Building a User-friendly Decision Support System While Improving Community Participation: A Case of Ecosystem-based Management in the Dominican Republic

Construyendo un Sistema de Decisiones Simple Mientras se Fortalece la Participacion Comunitaria: Un Caso de Gestión Ecosistémica en la Republica Dominicana

Développer une Système D'aide à la Décision (Dss - Decision Support System) User-Friendly: Un Cas de Gestion Écosystémique en République Dominicaine

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ABSTRACT

Ecosystem-Based Management (EBM) methodological guidelines are available in relevant literature. Nevertheless, quite often applying EBM can be challenging because it requires: (1) intense and continuous efforts to coordinate management actions across a wide array of agencies/sectors; (2) intensive work by professional teams in adjusting guidelines to the specificities of the ecosystem in their area of interest; and (3) significant amount of data and large databases.

This paper illustrates how a user-friendly Decision Support System (DSS) can break through the mentioned barriers toward the widespread application of EBM, by providing new methodological and software tools which make EBM applications easier for the decision-makers and the professional team involved.

The DSS methodological tools are built on a protocol capable of handling multi-stakeholders analytical processes which can be executed straight-forward providing analytical approaches based on deterministic rather than statistical ecological assessments. This protocol identifies and quantitatively assesses the relationships between ecosystem components, functions and services, along with the associated human activities, toward delivering an integrated set of Ecosystem-Based Management measures.

The DSS software enables the analysis of spatial and tabular datasets and the compilation of data-aware advanced reports, via a multi-windows interface which facilitates the browsing of large datasets through an ecosystem-based logical mapping framework. It has been successfully applied in different socio-economic and environmental contexts in various continents and, currently, is being adjusted for a north-western area in the Dominican Republic. The area comprises several ecosystems, a network of protected areas and a complex socio-economic context. This is a UNEP/CEP project funded by the Italian Agency for Development Cooperation.

KEYWORDS: Ecosystem-Based Management (EBM), Decision Support System (DSS), capacity building

INTRODUCTION

Ecosystem-Based Management (EBM) started to be used in marine and coastal environments since the ’90s (Grumbine 1994), as an alternative way to manage the resources and try to reduce overexploitation and degradations of marine ecological systems. Attaining comprehensive EBM is however still quite often seen as a daunting and complicated challenge by either manager and/or practitioners and, some time, also by higher-level decision makers (UNEP 2011).

EBM requires efforts to constantly guarantee the coordination of the management actions across multiple institutions and at different geographical scales (Leslie et al. 2015). Moreover, since EBM doesn’t have a universal application framework, it has to be adapted to every specific area through different experimental management approaches (Aswani et al 2012; Long et al 2015); this makes each case of EBM application highly demanding for the planning team and, at times, may also lead to some confusion among the management players (Long et al. 2016). Finally, effective EBM applications must be built on significant amount of data and, thus, require extensive data collection and the handling of large datasets, characteristics indicated as not always suitable for developing countries (Leslie et al. 2015).

One of the most critical elements of success for an EBM process is the active involvement of the appropriate stakeholders. This entails that people with various education level and experience background interact to share their own knowledge and participate to the management debate. Scientific, technical, administrative and civil-society stakeholders may see the same reality from a significantly different point of view and, thus, their involvement in multi-sector integrated management planning processes often bring conflicts (Gopnik et al. 2012, Röckmann et al. 2015). At the same time, the participation of all the stakeholders ensures the essential role of recognizing the entire set of relevant social dynamics and ecological interactions, while uncovering the compatibility-potential of multiple uses of the same set of resources as well (NRC 2004, Pomeroy and Douvere 2008).

In order for EBM policies to be crafted and implemented effectively, the stakeholders have to become able to explore potential alternative scenarios, to identify synergies and to finally gain a collective system thinking (Schwilch et al. 2012).

The challenge is to develop, implement and disseminate procedures and tools that allow expressing in quantitative ways a system thinking (Murray et al. 2016). In this respect, Arkema et al. (2006) suggested that "*tools for traditional, single-species management are available and widely used, but explicit approaches are still needed to successfully conduct EBM*". Since 2002 the Italian Development Cooperation has promoted and funded a string of projects which include the development and implementation of systemic decision support systems, that is of structured sets of tools and methodologies that are used to integrate EBM strategies in an organized manner.

This paper briefly illustrates the key features of a DSS toolset developed and applied in the framework of a number of the above mentioned Italian Development Cooperation projects, and discusses how the use of the very DSS facilitates the application of EBM, building at the same time a better level of communication within the relevant stakeholders. The named DSS has been successfully applied since 2002 in different ecosystems including: the Peruvian Amazonian rainforest (characterised by highly -productive ecosystems under strong pressure from agriculture, livestock, mining, and timber); archipelagos (Galapagos Archipelago, with its high sensitive biodiversity hotspots, and Socotra Archipelago, the Yemeni islands where people and nature have to cope with long periods of drought); and the savannah of the Great Limpopo Transfrontier Conservation Area, in southern Africa. Currently, as a pilot initiative for the Caribbean region, the DSS procedure described in this paper is being applied to create an EBM application in a coastal-marine ecological system north-west of the Dominican Republic. The said initiative takes place in the framework of a project implemented by United Nations Environment Programme - Caribbean Environment Programme (UNEP/CEP) funded by the Italian Agency for Development Cooperation (AICS).

METHODS

The DSS toolset includes two categories of instruments: an operational protocol for the execution of multidisciplinary ecosystem-based environmental assessments and a software package linked to spatial and tabular databases, to support the analysis of relevant ecological data and the preparation of synoptic reports. The operational protocol implements EBM applications through the sequential execution of two multi-disciplinary analytical methods: the *Ecosystem Context Analysis* and the *System Cause-Effect Analysis*. In turn, the DSS software package allows for the synchronized integration of multi-windows environment, facilitating the ecosystem-based analysis of spatial and tabular datasets and the compilation of data-aware advanced reports.

Preliminary Phase

At the beginning of an EBM project, meetings with relevant governmental and non-governmental organizations and the civil society are held in order to discuss and prepare the project implementation strategy, as well as to identify key stakeholders and potential partners. A survey to identify other relevant projects targeting similar conservation and resource-management objectives is also conducted. In this preliminary phase, relevant literature references and data sources start to be collated as an initial knowledge base for the EBM planning team as well as all other relevant stakeholders and actors involved in the EBM project.

Ecosystem Context Analysis

The *Ecosystem Context Analysis* is a methodological tool providing straight-forward paths for multi-stakeholders analyses. It allows establishing and managing a participatory analytical process, which ensures an effective dialogue between stakeholders from the civil society, technical and/ or scientific organisations, and administrative institutions toward reaching a common understanding of the relevant EBM context. This procedure is based on deterministic rather than statistical or algorithmic ecological assessments to identify and quantitatively assess the relationships between ecosystem components, functions and services, along with associated human activities. To this end, a box-and-arrows system diagram describes the natural and human systems which underlie EBM scenarios by identifying their structural components (boxes in Figure 1) and their interactions (arrows in Figure 1). These systems are essentially constituted by: the biotic and abiotic components of the natural ecosystem, the services that ecosystems provide to sustain life, and the uses that human society makes of these services. Each of the diagram elements is in turn further characterized through a set of quantitative indexes and indicators.

The construction of the system diagram follows a sequential three stages analytical process (Figure 2) to guide relevant stakeholders in moving from a conceptual (system matrixes), through a qualitative-structural (system diagram), to a quantitative-structural (system diagram and indicators) practical representation of the biological, environmental and socio-economic systems at the basis of the EBM of the relevant spatial domain. This is typically achieved through a set of workshops, usually ranging from one to three depending on the complexity of the given management context.

The first step of this process includes the identification of major characteristics of the area. This exercise helps the EBM planning team to break the reality down in several management sectors, such as natural resources, agriculture, tourism, fishery and so on. The analysis also includes the identification of the main services provided by the ecosystems of the focused area. The description of each single sector is developed in a set of system matrices, or tables where all the components are listed and illustrated, with components possibly comprising one or more sub-components. For example, a system matrix focusing the coastal and marine ecosystem sector of a given EBM application could include the components that give a synoptic representation of such sector (wetlands, karstic system, beaches and sand dunes, rocky coast, coral reef and marine prairies in the example of Figure 3). The sub-components that further describe the wetland could be: mangroves, coastal lagoons, and estuaries; similarly, the marine prairies component may include mixed-prairies, single-species dominated prairies, sandy sea bottom, and rocky sea bottom as sub-components. The system matrix

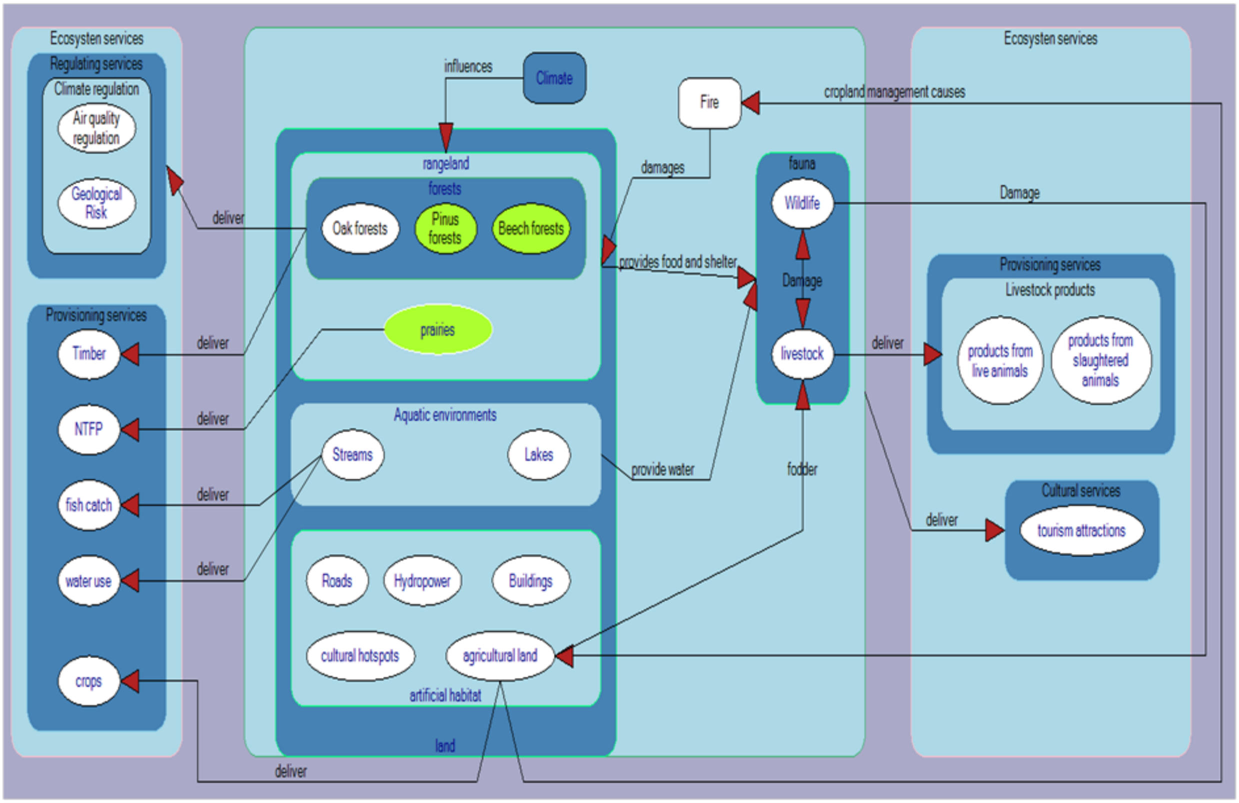

Figure 1. Example of DSS system-diagram (DSS application in Albania).

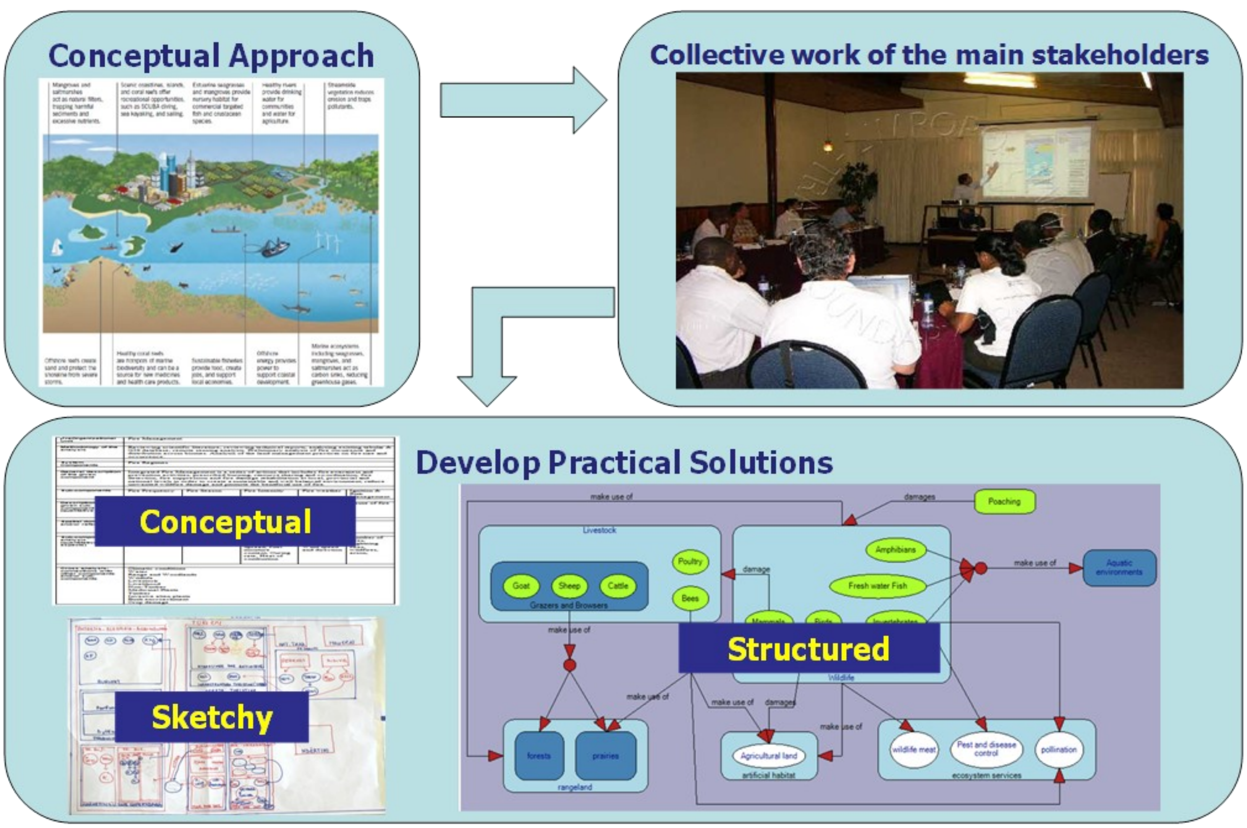

Figure 2. Key steps of the Systemic Context Analysis.

also includes a brief description of all the components and sub-components there listed, with circumstantial or local information included if available. Otherwise the description, albeit more generic, would still serve as a record of the common view that the EBM planning team has developed on the actual socio-ecosystem realities that the various components represent. The last analytical item to be included in the system matrix is a brief description of the key ecological or social mechanisms which regulate the interaction between the components and sub-components identified in the very matrix; an example of interactions could be the influence of the karstic system on the water quantitative and qualitative parameters of the wetland component.

In the second analytical step, the EBM Working Group further develops the collective understanding of the EBM scenario described in the system-matrices and transposes it into a diagram (Figure 4). All the components and sub-components defined in each of the matrix are initially drawn in a system-diagram as box items; the hierarchical structure of components and related sub-components is represented by drawing relevant boxes one inside the other. Once all components and sub components of the matrix have been drawn in the system-diagram, the information reported in the matrix to describe the interactions between the components and sub-components is used to draw the initial set of links (arrows) between relevant components (boxes) of the diagram. At this stage of development, the system-diagram is not providing any additional information other than that already included in the system-matrix. However, this new diagrammatic representation of the same information can help to identify possible inconsistencies and/or incompleteness of the model, either in the definition of components and sub-components (the "structure" of the system being studied) and/or in their interconnections (the dynamics of the given system, that is the way different components interact between each other). The EBM planning team can thus now work to adjust this basic diagram to solve inconsistencies and remove incompleteness, through a step-by-step iterative process leading to the construction of a strong-structured system-diagram modelling the biophysical and human system at the basis of the given EBM application. Detailed methods and examples are available to guide the execution of this task (PROGES 2009).

The third and final step of the *Ecosystem Context Analysis* is for the EBM planning team to develop a set of quantitative indicators to quantitatively characterize each component and sub-component of the system-diagram. Information and data from technical report, scientific papers as well from any other relevant source are collected and analysed to quantify chosen indicators. For example, one of these indicators for the characterization of the system-diagram component coral reef habitat could be the richness of coral fish species trend illustrated in Figure 5.

The System Cause-Effect Analysis

The *System Cause-Effect Analysis* is a straight forward procedure that, using the system-diagram and the indicators resulting from the *Ecosystem Context Analysis*, leads to the definition of an integrated set of management measures coherent with the principles of EBM. The systematic analysis is aimed at (Figure 6):

i) Assessing the conservation status of and the threats to each component of the ecosystem,
ii) Estimating the current level of use, or overexploitation, or untapped-potential of the ecosystem services,
iii) Using the assessments and estimations to identify management initiatives linked with the sustainable use of the ecosystem services.

Following this procedure, each management measure is directly linked to the relevant components of the social and ecological systems or to their interaction, both because: every single management proposal is originated by the analysis of the components and; because it is finally targeted to them. Baseline and target for assessing the performances in the implementation of these management measures can be defined using the same indicators resulting from the *Ecosystem Context Analysis.*

The DSS Software Package

The DSS software package, named Integrated Spatial Planning (ISP, PROGES 2009), is a user-friendly Ms Windows application that could be useful to implement several planning and management tasks, such as: Sustainable development; Environmental Based Management; Biodiversity conservation; Planning and management of protected areas; Rehabilitation and restoration of degraded land areas; Adaptation to climate changes; Risk assessment and management of natural disasters; Land use planning; Infrastructural networks (e.g. water, transportation, roads, agricultural & industrial facilities); Waste management; Urban development planning. The main window of the software shows maps, tables or charts, system diagrams, and a space for notes, comments or a report draft (Figure 7). It gives the opportunity to visualise different kind of information in order to compare different components targeted by a possible management action. The software also includes a tool (*hyperlink*) that links the name of the components in a report to the components shown in the DSS, as well as their relative maps, tables or charts , in order to support the decision making process (Figure 8).

RESULTS

The methodological tools and the ISP software package described are currently being applied to develop an EBM project application in a coastal-marine ecological system north-west of the Dominican Republic. The Dominican application is intended as a pilot to widespread the use of EBM in the Caribbean region through the use of the DSS. This initiative is being implemented through the extensive and active involvement of regional experts and stakeholders, with the aim of building a Caribbean community of EBM practitioners that, in a long-term perspective, can further widespread EBM in the region. The initial activities and the preliminary outcomes of the process for the development of the EBM DSS application in the Dominican Republic are summarized below.

The representatives of UNEP-CEP and Caribbean Marine Protected Area Management Network and Forum

(CaMPAM) met those of AICS and the DSS technical team (PROGES Consulting and Sapienza University of Rome) in Rome, in order to discuss and prepare the project implementation strategy (January 2015). This initial meeting was followed by an institutional meeting with the Ministry of Environment of the Dominican Republic, in order to identify the project target area, then identified in the network of protected areas in the Dominican provinces of Montecristi and Puerto Plata (Figure 9), the potential partners, as well as to explore the availability of relevant data. UNEP-CEP/CaMPAM and the DSS technical team also had meetings with governmental and non-governmental organizations, and visited twice the target site as well. They attended also a regional workshop organised by The Nature Conservancy (TNC) with representatives of other the DSS projects operating in the Caribbean to coordinate with other relevant initiatives at the Regional level (May 2015).

After the project had finalized relevant administrative procedures to get fully operational, the identification of key stakeholders and their potential role in the planning and management of the project target area was carried out in June 2016. The first two workshops for the establishment of the DSS were then held in October 2016, to introduce the DSS to the local stakeholders and initiate the *Ecosystem Context Analysis* by developing the system-matrixes for the marine-coastal ecosystems of the two Dominican provinces targeted by the project. The planning teams involved in the workshops included 15 members for Puerto Plata and for 23 in Montecristi; eleven people attended both workshops. They have discussed and agreed to create two main working-groups, and for each of these teams have collectively selected a leader to support the general project coordinator appointed by the Dominican Ministry of Environment for the development of the two DSSs.

The list of the main management sectors for each area was compiled, for Montecristi the stakeholders identified eight sectors: coastal-marine biodiversity, composed by **marine-coastal ecosystem** (11 sub-components) and **biodiversity** (two components, flora and fauna and 12 sub-components); **natural and cultural protected areas** (seven sub-components); **river basin** (two sub-components and 6 additional -sub-components); **coastal infrastructures** (seven sub-components); **tourism** (nine sub-components); (other) **economic activities** (eight sub-components); **transboundary aspects (**no sub-component**)**. For Puerto Plata

Matriz	**Ecosistemas Costero Marinos**						
Methodologia de analisi	Identificacion, classificacion y evaluacion de ecosistemas costero marinos						
Componentes	**Sistema Karstico**	**Humedales**	**Playas y Dunas**	**Costa Rocosa**		**Arrecifes coralinos**	**Praderas Marinas**
Descripción de los componentes (cualitativa y cuantitativa)	Superficial y subterraneo alimenta las reservas de agua subterranea y los humedales.	Areas planas inundables de manera permanente o temporal, ricas en flora y fauna	Deposito de sedimentos no consolidados (marina o terrigena) , la duna es un deposito de arena por las accion del viento.	Costa de sedimentos consolidados , estable, compuesta por rocas expuestas al castigo de las olas, de diferente tipologia		Ecosistemas constituidas por organismos calcáreos sedentarios (algas, corales, esponjas, y otros), sumergidas permanente o temporalmente	Vegetacion subacuatica compuesta por las fanerógamas marinas
Sub-componentes		Manglares Lagunas Estuarios Marismas	Playas biogenicas Playas de origen terrigena	Tramos de costa rocosa carstica	Tramos de Costa con rocas sedimentarias	Arrecifes de franja Parchos arrecifales Bancos arrecifales	Praderas mixtas Praderas monoespecificas Fondo Blandos Fondo Rocoso (ubicar)
Descripción de los sub-componentes (cualitativa y cuantitativa)		**Manglares** Bosques costeros compuestos por los mangles, en las áreas intermariales . Localizacion: Luperon, Isabela, Maimon, Estero Hondo. Aproximadamente 10% de linea de costa tiene manglares. Area estimada.. **Lagunas costeras** Cuerpos de agua permanentes o temporal, de aguas saladas /salobre o dulce. Principales: Cabarete y Goleta (espejo de agua ...m2), Laguna Grande (...m2), Cano Viejo (...m2), Laguna Cole (...m2). **Estuarios** Areas de desembocaduras de	Biogenicas están compuestas por depósitos de particulas de carbonato de calcio de origen biológico (coralino, algas, moluscos, etc) . Terrigenas son compuestas por los sedimentos provenientes de la erosión terrigena y rios. 25 playas descritas. Principales: Cabarete, Sosua, Long- Beach, Playa, Cofresi, Playa Dorada entre otras. Longitud aprox. 30% de linea de costa	Origen cárstico. Isabela, Cabarete (playa Encuentro), Sosua, Puerto Plata, Punta Burén.	Origen -rocas sedimentarias. Luperon, Maimón, Cofresi.	Arrecifes de franja: Formaciones arrecifales paralelas a la costa. Arrecifes de parche: Formaciones coralinas dispersas, en forma de monticulos, de diferente extensión. La linea de arrecifes de franja no es contimua con las formaciones interrumpidas por canales y de desarrollo de relieve bajo. La estructura arrecifal incluye las lagunas continuas. Arrecifes de parche son predominantes. Desarrollo corrales muy pobre. Extensión por la linea de costa es de 60%. Bancos coralinos: formaciones coralinas con significativo desarrollo vertical, lejos de la costa. Banco de la Plata. 42 km2. Cobertura coralina...	Asociación de vegetación subacuática compuesta por varias especies de fanerógamas marinas. Asociación dominada por una especie de fanerogamas marinas (Thalassia, Siringodium, etc.). Principales áreas: Bahia de Luperon, Maimon, Isabela, Estero Hondo, Sosua (parches), Costa de Puerto Plata.

Figure 3. Examples of DSS system-matrix

Matriz	Ecosistemas Marinos							
Methodologia de analisi	análisis de los principales hábitats marinos y de las especies de interés natural y económica							
Componentes	mar abierto			arrecifes externos	arrecifes corallinos			otros
Descripcion de los componentes (cualitativa y cuantitativa)				dos islas frente de la playa al oeste de la ciudad	arrecife coralino al oeste de la ciudad (256 km²)			-------
Sub-componentes	peces pelagicos y tiburones	mamiferos marinos	tortugas marinas	No hay	especies de corales	peces de corales	molluscos y crustáceos	-------
Descripción de los sub-componentes (cualitativa y cuantitativa)	Especies más pescadas: *S.commerson*, *makaira ssp.*, *T.albacare*, *E.affinis*, *K.Pelamis*	7 especies de delfines, manaties	Se encuentran 4 de las 7 especies de tortuga marinas de este océano		253 especies de corales formadores de arrecife 30 especies de corales blandos	Comunidades principales: *C.flavaxilla* 20%, *C.weberi* 11%, *P.caeruleus* 10%, *D.marginatus* 9%, *S.versicolor* 8%, ...		-------
Relaciónes con otros componentes	pesquería industrial: la pesca sostenible proporciona alimento, genera empleo y contribuye a la economía local (ver Matriz: Actividades Económicas)			protegen el litoral da tormentas severas	actividades recreativas y turísticas como buceo y pesca deportiva (ver Matriz: Actividades Económicas) pesquería artesanal (ver Matriz: Actividades Económicas)			-------

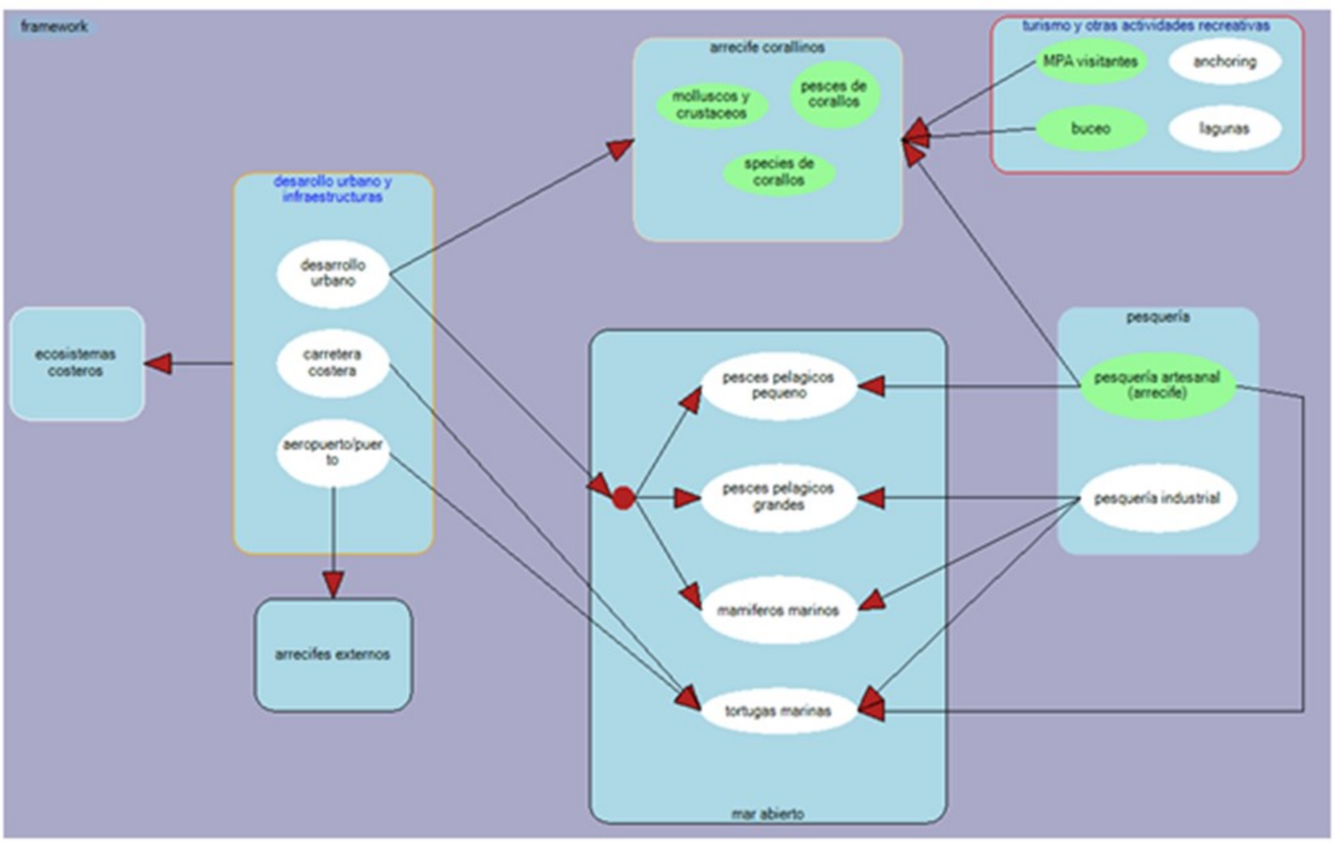

Figure 4. Transposition of a system-matrix into a diagrammatic view

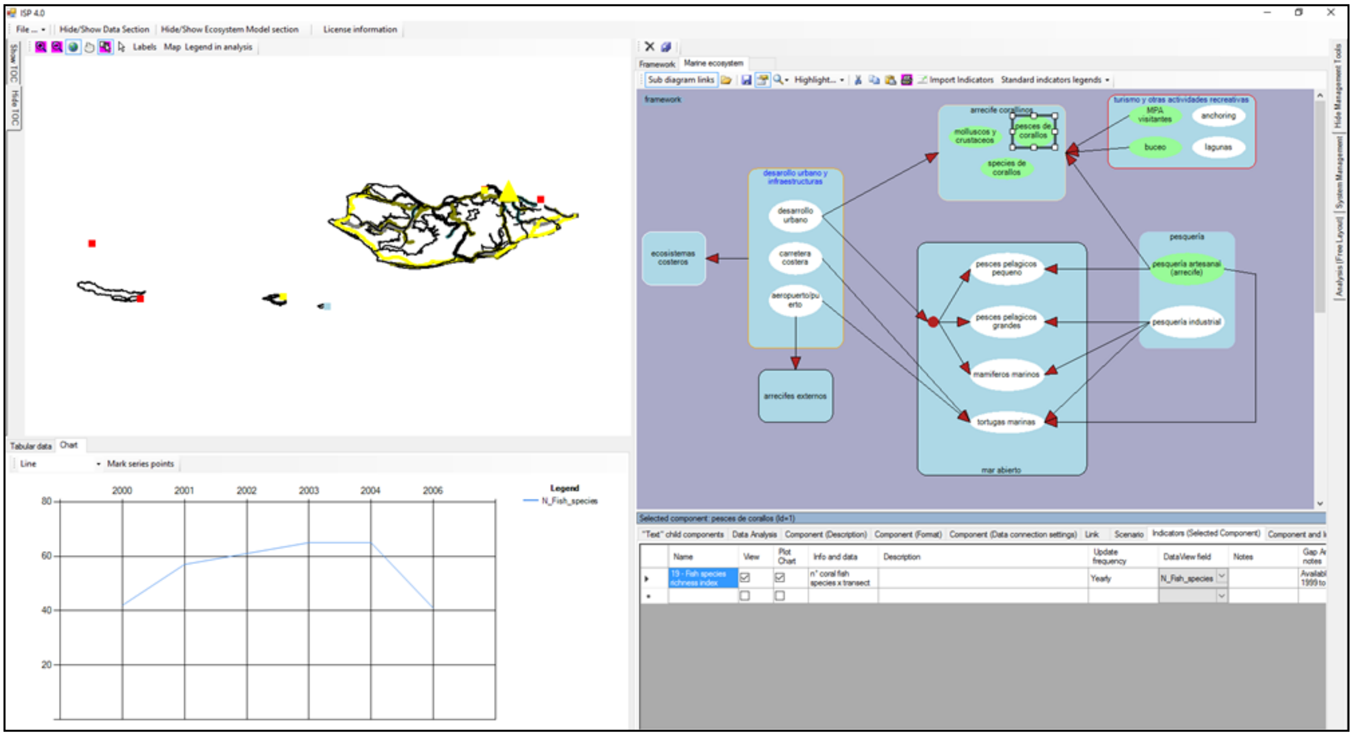

Figure 5. Examples of DSS indicator.

N.	Component		Direct Interaction with other components		Management options
	Name	Quantitative analysis	Related Component	Description of the interaction between components	
1	sistema naturales	Incluye sub componentes ilustrados en la fila 5 - 7.	sistema antrópico	competencia espacial con sistemas naturales (estenzion y fragmentación)	
2	ecosistemas marinos	Incluye sub componentes ilustrados en la fila 5 -			
33	ecosistemas costeros	Incluye sub componentes ilustrados en la fila........			
4	ecosistemas terrestres	Incluye sub componentes ilustrados en la fila			
5	aguas abiertas				
6	arrecifes externos				
7	arrecifes coralinos	Incluye sub componentes ilustrados en la fila 8 - 10.	actividades recreativas y turísticas	el número de turistas está creciendo continuamente en todos las AMP de Soqotra excepto en los de las islas exteriores donde siempre se mantiene a niveles despreciables. Emerge, por lo tanto, una relación de causa y efecto entre los turistas y la pérdida de riqueza de los peces de corales en las AMP de Soqotra.	Con el fin de aligerar la presión turística en las AMP de Soqotra: 1) Establecer conexiones semanales con número fijo de turistas entre la isla principal y la isla externa de Abd al Kuri 2) establecer límites de visitantes semanal para el acceso a las AMP de Socotra. Objetivo: recuperar la mitad de la pérdida de la riqueza de especies en las AMP de Soqotra y mantener estable aquellas de las islas externas.
8	peces coralinos	la riqueza de las especies muestra una tendencia decreciente en el 2005 - 2006 en todas las áreas excepto los de las islas periféricas			
9	molluscos y crustáceos				
10	species de corales				
...	...	...	...	...	....

Figure 6 .Example of System Cause-Effect Analysis.

Figure 7. Main window of the ISP software package.

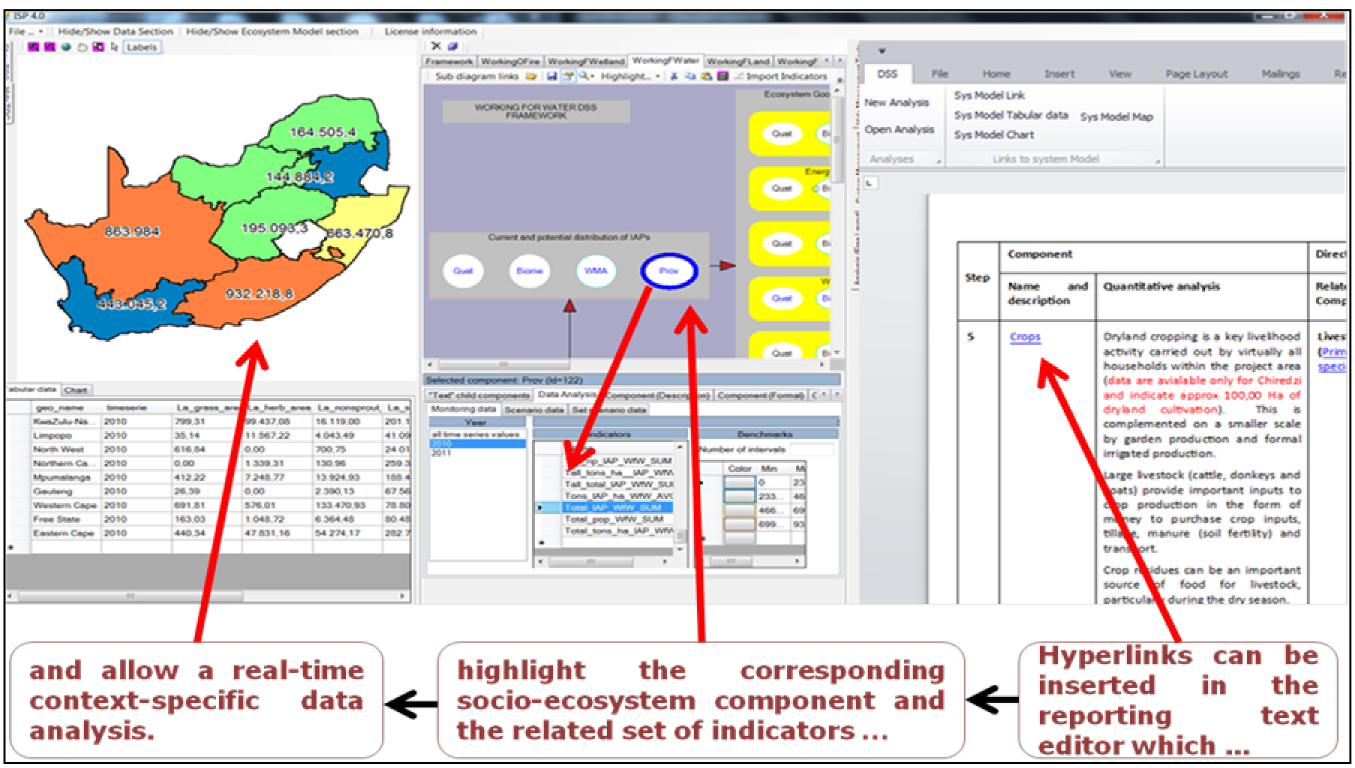

Figure 8. The quick report drafting tool of the SP software package.

the stakeholders listed seven components: coastal-marine biodiversity (9 sub-components); **marine-coastal ecosystem** and **biodiversity** (flora and fauna); **river basin** (6 sub-components); **coastal infrastructures** (five sub-components); **tourism** (11 sub-components); (other) **economic activities** (six sub-components); **natural and cultural protected areas** (no sub-component). The next two workshops to develop the system-diagram were scheduled for the last week of November.

DISCUSSION

An innovative DSS has been illustrated in this paper which includes a hands-on set of methodological and software tools to effectively handle the present challenges which hamper the widespread application of EBM.

The use of the *Ecosystem Context Analysis* and the *System Cause-Effect Analysis* methods dramatically reduces the efforts that, as also highlighted in Leslie et al 2015, are needed to ensure the coordination of EBM actions across multiple institutions and sectors at different geographic scales. This is because the use of the system-matrices and the system-diagrams drives the analysis of stakeholders to systemically focus each elemental component of the relevant social and ecological systems as well as, through the arrows of the system-diagram, to all other components associated by social, economic or ecological dynamics. The analytical pattern just described also allows the stakeholders to immediately realise all elements, relations, interactions or conflicting issues characterising the system, thus allowing them to decompose the complex EBM dynamics in a structured set of simple elements and, thus, to realise all the possible relations, interactions or conflicts between them. This work on a simple decomposed reality helps them to develop a common attitude and vocabulary toward EBM, thus removing one of the barriers that Arkema and colleagues (2006) have identified as hampering the communication among scientific communities, management agencies and the public involved in EBM application. The *Ecosystem Context Analysis* and the *System Cause-Effect Analysis* methods have indeed been applied in a variety of ecosystems, and have always proven easy-to-apply and extremely effective in ensuring that all relevant stakeholders reach a common understanding and management view of how environmental, social and economic considerations fit together in EBM applications. This effectiveness is also being confirmed in the current application in the Dominican Republic where, even if the project is still in its initial phase, the process of understanding, communication and mutual learning between stakeholders is already noticeable.

Leslie and colleagues (2015) evidenced that EBM applications require significant investments in data collection, management and consult, characteristics that could be a considerable limit when EBM is applied in

Figure 9. Focus area of the EBM-DSS pilot application in the Dominican Republic: the network of protected areas in the provinces of Montecristi and Puerto Plata (Picture modified from: Finke and Santana 2014)

developing countries. By applying the *Ecosystem Context Analysis* method, this investment can however be easily reduced to the minimum possible for a successful EBM application. This is because the data needs, availability and gap analyses are systematically executed in relation to the indicators attached to the key components of the relevant environmental and socio-economic systems. Also, the *System Cause-Effect Analysis* allows identifying the components which must necessarily be assessed with quantitative indicators, requiring the main investments in terms of economic or human efforts, and others that could be calculated using qualitative indicators or be analysed through expert's and/or local-community knowledge as an initial proxy. The DSS software tools also make extremely efficient handling the large EBM datasets.

The above discussion on what has been briefly illustrated in this paper supports the contention that the DSS here presented can be a significant step forward to meet the need for a general application frameworks that planners and managers can apply in a wide variety of ecological and socio-economic contexts for moving from know-how to how-to in attaining EBM. A need highlighted in a number of literature references cited in this paper (Arkema et al 2006; Aswani et al 2012; Long et al 2015). The Dominican Republic and Caribbean project currently being implemented by UNEP and AICS is of particular importance in this respect, not only because it focuses coastal and marine ecosystems which complement the array of terrestrial ones where the DSS has already been successfully applied, but also because quite a number of national, regional and international conservation and sustainable development players are particularly active in this region. Particular attention is being dedicated to the stakeholder participation, as a milestone of the DSS approach, answering to a necessity of capacity building promotion already recorded by Pomeroy et al. (2004) for all stakeholders in the Caribbean. All activities to develop the Dominican DSS, and later the management and the actions plans, are executed with the active participation and the constructive contribution of all the stakeholders. The final aim is to create a team that not only understand and apply the DSS tool, but develop a system thinking pattern that allow them to lead the widespread application of EBM at the regional level.

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