



HOW CAN SOCIAL SCIENCE-BASED SOFTWARE TOOLS ASSIST IN THE ECOSYSTEM-BASED MANAGEMENT PROCESS?

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INTRODUCTION

In an era of declining resources and habitat degradation, ecosystem-based management (EBM) of coastal and marine environments has been embraced by scientists worldwide. EBM is an integrated approach that takes into account ecosystem complexity when considering resource management options, and it is believed that such an approach could help to improve the health of our ecosystems (Hirshfield, 2005). One major challenge in resource use is obviously human involvement. EBM can be one way to meet “socioeconomic needs while conserving biophysical resources and respecting limits” (Slocombe, 1993). However, it seems increasingly that the latter part of this goal is emphasized in the literature, with biophysical, ecological and geographical issues being highlighted, and socioeconomics being left behind. Software tools have been developed and are used to help model biological interactions on an ecosystem level, but tools incorporating socioeconomic considerations are not widely used by EBM practitioners (Turrell, 2004). We believe that tools do exist, however, and the goal of this document is to provide a survey of the social science-based tools that are available to assist in the EBM process.

This paper first describes the social science disciplines, and what we mean by a social science tool. We then lead the reader through the process of EBM in a general way, highlighting where social science tools can be used by planners and practitioners. We next provide descriptions and examples of those tools, and point readers to helpful resources on the various tool types.

SOCIAL SCIENCE TOOLS

The social sciences are disciplines concerned with the study of the social life of human groups and individuals, and include anthropology, psychology, economics, political science, history, sociology and geography. We consider social science-based tools as those applications which provide a social context to a project, or analyze social information. For the purposes of EBM tools, we are concerned primarily with social science-based software applications that assist in the planning and implementation of EBM.

THE EBM PROCESS

EBM is an innovative management regime that considers whole ecosystems in planning, including humans and the environment, rather than just managing by a single sector approach. Slocombe (1993) broadly defines it as “integrated environment and development planning”. Although EBM may be ideal to capture the complexity of an ecosystem, it is challenging because it inevitably leads to conflicting and varied interests and objectives.

Figure 1 (adapted from Heiman et al, in review) illustrates a generalized view of the EBM process, from the planning stages to the implementation of a project or management plan. We will run through this schematic by giving an example along the way.

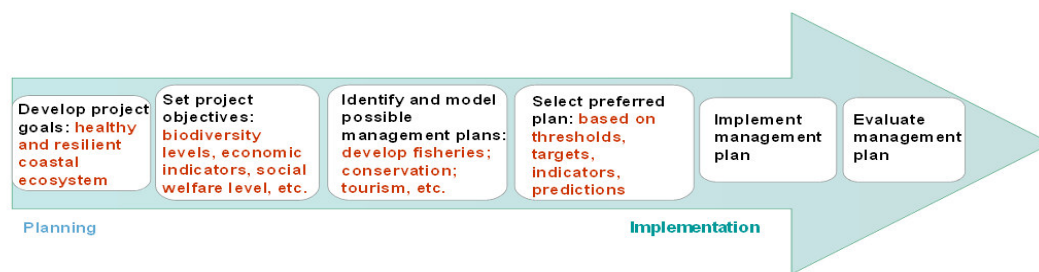


Figure 1. The EBM Process. Major steps in the process shown in black; examples given in red.

The first stage in an EBM plan is development of the project goals. These are general and broad, for example we would like a healthy and resilient coastal ecosystem. Following these broad goals, we specify project objectives which are more concrete and may be measurable (these may also be called ‘indicators’). In our example, we may set targets for biodiversity levels, economic indicators such as growth or per capita income, and social welfare levels, such as gender equality in coastal economic sectors, or increased quality of life as a result of ecosystem services provided by the coastal ecosystem.

Once we have identified the specific objectives for our community, we can identify and model possible management plans in an attempt to ascertain which plans will succeed in meeting our objectives. Examples of different management options could include the development of the fisheries sector, or increasing ecotourism. A plan is then selected and implemented. After some period of time, preferably agreed upon prior to project implementation, we can evaluate that plan. The evaluation should attempt to measure how successful we have been in meeting our objectives. For example – did the investment in ecotourism (potentially traded off against fisheries development) result in an increase in revenues to coastal communities? Were we able to conserve biodiversity levels?

Slocombe (1993) suggests that two types of obstacles limit EBM: those related to the “ends intended by those using” the approach and those related to “theory and implementation of (EBM) itself”. Focusing on the latter of these, it is not surprising that, given the interdisciplinary approach required for EBM, conceptualization and implementation can be difficult. In this paper, we suggest that the planning and implementation of EBM may fall short by not incorporating enough socio-economic objectives and tools, resulting in groups not reaching their project goals.

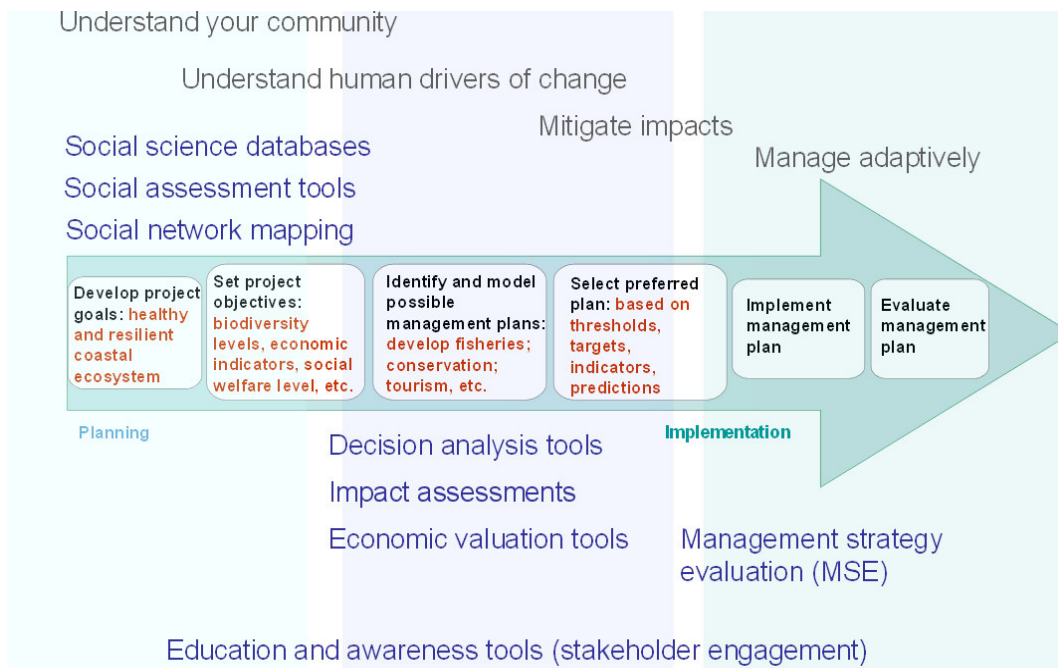


Figure 2. Examples of social science-based tool types used in EBM. Gray headers indicate some of the EBM goals that social science-based tools may help us reach, while the dark blue items are specific categories of tools that can be used to reach these goals.

Several social science-based tools exist to help us progress through the EBM plan. Social science EBM tools can help us to understand our communities and the human drivers of ecosystem change; help us to mitigate the social and economic impacts of a proposed management plan; and can help us evaluate the success of our programs and manage adaptively. Figure 2 shows some examples of where, in the EBM process, different types of tools can be used. A description of these tool types and some examples follow in the tools survey section.

Generally, the tools presented here are stand alone tools. But finding tools that work together (known as interoperability) is key in streamlining the EBM process. Interoperable tools allow the user to integrate several software applications, essentially enabling software tools to flow together. Although a difficult goal, we believe that it is an important goal none the less; something that software

developers should consider, and that EBM software tool users should seek out. One possible way to achieve interoperability from the users end, is through the creation of EBM practitioner teams, where software users with different expertise form networks to better use the existing software tool options. It should be noted that the tool types shown in Figure 2 are not necessarily exclusively social science-based, but rather that social and economic data and issues (inputs) can be incorporated into EBM through the use of some of these tools. Furthermore, it is important to remember that the EBM process is complex and constantly changing. Figure 3 emphasizes the feedback nature required of any EBM plan and implementation.

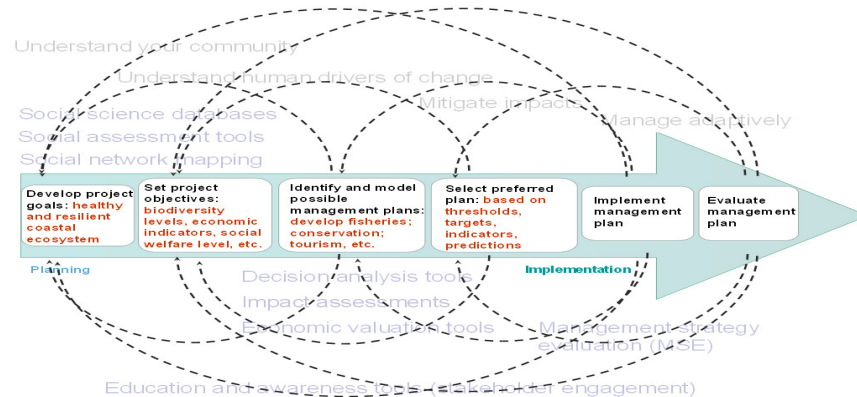


Figure 3. Feedback nature of EBM.

TOOLS SURVEY

This section is intended to give the reader a description of the different tool types shown in Figure 2, and to offer some examples. Some of these tools, as well as many more software tool options, are listed and searchable at the EBM Tools Network website (www.smartgrowthtools.org/ebmtools/index.php). The tools are grouped as shown in the diagram, under the dark gray headings, to give an idea of where in the EBM plan they could contribute. Many tool types can be used at several stages in EBM, so where the tool types appear in the list below does not indicate that they couldn't be used at other stages as well.

Understanding your community

The goal in this stage of the EBM process is for practitioners to get an idea of the people involved in the communities that are to be potentially affected by the EBM plan. What sectors are they employed in? How do incomes vary by sector? What are the ages and genders of workers in different sectors? What activities do local residents engage in? What activities might potential tourists engage in? Understanding the community/population for which a management plan is intended is a necessary step in designing that plan.

- **Social science database tools**

These types of tools allow practitioners to access information about their communities and can often generate summary reports. An excellent example is the Human Dimensions project's STICS mapping census tool, found at www.marineconomics.noaa.gov/socioeconomics/. This tool offers geo-referenced demographic data online, from which users can access and query data. Among its many features, the tool can provide statistical tests to compare two different areas. For example, it could be used to compare two communities in an effort to implement a management plan within the community showing lower socioeconomic risk to economic changes.

- **Social assessment tools**

These tools can provide a framework for analyzing and incorporating social information, and can help identify stakeholders. Generally tools here include surveys and questionnaires, and although this survey is primarily interested in software tools, we include this group because they do serve a function in the EBM process. An example of a software tool is SOCAT developed by the World Bank and available at: www.web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTSOCIALDEVELOPMENT/EXTT/SOCIALCAPITAL/0,,contentMDK:20193049~menuPK:418220~pagePK:148956~piPK:216618~theSitePK:401015,00.html. This software tool was developed to help collect social capital data at the household, community and organization level, and offers sample questionnaires at the community and household levels.

- **Social network mapping**

Social networks are constructed in an attempt to better understand the relationships between certain people/groups (for example stakeholders in a resource) and to allow for better planning between these people/groups. Examples of tools used for this purpose include Smart Network Analyzer (available through June Holley at Network Weaving www.networkweaving.com/june.html) and Netminer (www.netminer.com/NetMiner/home_01.jsp). One of the purposes of networks is to enable collaboration between stakeholders, researchers and government/policy makers. These types of tools generally involve a survey of stakeholders and then use software tools to analyze the connectedness of these stakeholders. Understanding the best ways to communicate with stakeholders (including who they see as reliable sources of information) can help EBM planning move toward the implementation stage. A list of available software tools can be found through the International Network for Social Network Analysis at www.insna.org/software/index.html.

Understanding the human drivers of change and mitigating impacts

In developing and implementing an EBM plan, we need an understanding of how humans affect their environment. How do the ways we use the environment alter or change it? This stage of the process involves identifying the possible ecological outcomes of human activities: how do humans affect the environment

and thus the possible future? The obvious follow up question is thus: how will that possible future environment affect humans, which is about mitigating impacts. We have thus grouped these tool types together because they address the middle section of the EBM process which involves the testing of various EBM scenarios.

- **Impact assessment tools**

Impact assessments are used to identify the future social and economic consequences of a current or proposed action. The Convention on Biological Diversity uses these tools to ensure that “projects, programmes and policies are economically viable, socially equitable and environmentally sustainable” (www.cbd.int/impact/). Social Solutions has developed software primarily targeted at non-profits to evaluate their impact, but of course this type of tool could be elaborated upon and used to assess other impacts(www.socialsolutions.com/Portals/_default/Skins/SocialSkin/home.aspx).

- **Decision analysis tools**

These tools can incorporate risk and uncertainty into decision making, often using probabilistic modeling (e.g. Netica software www.norsys.com/), to highlight the likely outcomes of a potential management plan. This software has been used extensively to incorporate biological uncertainty in fisheries management, but its use is totally dependent on the programmer, and as such could easily be used to model social and economic uncertainty in EBM planning. For example, given possible changes in expected interest rates, what are the probabilistic outcomes of a given plan, and where would socioeconomic changes be most severe?

- **Economic valuation tools**

Valuation tools can help policy makers put values (often in monetary terms) on items/processes within the ecosystem. Values on extractive items, such as fisheries or forestry are often straightforward to calculate. However calculating values for non-extractive items (sometimes referred to as non-use items), for example, ecosystem services, and existence values, can be much more difficult to ascertain. EVRI, the Environmental Valuation Resource Inventory (www.evri.ca/) offers users the ability to apply a benefit transfer approach to valuation, which uses published values from previous studies as a proxy for similar values. This saves the policy maker/researcher from having to conduct a new valuation, which can be costly and time consuming.

Managing adaptively

EBM is complex and dynamic. Our ecosystems and our societies are constantly changing, and thus an EBM plan should incorporate some amount of adaptive management.

- **Management strategy evaluation (MSE) tools**

These tools facilitate incorporating multiple objectives into planning and explicitly model tradeoffs in potential management plans. MSE tools include decision analysis tools (see above) and agent-based modeling.

Agent-based modeling simulates actions of individuals in a network and assesses effects to the whole system. The idea behind MSE is to plan for a successful management regime by modeling different integrated development scenarios and predicting the outcomes (and costs and benefits) of each scenario. These scenarios are then analyzed by explicitly considering the tradeoffs between different management choices. Although MSE is not strictly socioeconomic in nature, it is important that social science-based considerations are included in predicting the outcomes of different scenarios. InVitro is an example of an agent-based MSE software tool; however it places precedence on ecological modeling in its development scenarios (www.cmar.csiro.au/research/mse/). MSE allows a user to manage adaptively because parameters can easily be changed to reflect the current situation and scenarios rerun.

Education and awareness tools (stakeholder engagement)

Stakeholder engagement is an essential component of any successful management plan, and it is important at all stages of the EBM process. These tools are used to engage public and private investors in, or users of, a resource. They can help to communicate project goals (i.e. potential benefits of a proposed marine protected area) and to disseminate the results of a management plan. One such example has been developed by SustainNet. This tool is capable of recording, documenting, tracking, evaluating and reporting on stakeholder issues, and can be found at www.projectsigma.co.uk/toolkit/StakeholderEngagement.asp

Other useful websites

The EBM Tools Network has a large database of EBM software tools available at www.smartgrowthtools.org/ebmtools/index.php. This database is constantly updated.

The Humans Dimensions Project (www.HD.gov) provides methodologies, tools and data on addressing the human side of natural resource management.

The Society for Conservation Biology (SCB) established a social science working group in 2003 in an effort to strengthen the application of social sciences to conservation biology. Their website, www.conbio.org/workinggroups/SSWG/, is another great resource for information on the social sciences, and provides a searchable database of conservation oriented tools (although not necessarily EBM tools).

CONCLUSION

This paper is intended to provide a brief description of the EBM process, and how the incorporation and analysis of socioeconomic data can help practitioners. It is becoming more and more evident that for conservation of resources to succeed, managers and decision makers have to include social science-based

considerations into their planning. This tools survey presents a very general list of some possible ways to go about including those considerations. It is by no means exhaustive, and we welcome suggestions to improve upon it (www.ebmtools.org/about_us/social_science.html). Software tools that explicitly model social science considerations have been developed and are available, and it seems that other software tools are probably quite easily modified to include such issues. It may be the case that more social science-based software tools are not necessarily needed, but rather the inclusion of these issues into already-existing EBM platforms (via software plug-ins for example) may be adequate to better address social science issues in EBM. Furthermore, the creation of EBM network teams where software tool users can come together to help with user interoperability may assist in better inclusion of social science inputs, where necessary, in the EBM process.

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