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REPORT

SOCIAL SCIENCE INDICATORS FOR INTEGRATED COASTAL ZONE MANAGEMENT (ICZM)

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Abstract
There are many challenges to the inclusion of social data within SPICOSA, however similar to more physical types of data; the use of indicators has been suggested as a viable approach. The aim of this document is to examine the role of indicators and provide a discussion about the use of social and economic indicators within SPICOSA, and specifically, within the systems that are being created. The challenge of the use of indicators for social science will be explored and alternative approaches discussed. In addition, examples of indicators and their use within Integrated Coastal Zone Management will be presented.

Contents

1. What are indicators?

The Organisation for Economic Cooperation and Development (OECD) (1994) have provided a well used definition of indicators; “a parameter…provides information about, describes the state of phenomenon/environment/area, with a significance extending beyond that directly associated with a parameter value.” An alternative definition is provided by Aubry and Elliot (2006, p175) who state that “An environmental indicator is a qualitative or quantitative parameter characterising the current condition of an element of the environment or its change over time” they go on to argue that that indicators have three basic functions; to simplify, to quantify and to communicate.

Although these definitions suggest an ideal, when dealing within socio-economic data, broader ideas about indicators become important. Not all parameters are able to be quantified, nor should they be. If existing data is not available, or not closely related enough to the state or relationship needing representing, it may be possible to not only gather additional data, but also to develop some type of indicators from this. Within the context of SPICOSA, for example, it might be possible to translate the knowledge and experience of stakeholders and their expert judgements about the current, and future, state of the system into a less formalised indicator system. It is important to recognise that because information is not quantitative it does not mean that it cannot be useful or informative. Indeed, it may be useful for SPICOSA researchers to challenge the traditional notion of indicators: alternatives to the use of more traditional indicators are discussed in Section 3.

2. The challenges of using indicators

When dealing with physical phenomena and the use of indicators to represent system states (see discussion, *Key Ideas,* D3.2 Chapter 2, p36), there are a range of uncertainties regarding the ‘degree of fit’ of the indicator. These may relate to whether the indicator is representative of the system state or relationship, or to data characteristics, such as; the age of the data; data scale and resolution and degree of update. These concerns about the use of the data also exist within the social science context. Perhaps the most common problem across both physical and social sciences is that for some particular parameters data is lacking. When data is available, there are a series of addition common problems. These include:

- **Reliability**: the systemic and measurement errors in data collection, including gaps in the data record. Equipment may fail at the most critical or useful times (i.e. during extreme conditions).
- **Precision**: the precision with which a parameter can be estimated may be low.
- **Data coarseness**: the measurements are frequently coarse both in terms of time (e.g. the frequency of measurement) and in terms of spatial distribution of measurement points. Hence, it is often necessary to interpolate parameter values, particularly spatially.
- **The locations** at which the parameter is measured may be determined by considerations of convenience and practicality rather than an assessment of the most useful points at which to take measurements.
- **Scale variance:** indicators can vary much across geographic, cultural and social dimensions as well as scales from global to local. Differences between countries and heterogeneity within them constrain the adaptation and wide use of national-level indicators

It is important to consider the wider limitations of the use of indicators, as there are many issues that span the social, economic and ecological sciences. The timescale of measurement and establishing an indicator as a predictor of change is one difficulty to overcome in the use of this approach. Although indicators inherently are used to reduce complexity, this can also be seen as one of their problems as “they have a tendency to oversimplify and ignore many of the feedback loops between social, economic and ecological systems” (Conway, 2007; p636). This is problematic if it is these relationships that are trying to be represented. Additionally, there are a number of assumptions to be avoided in constructing indicators in both the physical and social sciences:

- **Linearity**: in this instance, the poor assumption is that the desirability of each increment is the same. For some potential indicators, the relationship between the quantity and its desirability is likely to rise to some peak level and then decline as the quantity is increased. An example is the relationship for per capita domestic potable water consumption. Around 20 litres per person per day (l/p/d) is the absolute minimum necessary for cooking, basic hygiene, and drinking; consumption levels of over 200 l/p/d are a sign of gross inefficiency in water use, whilst what is technically achievable and desirable currently lies in the range of 70-120 l/p/d.
- **Additivity**: the functional form of the relationship between variables is usually critical. A poor assumption here would be that different indicators can simply be added together to give an overall performance measure.
- **Symmetry**: the assumption of normality is one example of such a poor assumption. Another example is the assumption that a small change in one direction is equally desirable as an identical change in the opposite direction is undesirable.
- **Stability**: the assumption is that this is both normal (e.g. of equilibrium and homeostasis) and desirable. Change can be desirable; development is obviously about change and sustainable development requires change rather than continuing stability.

The nature of social science data

With the type of information and the relationships needing to be described, there are additional and more important questions to consider when seeking indicators of socio-economic systems; Should we be aiming to quantify these data? What can we do if no information is available? And fundamentally how can we usefully and rigorously represent social and economic system components?

The type of data that is used within social science does not always lend itself to being quantified or tightly fitted into an indicator framework. To social scientist knowledge is mediated, situated, incomplete and contested. Within the social sciences themselves, there is an argument about the superiority of quantitative versus qualitative measurement methods. To oversimplify drastically, the argument of the qualitative school is that if people have to construct a response to a question rather than answer it from memory, and if through constructing this response they would normally discuss it with others in their family, friends and so on, the only way to get both a considered answer, and to understand how they construct a response, is to observe this process. A quantitative approach in these circumstances would then produce only a trite answer of little meaning or use.

Economics is more quantitative than most of the social sciences. More generally, in the social sciences we are lucky to have what we believe to be a reasonable understanding of the parameters affecting some other variable. With luck we have a plausible idea of the direction of the affects. We are unlikely to have any agreement as to the functional form of the relationship and attempts at model building that made brave assumptions (e.g. the Forrester/Club of Rome systems dynamics models) were soon falsified. Causality is easier to establish in the case of the physical sciences, partly because the relationship between two elements is commonly in the form of a flow, such as energy, and an element may transform the flow (e.g. through a chemical reaction). Except in the case of catalysts, mediating variables are less likely to be found.

In models of social phenomena, the flows are much more intangible: causality defines influence of one element upon another, and in a general sense, models of social phenomena might be said to be of power, of which information is one example of the many different forms of power. In such flows, the topology – the pattern of interconnections - of the system network can be an important part of the modelling process (Skvoretz, 2003). Because the flows are intangible, models of social phenomena are generally poor at prediction.

Aggregation is a particular problem when seeking indicators of socio-economic behaviour as it may be necessary to present data only in an aggregate form, to protect personal privacy or maintain commercial confidentiality. People reasonably ask when any data collection exercise is undertaken: why do you want this data and what will you do with it? Data on household composition, income and other key parameters will, consequently, only be available in the form of a distribution of values, aggregated across some administrative unit. The geographical boundaries of that unit generally do not exactly match those of the coastal zone in question. Different data sets are commonly available for differing administrative units, and at different levels of aggregation. Those administrative units may be larger than the coastal zone being studied, overlap with it, or be included within it. Aggregation also requires some form of categorisation system (e.g. a Standard Industrial Categorisation system is usually used to collect and present statistics on the turnover, employment and other data for industrial and commercial firms). Any system of categorisation ideally involves the minimisation of variance within each class and the maximisation of variance between classes: this is often not achieved so that there is a lot of variance within a single class.

3. Alternatives to quantitative data/indicators

Social scientists can provide normative statements that could be linked through Extend to model how they believe stakeholders may act: these statements could be based on existing national or European surveys and databases. This is the current course of action in the SPICOSA project. The danger that we need to be aware of is seeking to force too much into a model in the form of fixed parameters and relationships, thereby 'enslaving' the stakeholders to the model. If knowledge systems are seen as interlinked and in constant dynamic, it could be clearly argued that it is not best practice to attempt to simulate the process of choice within the SPICOSA numerical model: either quantitatively or through qualitative links.

As an alternative, a more innovative and more useful approach from a social science perspective would be to put aside attempts at simulation of social behaviour and preferences and renew 'physical world' conversation ('real' world using WP3 handbook terminology). In such a scenario within

SPICOSA, scientists would take physical models back to stakeholders and use these Extend-supported physical models to communicate the impacts of human activities: allowing stakeholders to make simple changes in the virtual world (Extend) and explore subsequent impacts on the natural system and then on their use of the coastal zone. Through this activity, stakeholder actively express preferences and can begin to explore management options. If such real-time engagement between the models, modellers and stakeholders cannot be facilitated then an understanding how, what and why stakeholders choose and prioritise objectives and actions may be gained from group based discussion between stakeholders and modellers, or using interviews to gain insights on likely stakeholder behaviour. This is a vision for engagement which maintains participatory approaches, providing a framework though which we could gain useful insights of the dynamics and challenges of integrating the sciences and scientists with stakeholders. A fundamental problematic issue underlies the use of indicators: they reflect a very strong normative basis i.e. what the experts think society should be like.

Learning, through knowledge feedback processes should be in the form of *conversation* rather than *communication*. It is a social process through which we (scientists and stakeholders) negotiate and challenge each other's views and perceptions in order to change how we think about the problem situation and move to more sustainable decision-making. Exploring stakeholder preferences and perceptions is therefore best achieved in an active way where ideas can be explored and reconceptualised, as greater meaning will be deduced. The outcomes of this conversation constantly modify the original conditions from which they emerged. The current mood within the project towards including within the SPICOSA model a simulation of social preferences could actually be considered to move the project away from an appropriate system-based model for the social sciences.

The potential need for SSAs to both collect and analyse their own social science data - if relevant datasets are not available – raises a broader issue within SPICOSA about ways in which both qualitative and quantitative social science data is collected and interpreted. Educating SSAs about established techniques within the social sciences for analysing, utilising and establishing rigour from data is essential if they are to become more accepting and confident in the use of these types of data; as well as assessing the uncertainties and limitations apparent. The beginnings of a discussion of this kind can be found in Appendix A, although the authors of this document advocate that these types of ideas be tackled more fully within the chapter on tools for social science.

4. The selection of indicators: how?

It is clear that some circumstances may require using the more passive and static approach of using existing survey data to build indicators of likely societal or economic behaviour: perhaps as a result of challenges related to timing, resources and the need for the opinions from a broad spectrum of the population or from a stakeholder(s) who seem key to a decision-making process but have not be engaged in any active, participatory discussion.

In developing or adopting any form of indicator, it is important to revisit two crucial questions: Why is it important to measure this variable? And is the data available with which to apply the indicator? We will explore the first question in this section and reflect on social science data in the following section.

The fundamental purpose of indicators is comparative, usually either over time (i.e. for one nation, region or city) or between areas, perhaps for benchmarking. For comparison, the indicators must also compare success; how well have we been achieving a goal? Or how far are we along a process of achieving this more effectively? Quite simply, it is not sensible to measure something just because it can be measured. If we mean success to be sustainable development within coastal zones then indicators should reflect moves towards this goal. This means that indicators must always be associated to a principle or a criterion, that is, a standard by which success is to be judged. These standards are often in themselves second-order principles, giving meaning to perceived higher-order fundamental truths that form the basis of our reasoning and action. Indicators, then, as a third-order, are used to confer the status of a particular standard. The standard is not a direct measure of performance but a point to which information provided by indicators can be integrated: the level at which an interpretable assessment crystallises (CIFR, 1999). A point of particular relevance to social science is that multiple indicators are often necessary in seeking an interpretable or meaningful assessment of a standard.

Clearly this important relationship between performance and standards means that a selection process for societal and economic indicators must be rooted in some criteria by which success can be evaluated. Again, this is a challenging area for social science, raising questions regarding the nature of success. What are good behaviours or outcomes and how is successful long-term governance of resources defined? What are useful social and economic standards against which indicators can be developed?

- **Economic Efficiency**. Economic efficiency is determined by the magnitude of the change in the flow of net benefits associated with an allocation or reallocation of resources. The concept of efficiency plays a central role in studies estimating the benefits and costs or rates of return to investments, which are often used to determine the economic feasibility or desirability of public policies. When considering alternative institutional arrangements, therefore, it is crucial to consider how revisions in the rules affecting participants will alter behavior and hence the allocation of resources.

- **Fiscal Equivalence**. There are two principal means of assessing equity: (1) on the basis of the equality between individuals' contributions to an effort and the benefits they derive and (2) on the basis of differential abilities to pay. The concept of equity that underlies an exchange economy holds that those who benefit from a service should bear the burden of financing that service. Perceptions of fiscal equivalence or a lack thereof can affect the willingness of individuals to contribute toward the development and maintenance of resource systems.

- **Redistributional Equity**. Policies that redistribute resources to poorer individuals are of considerable importance. Thus, although efficiency would dictate that scarce resources be used where they produce the greatest net benefit, equity goals may temper this objective, and the result is the provision of facilities that benefit particularly needy groups. Likewise, redistributional objectives may conflict with the goal of achieving fiscal equivalence.

- **Accountability**. In a democratic polity, officials should be accountable to citizens concerning the development and use of public facilities and natural resources. Concern for accountability need not conflict greatly with efficiency and equity goals. Indeed, achieving efficiency requires that information about the preferences of citizens be available to decisionmakers, as does achieving accountability. Institutional arrangements that effectively aggregate this information assist in realizing efficiency at the same time that they serve to increase accountability and to promote the achievement of redistributional objectives.

- **Conformance to General Morality**. In addition to accountability, one may wish to evaluate the level of general morality fostered by a particular set of institutional arrangements. Are those who are able to cheat and go undetected able to obtain very high payoffs? Are those who keep promises more likely to be rewarded and advanced in their careers? How do those who repeatedly interact within a set of institutional arrangements learn to relate to one another over the long term?

- **Adaptability**. Finally, unless institutional arrangements are able to respond to ever-changing environments, the sustainability of resources and investments is likely to suffer. Rural areas of developing countries are often faced with natural disasters and highly localized special circumstances. If an institutional arrangement is too inflexible to cope with these unique conditions, it is unlikely to prosper. For example, if an irrigation system is centrally controlled and allocates only a specific amount of resources to annual and periodic maintenance; it may not be able to meet the special needs associated with a major flood that destroys a section of the canal system.

Figure 1: *Evaluative criteria for social and institutional systems*

Ostrom (2006, p10)

One example that will help us move towards addressing these questions within SPICOSA is performance criteria emerging from the study of how institutions affect incentives facing individuals and their resultant behaviour. Ostrom (2006) suggests a series of potential evaluative criteria for evaluating the outcomes that are being achieved under current institutional arrangements (Figure 1). These criteria provide standards – or in other words an assessment rationale – which can be used to inform the selection of direct indicators of social and economic performance. In reality, these criteria can be applied to both the process of achieving outcomes, as well as the outcomes themselves. For example, selecting indicators that can both be developed in an accountable way, but that also provide outcome accountability. A clear challenge for the SPICOSA SAF process is to work through translating these high-level measures of success to local-level problems and case studies. What needs to be clear at this stage is that when selecting indicators, it is important to consider ideas about what makes a successful resource governing framework.

We have argued that adopting a participatory approach is one of the central tenets of a successful process for understanding stakeholders' preferences for coastal management options and gaining insight to societal impacts and behaviour: suggesting that a sustained active process of engagement allows greater depth and meaning to be derived from an analysis. However, although indicators do represent a more passive and static approach to exploring societal behaviour, engagement should still be pursued to gain as much insight to the selection process as possible. Quite clearly, the relative weighting of importance attributed to social and economic standards will varying according to the context and dynamics of a study site. Trade-offs are often necessary in using performance criteria and these should be explored with and within stakeholder groups.

Fontalvo-Herazo *et al.* (2007) apply this participatory argument further to the selection of an indicator set: it will provide the best indications of the priorities and concerns of stakeholders and, therefore, the best representation of the system. They suggest a schematic representation of a process for defining and selecting indicators (Figure 2), arguing that there are two approaches to determining the most appropriate indicators to apply. The first method is to select those indicators which are most closely aligned with the priorities of the stakeholders. This would involve revisiting the priorities of the stakeholders and to select the indicators what most closely represent these. This however, might not fully recognise all of the elements of the system. The second method partly separates the process from the specific priorities of the stakeholder and reframes it back to the system in question and in particular the conceptual model developed; "the model is used for the selection of stakeholder indicators that characterise each of the subsystems, components and interactions identified" Fontalvo-Herazo *et al.* (2007, p784). The process presented by Fontalvo-Herazo in the schematic does not give adequate weight to the importance of social learning between stakeholders: the role played by discussion, examination and interpretation of information and experiences within a stakeholder group in leading to new ideas of problems and desires (for a discussion on social learning read the appendix in WP1 D.1.2). However, it is interesting and may be a useful approach for SSAs to examine as it directly complements the System Approach Framework (SAF); through the engagement of stakeholders within issue resolution, system definition and the conceptual modelling.

Whatever method is adopted for the selection of social science indicators, it is clearly important to try to represent all the important states and dynamics within the system which as representative set of indicators as possible. The extent to which this is possible will depend upon the social science data that is available.

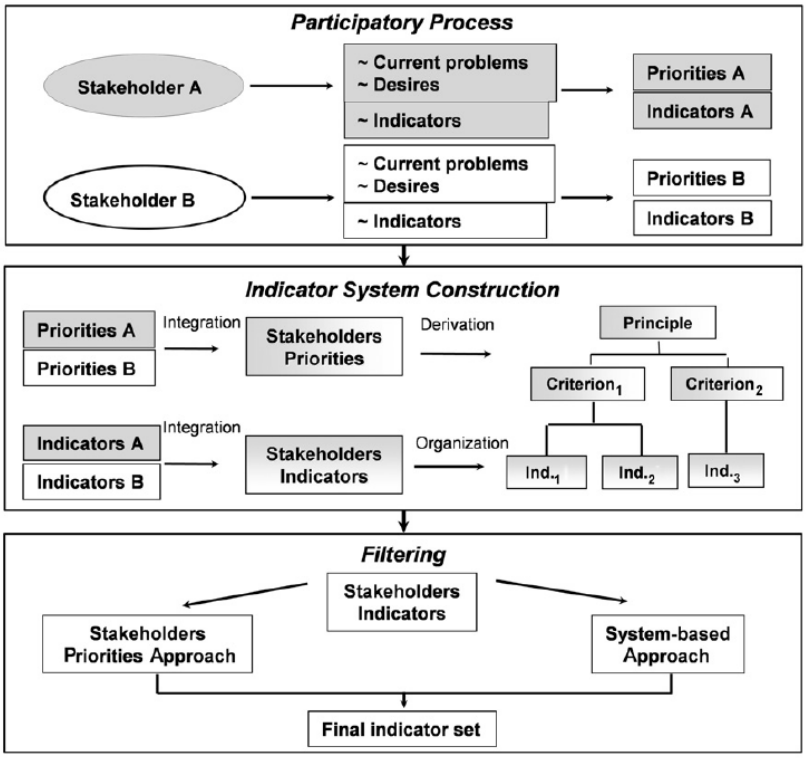

Figure 2:Schematic representation of the phases for the development of the method for the design of a participative indicator system as a tool for local coastal management.

Fontalvo-Herazo *et al.* (2007, p781).

5. Broad social science indicators and data sources.

The selection of indicators is invariably tied up with the data that is available, what is measureable and which data best fit the indicator and the criteria being measured. As discussed previously, relevant data and indicators do not have to come from long-established datasets, but relevant information and knowledge can be gathered as part of the stakeholder consultation process or through surveying or interviewing stakeholders. However, if a more 'traditional' use of indicators is adopted there are many social science datasets – at a range of scales - that can provide useful data and examples of sustainability indicators. Indeed, the process of developing sustainability indicators has been a continuing process at different scales over the last twenty years (e.g. Audit Commission, 2005; Defra, 2005; UN, 2001).

One indicator set of interest are those of sustainable development provided at the EU-level (European Communities, 2005). These are grouped in twelve themes (socio-economic development, sustainable consumption and production, social inclusion, demographic changes, public health, climate change and energy, transport, natural resources, global partnership and good governance) and are available at the Eurostat website, following the link:

(http://epp.eurostat.ec.europa.eu/portal/page?_pageid=1996,45323734&_dad=portal&_schema=PORTAL&screen=welcomeref&open=/basic/sd&product=EU_SD_main&root=EU_SD_main&depth=2)

The indicators are only available at the country level and the spatial coverage of Europe varies with indicator type. They exclude indicators which the UK government, for example, considers to be conditionalities for the delivery of sustainable development. For example, the Audit Commission's (2005) list of local community sustainable development indicators includes additional clusters of indicators under 'community cohesion and involvement', 'community safety', 'culture and leisure', and ‘housing’. Critically, the EU indicator set excludes two criteria which the UK government regards as central to the delivery of sustainable development: “social justice” and “environmental equality” (Defra 2005). Unfortunately, the UK government is still in the process of devising indicators for these latter two clusters. Whilst there may be some additional weaknesses in the EC indicator set (importantly, they are indicators and not criteria), it might be logical to use these as the basis for developing locally appropriate indicator sets which are geared towards functionalities which are affected by ICZM.

In addition to EU indicator set presented through the Eurostat website, there are other datasets (or databases that host different social science datasets) that might provide useful data for SSAs (Figure 3).

EURODATA Research Archive - http://www.mzes.uni-mannheim.de/projekte/mikrodaten/survey_profiles.htm
“The EURODATA Research Archive is an infrastructural unit of the MZES. The archive covers the whole of Europe and focuses on official statistics. Its core consists of tabular data (transnational, national and sub-national level) in the socio-economic and political domain. Via research projects (service projects and participation in projects of the research departments); it develops comparative databases and meta-information systems on official statistics in Europe. The archive continuously monitors major developments of the European data infrastructure both in the field of official statistics (tabular data and microdata) and science-based survey programmes.”

Flash Eurobarometers - http://ec.europa.eu/public_opinion/archives/flash_arch_en.htm#219
“Flash Eurobarometers are ad hoc thematical telephone interviews conducted at the request of any service of the European Commission. Flash Eurobarometer surveys enable the Commission to obtain results relatively quickly and to focus on specific target groups, as and when required (i.e. doctors, SMEs, etc.) e.g. attitudes of Europeans towards the issue of biodiversity.”

CESSDA Data Portal- http://www.nsd.uib.no/cessda/home.html
“The CESSDA Data Portal provides a seamless interface to datasets from 13 social science data archives across Europe

British library catalogue: social science electronic resources
http://www.bl.uk/collections/social/eresources/subjects/statistics.html - the British Library catalogue of social science electronic resources, with links to sites freely available on the web.

ESDS International - http://www.esds.ac.uk/international/access/access.asp
“ESDS International provides web based access to a range of macro and micro international datasets. Macro data are data aggregated to a country or regional level. The macro databanks in ESDS International all contain socio-economic time series data for a range of countries over a substantial time period. Micro data are typically survey or questionnaire datasets collected from groups of individuals within a number of different countries. International micro datasets such as Eurobarometer, International Social Survey Programme and the European and World Values Surveys cover a range of social science topics including household and demographic information, income, employment, education and housing. The macro databanks often contain secondary data derived from primary micro data sources.”

Figure 3: Examples of social science datasets

These data are constructed from a mixture of different types of social survey data including; official statistics (e.g. census), telephone surveys, other survey data. Further, research projects or international governmental initiatives can act as sources for data or guidance on relevance indicators. The Millennium Ecosystem Assessment for example discusses indicators of dimensions of human well-being including health, poverty and equity. The generic problem with such discussions and pointers towards indicators and indicator sets is of course the availability of data, the data either not being available or not being available for a geographic zone which is compatible with the coastal zone.

As stated above, it is important that the indicator used represents the state or relationship within the system as closely as it possible. Therefore, generally speaking, the finer the resolution of the indicator (within the area of interest), the greater the likelihood that it will reflect the local circumstances. Therefore, regional or local-level indicators (and data to represent them) are often preferable for use at the scale of ICZM. Data availability and applicability at a local and regional scale are therefore key issues when considering the use of indicators within SPICOSA. This is likely to be variable both between, and within, countries and similarly might also be heavily issue-related.

6. Examples of the use of social indicators with ICZM

The use of indicators, physical, environmental, social or economic are quite well represented within Integrated Coastal Zone Management. Examples of the use of social (and other) indicators will only be briefly presented here with additional details of the indicator sets presented in appendix B.

The first example is a set of sustainable development indicators proposed by an EU "indicators and data" expert working group (Breton, 2006). Although the EU dataset provides a basis for investigation, a number of strengths and weaknesses have been identified. The DEDUCE network (Martí *et al.,* 2007) have provided an evaluation of the usefulness of these indicators for measuring sustainable development in coastal areas; as well as commenting upon the accessibility, spatial and temporal resolutions and the accuracy and reliability of the data. Full details of the evaluation can be viewed at Martí *et al.* (2007). Martí *et al.* (2007) highlight that for some indicators the methodology of measurement is not sufficiently developed, nor is the understanding of the relationship between the indicator and the social, economic or environmental standard that it seeks to assess. An example that they provide is for the indicator 'intensity of tourism'. They suggest that; *"Further work is needed to ensure a realistic estimate of the true population in peak seasons…is taken into account and to improve our understanding of the impact that these population levels have in terms of the social and environmental carrying capacity of the coastal zones, their communities and heritage"* (Martí *et al.,* 2007; p86). This search for indicators is often driven by and linked to regulations and policy instruments. However, it is critical to keep the discussion in section 4 of this document in mind when exploring the usefulness of the EC-ICZM indicator set.

As well as the indicator set described above, examples of indicators can be drawn from local scales which are more appropriate to the scale that SPIOCSA SSAs are considering. Conway (2007) has developed a set of indicators for assessing the health – in social, economic and environmental terms – of the Solent, UK. Fifty indicators have been selected to provide information about the state of the marine and coastal systems under eleven different topics (physical environment, nature conservation, transport/ports and shipping, environmental quality, marine industries, natural resources, recreation and tourism, safety and emergency planning, human settlement, land use and management, coastal protection and sea defence and historic heritage and maritime archaeology). The full indictor set is provided in appendix B, however some examples of social indicators include; visitor numbers to key attractions, perceived quality of the coastal landscape, proportion of journeys taken by public transport and buildings and monuments at risk of decay.

A second example of an indicator set developed at a more local scale, is the one that emerges from the participatory process of indicator selection described by Fontalvo-Herazo *et al.* (2007). The indicator set is based on the priorities of the stakeholders consulted and comprises four overarching principles (well-being of the coastal population, governance performance, integrity of coastal ecosystems and the economic structure), ten second level criteria, which are to be assessed via thirty-five indicators (appendix B). This example is valuable becomes of the attention that it gives to the links between 'truths' (principles), standards (criteria) and performance measures (indicators), thereby providing a strong rationale and framework for the indicator study. A final, interesting point is that some of the suggested indicators provide little guidance about how the indicator would be measured or assessed; house quality, school facilities and citizen participation.

7. Conclusion

This document seeks to bring a key message: it is important that indicators and indicator sets are not considered for use 'off the shelf'. It is critical that SSAs, through a participatory process, allow stakeholders to identify and define criteria for measuring the success (or failure) of a social system - or an element of a social system - before beginning the search for appropriate indicators. There needs to be a clear rationale and justification for the adoption of an indicator and scientists need to ensure that what is chosen clearly represents the aspect that they are trying to measure. SSAs should also consider, and be open to, the notion that their understanding of the system, and the data through which they measure it, also be found within those conversations with, or between, different stakeholders.

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Appendix A

Grounded theory and the analysis of textual data.

A factor than may concern those not used to using qualitative data is how to obtain meaning and make decisions from what might be from large amounts of textual material (e.g. interview and focus group transcripts, questionnaire data). A 'grounded theory' approach (Glaser and Strauss, 1967) is often one approach that advocated when collecting and analysing qualitative data (particularly in situations where the discursive data is sought) as it allows researchers to be both flexible and interpretive in the methodologies used, but also adds the essential element of rigour. This approach considers an understanding the world of the research participants as they construct it (Jones, 1985) which permits an insight into the preferences of stakeholders and decisions taken by policy-makers. Grounded theory is primarily concerned with how the social world is constructed and operates and how information is generated inductively from the data. The approach enables the process of data collection and analysis to be evolutionary, with the interpretation of the data collected in the first instance acting as anchoring points for future data collection. An important element of the theory is that due to the nature of the information being researched – through interaction and conversation between the researcher and subject(s) of interest – data interpretations cannot be considered independently of the sampling methodology or the data collection (Symon & Cassell, 1998; Flick, 1998).

Similar, to quantitative or other types of qualitative data, information textual (or when transcribed conversational) data can be grouped into pieces of similar or interesting information through 'coding'. The process of coding makes the interpretation of texts more manageable, more systematic and more rigorous. Coding involves the filtering of the information presented to try to establish those ideas, opinions or preferences that keep reoccurring and thus are therefore considered to be most important within a group of interest. These categories and codes are able to be refined following multiple analyses of the same dataset; through the collection and analysis of new data; or following repeating data collection with the same participant. These ideas can be presented both qualitatively though quotes or quantitatively, for example the time spent discussing a topic (or the percentage of a meeting spent discussing a topic), the number of times a respondent mentions the topic of interest or how many respondents mentioned a particular topic. One question that often emerges when using this type of data is; when is there enough information to be sure of the validity of concept, relationship or opinion? This is difficult, but the theory of 'theoretical saturation' (Mason, 1996) emerges as being appropriate; which argues that conclusions can be drawn when the it appears that ideas and concepts cannot be advanced without undertaking another 'round' of research. The obvious generalisations that can be made with regard to the data are where similar comments and responses have been discovered numerous times and through additional rounds of data collection or stakeholder engagement would allow a researcher to test the theories or generalisations that have appeared, as well as investigating any changes in opinion or social learning that might be emerging from the process. This type of systematic approach to the handling and analyses of textual and conversational data – although admittedly is not perfect – does provide a framework from which a researcher can achieve some degree of procedural rigour and ensure that an output is both as valid and representative as it can be. Transparency of the approach and the acknowledgement of limitations and uncertainties are essential.

Appendix B Sustainable development indicators proposed by the European ICZM expert working group on "indicators and data" (Breton, 2006)

Goals	Indicators	Measurements
To control further development of the undeveloped coast as appropriate.	1. Demand for property on the coast	1.1. Size, density and proportion of the population
		1.2. Value of residential property
	2. Area of built-up land	2.1. Percentage of built-up land by distance from the coastline
	3. Rate of development of previously undeveloped land	3.1. Area converted from non-developed to developed land uses
	4. Demand for road travel on the coast	4.1. Volume of traffic on coastal motorways and major roads
	5. Pressure for coastal and marine recreation	5.1. Number of berths and moorings for recreational boating
	6. Land taken up by intensive agriculture	6.1. Proportion of agricultural land farmed intensively
To protect, enhance and celebrate natural and cultural diversity.	7. Amount for semi-natural habitat	7.1. Area of semi-natural habitat
	8. Area of land and sea protected by statutory designations	8.1. Area protected for nature conservation, landscape and heritage
	9. Effective management of designated sites	9.1. Rate of loss of or damage to, protected areas
	10. Change in significant coastal and marine habitats and species	10.1. Status and trend of specified habitats and species
		10.2. Number of species per habitat type
		10.3. Number of Red List coastal area species
To promote and support a dynamic and sustainable coastal economy.	11. Loss of cultural distinctiveness	11.1. Number and value of sales of local products with regional quality labels or European PDO/PGI/TSG
	12. Patterns of sectoral employment	12.1. Full time, part time and seasonal employment per sector
		12.2. Value added per sector
	13. Volume of port traffic	13.1. Number of incoming and outgoing passengers per port
		13.2. Total volume of goods handled per port
		13.3. Proportion of goods carried by short sea routes
	14. Intensity of tourism	14.1. Number of overnight stays in tourist accommodation
		14.2. Occupancy rate of bed places
	15. Sustainable tourism	15.1. Number of tourist accommodation units holding EU Eco-label
		15.2. Ratio of overnight stays to number of residents
To ensure that beaches are clean and that coastal waters are unpolluted.	16. Quality of water bathing	16.1. Percentage of bathing waters compliant with the guide value of the European Bathing Water Directive
	17. Amount of coastal, estuarine and marine litter	17.1. Volume of litter collected per given length of shoreline
	18. Concentrations of nutrients in coastal waters	18.1. Riverine and direct inputs of nitrogen and phosphorus in inshore waters
	19. Amount of oil pollution	19.1. Volume of accidental oil spills
		19.2. Number of observed oil slicks from aerial surveillance
To reduce social exclusion and promote social cohesion.	20. Degree of social cohesion	20.1. Indices of social exclusion by area
	21. Relative household prosperity	21.1. Average household income
		21.2. Percentage of population with a higher education qualification
	22. Second and holiday homes	22.1. Ratio of first to second and holiday homes
To use natural resources wisely.	23. Fish stocks and fish landings	23.1. State of the main fish stocks by species and sea area
		23.2. Recruitment and spawning stock biomass by species
		23.3. Landings and fish mortality by species
		23.4. Value of landings by port and species
	24. Water consumption	24.1. Number of days of reduced supply
To recognise the threat to coastal zones posed by climate change and to ensure appropriate and ecologically responsible coastal protection.	25. Sea-level rise and extreme weather conditions	25.1. Number of 'stormy days'
		25.2. Rise in sea level relative to land
		25.3. Length of protected and defended coastline
	26. Coastal erosion and accretion	26.1. Length of dynamic coastline
		26.2. Area and volume of sand nourishment
		26.3. Number of people living within an 'at risk' zone
	27. Natural, human and economic assets at risk	27.1. Area of protected sites within an 'at risk' zone
		27.2. Value of economic assets within an 'at risk' zone

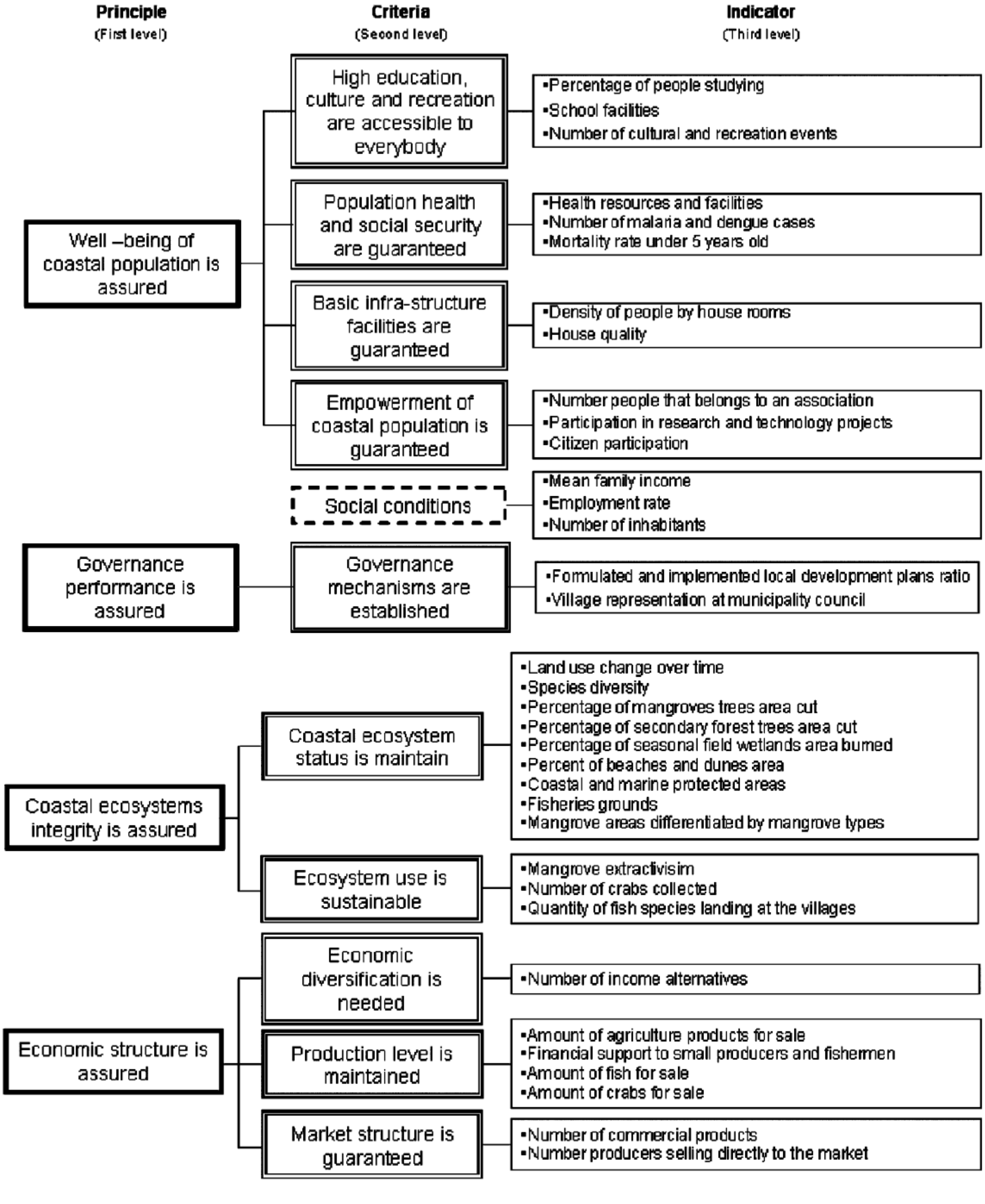
State of the Solent (UK) indicators

Topic	Indicator Selection	Status
Physical Environment	Mean Sea Surface Temperature	✓
Nature Conservation	Wildfowl and wader counts	✓
	Change in the extent of coastal habitats in the Solent	✓
	Condition of sites designated for nature conservation	✓
	Loss / gain in area of land and sea protected by nature conservation designations	X
Transport / Ports and Shipping	Total volume of freight handled by Solent ports	✓
	Economic importance of the ports industry in the Solent	*
	Employment reliant on the ports industry	*
	Number of shipping movements through the Eastern and Western Solent	✓
	Proportion of journeys taken by public transport	*
	Number of ferry passengers to the Isle of Wight	✓
	Volume of traffic on major coastal roads	✓
Environmental Quality	Compliance with the EC Shellfish Hygiene Directive	✓
	Compliance with the EC Bathing Waters Directive	✓
	Beach litter	✓
	Estuarine Water Quality	X
	Dangerous substances in water	X
	High estimates of Nitrate and Orthophosphate from point sources in the Solent	✓
	Volume of oil spillages and discharges	*
Marine Industries	Economic importance of marine industry, excluding the port industry, in the Solent	*
	Employment reliant on marine industries	*
	Diversity of the marine industry base in the Solent	*
Natural Resources	Number of salmon returning to the rivers Test and Itchen	✓
	State of the main fish stock in the Solent	✓
	Number, size and average power of registered fishing vessels in the Solent	✓
	Number of licences issued in the Solent and area / volume dredged	✓
	Number of aggregates wharfs in the Solent and tonnage landed	✓
	Levels of aggregates from secondary and recycled sources	*
Recreation and Tourism	Number of berths and moorings for recreational boating in the Solent	✓
	Number of overnight stays in tourist accommodation on the Solent coast	*
	Intensity of recreational activity, land and water based	*
	Visitor numbers to key attractions	✓
	Proportion of attractions with implemented environment quality management plans	✓
	Level of participation in coastal based recreation facilities in the Solent	*
Safety and Emergency Planning	Health and safety incidents in the Solent	✓
Human Settlement, Land Use and Management	Change in the area and type of developed land in the coastal zone	*
	Change to the seascape of the Solent	✓
	Use of Brownfield as opposed to Greenfield sites for development on the coast	✓
	Number / percentage of landscape features lost, degraded or enhanced	*
	Changes in landscape assessments carried out by local authorities	*
	Number, extent, quality and degree of landscape and seascape improvement schemes	*
	Perceived quality of the coastal landscape	*
Coastal Protection and Sea Defence	Length of protected and defended coastline (% of natural coastline and that protected by hard and soft defences)	✓
	Rate of relative sea level rise and number of stormy days	✓
	Frequency and duration of floods	X
	Change in Shoreline Management Plan Policy	X
	Natural, Human and economic assets at risk from coastal flooding	✓
Historic Heritage and Maritime Archaeology	Buildings and monuments at risk of decay	✓
	Number of sites recorded on the sites and monuments record	✓
	Area and number of designated conservation areas for heritage and archaeology	*

* Further work is needed to collect the data for this indicator for the Solent
✓ This information is available and will be published in the State of the Solent report
X This indicator is not included in the final selection

Conway (2004, p40)

Bragantinian coastal region indicator system structure with three hierarchical levels: principles, criteria and indicators



Fontalvo-Herazo *et al.,* (2007, p789).