PRACTICE NOTE

Indications from Sustainability Indicators

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ABSTRACT Sustainability Indicators are a measure to assess progress towards sustainable development, but how and why certain indicators are produced and used is often hard to understand. There is also a lack of common ground, so that different indicators cannot be directly compared. This paper explores the suitability of some existing sustainability indicators and measurement tools in this light. It suggests there is a need to develop simple local quantitative indicators in addition to the more commonly used qualitative indicators. A new method is outlined for the development of quantitative physical indicators as part of an integrated approach to a more sustainable urban environment.

Introduction

The applicability and usefulness of the extensive range of sustainability indicators that cover social, economic, institutional and ecological issues must be questioned. At present, more emphasis seems to be put on producing indicators rather than on making a sustainable urban environment. Moreover, the tendency to put more emphasis on qualitative indicators rather than quantitative measures, when both are equally important in an integrated approach, may overlook many promising approaches to sustainability. Hence, the possibility of developing a new approach and the re-navigation of what sustainability is and sustainability indicators are may be essential to fulfil current objectives and goals, at both policy and individual levels.

The Need for Indicators of Sustainability

The main aims of sustainable development, to contribute to the protection and utilization of resources by people within the regenerative capacity of the earth, essentially need measurements in order to assess progress towards the goal. The present awareness of communities, governments, businesses, international agencies, non-governmental organizations and voluntary organizations clearly represents the fact that many people are concerned to establish an indicative system which will report, measure and assess progress in meeting the targets of...
sustainable development. This is the starting point for understanding the significance of indicators as important instruments in the process.

Indicators are multi-dimensional, multi-disciplinary indices with sub-themes developed with care to evaluate and measure the status of an area in terms of progress towards sustainability. They serve as experiential, quantitative and qualitative bases for the assessments of policy performance and are able to indicate a desired change in policy direction, if required. Indicators also give the possibility of finding new and valuable correlations, thus providing a basis for future planning actions.

An indicator can be a variable (e.g., the total amount of organically farmed products) or a function of variables (e.g., a ratio, such as recycled vs. total amount of solid waste). An indicator can be a qualitative variable (e.g., safe–unsafe neighbourhood, participatory–non-participatory decision making), a ranking variable (e.g., best or worst training program, lowest or highest mortality rate) or a quantitative variable (e.g., energy use in kilowatt hours/year, gross domestic product/capita). (Hardi et al., 1997, p. 8)

In 1987, the Bruntland Report, also known as ‘Our Common Future’ (World Commission on Environment and Development, 1987), provided a definition of sustainable development and highlighted its three fundamental components as environmental protection, economic growth and social equity. In 1992, the United Nations Conference on Environment and Development, or ‘Earth Summit’, at Rio de Janeiro, Brazil established ‘Agenda 21’, considered to be a blueprint for sustainability. Agenda 21 focused on the importance of indicators.

Indicators of sustainable development need to be developed to provide solid bases of decision making at all levels and to contribute to self-regulating sustainability of integrated environmental and development systems. (United Nations, 1992, section 40.4)

The Commission on Sustainable Development (CSD) approved, in its Third session of April 1995, a five-year Work Programme on Indicators of Sustainable Development (1995–2000) and called upon the organizations of the United Nations system, inter-governmental and non-governmental organizations, with the co-ordination of its Secretariat, to implement the key elements of the Work Programme (United Nations Division for Sustainable Development (UNSD), 2005a, b). A comprehensive set of 134 indicators related to the chapters of Agenda 21 in the categories of society, economics, environment and institutions, with methodology sheets for each indicator, was developed, improved and tested. The categories were divided into sub-themes vertically, and each theme was further sub-divided horizontally into driving force (the cause), state (the present status) and response (policy measures taken for solution). Many countries followed this driving force–state–response model in order to develop their own sustainability indicators. This model has an inherent problem as sometimes all three items (cause–status–solution) are not available for a particular indicator and it is often ambiguous whether the indicator is to be interpreted as a cause or a state. However, the method offers some overall indication of what sustainability might mean.

Following the start of the five-year Work Programme, in 2001 the UNSD published detailed guidelines and methodologies for developing sustainability
Indicators (UNDSD, 2001) Indicators are generally developed at three spatial levels: global, national and local. The Netherlands has developed Environmental Policy Performance indicators at a national level on change of climate, depletion of the ozone layer, acidification and eutrophication of the environment, disposal of solid waste, toxic substances and others (Hardi et al., 1997, p. 27). World Watch Institute Vital Signs, Washington, USA has developed global indicators on food, agricultural resources, energy, atmospheric, transportation and social trends (Campbell et al., 1997). These global indicators can seem far removed from everyday life. At the other extreme, Sustainable Seattle has developed local-level indicators covering aspects relevant to the city and its region, such as environment, population and resources, economy, culture and society and others (Warren, 1999, pp. 138–139), but it can be hard to link these to global issues.

The United Kingdom Department of the Environment, Transport and the Regions (DETR) has also developed a set of 150 indicators, summarized in 1999 into 13 headline indicators to measure the ‘overall index of progress’ (DETR, 1999). However, in a short list of headline indicators, a single key indicator may not be reflective of the whole situation. For example, in the 13 headline indicators, the indicator for placing new homes on previously developed land cannot be an absolute and key measure for the re-use of land. Re-use of land may also involve related issues such as increasing impervious areas of pavements, re-use of brownfield sites not only for housing but also for shopping, commercial, industrial and other land uses, rejuvenating contaminated sites, local ecosystem health and the creation of new open spaces on re-usable lands. Thus it may include links to many other issues in the environmental field, even if the social and other aspects are kept aside. This launches the debate on the acceptable level of simplification, as erroneous results may be the outcome. As Bell & Morse comment:

Essentially, all science is the study of either very small bits of reality simplified or surrogates for complex whole systems. How we simplify can be critical. (1999, p. 31)

So if it is necessary to judge whether the simplification of complicated issues is misleading, this also raises the question of the worth of using simple indicators for complicated issues. On the other hand, if indicators are too complex or numerous they will not be understood by the widest cross-section of the population.

A crucial point relating to indicators is to consider how far they are applicable to the process of change. A high number of indicators is not only a complex juxtaposition of complicated discrete issues but also makes it difficult to understand the situation as a totality. The diverse measurement units of different indicators complicate comparison and the formulation of a meaningful result. However, in cases both of a detailed extensive list of indicators and short lists of headline indicators derived from these lists, there can be a lack of clear identification of the linkages among the interrelated issues. Household travel patterns, for example, are dominated by residential locations which are likely to be shaped by people’s personal preferences, but these patterns will have an effect ultimately on the overall land-use planning, environmental quality and urban morphology of the city. Moreover, appropriate methodologies for measuring some desired indicators are sometimes not available. The UK Government’s 2005 sustainable development strategy ‘Securing the Future’, which builds on the 1999 Strategy, has a total of 68 indicators. Out of these, 20 are priority ‘UK Framework
Indicators’ and the remaining 48 ‘non-framework indicators’ highlight additional priorities (National Statistics & Department for Environment, Food and Rural Affairs (DEFRA), 2005, p. 11). Out of these, eight indicators (water stress, farming, environmental stewardship, local environmental quality, flooding, social justice, environmental equality, and well-being) are considered to require further research to establish appropriate measurement methods (National Statistics & DEFRA, 1995, p. 95).

Although it explores a considerable number of avenues of sustainable development and gives an overall picture of the situation, the integrated approach to all the social, economic, environmental, and institutional issues can present a disproportionate emphasis on the different issues. In many cases, environmental performance indicators have been limited to discrete measurements of atmosphere, land, water, and marine ecosystems only in terms of the presence of pollutants or the numbers of indigenous species.

…strategies devised to minimize ecological impacts of urban growth often fail to identify key underlining mechanisms that link urban patterns to ecosystem functions (i.e., interactions between extent and distribution of impervious surface and pollution generation caused by roads to affect stream conditions) … (Alberti, 2005, p. 171)

They have tended to exclude the measurement and impact of the human built environment in urban and rural areas, important contributors to environmental degradation in the ecosystem. Similarly, there is an increased emphasis on developing quality-of-life indicators, and ‘building sustainable communities’. This emphasis tends to downplay the impact of the built environment on natural ecosystems. It seems that the qualitative social indicators, though basically dependent on a quantitative base, are more popular among many organizations compared with quantitative indicators of sustainability. In 2000 the New Zealand Ministry for the Environment (MfE) developed national ‘Environmental Performance Indicators’ in the areas of ozone, climate, air pollution, marine, land, fresh water, waste, transport, energy, biodiversity, toxic contaminants and contaminated sites, pests, amenity, and Maori (indigenous people and their values) (MfE, 2000). These are largely quantitative indicators. On the other hand, a report on quality-of-life indicators for each of the six largest cities of New Zealand contains nine largely qualitative primary indicators: health; housing; education; demographics; democracy; community cohesion; safety and employment; urban environment; and economy. This report was revised and updated in 2001 for the eight largest cities of New Zealand (North Shore et al., 2003).

There is no doubt about the far-reaching effect of developing awareness in communities and individuals of sustainable development but, to be a part of an integrated approach, quantitative physical sustainability indicators are also equally important in the process and need simultaneous development. For example, Boston’s Indicators Project for building sustainable communities has as one of its objectives the restoration of the city’s degraded natural environment and resources. This is to generate ecological health for the neighbourhoods in addition to developing community assets and an improved quality of life. The indicators refer to restoration and re-use of land and water bodies, identification of the use of land in productive use of neighbourhoods, and supporting diverse human activities without hampering the environmental health of the urban ecosystem (Kline, 1997, 1999, 2000).
Sustainable limits are also a main criterion for producing indicators. The expected concentration of carbon dioxide in air is known, but it is equally important to identify what are sustainable limits for paved areas, buildings, trees and vegetation, and energy use in a residential area when creating sustainability indicators at a local level. Sustainability might also be indicated by the amount of food grown within city limits, or it might be indicated by the orientation of residential buildings so as to gain energy from the sun. However, such indicators mean that some image of what a sustainable urban environment might be like has to be created. Too many current indicators of sustainability are based on an assumption of no change to the built environment and it is doubtful whether the current built environment can become more sustainable without change to its form.

General and Core Indicators

The indicators that have been developed to date could be classified as general- and core-level indicators. At a general level, indicators are simple, act as awareness signals and are easily understood by the public. At core level they are decision making and modification indices and performance appraisal guides for formulating and initiating effective policy planning. The core-level indicators will obviously include complicated issues in addition to general indicator issues. In order to empower an individual to be part of the process of sustainable development, he or she needs to be provided with simple indicators to help increase awareness of the physical performance in terms of sustainability of the immediate residential area. However, if this process is not to be intrusive, data for compiling indicators for residential areas will have to be collected from sources such as maps, satellite images or aerial photographs. This has been the approach taken with the work that is described later in this paper.

Examples of Indicators Related to Urban Development

Marling, Knudstrup and Vaerum presented a project on site-specific indicators for the urban environment (Marling et al., 1997). Here the urban environment was defined as an integration of physical form, socio-economic structures and activities leading to environmental pollution, and matter–energy flow (or resource consumption) in the city. This project explored holistically the interconnection between these through lifestyle analysis and site plan analysis. This was linked simultaneously with an understanding of the historical development of the city that had led to the particular city pattern, thus taking a holistic approach. From the city plan, 13 different types of site plan typology were identified as representing the period of development for a particular residential area, for example, apartment buildings (1850–1920), free-standing blocks of flats (1930), etc. The different types of site plan have different physical structures in terms of plot ratio, physical form, building tradition, architectural style, building materials used, construction, etc., hence they vary considerably in terms of their operating energy efficiency, life-cycle energy, the type of lifestyle they can support, and so on. For example, the sites in suburbs demonstrated a more open structure and lower plot ratio compared to the sites in an inner-city area dating from the Middle Ages (Marling et al., 1997).
The plot ratio and many of the factors mentioned above can be considered ‘general’ indicators. The goals presented in this paper of developing a site-specific typology for housing and living, labelling different sites and producing site-specific indicators represent a pioneering approach. Although the study is detailed, the selection of the essential simplified data from a practical and planning point of view in the physical forms, and from socio-economic statistics, pollution measurements and flow of resource statistics, is intended to generate simple ‘general’ indicators for residents as well as ‘core’ indicators for policy makers. The selected analysed data are transferred to geographic information systems (GIS) for the urban environment, giving results which will not only act as important ‘core’ indicators for the formulation of environmental action plans, for policy planning, and to show the trends, but also act as an effective public tool. All these site-specific indicators are complex ‘core’ indicators when cumulatively used at a city level, but at a local level for each type of discrete site they act as ‘general’ indicators for individuals. So, the macro and the micro levels are both taken into account, and these indicators should reflect the social geography of the city, the physical environment and environmental accounting at the same time.

In 1998 the Australian Department of the Environment developed indicators for human settlement as part of the reporting of the national state of the environment. These indicators, which followed the pressure–state–response model, covered all major environmental themes, identified suitable measuring methods, defined a spatial scale for reporting the data and the geographical extent of monitoring, and provided baseline information for the proper interpretation of the indicator. For example, domestic energy use is a state indicator, expressed in gigajoules (GJ) per capita by end use and fuel (including renewables) and reported as cumulative bar charts at sample settlement scales representative of urban, rural and remote locations accounting for variability of the climate. This indicator also shows links to other indicators such as floor area per person, building materials and operating energy efficiency (Environment Australia (EA), 1998, pp. 64–65). Some of the indicators grouped in the housing, urban design and transport sectors could form useful physical sustainability indicators. For example, in relation to housing, the floor area per person, range of lot sizes, new dwellings completed on new sites (as opposed to infill or redevelopment), dwellings constructed on greenfield sites, building materials used in housing/embodied energy, operating energy efficiency, proportion of medium- and high-density dwellings, etc. can all be useful in assessing how resources are being used. In urban design, land-use indicators such as public green space per capita, residential density and mixed land-use ratio can be valuable. In transport and accessibility, mode choices by trip purposes by area, perceived daytime density, access to public transport stops and total time and distance travelled, etc. can help to develop a picture of the impact of human urban activity on the environment.

Most of the indicator collection categories mentioned above can be easily understood by the public, and hence can be used as ‘general’ indicators. The extensive set of indicators can act as ‘core’ indicators for human settlement. The important point to note here is that these indicators are still not prescriptive enough at a local level to enable individuals to understand their local sustainability. They are complex and descriptive on a much larger scale, but it is still possible to derive ‘general’ indicators from this list, to help involve the general public in the move towards sustainable development.
The Ministry for Planning, Perth, Western Australia formulated a set of measurable criteria in order to measure and compare how the sustainability of the built environment varies between traditionally planned suburbs and conventional suburban development. The attributes are identified as connectivity, permeability, accessibility, street safety, efficiency of land use, diversity of land use, provision of parkland, access to parkland, number of residents, residential density, number of workers, employment self-sufficiency, diversity of lot size, built-form robustness, solar orientation and energy use and emissions. The top-down approach exploring all the facets of sustainability simplistically indicates that the attributes could be converted into both core and general indicators for assessing different residential patterns (MacKay, Ministry of Planning, 2001).

The interaction between people and nature is complex, and measuring all human activity and impact may be very difficult. Nevertheless, the National Round Table on the Environment and Economy (NRTEE) in Canada defined a new approach that linked the ecosystem and the well being of the people within that ecosystem. The model used for this approach is known as the ‘Barometer of Sustainability’ (Prescott-Allen, 1995). It is an experimental sustainable development measurement tool which considers firstly the index of ecosystem well being (IEW) and secondly the index of human well being (IHW). The IEW is basically a function of land, water, air, biodiversity and resource use indicators, followed by a set of sub-indices. For example, a sub-index of land is land naturalness, which is a function of natural, modified, cultivated and built-up land, and the categories are ranked on the basis of their modification from original natural land to built-up land, all represented by a formula. The IHW is a function of health, education, unemployment, poverty, earnings, crime, business and human action. The approach has been tested in a report on British Columbia’s progress towards sustainability (Hardi et al., 1997, p. 25).

The Barometer of Sustainability is a whole-system approach and a pioneering step to integration, but it lacks the ability to inform people at a general level in simple terms. Unless the developed indicators are simple it is almost impossible for people to know how to behave more sustainably. It also involves too many aspects and the feasibility of the model depends on an appropriate ranking system, so that each issue needs to be carefully detailed before assigning a rank value to it.

The Ecological Footprint model developed by Wackernagel & Rees (1996) starts with the assumption that a finite productive land area or water area is needed to sustain the energy use, material consumption and waste discharge of a human population or economy. The ecological footprint of the study population is measured by multiplying the study population by the average per-capita footprint, which is the sum of the land areas needed to support the particular consumption behaviour of the population (Wackernagel & Rees, 1996). This concentrates on measuring required land area per person instead of population per unit area, which opens up the comparative issues of social equity (also an important issue in Agenda 21) between developed and developing countries based on basic consumption patterns. For example, the ecological footprint of the USA is 5 hectares per person, compared to 0.5 hectares per person in India. The possibility of conversion of all the factors into a single land-area unit allows vivid comparisons. The calculation of ‘Fair Earth Share’, the amount of ecologically productive land available on earth per person (only 1.5 hectares today, out of which only 0.62 acres are arable), is an attempt to formulate a key global indicator.
The most convincing advantage of this footprint model is that the final result is simple and easily understood by the general public. The strength of its representation initiates logical reasoning in the mind of the public to generate individual and community awareness about their unsustainable consumption patterns, and can be utilized for the encouragement of sustainable development. The model is applicable not only at global and national scales, but also at a local and micro level for estimating the carrying capacity of a particular urban or rural area, thus acknowledging the complex human–nature interface.

Land productivity is an excellent indicator of the locally, regionally or globally available natural ‘interest’. (Simmons & Chambers, 1998, p. 355)

It is an integrated approach combining economic, social and environmental fields. It can be classified as a general-level indicator in relation to its final result expressed in land-area units, as well as an indicator of process as the behaviour leading to resource consumption can be translated into energy-use terms. The problem with the approach is incorporating land uses that are not related to human activity. How much land should be set aside for tigers, or for habitat to support a certain butterfly population? The impact of human activity on the sea also needs to be considered as part of the total footprint. However, because many of these issues are remote from human activity in urban areas, a type of footprint analysis could be used to define the land area required for different styles of human urban living. This is the approach taken in the method described in the remainder of this paper.

A New Approach to Local-level Urban Sustainability Indicators

The new approach attempts to develop a methodology for quantifying certain key and relevant residential sustainability indicators from aerial photographs. The key indicators chosen are: domestic energy use; household transport energy use for travel to work; on-site food production; carbon sequestration; and waste production. All these are related to lifestyle and have an impact on the environment at a local level. At the same time, all can be measured nationally. All are also related to patterns of residential development, so it will be possible to compare different residential patterns to see if they have different potentials to be sustainable in terms of these key indicators. The study was based on different residential zoning patterns in Auckland, New Zealand. Five residential blocks with different urban forms were selected.

A residential block may be defined as an intermediate planning module, placed just after a neighbourhood level in hierarchy in a descending order. It may consist of a mesh block (the basic physical planning unit in New Zealand) or more than one mesh block, is mainly determined by the numbers of households contained and the prescribed range is in between 50 to 200 households per residential block. (Ghosh, 2004, p. 226)

The method makes use of land-use patterns classified from maps, mainly in two categories: non-productive land uses (such as roof areas of buildings, tree and shrub canopy cover, paved/non-paved pathways and road areas, including half site perimeter road widths); and productive land uses, including remaining open spaces available for growing additional biomass. In addition to this, available solar-efficient roof area oriented 45° on either side of north (Breuer, 1994) and total
site area were calculated. The method uses the GIS-based software ‘CITYgreen’ developed by American Forests. The land-use patterns for one of the blocks studied are presented in Figure 1.

Measurements are quantified as percentages of total site area as well as in square metres per household in the same category. As an example, the orientation of the roofs shows the potential for generating electricity from photovoltaic arrays and for using solar water heaters. The method uses this area to see how the residential pattern can contribute to sustainable domestic energy use on site.

To see how the method can be used, the potential for domestic renewable energy production is considered further. The domestic energy use and potential generation of energy are measured by two methods:

(a) the Deficit Energy Method measures the energy deficit of the residential blocks between consumption and potential on-site generation. The lower the energy deficit, the higher the energy self-sufficiency of the residential area becomes.
(b) the Land Area Method (based on ecological footprint techniques) converts energy consumption into land areas to calculate the maximum off-site land area needed by the different residential block patterns. The lower the off-site land area required, the higher the potential for energy self-sufficiency of the residential area.

Energy demands and potential on-site supply are calculated and converted into corresponding deficit land-area equivalents per household per annum in hectares,
a single unit which offers an easy comparison. Deficit land-area equivalent may be defined as the household share of off-site land area required to supply the deficit energy demand per household per annum for a residential block in a particular year. Generally the land-to-energy ratio for New Zealand is assumed to be 120–150 GJ per hectare per annum (Wackernagel & Rees, 1996, p. 72). Assuming an average value of 135 GJ per hectare per year, the total amounts of available productive land on site and off site for each residential block as well as per household could be calculated.

The deficit land-area equivalents per household per annum in hectares for a range of factors can be added to determine the most sustainable residential block.

This method initially formulated a set of five land-area-based local indicators of sustainability:

(a) domestic energy use indicator;
(b) transportation energy use for travel to work indicator;
(c) carbon sequestration indicator;
(d) food energy (for vegetable production only) indicator; and
(e) waste indicator.

The indicators allow the comparison of the degree of sustainability of existing residential blocks, and also permit studies to be made of the effect of changing residents’ behaviour in terms of energy consumption or travel patterns.

The factors that will influence the physical aspects of residential layout patterns are: configuration of the site; ratio of lot depth to site depth; numbers of minimum and maximum lots between adjacent roads; perimeter of the site; orientation of the roofs; types of roads and residential building density per hectare in a particular year; and floor-area-based household density per hectare in a particular year. If factors like these, that reflect the physical differences in different residential development patterns, can be assessed in terms of their potential to contribute towards the sustainability of the residential sector, the use of indicators such as those outlined above may help developers to plan sub-divisions to allow for the maximum potential sustainability in the future. The aggregation of various factors in terms of the land needed off site to make up the deficit where there is insufficient land on site for things such as food growing or energy generation may become an important measure of sustainability. The indicators may help planners in pinpointing optimum densities for maximum urban sustainability. At a later stage, GIS analysis could be used to speed up the measurement process.

This methodology is still in the process of further development. The physical sustainability indicators that it produces may prove to be very effective in formulating general sustainability indicators not only for existing settlements but also for proposed developments (Ghosh et al., 2002). The conversion of different measurements into a single aggregate index of either energy units or land-area units allows clear comparison and uncomplicated handling. Like the ecological footprint approach, it also produces an indicator that is easily understood by the general public and that can be used to see progress to becoming more sustainable.

Relevance of the New Approach to the Objectives of Agenda 21

The objective of promoting Sustainable Human Settlement Development is to initiate sustainable land-use planning and management (United Nations, 1992,
The land requirements for human settlement development should have a strong foundation of environmentally sound physical planning. The indicators developed with the new methodology will comply with these physical planning aspects. Progress towards sustainability can be measured by comparing data from past and present aerial maps.

The methodology for the process of generating the indicators will also store land information and land resource use in terms of building and paved areas (as urban ‘hardening’), productive areas, trees for carbon sequestration, biomass as an alternative fuel, sub-division patterns, and so on. This is in accordance with Agenda 21, which said that all countries should consider a comprehensive national inventory of their land resources in order to establish a land information system in which land resources are classified. (United Nations, 1992, Chapter 7, Sec. C, 7.29)

The new approach will be able to accelerate the activities listed in ‘community-based land resource protection practices’ (United Nations, 1992, Chapter 7, Sec. C, 7.30 (e) and (h)) and can support and deal comprehensively with improved land management as the approach measures the land-use pattern for activities like transport and agriculture in square metres per household.

At a core level, the indicators will serve as an experiential, quantitative base for assessment and estimation of performance of policies for sustainability already implemented. At a local land-use level, it will open up the opportunities of finding new connections between activities.

In promoting sustainable energy systems in human settlements (United Nations, 1992, Chapter 7, Sec. E (7.49)), the objective of these indicators will be to derive energy-efficient settlement patterns using alternative or renewable energy and sustainable sub-division layout practices, encouraging low-energy-impact lifestyles and eliminating adverse impacts on built-environment–ecosystem relationships.

This methodology of indicator development is in conformity with the objectives of Agenda 21 and can be implemented by local authorities as a micro-level sustainability agenda for planning. These local indicators also reflect local practices.

... the methodology of measuring ‘sustainability’ or ‘sustainable development performance’ is not standardized. There is no textbook, which gives a methodology that is generally accepted and applicable across regions and sectors. (Hardi et al., 1997 p. 13)

There needs to be incessant research to understand the basic concepts underlying sustainability and it is suggested that the development of quantitative indicators as described above, although local, will contribute to promotion of sustainability at a global level, thus reducing global pressures on resource consumption.

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