The Sustainability Assessment Model (SAM): Measuring Sustainable Development Performance

*Jo-Anne E. Cavanagh, Bob Frame and James Lennox**

Introduction

Increasingly, legislative requirements are being placed on councils and businesses to incorporate sustainability into their activities. However, it is inherently difficult to assess the sustainability of activities and there are few tools to do this. It is therefore difficult to understand if an individual project contributes to broad sustainability objectives or if it incorporates understanding of sustainability into organisations' activities. The Sustainability Assessment Model (SAM) is a tool for engaging people within organisations in sustainable development thinking and to evaluate the sustainability of projects (Baxter et al. *2002; Bebbington and Frame 2003). This article provides an overview of the SAM and presents a preliminary assessment of how it was used to assess organic waste processing options for a local council in New Zealand.*

Brief overview and history of the SAM

The SAM was originally developed in the late 1990s for the UK oil and gas industry by the petroleum company BP, Genesis Oil and Gas Consultants, and the University of Aberdeen. The model was developed over three years from a combination of primary research, conceptual work, and applied experience with actual projects at BP. It follows a four-step, full-cost-accounting approach (FCA) to a discrete project and considers the full life-cycle, including identification and monetisation of the project's impacts. FCA generates information about externalities that are not currently reflected in pricing systems and which are not likely to be reflected in pricing systems in the near future. In this respect, FCA is part of an approach where information about the externalities is provided to improve understanding the full impacts of a particular activity. The costs generated by FCA are not 'real' in the sense that they will be borne by the organisation from which the externalities originate. Rather, the costs are notional and provide a glimpse of the total costs (and benefits) of an activity over some defined boundary. The primary benefit of FCA is, therefore, the information that it generates which has been previously unavailable to decision-makers.

FCA requires a generic four-step approach to identifying and quantifying (in physical and then financial terms) the external costs and benefits associated with a particular activity. Table 1 summarises the approach. FCA, therefore, requires the systematic identification of externalities around a particular object of interest. The externalities are initially measured in physical terms and are then translated (by some method) into financial figures. The resulting data is then brought together with existing financial information about a project to ascertain whether or not the internal accounting data, in combination with the externalities data, results in a net positive or negative outcome. At this final stage of evaluation, some idea of whether or not an activity could be said to be 'sustainable' may be offered.

It is important to stress that development of the SAM is something that must be achieved in true partnership with the main project stakeholders. It is much less effective if it is seen as a process conducted separately to the project by consultants or researchers. Much of its tacit value is gained by the 'owners' of the project becoming aware of 'their' impact on a much wider sphere of influence than is considered under more traditional assessment methods. It is our experience that much of the data required for the SAM is available within an organisation or project team but, for example in terms of travel or resource usage, is not immediately connected with the decision-making processes.

The SAM and FCA are now explained in more detail, before studying specific case studies. More details on development and implementation of the SAM are given by Bebbington and McGregor (2005) and Baxter *et al*. (2002), with more on FCA in Bebbington *et al*. (2001).

In steps one and two, the SAM tracks the sustainable development impacts of a project over its full life-cycle; for example, in the case of an oil and gas installation, from exploration and design, through construction, installation and commissioning, to the 'production' phase and eventual decommissioning. The SAM extends the

* *Jo-Anne Cavanagh, Bob Frame and James Lennox are with Landcare Research, PO Box 60, Lincoln 8152, New Zealand; contact author's email: cavanaghj@landcareresearch.co.nz.*

Table 1. Steps in Full-cost Accounting (FCA).

	Steps in Full-cost Accounting (FCA)
1	Define the focus of the costing exercise. This may be, for example, a product, production process, waste disposal option, project, part of an economic entity, an entire entity or an entire industry, and is the overall cost objective.
2	Specify the scope or limits of analysis. This is the subset of all possible externalities to be identified.
3	Identify and measure external impacts. This involves making the link between a cost objective and the externalities arising from the cost objective.
4	Cost external impact. This is the monetisation of the externalities, or determination of the fuller-cost associated with, but not already captured by, the current accounting for the cost objective.

Source: Bebbington and MacGregor (2005).

analysis beyond extraction of oil and gas and traces the external impacts from processing, manufacture of products from oil and gas and eventual product use. Thus the SAM can examine cradle-to-grave impacts of a project.

The third step is to identify and measure the impact of a project. Impacts have currently been categorised in 22 fields grouped under four headings: economic, resource use, environmental and social impacts. The data from which to impute impact has been drawn from the actual activities of a project (such as hours worked, people employed, barrels of oil produced, materials used in fabrication, waste produced and estimates of the project's financial performance). This activity data is then either used directly in the SAM or used to impute the economic, resource use, environmental or social impacts.

Finally, 'externalities' arising from the project are monetised, a difficult and contentious element of FCA for practical and philosophical reasons. The problems which sustainable development seeks to address arise from fundamental structural weaknesses within society, and are not amenable to attempts that reduce, for example, 'the environment' to a monetary figure. Hence, to seek to remedy the problem by adding more of the very thing (economic calculative rationality) that caused the problem in the first place can be construed as misguided. However, if it is viewed as a genuine attempt to increase the level of debate and understanding of the complexity of the debate and not as a panacea, then the solution presented can, it is proposed, be accepted.

Reservations over monetisation of external impacts also arise from the difficulty of obtaining a single, uncontested figure for monetisation. The main approaches to monetisation, such as the maintenance-cost approach and a variety of approaches under the broad heading of the damage-cost approach (see Bebbington *et al*. 2001, pp. 63-67), may yield significantly different measures of externalities. As a result, knowing what the resulting figures mean is often very difficult. In the case of the SAM, damage-cost estimates are used (in the main) to monetise externalities.

The SAM has been presented to various New Zealand businesses and public sector organisations, which regarded it as able to assist in developing more sustainable ways of operating (Bebbington and Frame 2003). The current paper takes the next step, by providing a case study of SAM applied in a New Zealand context.

Case study – organic waste in Christchurch

Organic waste (food- and green-waste) is a key focus within the *New Zealand Waste Strategy* (Ministry for the Environment 2002). Environmental concerns stem from the potential impact of leachate and methane formed from the decomposition of organic waste in landfill. Further, the disposal of organic waste represents an opportunity to produce beneficial products in the form of compost and electricity (through anaerobic digestion processes)[1]. However, councils often struggle to decide on appropriate options for organic waste management that meet sustainability objectives in practical ways.

A preliminary assessment of organic waste processing was undertaken by Landcare Research for Christchurch City Council to assess the applicability of the SAM in assisting decision-making. Two assessments were undertaken:

1. the collection of organic waste through various routes across the city, and processing of the waste in centralised transfer stations

2. the processing of organic waste through community gardens; that is, on council-owned land that has been gifted to the public to develop a garden that the local community can look after. There are six such community gardens in Christchurch.

In undertaking a sustainability assessment using the four-step FCA approach detailed in Table 1, the first step is to determine what activities are being undertaken within the project. For example, in Christchurch, residential organic waste is processed via several routes including through:

- composting of green-waste delivered by residents or commercial operators under council-operated or commercial composting operations

1. Electricity can also be generated from methane capture at landfills although this process is typically less efficient than anaerobic digestion processes.

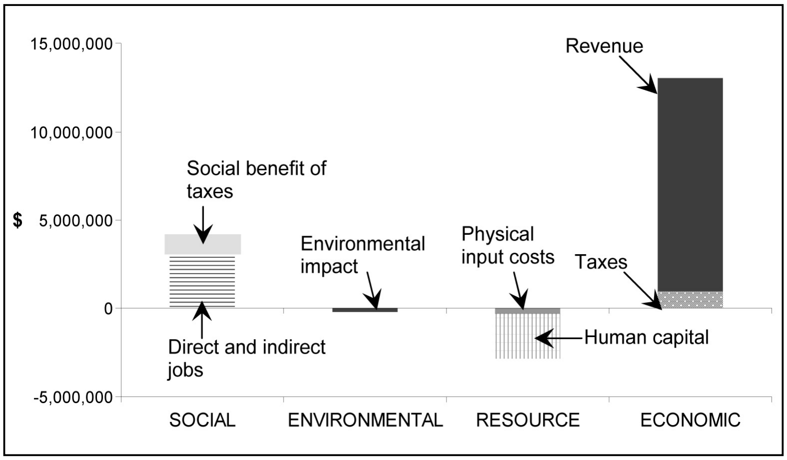

Figure 1. SAM profile generated by considering all routes of organic waste processing in Christchurch.

Operational data were obtained from council staff and commercial operators, and included the number of people employed by different organisations involved in the collection or processing of waste; the average distance travelled per waste collection or delivery trip; the fuel efficiency or amount of fuel used in different operations (e.g. collection, composting, landfill compaction); water-usage (i.e. in composting); and the amount of compost and electricity produced from residential organic waste[2]. The social benefits of community gardens were determined through a separate study, and included identification of jobs created indirectly by the organic waste industry.

- sewage treatment systems via in-sink disposal units
- home composting or worm farms
- composting in community gardens.

Green-waste received at the three council-owned refuse transfer stations is transported to the central transfer station for processing. Some green-waste is delivered to a commercial operator for processing. Green- and food-waste is also disposed of in landfill via council or commercial solid-waste collection. Some food-waste may be disposed of into the sewage treatment system via in-sink disposal units. In Christchurch, anaerobic digestion of the biosolids received via the sewage system is used to generate electricity, which is then supplied back to the national grid.

Figure 1 shows the SAM profile developed for organic waste processed via all routes. The profile is dominated by the project revenues (economic bar)[3]. A large number of people are employed in the waste management and home gardening industries, and this is reflected as a social benefit. Surprisingly, the impact of air emissions is minimal, although further work is being undertaken to develop more appropriate emission factors and damage costs for air pollutants. The social benefit of organic waste management is primarily driven by indirect jobs created as a result of the organic waste industry (e.g. machinery maintenance, support services), with limited social benefit generated by the product (e.g. sale of compost).

This 'all-routes' profile contrasts markedly to that generated by considering the processing of organic waste through community gardens (Figure 2). This 'community garden' profile is dominated by the social benefit and wages. Although the actual dollar-value is less relevant than the shape of the SAM profiles, as our focus is on the absolute values, it is worth noting that the community garden profiles were significantly less than those of the whole system.

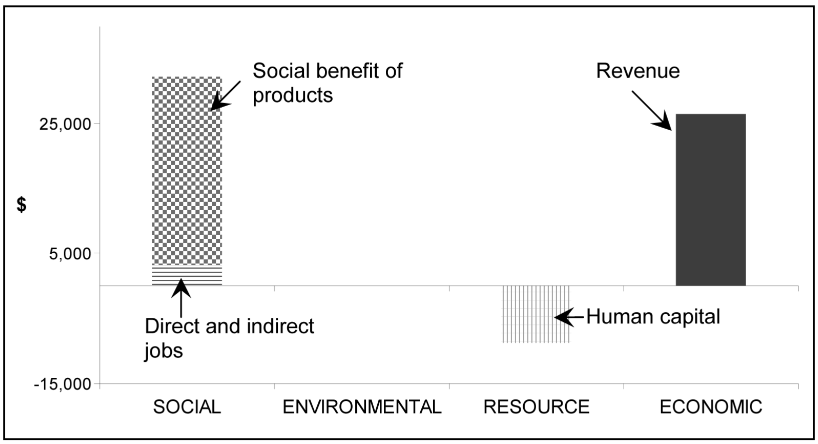

Figure 2. SAM profile generated by consideration of the processing of organic waste by community gardens.

From the preliminary profiles generated, and according to the assumptions of this model, the community gardens appear to provide a more sustainable option than the current system within the boundaries considered. However, there may be additional factors that cannot be included in the SAM but which

2. For the current study, capital costs of infrastructure (e.g. landfill, refuse transfer stations) were excluded, as the primary focus was on the collection and processing aspects of organic waste management.

3. In the SAM, no distinction is made between public and private ownership or funding. Public and private funds spent on a project are both treated as revenue, which in SAM, are accounted for as contributions to GDP associated with the life-cycle.

should be considered in the context of making a decision. For example, the community garden system considered here was based on local residents taking their organic waste to the community garden. For this system to be effective on a larger scale requires that the wider community alter their waste disposal habits, by separating organic waste at the home and taking it to the community garden, as opposed to putting it in the rubbish bin. This may be an appropriate behaviour to encourage, although the extent of uptake in the current environment may be limited. Further, there is a limit on the amount of organic waste that can reasonably be processed through community gardens. Factors such as these would need to be considered when making decisions about investing resources in community gardens. The SAM permits longer-term benefits to be assessed. It also provides the ability to look at the aspects of a project that could be encouraged, or discouraged, that would enable an organisation to move in a more sustainable direction, and to consider how this could be achieved feasibly.

In this particular case, the information provided by the preliminary SAM assessments assisted the council in deciding to retain a community garden as opposed to selling the land for residential development.

Discussion

The preliminary assessments reported here demonstrate the potential application of the SAM as a tool to assist local authorities in decision-making on sustainability issues. Further work is being undertaken to develop the original oil and gas model. This will require parameters more appropriate to New Zealand that permit more accurate representations of local conditions. This will take place in new sectors for the SAM, notably transport and housing in the first instance. Additional work is also being undertaken to consider the whole waste stream. In doing so, we hope that a model can be developed and applied to a range of projects in New Zealand and Australia. Such a model will represent, on one level, a contribution to the general impact assessment area. In so doing, it is not presented as a panacea but as a tool with a possible place in the project-cycle decision-making process. Success in this may well be marked by development of more rigorous methods in due course.

Acknowledgments

The authors acknowledge funding under the FRST programme 'Building capacity for sustainable development: The enabling research' (C09X0310); and the support of Christchurch City Council in making this research possible. Thanks are also due to Jan Bebbington, St Andrews University, Scotland, for her support for the project, and to BP and Genesis Oil and Gas Consultants for permission to develop an Australasian version of the SAM.

References

Baxter, T., Bebbington, J. and Cutteridge, D. 2002. The Sustainability Assessment Model (SAM). In: *Proceedings of the SPE International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production*, pp. 697-701. Paper No. 83986-MS. Conference held 20-22 March, 2002, Kuala Lumpur, Malaysia. Society of Petroleum Engineers, Richardson, Texas.

Bebbington, J. and Frame, R. 2003. Moving from SD reporting to evaluation: The sustainability assessment model. *Chartered Accounting Journal of New Zealand,* 82(7): 11-13. Online at http://www.nzbcsd.org.nz/story.asp?id=356 (accessed September 2005).

Bebbington, J., Gray, R., Hibbitt C. and Kirk, E. 2001. *Full Cost Accounting: An Agenda for Action.* Association of Chartered Certified Accountants, London.

Bebbington J. and MacGregor, B. 2005. *Modelling and Accounting for Sustainable Development.* RICS Foundation, London.

Ministry for the Environment. 2002. *The New Zealand Waste Strategy: Towards Zero waste and a Sustainable New Zealand.* Ministry for the Environment, Wellington, New Zealand. Online at http://www.mfe.govt.nz/publications/waste/waste-strategy-mar02/ (accessed September 2005).