Fondazione Eni Enrico Mattei

Measuring Progress Towards Sustainable Development in Venice: A Comparative Assessment of Methods and Approaches

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I INTRODUCTION

1. Sustainable development and Local Agenda 21

There is no single agreed upon definition of sustainable development, although the most commonly accepted is the Brundtland definition:

"to provide for the needs of the present generation without compromising the abilities of future generations to meet their needs"

The underlying idea is that there is a need to balance social, economic and environmental development (Fig. 1), and that this should be a major goal of society to be achieved at various levels (e.g. local, regional, national, international). Placing exclusive importance on any one of these components will often be at the expense of another.

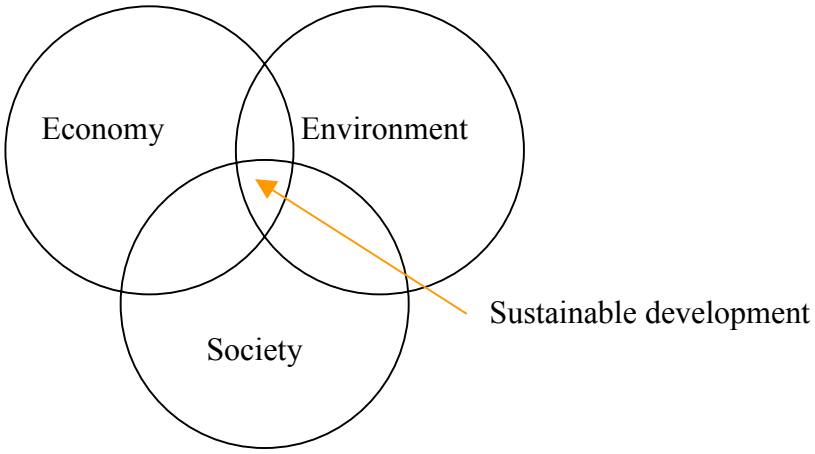

Fig. 1: Sustainable development: Interaction between society, economy and environment

The term 'sustainable development' was coined in 1987 by the Brundtland commission on "Our Common Future", and a major agenda for sustainable development at all levels was produced in 1992 during the world summit in Rio de Janeiro. An important outcome of the summit was a proposal for an action plan for sustainable development, in the form of a 300 page document entitled *"Agenda 21: Blueprint for Sustainable Development"*.

The document places particular importance on action at the local level, and strongly encourages communities to adopt a 'Local Agenda 21', which is an action plan to achieve

sustainability at the local level. This involves collaboration and co-operation between all stakeholders and levels of government such that a consensus-based community vision may be created, and the most efficient ways of realising the goals described in the vision decided upon.

2. The importance of Measuring Progress

It is important to measure progress towards sustainable development for a number of reasons, in particular:

1. In terms of *decision-making,* such that the efficiency, effectiveness and impact of existing policies may be understood and new policies directed towards sustainable development.

2. Measuring progress is important in terms of c*ommunication* and *participation*. The methods described below are a useful way of simplifying complex information such that it can be communicated to non-experts in a simple manner. This is likely to increase public awareness on sustainability issues and initiate public input and creativity, which is important because to initiate a participatory processes at the local level, a basis for discussion amongst stakeholders is useful.

3. Objectives and Structure of Paper

The aim of this paper is to provide an overview and comparative assessment of some of the main approaches to measuring progress towards sustainable development in order to develop a proposal for an appropriate methodology for Venice.

Venice is presented with unique environmental, economic and social circumstances, which will be discussed in more detail in section IV. These make the definition of sustainability particularly difficult, and choosing and adopting a specific method for measuring progress towards sustainable development is therefore especially challenging.

Work on sustainability indicators for Venice has previously been carried out as part of the *Progetto Venezia 21*. This paper attempts to build on this by providing a general assessment

of the strengths and weaknesses of indicators, and comparing these with other methods of encouraging public participation and measuring progress towards sustainable development.

The five approaches for assessing progress towards sustainability presented and discussed in this paper are:

(1) Sustainability indicators, currently the most commonly used methodology.
(2) The Index of Sustainable Economic Welfare/ Genuine Progress Indicator,
(3) The European Environmental Pressure Indices Project and
(4) The Barometer of Sustainability: 3, 4 and 5 are indicators which have been aggregated to produce one or more indices.
(5) The Ecological Footprint. This is a rather different approach: although it is not strictly speaking a measure of progress towards sustainability, it is included in this paper as it is a popular method used to encourage public interest in sustainability.

Whilst a number of other approaches do exist, the five selected are considered to provide an overview of the diversity of approaches which have been developed to date.

Each of the approaches is faced with the common difficulty of finding a balance between complexity and simplicity; information which is by its very nature complex must be communicated to the non-expert in a simplified manner. However experts may then criticise the contents for over-simplifying the complex world. The other challenge of developing good measures of progress is the integration of public opinion, since some aspects of sustainable development are subjective. For example, deciding on 'targets' for indicators usually requires an understanding of the priorities of the local community.

The paper is structured as follows: each approach to measuring progress is discussed in turn, along with a review of its relative strengths and weaknesses. The order of the approaches represents a progression from methods highlighting sustainability to methods with a stronger focus on the environment. A discussion of the approaches is then presented and some general conclusions are drawn. Finally, an assessment of the applicability of each of these to Venice

is given in light of the characteristics of the city and its people, and a specific methodology is proposed.

II APPROACHES TO MEASURING PROGRESS

1. Sustainability Indicators Sets

i. What is an indicator?

An indicator is something which *"translates data and statistics into succinct information that can be readily understood and used by several groups of people including scientists, administrators, politicians and citizens with a wide range of interests"* (OECD, 1997). They allow the current situation to be represented, as well as the direction of change and distance from the goal.

Indicators are not a new concept, although the emergence of sustainability indicators is relatively recent. In the short time since the latter have emerged they have progressed, and are progressing, rapidly both in terms of their development and use.

The basic principles underlying sustainability indicators are outlined in this section. A detailed discussion is not provided as this would constitute an entire paper in its own right. Rather the purpose here is to provide the reader with a general overview such that he/ she may assess the use of indicators in relation to the other models described in this paper. The principles outlined here are applicable to the following three sections on aggregate indicators. As a result, this section is relatively long.

ii. The importance of sustainability indicators

Economic, social and environmental progress have traditionally been treated as separate issues, and this is reflected in the indicators commonly used to assess these. Traditional indicators include atmospheric concentrations of certain gases for the environment, employment rates for society and Gross Domestic Product (GDP) for the economy. The main problem with these types of indicators is that they measure each aspect as if it were independent from the other two. In reality the economy, society and environment are linked in many ways, and sustainability indicators allow this to be represented.

Sustainability indicators have therefore been developed in order to reflect the inter-relatedness of these aspects. The function of sustainability indicators can be summarised as follows:

- To **measure progress towards sustainable development**, and highlight problem areas within a community, thereby acting as a warning system for future conflicts
- To allow decision-makers to **direct and monitor policies** towards sustainable development
- As a **communication tool** to simplify complex information and convey goals and progress to the public
- As a **public participation exercise:** collaboration and consensus between stakeholders are important components in the selection of indicators.

iii. Characteristics of a good sustainability indicator

A sustainability indicator should highlight the links between the economy, society and environment. In order for it to be effective, it must have a number of characteristics, including (Musu, Ramieri and Cogo, 1998):

1. **Significant** in terms of evaluating sustainability, both in the long and short term
2. **Relevant** to local conditions, highlighting aspects and problems in relation to local sustainability
3. Easily **measurable**; it should be based on information which is easily available and on measurements which will be comparable and consistent over time
4. **Understandable**; it should be simple, clear, unambiguous, and understandable also to those without specific knowledge
5. **Sensitive;** it should change following changes in social, economic and environmental conditions
6. **Coherent** with other indicators in the set, such that they are significant both on their own and as part of a set
7. **Synthetic;** it should be capable of synthesising a large quantity of information in a single numeric value
8. **Scientifically valid**

9. **Reproducible;** the way of calculating or measuring the indicators should be easily reproducible
10. **Disaggregrateable** for smaller territories, for social groups, etc
11. **Convenient** and economical in terms of measurability such that measurements may be carried out frequently

Although it may be difficult for every indicator to conform with all of these requirements, it is important that they are adhered to as far as possible.

The number of indicators within a set is highly variable, and can range from a single indicator to a few hundred. There is no 'correct' number for a given community, although it is often suggested that around twenty to fifty is a useful number, depending on the intended use of the indicators: if the indicators are intended to be used primarily for communication purposes, a smaller set is more appropriate. If, on the other hand, the set if to be used mainly for policy directing and monitoring, a larger set may be necessary. In both cases the set should be large enough such that the most important issues are covered, yet small enough that the set is manageable.

iv. How are indicators collected and compared?

There a number of methods which may be used to select a set of indicators. These fall broadly into two categories: those selected from a pre-defined list, and those 'tailor-made' for and by a community.

The Bellagio principles (Box 1) provide useful guidance "*for the whole of the assessment process including the choice and design of indicators, their interpretation and communication of the result"*. (IISD, 2000). These were developed during the international Bellagio Conference in Italy, 1996.

Bellagio Principles- Guidelines for Practical Assessment of Progress Toward Sustainable Development

1. GUIDING VISION AND GOALS

Assessment of progress toward sustainable development should:

- be guided by a clear vision of sustainable development and goals that define that vision

2. HOLISITC PERSPECTIVE

Assessment of progress toward sustainable development should:

- include review of the whole system as well as its parts;
- consider the well-being of social, ecological and economic subsystems, their state as well as the direction and rate of change of the state, of their component parts, and the interaction between parts;
- consider both positive and negative consequences of human activity in a way that reflects the costs and benefits for human and ecological systems, both in monetary and non-monetary terms.

3. ESSENTIAL ELEMENTS

Assessment of progress towards sustainable development should:

- consider equity and disparity within the current population and between present and future generations, dealing with such concerns as resource use, overconsumption and poverty, human rights, and access to services, as appropriate;
- consider the ecological conditions on which life depends;
- consider economic development and other non-market activities that contribute to human and social well-being.

4. ADEQUATE SCOPE

Assessment of progress toward sustainable development should:

- adopt a time horizon long enough to capture both human and ecosystem scales, this responding to current short-term decision-making needs as well as those of future generations;
- define the space of study large enough to include not only local but also long distance impacts on people and ecosystems;
- build on historic and current conditions to anticipate future conditions: where we want to go, where we could go.

5. PRACTICAL FOCUS

Assessment of progress toward sustainable development should be based on:

- an explicit set of categories or an organising framework that links vision and goals to indicators and assessment criteria;
- a limited number of key issues for analysis;
- a limited number of indicators or indicator combinations to provide a clearer signal of progress;
- standardising measurement wherever possible to permit comparison;
- comparing indicator values to targets, reference values, ranges, thresholds or direction of trends, as appropriate.

6. OPENESS

Assessment of progress toward sustainable development should:

- make the methods and data that are used accessible to all;

make explicit all judgements, assumptions and uncertainties in data and interpretations.

7. EFFECTIVE COMMUNICATION

Assessment of progress toward sustainable development should:

- be designed to address the needs of the audience and set of users;
- draw from indicators and other tools that are stimulating and serve to engage decision-makers; aim, from the outset, for simplicity in structure and use of clear and plain language.

8. BROAD PARTICIPATION

Assessment of progress toward sustainable development should:

- obtain broad representation of key grassroots, professional, technical and social groups, including youth, women and indigenous people to ensure recognition of diverse and changing values;

- ensure the participation of decision-makers to secure a firm link to adopted policies and resulting action.

9. ONGOING ASSESSMENT

Assessment of progress toward sustainable development should:

- develop a capacity for repeated measurement to determine trends;
- be iterative, adaptive and responsive to change and uncertainty because systems are complex and change frequently;
- adjust goals, frameworks and indicators as new insights are gained;
- promote development of collective learning and feedback to decision-making.

10. INSTITUTIONAL CAPACITY

- continuity of assigning responsibility and providing ongoing support in the decision-making process;
- providing institutional capacity for data collection, maintenance and documentation;
- supporting development of local assessment capacity.

Box 1: The Bellagio Principles (Bossel, 1999)

An example of a pre-defined list is the Global Urban Indicators Database developed by the UN Centre for Human Settlements (UNCHS, 2000). Such a list is useful as it allows cities and countries using these indicators to compare progress and learn from each other. The database consists of around 40 core indicators which are measured by all participating cities and countries (currently around 110 countries and 237 cities), as well as a list of supplementary indicators from which participants may choose those which are particularly relevant to their local situation.

There are many ways in which a set of community 'tailored' indicators may be defined. For example, the indicators may be selected by brain-storming and discussion sessions. The danger with this method is that it frequently reflects the composition of the group rather than the issues considered to be a priority for the citizens, thereby resulting in over-representation of some aspects and gaps in others. As a result systematic selection methods are often believed to lead to a more complete set of indicators.

A number of frameworks exist for this purpose, the most common being the Pressure-State-Response (PSR) framework developed by the OECD (OECD, 1997). Using this system, indicators are systematically selected according to the various pressures considered important in a given community, the changes in the state of the environment that this creates and the policy or other types of response adopted. The European Environment Agency has carried out work based on this and expanded the PSR to the DPSIR (Driving force-Pressure-State-Impact-Response) framework (Lourens, van Zwol and Kuperus, 1997). This is illustrated in

Figure 2. Although both the PSR and DPSIR are widely used, they have been criticised for representing the world in an overly simplified manner, thereby ignoring the links and feed-backs between systems. Furthermore whilst changes in the economy and society are represented, the focus is largely on environmental issues.

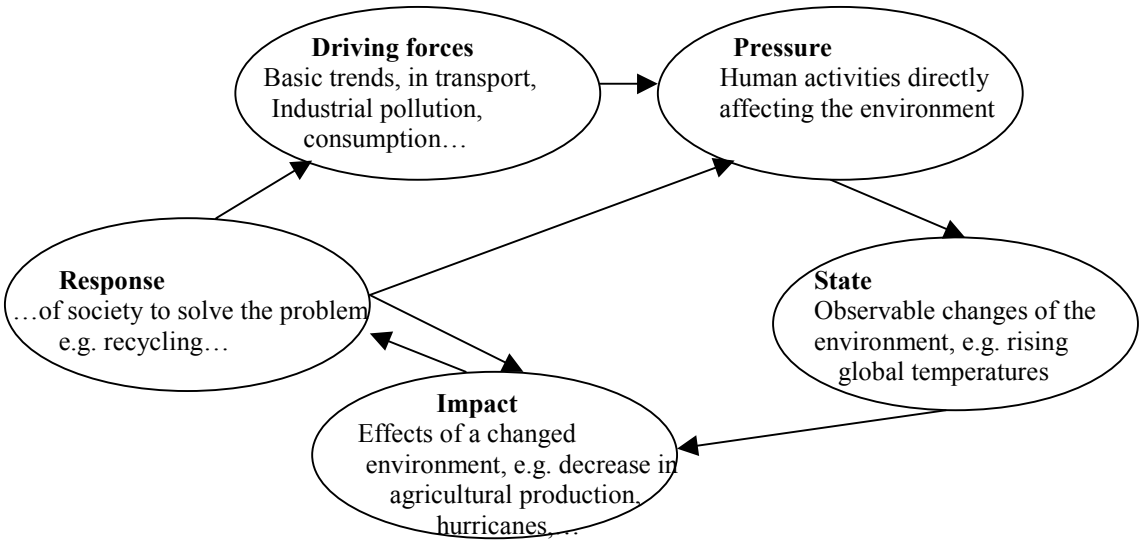

Fig. 2: The DPSIR framework (EEA, 1999)

There are hundreds of examples of communities all over the world that have selected a set of local sustainability indicators, either by using a pre-defined list or creating a 'tailor-made' set, or even by using a combination of the two techniques.

One of the earliest and possibly best known case studies is the Sustainable Seattle project. This was initiated in 1990, and the process of selecting indicators took five years (Sustainable Seattle, 2000). Hundreds of people were involved in the process, and a volunteer network and civic forum were set up. A final set of 40 indicators was selected. Not only was the outcome important for the City, but the actual process itself was beneficial in terms of creating enthusiasm and building up partnerships within the community.

v. Strengths and weaknesses of indicator sets

The process of selecting indicators in itself is a useful public participation exercise. However, selecting 'good' indicators relevant to the particular location and the priorities of the local population is a difficult task, both in terms of ensuring the number is manageable and that

each indicator within the set conforms with as many of the characteristics described above as possible.

Sets of indicators have been criticised for sending conflicting messages: within a single set indicators may point in all directions (i.e. towards/ away from sustainability, fast/ slow changes), making it difficult to understand overall progress. In order to overcome this problem a number of aggregate indicators have been developed to provide a more general picture, including the Index of Sustainable Economic Welfare/ Genuine Progress Indicator, the European Environmental Pressure Indices Project and the Barometer of Sustainability. These are described in the following sections.

2. Index of Sustainable Economic Welfare/ Genuine Progress Indicator

i. What is the Index of Sustainable Economic Welfare (ISEW)/ Genuine Progress Indicator (GPI)?

Gross Domestic Produce (GDP) is frequently used as an indicator of a country's progress. GDP is a purely economic indicator, and it includes expenditure on problems which have a negative impact on human and social welfare (such as crime, cleaning up pollution) and does not take into account non-monetary benefits (such as unpaid household labour) and externalised environmental issues (such as climate change). As a result GDP has come under much criticism as the sole measure of wealth.

To the best of my knowledge, the only monetary indexes developed to date as an alternative to GDP are the ISEW and GPI. These build on GDP by internalising environmental and social costs, and subtracting expenditure which has a negative impact.

The ISEW has been developed by Friends of the Earth, the Centre for Environmental Strategy and the New Economics Foundation (in collaboration with others) (FoE, 2000). It is "*an attempt to measure the portion of economic activity which delivers genuine increases in our quality of life – in one sense 'quality' economic activity.*"

The GPI, developed by Redefining Progress, is based on similar principles. The main components of the GPI are (Redefining Progress, 2000):

1. **Crime and family breakdown**; treated as additional costs in GDP, these are subtracted from the GPI
2. **Household and volunteer work;** not included in GDP, these are included as benefits in the GPI
3. **Income distribution;** since the poor benefit more from a small increase in income, the GPI rises as the poor receive a larger percentage of national income
4. **Resource depletion** is included in the GPI as a current cost, in contrast to GDP where it is counted as current income
5. **Pollution;** (in terms of damage to human health and the environment) is subtracted from the GPI, whereas it is counted twice as a benefit in GDP (both when it is created and cleaned up)
6. **Long-term environmental damage** by the consumption of certain forms of energy (emitting greenhouse gases and nuclear waste) and the release of ozone-depleting chemicals is subtracted from the GPI, but not included in GDP
7. **Changes in leisure time;** not included in GDP; the GPI increases with increasing leisure time, and vice versa
8. **Defensive expenditures;** (e.g. medical bills, repairs from car accidents) counted positively in GDP, but subtracted from the GPI
9. **Lifespan of consumer durables and public infrastructure;** to account for products that are made to wear out quickly, the GPI subtracts money spent on these items, but includes the value of the service they provide after a year
10. **Dependence on foreign assets;** money used to finance consumption is subtracted from the GPI

ii. Strengths and weaknesses of the ISEW/ GPI

The ISEW and GPI build upon GDP in order to include environmental and social issues, thereby 'correcting' GDP to better represent quality of life and the environment rather than simply expenditure. Similar to GDP, they are economic indices, therefore everything must be expressed in monetary terms. This has both positive and negative implications: placing a financial value on non-monetary aspects (e.g. global warming, household labour, health and well-being) is a highly subjective task. On the other hand, the fact that these indices are expressed in monetary terms allows them to be compared with GDP using the same scale.

In more general terms, aggregate indices of welfare are useful for communicating complex information to non-experts in a simple manner and presenting an overall picture of progress towards sustainability. However, the picture they provide may be misleading, for example an extreme value pointing in one direction may mask several less extreme values pointing in the other, thus giving an overall impression of sustainability where this is not the case or *vice versa*.

3. The Barometer of Sustainability

i What is it the Barometer of Sustainability?

The Barometer of Sustainability, created by the World Conservation Union (WCU, 2000), is *"a tool for measuring and communicating a society's well-being and progress toward sustainability. It provides a systematic way of organizing and combining indicators so that users can draw conclusions about the conditions of people and the ecosystem and the effects of people-ecosystem interactions"*.

The underlying concept is that the world is viewed as an 'egg of wellbeing', in which the 'human ecosphere' (yolk) lies within the 'ecosphere' (white).

The Barometer of Sustainability is composed of two axes: a human wellbeing and an ecosystem wellbeing axis (Figure 3), which are considered to be of equal importance. A lower score on one axis overrides a higher score on the other, and the intersection of the two points provides an overall indication of progress towards sustainability. The indicators used are 'progress indicators', meaning that they measure progress towards a specific goal, for which quantitative targets are necessary. Progress is then represented as bad, poor, medium, ok or good such that the indicators may be aggregated (aggregation would not be possible if different indicators were measured on different scales).

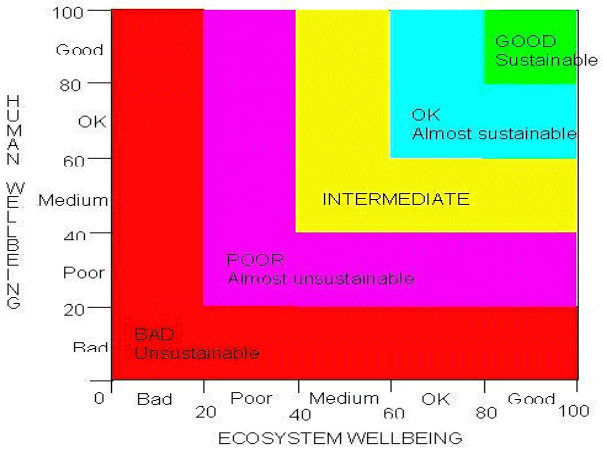

Fig. 3: The Barometer of Sustainability (http://www.iucn.org/themes/eval/english/barom.htm)

ii. Strengths and weaknesses of the Barometer of Sustainability

The barometer of sustainability is particularly useful as a communication tool due to its simplicity. Furthermore it can be used to compare countries (the wellbeing of 180 countries has already been determined), and to compare where people consider themselves to be on the scale compared to where conventional data would place them. This can provide a useful basis for discussion.

A weakness of the barometer is that assuming that ecosystem and human wellbeing are of equal importance is a value judgement which may not hold true for all communities. This could be corrected for if the relative importance of these according to the priorities of stakeholders is assessed, and the relative size of the 'sustainability' categories illustrated in Fig. 2 altered correspondingly.

3. The European Environmental Pressure Indices Project

i. What is the Environmental Pressure Index?

Currently in its third year, the TEPI (Towards Environmental Pressure Indicators for the EU) project (TEPI, 2000) was undertaken to develop a set of aggregate indices for measuring progress towards sustainable development (Jesinghaus, 1999) . Lead by Eurostat, this was designed *"to provide the European Union with a tool that supports environmental policy by giving a comprehensive and systematic description of human activities affecting the environment"*. The aim of the project was to produce a set of ten environmental pressure indices showing trends for ten policy fields (air pollution, climate change, loss of biodiversity,

marine environment and coastal zones, ozone layer depletion, resource depletion, dispersion of toxic substances, urban environmental problems, waste, water pollution and water resources), each of which is based on 6 physical pressure indicators, following the Driving force-Pressure-State-Impact-Response framework (Section II/1.iv). The indicators were selected on the basis of propositions from a panel of 2300 environmental experts. Following the selection, each indicator was assessed according to four criteria: relevancy, overall accuracy, comparability over time and comparability over space

ii. Strengths and weaknesses of the Environmental Pressure Index

The primary goal of this project is to communicate complex issues to the non-expert. It is an attempt to find a common position between the worlds of scientists, statisticians and politicians. In the future, it is envisaged that a 'European Sustainability Index' will be created as part of this project.

The general strengths and weaknesses of aggregate indicators (described in Section II/2.ii) are applicable to the Environmental Pressure Index.

In addition, the fact that the index is being produced at the European level has clear advantages in terms of comparison, however this does also present problems. Possibly the greatest barrier facing this project are the different and unharmonised methods of data collection between EU countries, resulting in significant gaps and inconsistencies in available data.

Finally, the choice of indicators is based on the DPSIR framework, allowing a systematic selection process. As a result, although some economic and social aspects will be considered, environmental issues will be predominant.

5. The Ecological Footprint

i. What is the Ecological Footprint?

"The Ecological Footprint measures what we consume of nature. It shows how much productive land and water we occupy to produce all the resources we consume and to take in all the waste we make" (Redefining Progress, 2000).

In other words, an ecological footprint represents the average amount of bioproductive land and ocean required to sustain an individual or a community. It has been calculated that *"nature provides an average of 5.5 acres of bioproductive space for every person in the world. With a global population of 10 billion for the year 2050, the available space will be reduced to 3 acres. This should also give room for the 25 million other species. Already, humanity's footprint may be over 30 percent larger than what the world has to offer as it consumes more than what nature can provide."*

It is also useful to compare the average space used per capita within a country (i.e. the footprint) to the space available per capita. The difference between these is known as the 'deficit'. A negative deficit signifies that the space available within a country is not sufficient to support its population, and the situation is therefore not sustainable as the population must rely on external resources. Table 1 shows some values of space used per capita (i.e. footprint) and the relative deficit. This illustrates that even for countries with similar footprints (e.g. America and Australia), the deficit may be very different (-10 and +9 acres respectively). This is thus dependent on the population density of the country in question.

Country	Footprint	Deficit	Notes
World average	5 acres	-1 acre	
America	25 acres	-10 acres	World's highest footprint
Australia	23 acres	+9 acres	
Italy	10 acres	-7 acres	
Bangladesh	1 acre	1 acre	World's lowest footprint
Singapore	16 acres	16 acres	World's highest deficit

Table 1: Some examples of the Ecological Footprint (Redefining Progress, 2000)

The ecological footprint is a politically interesting approach as instead of measuring progress it is in fact a measure of equity because it is based on the assumption that everyone should be

entitled to an equal environmental space. In addition, it highlights the interactions between the local and global scales, and in doing so encourages users to think about the impact of their every day actions on a larger scale.

ii. Strengths and weaknesses of the Ecological Footprint

The ecological footprint is a simple and thought-provoking approach. It encourages individuals to make connections between what they do in their everyday lives and the impact of this on the environment. Footprints can be calculated for countries, cities or individuals, allowing comparisons at these levels.

The ecological footprint has been criticised for a lack of scientific rigour. However although the calculations of ecological space are approximations, this does not take away from its value as a thought-provoking tool that illustrates how an individual may reduce his/ her impact on the environment by making small changes to his/ her lifestyle.

The main weakness of this approach is that it measures only natural resource use and does not take into account social or economic aspects, the other two dimensions of sustainability. To overcome this problem, Redefining Progress use the ecological footprint in combination with the GPI (Section 2) and the Satisfaction Barometer ("*which monitors people's degree of contentment with their personal, social, and civic surround, measures the 'quality of life'"*).

III GENERAL DISCUSSION

There is a clear need for local communities to measure progress towards sustainable development. This provides a basis for monitoring and re-directing policies; furthermore it is necessary to provide a framework within which communication can take place. This is important in order to build up trust and collaboration between policy-makers and stakeholders: in a two-way communication process, the former can learn about the priorities of the local community, and can benefit from their creativity and local knowledge. In turn, citizens will be more ready to accept decisions if they feel they have been part of the decision-making process, and will be more ready to make necessary changes to their lifestyle.

In order to be able to assess progress towards sustainable development, communities must first develop a vision describing what this entails at the local level. A vision allows clear goals and objectives to be stated, and progress can then be measured by using methods such as those discussed in this paper. This is often carried out as part of a Local Agenda 21 process.

Sustainability indicators are the measures most frequently adopted by communities world-wide to measure progress towards sustainability. The selection of a set in itself is a useful public participation exercise, and the resulting set will reflect the priorities of the local community. Furthermore they provide a useful warning system for a community to foresee where problems may occur. Selecting a set of sustainability indicators is not an easy task as there is an almost infinite set of indicators from which to chose. Furthermore they should ideally reflect the priorities of stakeholders, and to assess this requires a public participation process. However, whether individual or aggregated, indicators highlight the linkages between the three components of sustainable development (economy, society and environment).

Aggregate indices have the advantage over individual indicators of sending a clearer message to the public in terms of progress towards sustainability: it may be difficult to grasp the general message of a set of indicators pointing in all directions in terms of whether overall progress is moving towards or away from sustainability and at what speed. However it must be remembered that the picture presented by an aggregate indicator may be misleading.

The *Barometer of Sustainability* is composed of indicators which reflect the concerns of the local community. Therefore each barometer is different, and comparison between countries/ cities is not entirely consistent. The fact that ecosystem and human wellbeing are considered to be of equal importance is a value judgement, and may need to be altered according to the community in question.

Using the *European Environmental Pressure Indices Project*, the overall sustainability indicator can be broken down into aggregate indices (such as climate change, waste, urban environmental problems), each of which is composed itself of a number of indicators. This therefore can present a more detailed picture of sustainability to stakeholders. However this project, and the European Sustainability Index, are based on the DPSIR framework. This represents mainly environmental issues, and therefore does not present a balanced picture of sustainability in terms of its three components.

The *Ecological Footprint* is useful as a communication tool and for encouraging individuals to change their lifestyles, however in terms of policy-making its use is limited. Although it can be combined with other approaches to measure progress in other areas, it is not effective in illustrating these links. However it is particularly useful in highlighting the links between the local and the global, and in this way is a thought-provoking tool. The underlying theories and implications of this tool are particularly interesting: the basic assumption is that each individual should be entitled to an equal environmental space. Furthermore, it has been suggested that ecological space could potentially be traded for money, such that countries with excess space could sell some to nations with a high deficit.

As has been seen, significant progress has been made in terms of the development of methodologies and approaches for assessing progress towards sustainable development at the local level. However it is important that this is accompanied by a change in attitude by policy-makers and stakeholders away from measuring progress based essentially on economic terms to a method which also captures social and environmental dimensions, as this is fundamental to sustainability.

With the exception of the ecological footprint and to some extent the European Environmental Pressure Indices Project, the approaches described in this paper do highlight these interactions; however all suffer from inherent weaknesses in terms of the difficulty of participative processes or a focus on environmental issues rather than social or economic. It is important that these weaknesses do not hinder progress: it is far better to have an imperfect system for measuring progress which reflects, at least to some degree, the three components of sustainability than to carry on using economic, social and environmental indicators alone. If the inter-relations between the components are not recognised, this will make it much harder to move towards sustainability as progress in one field will frequently result in a deterioration in another. Therefore approaches, or a combination of methods, must be developed which highlight the impact on all three of these dimensions.

Since there is still much progress to be made, it is important that communities and institutions work together such they can learn from each other's experiences through trial and error. This is the most effective way of developing, step by step, more advanced approaches for measuring progress which are effective as communication and monitoring tools, and highlight the underlying concepts of sustainability.

IV APPLICABILITY TO VENICE

As has been mentioned, Venice is presented with unique environmental, social and economic characteristics, in terms of its physical features, rich cultural and historic heritage and local traditions and people. It is important that these are taken into consideration in formulating a proposal for encouraging public participation and measuring progress towards sustainable development in the city:

There is a particularly high level of awareness of local issues amongst residents. However there is not a well-developed tradition of public participation in the city. A factor contributing to this is thought to be the fact that the specific circumstances and problems of the city have been discussed for many years, but little concrete action has been taken as yet. As a result many residents have become unwilling to participate in collaborative processes due to a belief that no action would be taken on the basis of their efforts. Furthermore, a Local Agenda 21 process was initiated in 1996, and although it was hoped that this would build credibility and

trust in the local government and participatory processes, most people were unaware even of the existence of this project. The project took place in two phases, both of which came to a premature ending due to local political changes. As a result, those who were aware of the project have generally become disillusioned about the effectiveness of public participation in Venice. Encouraging public participation in Venice is therefore not an easy task, and any methods adopted must take this into consideration.

Other relevant characteristics are the extremely high costs and benefits associated with certain issues. For example tourism is associated with great economic benefits, but also potentially high environmental costs. Therefore an appropriate method would need to be able to deal with this in such a way that changes in less extreme issues are also made apparent.

The selection of a set of local sustainability indicators for Venice is a particularly difficult task because of the atypical conditions of the city, making the definition of sustainability exceptionally challenging. For example in the case of mobility, the usual indicators related to air pollution and congestion are not applicable, instead indicators must measure issues such as the intensity of wake motion. However this is considered to be a worthwhile task given the benefits associated with the use of indicators.

In fact a set of sustainability indicators has been selected for Venice as part of *Progetto Venezia 21* (Musu, Ramieri and Cogo, 1998). This is a comprehensive list of all issues related to the Venetian society, economy and environment. However it consists of 166 indicators (which is relatively long) and has not been subject to a participatory process. In addition, it has not been put to practical use. It is therefore believed that testing and building upon this existing list would contribute to the objectives of sustainable development for the city.

The ISEW and GPI are potentially useful, in particular for the ease of comparison with GDP and between cities/ countries. However it is believed that they are not entirely appropriate in terms of meeting the specific objectives for Venice: firstly, it is a challenging task to develop a monetary index which is able to clearly convey the interactions between the economy, environment and society to the public. Secondly, attaching a monetary value to the Venetian

economy, society and environment is a particularly difficult task due to its extremely precious cultural heritage. Furthermore it is believed that this would not provide a particularly sensitive indicator because of the huge costs related to a limited number of issues (for example tourism), which would mask smaller, more sensitive changes.

The Barometer of Sustainability is a simple way of communicating progress to the public, and similar to other aggregate indices, can then be disaggregated to provide a more detailed picture for those interested. The indicators within the ecological and human wellbeing categories should ideally be selected on the basis of the priorities of the local community. This requires a public participation process which, as has been discussed, is unlikely to be possible in Venice in the near future. As a result it is felt that the Barometer of Sustainability is not currently the most appropriate approach for Venice.

The European Environmental Pressure Indices Project, in particular the European Sustainability Index, is a potentially useful model in terms of its applicability to Venice. The individual indicators from which the index is composed provide an in-depth and useful picture for policy-makers, whilst the aggregate indices and index allow for this to be communicated to the public in a simple manner. Furthermore, since the project is being developed at the European level, comparisons could be made between cities and/ or countries such that progress can be compared and lessons drawn from the experience of others. In addition, it is likely to be more sensitive to changes than the ISEW/ GPI, for example. Unfortunately, this project has been hindered by a lack of data and is not yet at a stage where it can be used and adapted to individual communities.

As has been mentioned, the Ecological Footprint, used on its own, only assesses one component of sustainability. However it is particularly useful in terms of encouraging interest in sustainable development by helping people understand the impacts of their lifestyle on the environment, and showing them how small changes in their lifestyle can make a difference. In doing so this thought-provoking tool increases interest in sustainable development by indicating to people that each and every input is important. For these reasons, adapting the Ecological Footprint to Venice such that it can be calculated for the city as a whole, and such that each individual could calculate their own footprint would be highly beneficial.

V PROPOSAL OF METHODOLOGY FOR MEASURING SUSTAINABLE DEVELOPMENT IN VENICE

At this point in time, given the current situation and characteristics of Venice, it is felt that the most appropriate approach to monitoring and directing policies, to initiating a two-way participation process between stakeholders and policy-makers, and to increasing awareness on sustainability in Venice would be the selection of a new set of indicators and the adaptation of the ecological footprint.

The former has been carried out as part of this paper. A list (see Table 2) has been compiled based on the European Environment Agency's DPSIR framework, and individual indicators have been selected largely from the existing list for Venice and the UNCHS database. Whilst it is true that using the DPSIR framework by its nature places more emphasis on environmental issues, every effort was made to ensure that pertinent economic and social issues are adequately represented. The fact that the environment is central to this approach is believed to be positive since it is considered that environmental vulnerability in Venice probably exceeds social and economic vulnerability, although it is recognised that these latter are also important issues.

It is beyond the scope of this paper to initiate a public participation process, however it is hoped that in the future this list will provide a useful basis such that it can be revised in a manner which takes into account greater consideration of public opinion and priorities. In the meantime it is potentially useful as a means of communicating complex information and trends in sustainability to interested stakeholders and policy-makers.

The adaptation of the ecological footprint to Venice at the individual and/ or city level would require a substantial amount of further work and contact with relevant organisations, however it is felt that this would be worthwhile task.

Finally, it is recommended that other approaches discussed in this paper are considered in the future, in particular as the European Sustainability Index when this is available, and/ or the Barometer of Sustainability.

A *Sustainable Venice* web-site is currently under construction. The aim of this is not only to provide information to residents and tourists, but also to provide a forum for interaction by means of online debates, quizzes, etc. This will be useful in terms of measuring progress towards sustainable development as it will allow for communication between stakeholders. Any approaches adopted could be presented on the web-site in order to benefit from external input and opinions, and communicate any results obtained.

TABLE 2: SUSTAINABILITY INDICATORS FOR VENICE

Driving force	**Pressure**	**State**	**Impact**	**Response**
Fishing	-Number semi-industrial fishing boats x average surface for fishing (or hours/ fishing) x average days fishing/ boat (m2 or hours/year)[1] -Number artisanal boats x average number *'chebe'* and *'bertovelli'* (fixed nets) x average fishing days/ year (no. nets/ year) [1]	-Spawning stock biomass (for species sedentary in lagoon) (kg) -Biomass of *Tapes* (kg) [1] -Total income for artisanal and semi-industrial fisheries (lire/ year) [1]	-Biomass fished/ maximum sustainable yield (e.g. *Zozsterisessor* or *Atherina boyeri)*[1] -Spawning stock biomass of non-target species (kg) [1] -% fished surface with seagrass meadows/ % fished surface without sea-grass meadows[1] -Number semi-industrial fishermen/ number artisanal fishermen[1]	-% of total commercial catch under sustainable conditions[1] -Number fines and infractions/ year on fishing regulations[1] -Fishing regulations and quotas (e.g. seasonal restrictions, size of fish, size of catch) [1]
Climate change	-Relative sea-level rise (mm/ year) [1]	-Average duration of high water (hour/ event)[2] -% of island inundated during high water events >90 and >110cm[1] -Number high water events/ year[2]	-Annual capital loss due to high tides (lire/ year) [1]	-Government expenditure dealing with high water events (lire/ year) (mitigation, warning, etc) [1]
Water and sediment Pollution	-Nutrient disposal (P,N,K) in lagoon (kg/ year) [2] -Concentration of heavy metals and hydrocarbons in water[1] -Number of pollution accidents and interventions/ year[1]	-Concentration of pollutants in sediments and organisms (ppm) [2] -Turbidity[2] -BOD[2]	-Changes in Bathing water quality according to EU criteria[1] -Changes in Species richness (numbers of different categories of organisms that occur) -Changes in Ecosystem richness (number of terrestrial or marine ecosystem types or biomes, based where possible on an existing classification or estimated from the island description and structure) -Duration of anoxic crisis and area of lagoon affected[2]	-The rate of restoration of baseline conditions of the level of metals in seawater[4] -% of urban wastewater undergoing some form of treatment
Tourism	-Total number of tourists/ year[2]	-Number visitors over total population[2]	-Level of satisfaction and insatisfaction of the resident	-Expenditure on provision of information to tourists on

		-Income produced[2] -Number of jobs[2] -Relationship between number of excursionists and over-night stays[2]	population in terms of tourism (scale of 1-10) [2]	characteristics of lagoon and eco-compatible tourism[1]
Population change	-Number of inhabitants[3] -Migration rates: Net migration to and from the city : (a) within country; (b) overseas; (c) total[3] -Birth and death rates: Crude birth and death rates are defined as births and deaths per 1000 population[3]	-Distribution by origin of 'non-Venetians'[2]	-Rate of ageing (% residents >65 over total population) [2]	-Government incentives to encourage young people to stay (e.g. housing benefits, employment)[1]
Education and Governance	-Level of education (% population graduated from high school, further education, etc) [1]	-School enrolment rate: % of children of eligible age, by sex, who are enrolled in : (a) primary school; (b) secondary school[3] -% inhabitants inscribed to voluntary associations[2] -Number of associations per 10000 population: number of voluntary non-profit organisations, including NGOs, political, sporting or social organisations, registered or with premises in the city, per 10 000 population[3] -Decentralised district units: number of separate local governments or administrative units (quarters, wards, regions or similar) which are responsible for provision of more than two local services [3]	-Voter participation rate (percentage of adult (male and female) population (having reached voting age) who voted in the last municipal election. [3]	-% education centres and schools including environmental education programmes[2] -Environmental expenditure by public administration[2]
Transport	-Number and typology of boats[2] -Number of journeys per capita on public transport[2]	-% traditional boats (rowing and sails) [2] -% public transport with respect	-Area of mud flats and sand bars (m2) [2] -Extent of damage to foundations	-Number of fines/ year due to infractions of the maritime code[2] -Number and frequency of public

		to total[2] -Daily number of passengers boarding at certain stations[2]	of buildings (qualitative indicator?)[1]	connections between islands, the mainland and historic centre[2] -Expenditure on restoration and mitigation of erosion[1]
Air pollution	-SO2 and NOx emissions[3]	-Number of days/ year that WHO standards are exceeded, and average annual measured concentrations for SO2, SPM, O3, NOx, Pb[3]	-Number of cases of asthma and chronic bronchitis[2] -Biomonitoring of the quality of air by evaluation of the condition of lichens[2]	-Number of firms with environmental certification[2] -Number firms with environmental balance/ reporting[2]
Employment	-City product: the total product of the city as defined in national accounts procedures. This may either be taken as the total income or value-added (wages plus business surplus plus taxes plus imports), or the total final demand (consumption plus investment plus exports) [3]	-Income per capita[2] -Unemployment (average proportion of unemployed men and women during the year, as a fraction of the (formal) workforce. The unemployed are the average number of persons above 15 years who, during the reference period were 'without work', 'currently available for work' and 'seeking work'[3] -Number employees in each economic sector[2]	-Company dynamics: birth and death/ year[2] -Total income for each activity[2]	-Number firms with risk management system[2] -Number firms with health management system[2] -Number firms with public relations system[2]
Energy consumption	-Energy usage per person (metric tonnes of coal equivalent) and per sector (agriculture, industry and domestic) [3]	-Renewable energy usage: proportion of energy derived from renewable sources (hydro, wind, geothermal and solar electricity, combustion of animal wastes, fuelwood where this is being replaced through reforestation) [3]	-Total consumption of primary materials[3]	-Expenditure on education regarding energy consumption[1]
Urbanisation	-Average cost of housing[1] -Household types: Percentages of households with: (a) more than one adult and children; (b) single parent households; (c) more than one adult, no children; (d) one person only[3]	-Number of shops according to typology[2] -Household expenditures: Proportion (%) of average household income spent on : (a) food; (b) housing; (c) travel; (d) other[3]	-Availability of meeting spaces for elderly people[2] -Availability of sport structures[2] -Availability of cultural structures[2]	-Government expenditure on housing, recreation, etc[1]

	-Extension of green public space[2] -Cost to household income ratios: Defined as median expenditure on services divided by median household income for : a) water; (b) sewerage; (c) electricity[3]	-Inadequate housing: Defined as the proportion of dwellings that are deemed to be inadequate or in need of major repairs[3] -Vacant dwellings: Defined as the percentage of the total number of completed dwelling units which are presently unoccupied[3]		
Waste	-Solid waste generated per person (t/ year) [3]	-% of solid waste (a) disposed to sanitary landfill; (b) incinerated; (c) disposed to open dump; (e) burned openly; (f) other[3] -Production toxic waste (kg/ year) [3]	-Recycling rate: Percentages of (a) paper, (b) glass, and (c) aluminium disposed which are recycled[3] -Number and of area contaminated land[2]	-Expenditure on campaigns regarding education on consumption, recycling, etc[1]

[1] Indicator developed specifically for this paper
[2] Ramieri, E. (1999) Indicators for Venice
[3] United Nations Centre for Human Settlements (UNCHS) (2000) Global Urban Indicators Database
[4] Peronaci, M. (1998) Marine and Coastal Environment, Annual Topic Update, Topic Report no. 4/1999, European Environment Agency

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