerous authors reporting on the relative merits of alternative treatment technologies (Shanableh *et al*., 2000, Burnett *et al*, 1997, Campbell, 2000, Cheeseman *et al,* 2003). The second is primarily concerned with the economic dimensions of reuse (Crase, 1996; Redwood, 2003; Chakravorty *et al*., 2003; Liaw *et al.*, 2004). Economic analysis of reuse options typically employs techniques like Benefit Cost Analysis to judge the welfare implications of particular reuse projects, often studying the ramifications for larger communities where economies of scale favour adoption of the more expensive options. Relatively little is known of the economics of amending waste water technologies appropriate for small rural towns. This study attends to this deficiency.

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This research aimed to explore the preferences of small town residents for enhanced waste water services. A conjoint technique known as choice modelling was used to examine consumers' decisions to improve their current waste water system.
The Victorian government is presently examining waste water technologies in smaller urban communities in order to identify appropriate technical improvements. Ultimately, improving the waste water treatment in small country towns could produce two distinct benefits. It would demonstrably address local environmental and human health concerns and significantly enhance water quality for downstream users, offering a form of catchment-wide reuse. While such benefits are assumed desirable, their relative importance in the minds of consumers has not been assessed.

Waste Water in Victoria

Victorian Water Reform

The legislation governing water resource usage in Victoria is predominantly encapsulated in the Water Act of 1989. However, in 2003 the government released a Green Paper followed in 2004 by a White Paper titled *Securing our Water Future* (DSE, 2004). This embodied a range of reforms aimed at irrigators, environmental interests, industrial and urban users. In the context of urban waste water services and reuse, the document also proffered several pertinent policy statements including the following:

- "The Government will support strategic recycling and water recovery projects that provide significant benefits at a State and regional scale" (DSE, 2004, p. 112)
- "All Victorians will be provided with safe and reliable drinking water and sewerage services that protect public health and the environment" (DSE, 2004, p. 121)

These policy stances represent a significant challenge with approximately 42,000 properties in outer Melbourne requiring sewerage infrastructure and another 22,000 properties in towns of more than 100 properties lacking reticulated sewerage (DSE, 2004).

Waste Water Services in Victoria

Whilst the provision of water and waste water services in non-metropolitan Victoria now resides with rural urban water authorities (RUWAs), smaller towns are often excluded from the declared areas for which RUWAs are responsible. Moreover, the amalgamation process has left most RUWAs with a complex mix of water and waste water distribution systems. Some areas have little potential for economies of scale and yet pressure remains to achieve financial sustainability and to deliver the levels of service expected by communities. These challenges were increased in 1997 when the state government made a commitment to sewer all Victorian towns with a population in excess of 500 by 2001. Since 2001, the state has relied primarily on the use of Water Service Agreements to encourage RUWAs to extend wastewater services to small towns under the New Town Sewerage Initiative (DSE, 2004).

However, two major obstacles remain. The provision of waste water services to small rural towns is constrained by the need for water authorities to remain financially viable. Authorities also realise that there are economic limits that prevent most small communities from funding such works in their entirety (i.e. it is not feasible to invoke the user pay principle). Secondly, in those communities not sewered, responsibility for enforcing appropriate management of waste water rests predominantly with local government, often resulting in significant enforcement costs. For example, ensuring that each household is maintaining their septic tanks would require a large amount of resources.

The problem is exacerbated by the dearth of public information on community preferences for different types and levels of service. However, insufficient attention has been paid to the health and environmental concerns of alternative technologies, let alone to varying attitudes of communities toward these different alternatives. A way forward is to treat waste water services as 'products' which have the potential to contribute value to consumers. The unbundling of product attributes to establish their specific contribution to overall utility would provide valuable insight for decision makers and consumers.

Conjoint Analysis and Choice Modelling

Given the complex nature of both the 'product', which is waste water services, and each individual's decision-making processes, it is evident that some form of multi-variate analysis (MVA) would be useful. This particular approach enables us to measure the influence that particular product attributes have on the householder's decision to purchase waste water services.

More specifically, choice modelling (CM) is a type of MVA that enables us to better understand the way respondents form product preferences (Hair *et al.,* 1998). Choice modelling assumes that products are made up of bundles of attributes and it is these attributes that consumers base their preferences on (Kaul & Rao, 1995). The aim of CM is to statistically unbundle these attributes and assign the part-worth utilities to them.

CM has been employed in many studies and proved to be a useful tool for predicting choice behaviour. More specifically, several applications of choice modelling have successfully estimated the value of environmental and recreational goods (see, for instance, Opaluch *et al*., 1993; Rolfe & Bennett, 1996; Boxall *et al*., 1996; Adamowicz *et al*., 1998; Hanley *et al*., 1998; Morrison & Bennett, 2000).

From a practical standpoint, CM can assist policy makers determine the perceived relative importance of improved waste water services and its various attributes. The results of CM can be used to predict expected market share changes with various waste water services (Huybers, 2003). Thus, CM can be employed to assess the positioning of particular waste water services within small rural communities and to generate input into the development of waste water services that accommodate the current waste water challenge.

Identifying Key Attributes of Choice

This study adopted the experimental design process used by Lockwood and Carberry (1998), involving focus interviews, focus groups and survey pre-testing. It was anticipated that this process would reveal the relevant attributes of the 'product' waste water services.

A group of *a priori* attributes and levels were developed through obtaining a technical and consumer perspective on waste water services. In-depth interviews were conducted with several technicians from RUWAs in the North-East of Victoria and extensive focus group sessions were conducted with community members of small rural towns across the state. The attributes considered to be most significant to potential buyers of waste water services included the price of the service, the ability of the service to improve the current state of the environment, whether the waste water system permits residential subdivision, and the extent to which the waste water service imposes on-going responsibility on the householder to ensure optimal performance of the system.

It became evident from the focus group sessions that environmental concern was an important factor in the mind of the consumer. Thus, environmental improvement was included as an attribute, with percentages employed to represent the extent to which a waste water system has the ability to improve the current state of the environment. A number of participants in the focus group sessions revealed that without sewerage infrastructure, residential 'subdivision' is problematic in several rural towns. This was considered an important issue affecting decisions to purchase waste water services. As some respondents noted:

"This place would really take off if we had sewerage because we are so close to town".
"There are plenty of people just waiting for sewerage to come so they can subdivide".

'On-going responsibility' was also an issue selected as an important attribute. Residents expressed a desire for waste water services where their personal maintenance responsibility was limited. As two respondents inquired:

"What I want to know is can I push the button and forget about It?"

"Will I have to worry that others are not doing their bit on their property to make the thing work?"

This attribute was captured as a percentage representing the degree to which the waste water system imposed responsibility on the householder to ensure optimal performance of the system.

The information gathered through the in-depth interview and the community focus groups was then used to construct a survey instrument. Generally, four levels characterised each attribute in an attempt to reduce imbalance and minimise potential biases (see, for instance, Wittink *et al.,* 1990). For a summary of the attributes and levels used in this choice model see Table 1. Adopting Dillman's (1978) design method, a mail survey was used to collect choice data. The survey population comprised residents of fifteen small rural towns across North-East Victoria.

Table 1: Coding of the variables and the base-case scenario

Variable/Constant	Definition	Coding
PRICE	Price of the waste water system per annum.	0, 100, 300, 500, 700
ENVIRONMENTAL IMPROVEMENT	Improvement to the current state of the environment.	0, 50, 65, 80, 98

SUBDIVISION/BUILD	Permission to subdivide or add a new building.	Dummy variable taking on the value of 1 for systems that enable the householder to subdivide or add a new building.
ON-GOING RESPONSIBILITY/ REQUIRED MAINTENACE	The extent of householder responsibility for ongoing system function.	10, 30, 50, 70, 100
C_1	Alternative specific constant [ASC]	Constrained to be equal across V_1 and V_2

Findings of this CM

Using a multinomial logit model which analyses limited dependent variables, each of the attributes was found to exert a significant influence on the consumer's decision. Specifically, the model indicated that as the PRICE of alternative technologies increased, so too did the likelihood of an individual choosing to stay with the *status quo* option. The study also found that increasing the level of ON-GOING RESPONSIBILITY associated with a waste water service, also increased the likelihood of the respondent selecting the *status quo* option. However, the ENVIRONMENTAL IMPROVEMENT attribute proved positive. An increased capacity of the waste water system to improve the environment saw a decrease in the likelihood of an individual selecting the *status quo* option. Similarly, the findings indicate a positive response to the SUBDIVISION attribute where the respondent was less likely to choose the *status quo* option when the waste water system enabled them to subdivide or build.

In addition to these general findings, the research quantified the impact that environmental improvement, ability to subdivide and on-going responsibility had on the consumer's willingness to pay for different waste water services by examining the implicit price of these attributes from the buyer's [householder's] perspective.

Implicit prices are derived by statistically examining the trade-offs that individuals make between the price attribute and the other three attributes. In theory, the magnitude of this trade-off determines the individual's willingness to pay (WTP) for an improvement in the environment, the ability to subdivide or build, and a decrease in the on-going responsibility of a waste water system. This is done by using the statistical data from the basic linear model and the following functions.

Implicit Price $_{\text{(LINEAR)}} = \beta_{\text{ENVIRONMENTAL IMPROVEMENT}} / \beta_{\text{PRICE}}$
Implicit Price $_{\text{(LINEAR)}} = \beta_{\text{SUBDIVIDE/BUILD}} / \beta_{\text{PRICE}}$
Implicit Price $_{\text{(LINEAR)}} = \beta_{\text{ONGOING-RESPONSIBILITY}} / \beta_{\text{PRICE}}$
(Blamey et al*.*, 1999) [1]

A summary of these WTP estimates appears in Table 2.

Table 2: Willingness To Pay

	Mean Implicit Price	Implications
Environmental Improvement	$5.60	$5.60 = 1% improvement
Subdivide/Build	$236.70	$236.70 = ability to subdivide/build
On-Going Responsibility	$2.80	$2.80 = 1% less responsibility

From a policy making perspective, these estimates provide valuable information since they quantify the preferences of consumers. In this case, using the basic linear model it would appear that consumers in regional North-East Victoria are willing to pay about $5.60 for every 1 percent improvement in the current state of the environment. Moreover, they are prepared to pay $236.70 for a waste water system that enables them to subdivide or build, and about $2.80 for every 1 percent decrease in the on-going responsibility of the waste water service

From this information we can now determine how much a consumer will be willing to pay relative to particular variations in the attributes and their levels. Table 3 provides us with three hypothetical examples of waste water services. For instance, take waste water service 1, which provides a 50 percent increase in environmental improvement, does not give the householder the ability to subdivide and places 70 percent of on-going responsibility on the householder. The data suggests that householders are willing to pay $364 for this level of service. In contrast, with waste water service 3, which enables a 98% improvement in the environment, allows the householder to subdivide and places only 10% of on-going responsibility on the householder, consumers are willing to pay about $1037.

Table 3: Waste Water Service Scenarios

	Waste Water Service 1	**Waste Water Service 2**	**Waste Water Service 3**
Environmental Improvement	50%	70%	98%
Ability to Subdivide/Build	No	Yes	Yes
On-Going Responsibility	70%	40%	10%
Willingness To Pay	**$364**	**$796.70**	**$1037.50**

Limitations, Further Research and Concluding Remarks

This study has identified non-trivial differences between the views of consumers compared to those of technicians. Application of this information to a choice experiment has provided us with an empirical estimate of the relative value of each of these attributes. Accordingly, this information can be provided to engineering groups who are working to develop affordable and innovative solutions to the waste water situation in small regional towns. For example, they are investigating the feasibility of projects such as small community treatment plants. Moreover, the findings may also potentially lead to improved policy decisions in this context. For instance, determining the appropriate amount to charge consumers for particular waste water services.

In sum, our analysis of buyer behaviour clearly indicates that consumers in rural North-East Victoria are WTP a significant sum for the various attributes of a waste water service. Specifically, they are WTP more for a waste water system that improves the current state of the environment, enables the householder to build or subdivide, and reduces the level of on-going responsibility required to maintain the service to its optimal level.

Although a number of limitations of stated preference techniques have been identified, Choice Modelling clearly has potential to better inform policy makers in this context. The model developed here, whilst relatively simplistic, clearly showed the importance of the various product attributes in the decision making process of consumers. Future studies may employ the data to add increased realism and sophistication to the model through the inclusion of socioeconomic and attitudinal variables.

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