Chapter 4

Integration of Sustainability Indicators

2009

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4. INTEGRATION OF SUSTAINABILITY INDICATORS

4.1 Approaches for integration

Indicators are useful for presenting relatively complex situations in a simplified form to facilitate understanding. The previous chapter introduced indicators for assessment of the environmental, social and economic performance of biomass utilisation systems. Within each category, several parameters were needed for assessment. So, for sustainability assessment of biomass utilisation systems, a suite of indicators need to be considered. From the scientific point of view, such a system of indicators would be useful to make an overall assessment of sustainability. But from the point of view of communication as well as decision-making integration of the indicators is sometimes sought (Dahl, 1997). Clear-cut decisions are usually difficult to make based on a plethora of indicators; thus decision-makers would prefer to have a single index by which they can "unambiguously" evaluate a system to arrive at a decision. The 'pyramid of indicator sets' in Figure 4-1 displays the hierarchy of data to indices.

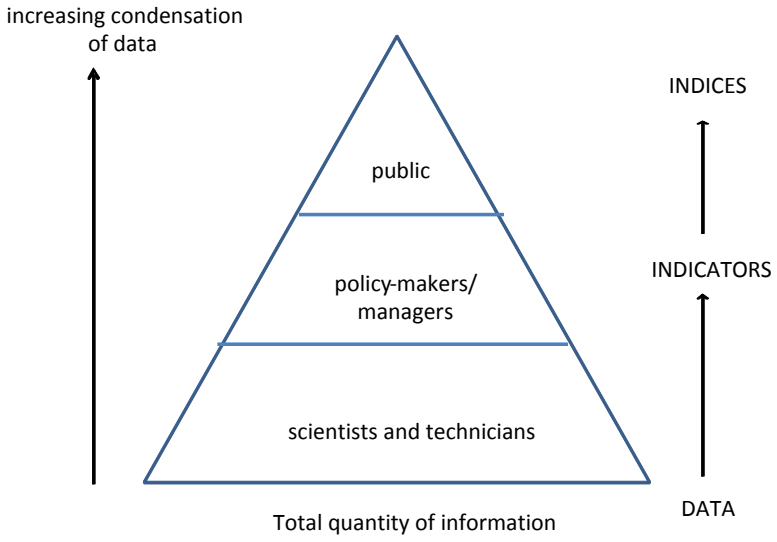


Figure 4-1: Relationship between indicators, data and information: the OECD 'pyramid of indicator sets' Source: Braat, 1991

High-level decision-makers are often unwilling to accept that something as complex as sustainable development can be represented adequately by a single index. The apparent "lack of ambiguity" associated with a single index is misleading as such an index is based on the inherent assumption that the indicators being integrated are actually tradable. Thus we are implicitly faced with the situation where we equate, for example, a ton of greenhouse gases with a certain number of jobs. This is the major reason why integration is not acceptable to many scientists and technicians; how meaningful is it to add up apples and oranges to a single number coefficient? On the other hand, even a moderately successful attempt at developing a small set of indices would at least encourage sustainable development goals to be included in policy and decision-making.

Integration of indicators is to be done at two levels – within the environmental, social and economic categories as well as across the three categories. Integration within a category has been done for environmental impacts in life cycle assessments using normalization and weighting techniques (Baumann and Tillman, 2004). Here, the various impact categories are normalized to a single unit, for instance person equivalents based on the impacts of an average person in a year and then weighting factors assigned based on the relative importance of the impact categories (which clearly can be quite subjective). Another approach has been to model impacts at the 'end-point' or 'damage' level relating environmental emissions to areas of protection such as human health, ecosystem quality and resources (Goedkoop and Spriensma, 2001). Yet again there are integration techniques based on monetization – money is a unit which is quite easy to understand for a varied audience. One major effort in this regard at the EU level was the ExternE project (ExternE, 2005). The underlying assumption with monetization of course is that everything can be monetized which apart from reservations based on scientific considerations also has strong ethical implications (Stirling, 1997). All the above integration techniques are numerical ones yielding a limited number of indices or a single index to facilitate decision-making.

Apart from the numerical integration techniques presented above, indicators could be kept entirely separate but presented together in a single table or diagram. This would be a visual integration that would facilitate looking at all the indicators together. One such technique, called the Dashboard of Sustainability, has been developed by a small group of indicator program leaders called Consultative Group on Sustainable Development Indices (CGSDI, www.iisd.org/cgsdi/). An analogy is drawn with a vehicle dashboard, with all its dials and lights, and sustainable development. Separate dials and warning lights are included for various dimensions of sustainability, so there is some disaggregation. The size of a segment reflects the relative importance of the issue described by the indicator, for example, the theme 'Economy' in Figure 4-2 has a weight of 45%. The colours indicate the level of evaluation, from green which is "very good" through yellow indicating "average" to red which means "crisis".

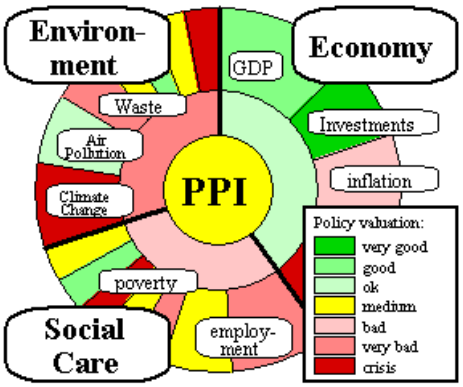


Figure 4-2: Dashboard of Sustainability screenshot (A number of indicators in the outer circle are combined to three sub-themes; the sub-themes are then condensed to a Policy Performance Index, PPI)
Source: http://esl.jrc.it/dc/pics/ppi_fut.gif

Another integrative approach is the use of an amoeba or radar diagram where indicators are arrayed as arms. It essentially comprises a bar graph of indicator values turned into a circular presentation. Figure 4-3 is an example of a radar diagram for assessing sustainability of buildings (Abeysundara et al., 2009).

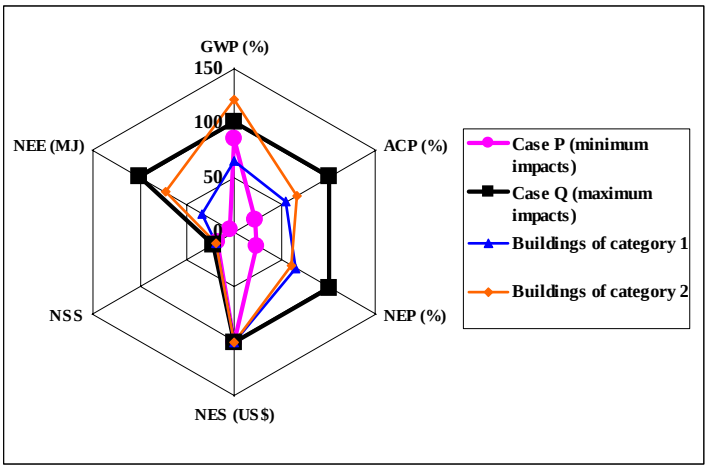
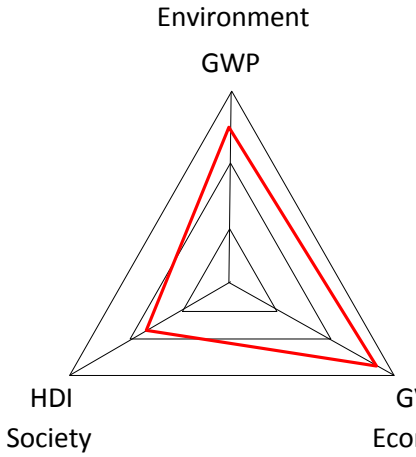


Figure 4-3: Environmental, economic and social scores of existing buildings with the cases that have minimum (P) and maximum (Q) impacts (NEE, NSS and NES refer to normalized embodied energy, social score and economic score respectively)
Source: Abeysundara et al., 2009

4.2 Integrated of indicators for assessing biomass utilisation

In the previous chapter, indicators have been proposed for assessing environmental, economic and social sustainability. For environmental sustainability, global warming potential has been proposed as the priority indicator in line with the current world effort in reducing greenhouse gas emissions. Of course this is not to trivialize other impacts on air quality, water resources, land use, biodiversity, etc. which must be considered too. For economic sustainability, gross value added and for social sustainability, the human development index (HDI) which is an aggregate index, have been proposed. These three broad indicators/indices could be easily presented in a radar diagram format shown in Figure 4-4 to give an overall visual effect of integration without actually aggregating them. Other impacts which are more qualitative in nature could be presented in a tabular form indicating current status and target to be achieved. Such an approach would address the need of policy and decision-makers for integration but at the same time having enough detail to allow transparency at the level of communication.



Other indicators	Target	Current status
Air quality		
Water use		
Others …		

Figure 4-4: Illustrative diagram for representation of sustainability

Further integration of the indicators for environmental, economic and social performance could be done numerically, if so desired, by setting target values of performance for each issue. Then, the values for each could be normalized based on the target value and aggregated based on a suitable weighting scheme formulated by the decision-makers based on their priorities. If the indicator values for environmental, economic and social performance are I_{en}, I_{ec} and I_{so} and the target values T_{en}, T_{ec} and T_{so} respectively; then based on relative weights of the three categories, W_{en}, W_{ec} and W_{so}, the single index would be:

$$\text{Sustainability Index} = \frac{\left(\frac{I_{en}}{T_{en}}\right)\cdot W_{en} + \left(\frac{I_{ec}}{T_{ec}}\right)\cdot W_{ec} + \left(\frac{I_{so}}{T_{so}}\right)\cdot W_{so}}{W_{en} + W_{ec} + W_{so}}$$

Such an index would be a fraction varying between 0 and 1 or could also be expressed as a percentage. The indicators could be suitably defined so that a higher value of the sustainability index would indicate a relatively more sustainable biomass utilisation scheme.

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