

Biodiversity for Sustainable Development in the Caribbean through Ecosystem Based Management (EBM-DSS)



REGIONAL WORKSHOP ON ECOSYSTEM-BASED MANAGEMENT AND APPLICATION OF DECISION SUPPORT SYSTEMS IN THE WIDER CARIBBEAN REGION

4-6 December 2017, Crowne Plaza Panama Hotel

Panama City, Panama

Final Report

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I. WELCOME AND INTRODUCTION

1. In keeping with the objectives of Protocol on Specially Protected Areas and Wildlife (SPAW) under the Convention for the Protection and Development of the Marine Environment in the Wider Caribbean region (Cartagena Convention) and the Agenda 2030 (plan of action for people, planet and prosperity), the Government of Italy and UN – Caribbean Environment Programme (CEP) have developed a partnership in support of implementation of UN Sustainable Development Goals by Governments of the Caribbean, through a Project: “*Biodiversity for Sustainable Development in the Caribbean through Ecosystem Based Management*” is being implemented by UN Environment-CEP thanks to financial support from the Italian Ministry of Foreign Affairs and its Italian Agency for Cooperation and Development (AICS).
2. The project was launched in 2015 with the aim to develop the region’s institutional capacities through knowledge transfer needed for integration of a regional Decision Support System (DSS) for strategic/operational planning of marine managed areas. As such, the project will promote and enhance the capacity and sustainability of CEP programmes regionally and globally, including SPAW activities, the Caribbean Marine Protected Areas Management Network (CaMPAM), and collaboration with governments, local, and international partners.
3. The practical application of Ecosystem-Based Management (EBM) is still a challenging task for relevant stakeholders primarily as it relates to availing innovative operational protocols and software tools to establish EBM Decision Support System (EBM-DSS) across the Wider Caribbean. An EBM approach, moving beyond the business-as-usual, sectoral management, is key to maintaining viable healthy ecosystems and their associated goods and services to enhance livelihoods of vulnerable coastal populations across the Wider Caribbean Region. Developing capacities and promoting information systems are an integral part of sound planning and management of such coastal resources.
4. The Workshop was opened at 09:10 on 4 December 2017 with remarks by Ms. Monica Borobia-Hill on behalf of UN Environment-Caribbean Environment Programme (CEP) and its Coordinator, Ms. Lorna Inniss, welcoming participants and thanking them for their presence and the Government of Panama for their hospitality.
5. In her remarks she outlined that through this project an EBM/DSS tool along with the complementary use of the Integrated Spatial Planning (ISP) software built by the Italian consulting company PROGES, is being further developed and adjusted for the region. Selected pilot sites in the Dominican Republic are using the EBM/DSS application to guide



either responses to the degradation of ecosystem services, or the improvement of conservation strategies resulting from the recommended priority actions. The future is uncertain, and so EBM tools need to account for that uncertainty.

6. Mr. Alberto Pacheco, Programme Officer, UN Environment Regional Office for Latin America and the Caribbean (ROLAC), Panama City, addressed the workshop and highlighted the importance of the Cartagena Convention as the framework for collaboration regarding marine resources protection and climate change in the Caribbean which was being discussed at the session underway at the UN Environment Assembly in Nairobi. He acknowledged the support of the Italian Government to the project in building capacity to develop decision support systems for coastal management in the Caribbean.
7. Mr. Mauro Ghirotti in representation of the Italian Agency for Cooperation and Development (AICS) expressed his appreciation for the opportunity to learn details of project implementation and to meet colleagues from the Wider Caribbean. He highlighted the importance of the Cartagena Convention and its historical significance and leadership in the region regarding marine protection, as demonstrated at the UN World Ocean Conference held in New York (June 2017).
8. Mr. Ghirotti noted that differences among Caribbean countries were assets rather than limitations, as recognized through the commitment of his government in supporting this project. Under the coordination of UN Environment, the EBM approach to decision making has been effectively incorporated to transform bureaucracy into real activities and practical actions. He remained optimistic in accomplishing the target of conservation of 10% of marine protected areas, and acknowledged the collective efforts needed to continue partnerships to achieve this goal. Mr. Ghirotti there is a need to understand the complexity of the problems, and to build solutions together that were based on sound science.

II. WORKSHOP OBJECTIVES

9. The EBM/DSS regional workshop aimed to provide a general introduction to concepts surrounding an ecosystem-based approach so as to enhance the skills of scientists, Marine Protected Area (MPA) practitioners, and planners across the Wider Caribbean Region (WCR) to:
 - a) Strength understanding on the use of EBM methods and tools through the simulation of applying a Decision Support System (DSS), including in-depth discussions;
 - b) Allow learning and provide feedback on the role of Regional EBM Network Nodes;
 - c) Explore opportunities to further expand efforts in the region or promote potential partnerships in developing EBM-DSS applications; and
 - d) Capture and disseminate best practices and lessons learnt, for the replication and up-scaling of the EBM approach within and beyond national boundaries.

III. PARTICIPANTS

10. The EBM/DSS regional workshop was attended by forty-one (41) participants from sixteen (16) Caribbean countries which included representation by/from government officials, non-governmental organizations, and EBM/DSS scientists and experts (Table 1, Figure 1). In addition, there were six (6) representatives from UN Environment-CEP to assist with logistical and technical aspects, along with support from the UN Environment ROLAC office in Panama which was greatly appreciated. The list of participants appears as ANNEX 1 to this report.

Table 1. Summary of the type of EBM/DSS workshop participants

Type participants	Government	Non-government	Countries
Experts	8	4	8
MPA managers	11	3	12
Planners	14	1	8



Figure 1. Group picture taken at the end of the workshop



IV. METHODS

11. The three (3) day workshop consisted of five (5) main sections. The Agenda appears as ANNEX 2 to this report.
12. **Section (1) INTRODUCTION AND WORKSHOP BACKGROUND**, consisted of providing context for the workshop, welcome remarks, background issues, the adoption of the workshop agenda and the organisation of work.
13. **Section (2) BASIC TRAINING ON THE USE THE EBM METHODS, TOOLS AND TEMPLATES: SIMULATION OF AN EBM-DSS PROJECT**, addressed firstly the basic concepts and definitions of the EBM/DSS methods and tools which were delivered through presentations made by the core Project Team, led by Ms. Martha Prada, Project Coordinator and PROGES Consultancy (Mr. Marco Falcetta, Mr. Edoardo Scepi and Ms. Francesca Pella). The adaptation of the PROGES EBM/DSS methodology to local realities and its potential application to different situations and problems were extensively revised and discussed. An overall presentation of the project was made, prior to introducing the specifics regarding the EBM/DSS application.
14. Subsequently, training through the simulation of real case scenarios was initiated, thus applying the '*learning-by-doing*' concept. A detailed description of the project pilot site of Montecristi, Dominican Republic, was presented by PROGES and the Ministry of Environment and Natural Resources of the Dominican Republic (See ANNEX 3 to this report). It was illustrated with real data, a series of imagery, and additional tables and graphs. With this information, participants acquired relevant information to enter into and to complete working groups exercises. Three (3) working groups were therefore formed to ensure a good mix of scientists, resource managers, and planners from public and non-governmental organisations (Table 2).
15. Each working group followed the step-by-step process of the DSS methodology, including the generation of matrices, box and arrows diagrams, identification of indicators, and assessment of ecological risks and socio-economic stresses for the three (3) pre-selected ecosystem components: **1)** coastal and marine ecosystems; **2)** economic activities; **3)** coastal infrastructure.
16. The working groups were guided through this process by a PROGES expert, with assigned note takers. For this exercise the working groups utilized a simplified version of the Dominican Republic EBM-DSS application specifically prepared by PROGES.

Table 2. List of Participants of the workshop working groups

Working Group 1: Coastal & marine ecosystem	Working Group 2: Economic activities	Working Group 3: Coastal infrastructure
Maria Rosa Garcia	Bob Glazer	Pamela Fltecher
Alejandro Acosta	Arejen de Woelf	Carolina Garcia
Alessandra Vanzella	Julian Walcott	Sussane Leib
Hyacinth Armstrong	Orlando Harvey	Tadzio Bervoetes
Ruleta Camacho	Gilles Kleitz	Alain Pibot
Nina Lysenko	Kashief Hynes	Stephen Nimrod
Thenna Ward	Loureene Jones	Rohan Payne
Irker Irazabal	Juan Posada	Antonio Clemente
Andre Edwards	Pauloine Siret	Luis Alejandro Bastidas
Gonzalo Cid	Margarita Rozo	Magali Torres
Prenor Coudo	Oderay de Negrís	John Knowles
Marino Abrego	Frederik Southwell	Frank van Slobbe
Francesca Pella	Edoardo Scepi	Marco Falcetta
Martha Prada	Monica Borobia	Sandrine Pivard
Jodi Johnson		Georgina Bustamante

17. Upon completion of each DSS step, a plenary was convened to present the results from each working group, followed by questions, further discussion, and general feedback from participants.
18. **Section (3) THE ROLE AND ESTABLISHMENT OF REGIONAL EBM NETWORK NODES IN THE WIDER CARIBBEAN** was aimed at exploring the role of the regional nodes, institutional profile and capacities needed;
19. Representatives from both Carolina García (INVEMAR) and Julian Walcott (CERMES) introduced their institutional profiles, capacities, and the expected roles and outcomes as institutions which will serve as regional coordinators/nodes. Such regional nodes emanating under the present project are envisioned to be instrumental in the scaling-up results achieved from the two (2) pilot sites to sub-regional levels and/or national levels.
20. **Section (4) THE WAY FORWARD AND UP-SCALING OF EBM IN THE WIDER CARIBBEAN** addressed lessons learned, challenges and limitations, and road map for the sustainability and replication of the EBM-DSS approach, both at national and regional scales.
21. **Section (5) WORKSHOP CLOSURE** dealt with recommendations, conclusions and closing remarks.



V. RESULTS

Section (1) Project achievements

22. UN Environment-CEP consultant and Project Coordinator, Ms. Martha Prada, provided an overview and update on the implementation of the EBM-DSS project, and summarised the status of activities under each of its expected results, as follows:
23. R1: Regional MPA database improved
- Evaluation of Caribbean Marine Protected Area Network and Forum (CaMPAM) MPA database completed
 - CaMPAM MPA database transitioning to UN Environment server
 - UN Environment team analysing the independent evaluation report of CaMPAM
 - Strategy for updating database information for 42 MPAs, including those listed under the SPAW Protocol
24. R2: Two (2) areas in the north coast of Dominican Republic selected as pilot sites (Montecristi and Puerto Plata) and DSS established
- Three (3) national workshops completed, one (1) final workshop being developed
 - Socio-economic context and local needs addressed
 - Developing systems diagrams
 - Set of indicators developed for DSS application, analysis and management actions
 - DSS software update - ISP software updated to v 5.0
25. R4: Promoted and developed technical skills for MPA practitioners to run the DSS
- Planning and development of the XII edition of the Training of Trainers (ToT) in Marine Protected Area Management course, for Spanish speaking countries in October, 2016
 - Seven (7) in country follow-up course activities that benefited 716 people from the Wider Caribbean Region
 - Strengthened educational strategies on EBM-DSS
 - Planning and developing the ToT for English speaking countries to be held in Barbados, April 2018.
26. R5: A regional DSS established and planning measures for conservation and sustainable management coastal and marine resources in the Wider Caribbean Region identified
- Establishment of an EBM-DSS regional node set at the Centre for Resource Management and Environmental Studies (CERMES) at the University of West Indies, Cave Hill campus, in Barbados. This node will work English speaking countries



- b) Establishment of a second EBM-DSS regional node at INVEMAR (Instituto de Investigaciones Marinas y Costeras Jose Benito Vives de Andreis), in Santa Marta, Colombia. This node will work with Spanish speaking countries
- c) A special workshop on marine spatial planning and EBM-DSS in association with the 70th GCFI annual meeting, held in Merida Mexico, November 5, 2017
- d) Regional workshop on EBM-DSS in the Wider Caribbean Region held in Panama City, Panama, December 4-6, 2017 (This workshop)

27. R7. Project outcomes consolidated, and integrated into relevant UNEP EBM Program which & shared among WCR and globally

- a) Project results and lessons learnt have been presented at eight (8) different forums in the United States (Miami, San Juan, Puerto Rico), Italia (Roma), Dominican Republic (Puerto Plata, Montecristi, Santo Domingo), Cayman Islands (Grand Cayman), Panama (Panama City), Barbados (Bridgetown), and Mexico (Merida)

EBM concepts and EBM-DSS introduction

- 28. Ms. Martha Prada, along with the PROGES Team, defined the various concepts that would be mentioned during the training exercise including the ecosystem components consisting of biotic, abiotic, human dimensions, species composition, population/community levels. She also introduced the EBM process and available tools that help its progressive application by resource managers and planners.
- 29. An emblematic example using coral reefs was introduced – noting that coral reefs cover 1% of the global surface, but generate 2 to 8% of global fisheries through its vast biodiversity. 75% of shallow corals are in developing countries but represent an immense source of livelihood for thousands of coastal communities. Poor land-based management, increase in sedimentation, nutrients, and pollution, increase in population, resource needs, unregulated development and tourism, and impacts from climate change, are all threats that affect coral species in both space and time. The use of EBM in their management is a process, not an ending point. It varies as a gradient that may begin from the inexistence of EBM, to low levels of implementation to higher levels of EBM, from individual species management to entire ecosystems management, from focusing on a single society sector to several socio-economic sectors.
- 30. A general overview was provided on available software for Marine Spatial Planning (MSP) and EBM applications, including Seasketch (online tool to support collaborative MSP), MARXAN (software-suite design to help decision makers), and other data repository platforms of relevance to the region such as CaribNode, IUCN-BIOPAMA Gateway, CaMPAM MPA Database, Marine Atlas (*introduced in the context of how they can interact with the Integrated Spatial Planning (ISP) tool developed by PROGES*). In particular, a



detailed explanation was provided on the way that the ISP tool collects and displays information to build matrices, box and arrows diagrams, select ecosystem indicators, and how data can be quantitatively analyzed to determine ecosystem trends and run some risk analysis. As a result of this process, specific management actions are identified, prioritized, and then included into technical/management reports/plans for gradual implementation.

31. The need to involve main stakeholders early in the process, independently of the use of a given tool was highlighted, and the establishment of multi-disciplinary working groups was raised as a vehicle to receive basic training to collectively identify key ecosystem components and sub-components. This would also include the need for familiarity with a given area's biodiversity, its socio-economic and cultural networks, and how they all inter-connect through time and space - in other words, to enhance understanding of an ecosystem's complexity.

Analysis of available tools for conducting EBM/DSS

32. Overall, it is possible to structure a regionally collaborative scheme in order to expand the implementation of MSP to DSS, in which data repositories such as IUCN-BIOPAMA and the CaMPAM MPA Database, can provide datasets to large user groups. Seasketch and MARXAN can provide manipulated data to ISP in order to support management plans and decision-making processes.
33. All the key features of EBM-DSS tools and methods require intense and continuous efforts to coordinate management actions. While integration across two (2) or three (3) sectors can be handled easily, expansion across various sectors and stakeholders is often highly demanding for a planning team and may create confusion. As such, EBM is often seen as a daunting and complicated process.
34. In the case of Puerto Plata in the Dominican Republic (one (1) of the project pilots), there are a number of tourism activities which include small hotels, large resorts and cruises, small boat charters, each with different and sometimes conflicting interests. This in turn creates the need for several meetings, collection of extensive data, and handling of large datasets – this is not always feasible in a developing country setting.
35. The PROGES EBM-DSS tool includes two (2) categories of instruments: **1) the ISP software package**, linked to spatial and tabular databases - to support the analysis of relevant ecological data; and **2) the ecosystem context analysis** providing straight-forward paths for multi-stakeholder decisions in three (3) sequential stages:
 - i) components system matrices;
 - ii) interactions with system box-and-arrow diagrams; and
 - iii) quantification with indicators.



36. The application allows for cause-effect analysis and EBM modelling which compiles EBM actions across sectors at different geographic scales. Using this methodological approach, stakeholders reach a common understanding and management view of how environmental, social, and economic considerations fit together. They recognize all elements, relations, interactions, or conflicting issues characterizing EBM, by working on a simple decomposed reality that helps to develop a common attitude and vocabulary toward EBM. A live demonstration on how to use the EBM-DSS software, and methods to attain effective EBM in a real pilot case was also performed.

General discussion with questions and comments

37. Subsequent to the above presentations participants were actively involved in discussions with many expressing a high interest in using the EBM-DSS tool, especially if it provided an avenue for rapid assessment for instance after catastrophic events.

38. The usefulness of the PROGES EBM-DSS methodology in this context is particularly relevant, considering that several Caribbean islands were impacted during the 2017 hurricane season by hurricane's Irma and Maria, leaving behind extensive devastation. Confronted with a lack of data to guide informed decision-making, a discussion issued as to how the tool would allow for capturing uncertainty in the models, reducing the high cost of conducting biophysical and socioeconomic formal surveys, while delivering in rapid turnover. Therefore, it would be beneficial to devise a simplified mechanism/process for better allocation in the case of limited available resources. It was also noted, on the other hand, that quick decision-making processes can be very inadequate if all aspects involved in formulating solutions are not analyzed.

39. Correspondingly, points were raised concerning existing regulations required for the management of single versus groups of species (e.g. sharks), which may play an important role in examining the dynamics of an ecosystem. By exploring the complexity of an ecosystem, it may then be possible to prioritize components (e.g. biological or political), thus focusing research and management actions in the correct areas.

40. There should also be consideration for the 2030 agendas of countries, highlighting the need to utilize science, and streamline the approach of having a common language (considering biological connectivity and building synergies among different projects that government agencies/private organizations are implementing). The PROGES EBM-DSS tool can also be useful if structured databases generate an information system for decision makers on coastal management. The Government of Italy for instance, is assisting countries with writing competitive proposals on climate change adaptation for accessing available resources as they utilize good information and analysis.

41. The question was raised on how to overcome difficulties while working with regional monitoring protocols such as the Global Coral Reef Monitoring Network (GCRMN) which generates valuable and good data from both socio-economic and biophysical



perspectives. Unfortunately, few human resources are able/available to maintain the surveys in the long run because the process is resource dependent requiring training, and an expert exchange programme. The real question is therefore, how can data collection be strengthened to apply this kind of tool? As such, the importance of establishing mechanisms for sharing existing data was highlighted, while noting that some data was already available in regional databases (e.g. fisheries information housed at Caribbean Regional Fisheries Mechanism (CRFM)/Caribbean Community (CARICOM), Central America Fisheries and Aquaculture Organization (OSPESCA) or Organization of Eastern Caribbean States (OECS). Having standardized monitoring protocols may not be as important as being able to measure relevant indicators through time and space. It is key that protocols be based on sound scientific data and reliable indicators.

42. Feedback was requested on how to ensure robust decision-making which was flexible for the future while using the tool. It was explained that management decisions are not the result of a calculation or an estimate. Hence the PROGES EBM-DSS tool can be seen as an aid to bring stakeholders from different backgrounds together, and to ensure that they reach the same goals. The tool is not designed for scientists, but instead indeed for stakeholders and decision-makers.
43. Another comment touched on the usual disconnect between biodiversity and decision-making processes. It is therefore desirable to focus on prioritise actions for solving problems, instead trying to attend multiple solutions derived from complex models.
44. It was also highlighted that a DSS tool should assist in identifying key indicators before decisions are made. At a country level, it must respond to key questions (e.g. population, economic growth) needed for the effective implementation of sustainable resource use linked to Agenda 2030. There are currently numerous initiatives which should be screened to determine areas of overlap.
45. An example was given to reflect the need to consider and have discussions on areas of priority at all levels, particularly including local government- the marine park in Sint Maarten. The Park, which was created following a bottom-up approach, was unexpectedly impacted by Hurricane Irma 15 years after its legal declaration. It lost 90% of coral reefs and mangroves and will require Government support to facilitate any meaningful remedial actions, while ensuring that the local community remains informed.
46. The workshop was reminded that the development of further cooperation and enhanced connectivity at the regional level will be not possible without resource mobilization. This will require prioritization in sourcing external funds from donors and further efforts to build internal, long-term funding mechanisms.



Section (2) Learning by doing approach

47. The PROGES EBM-DSS is a practical, flexible method (step by step process) which promotes training using a hands-on approach. The first step involves working with a multidisciplinary team to list the various ecosystem components - from this list, matrices and then diagrams are developed. To demonstrate the entire process of applying an EBM-DSS methodology utilizing ISP version 5, the province of Montecristi on the North coast of the Dominican Republic was chosen.

Study area

48. Montecristi is located in the northwest region of the Dominican Republic in the coastal lowland, and is confined by the Atlantic Ocean (to the north), Valverde and Puerto Plata provinces (to the east), Santiago Rodríguez and Dajabón provinces (to the south), and the Atlantic Ocean and Republic of Haiti (to the west). The total surface is 1,880.34 km² with a population of 135,710 inhabitants (46.8% urban and 53.2% rural population). In 2010 almost 80,000 people (70.8% of the population) had completed primary or high school level education and 6% up to the tertiary level (Figure 2).

49. With an area of 7,044 km², the watershed of Yaque del Norte river is the largest in the Dominican Republic, and the second largest in Hispaniola. The water from the river is used for irrigation, mainly in the valley that extends from Santiago to Montecristi (known as the Yaque del Norte Valley). There are several dams along the river which generate electricity, store water for irrigation, and provide flood control. Other provincial rivers include the Chaquey river, Masacre river, and Guayajal river.

50. The province biodiversity consists of coastal dry forest, dry limestone forest, and a mixture of wet forest and mangroves. Vegetation and flora are therefore adapted to variations in humidity, salinity, and high and low temperatures. Flora consists of 203 species of vascular plants, 25 of which are endemic and 159 native. The transitional dune ecosystem is also characterised by a wide variety of species due to direct interaction with the different ecosystems present in the coastal area. Of the 161 species of flora reported in this zone, 17 are endemic, 139 native, and 5 naturalized. Even though invasive vegetation dominated by exotic species is naturalized, but do not cover large areas, their presence could still have potentially negative impacts on the local vegetation.

51. Fauna is characterized by 6 local amphibian species, in addition to 1 endemic, and 2 introduced species. Another 4 species of reptiles are frequently observed, not including the marine turtles.

52. Within the marine environment, coral reefs occupy a significant area, and are considered to be of immense importance for the country serving as a vital coastal barrier and protection against strong currents commonly experienced in the Atlantic Ocean. The coral landscape is interconnected with other neritic ecosystems such as seagrass beds,



- mangroves, and sandy beaches, which in conjunction offer essential habitats for many species (including those of commercial or ecological importance). It is therefore common for these reefs to be targets for artisanal fishing.
53. The increasing use of both legal and illegal fishing gear have resulted in overfishing which is likely contributing to some ecological imbalance within the area.
 54. Marine biodiversity of the province is represented by at least 111 families, 198 genera and 336 reported species - another 127 reef-associated fish species have been reported. Monitoring indicates that the reef is characterised by a low abundance of large organisms (e.g. herbivorous fish, sharks, turtles), the presence of coral reef disease, and an average dominance of small fish - all indicators of suspected overexploitation of reef resources.
 55. The Montecristi province (see Figure 2) includes the following protected areas: El Morro National Park (II.A.12), Manglares de Estero Balsa National Park (II.A.15), Montecristi Submarine National Park (IV.B.1), Cayos Siete Hermanos Wildlife Refuge (IV.A.5), and Laguna Saladilla Wildlife Refuge (IV.A.6).
 56. Around the protected area of El Morro, 28 species of birds are reported which include resident, migratory, terrestrial, coastal marine, and aquatic species. The Siete Hermanos Keys are home to nesting colonies of several species of seagulls (*Onychoprion fuscatus*, *Sterna anaethetus*, *Anous stolidus* and *Sterna antillarum*), along with the Saladilla lagoon where 24 species of birds have also been reported.
 57. The overall biodiversity of the province includes at least 6 subpopulations of manatees (*Trichechus manatus*), humpback whales (*Megaptera novaeangleae*), and bottlenose dolphins (*Tursiops truncatus*) which are frequently sighted.
 58. Economic income comes from the agricultural sector and includes bananas (organic and conventional), mangoes (organic and conventional), and rice crops, with minor production of cocoa, garlic and peppers crops. In addition, salt production has become a preference in the province utilizing extensive coastal plains which facilitates the formation of terraces built for salt storage. This process consists of more than 300 artisanal productions traded mostly at the national level.
 59. Tourism is incipient and some infrastructure has been built for its promotion such as the Osvlado Virgil National Airport and the El Morro port. Indeed, the tourism sector is progressively increasing using as a base the rich biodiversity and husbandry culture of the province.

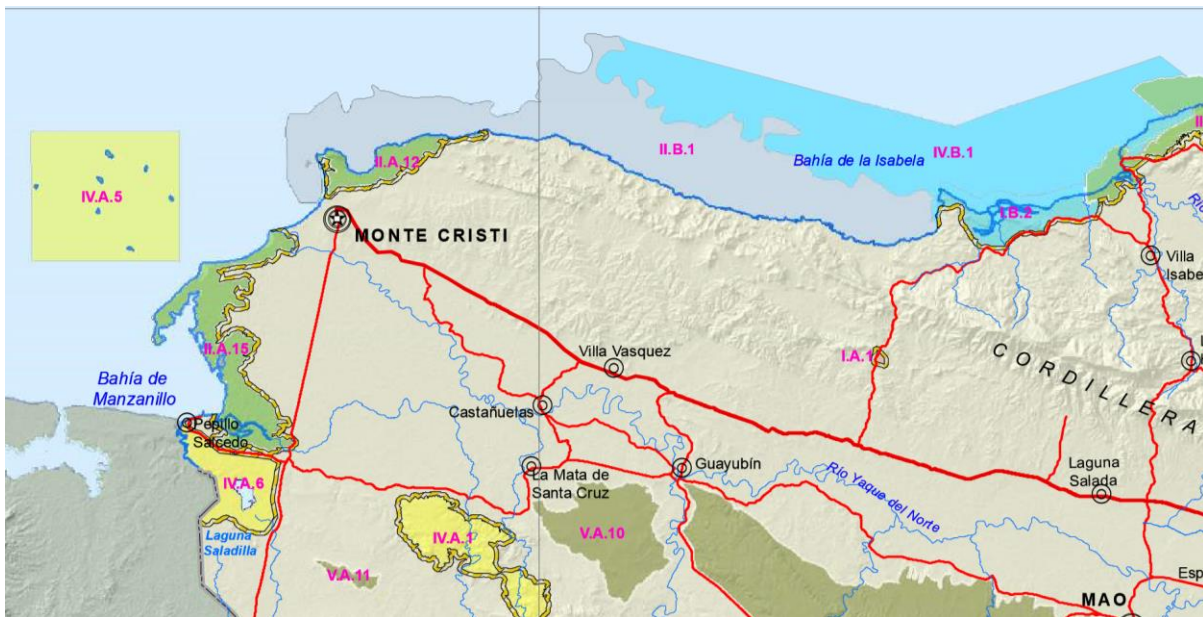


Figure 2. Protected areas of Montecristi province (selected picture from the map of Atlas 2012)

The Process

60. The EBM/DSS exercise developed by the three (3) working groups can be summarized as follows:
61. **Step 1. Drafting System Matrices:** The three (3) working groups identified the main components and sub-components as assigned based on the information provided, and complemented this with information provided by participants that were familiar with the Montecristi area. Matrices of components and their connections were then built. The pilot example allowed participants to have a better understanding of how the software is fed with information, and how the data and connections can be collected and established. Data can be also generated from good interpretation of maps/imagery (ANNEX 3).
62. **Step 2. Development of system box-and-arrows diagram:** Work continued with the development of the box-and-arrow diagrams that describe the dynamics (arrows) between the biotic and abiotic components (boxes) of the natural ecosystems - the services that ecosystems provide to sustain life (boxes), and how these services are used (boxes) (Figure 3a,b,c). During the process it was realized that the social/governance component needed to be reflected and so it was added to the matrix and diagram. The software facilitates simplification of the linkages among components that help to better visualize relationships, and so, users can adjust the number of groups and regroup components depending on the overall analysis of the multidisciplinary team.



63. **Step 3. Development of indicators, construction of an EBM database:** With the establishment of indicators, it was possible to reduce/simplify the previously identified interactions. The importance of monitoring and protocols were discussed as vital sources of high quality data.
64. **Step 4. Assessment of ecological risks and socio-economic stresses and identification of management interventions:** priority activities under each component were selected by each working group as it was recognized that the process could be useful in identifying research need priorities.

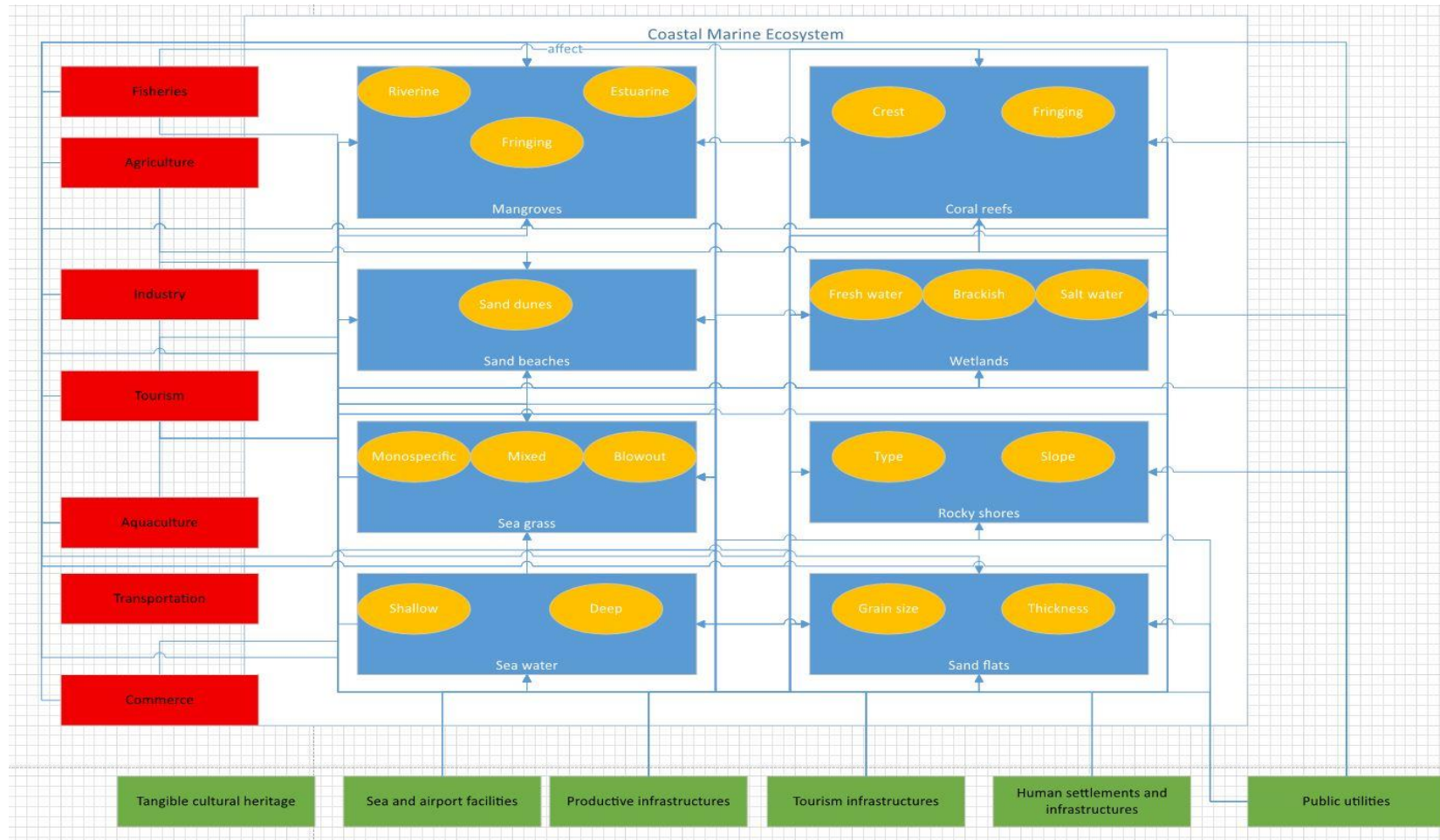


Figure 3.a. Box and arrow diagram for the coastal and marine component generated by working group 1.

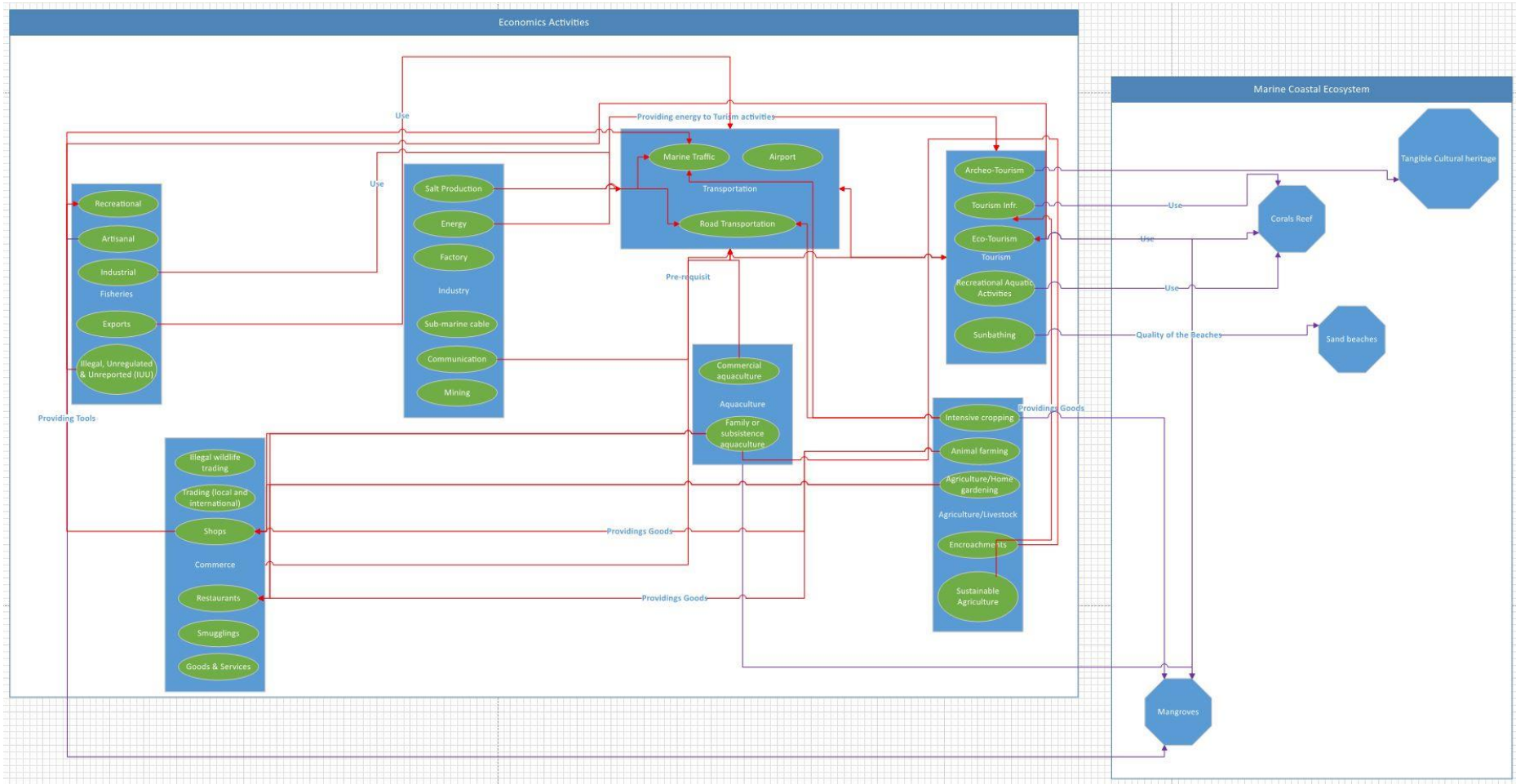


Figure 3.b. Box and arrow diagram for the economic component generated by working group 2.

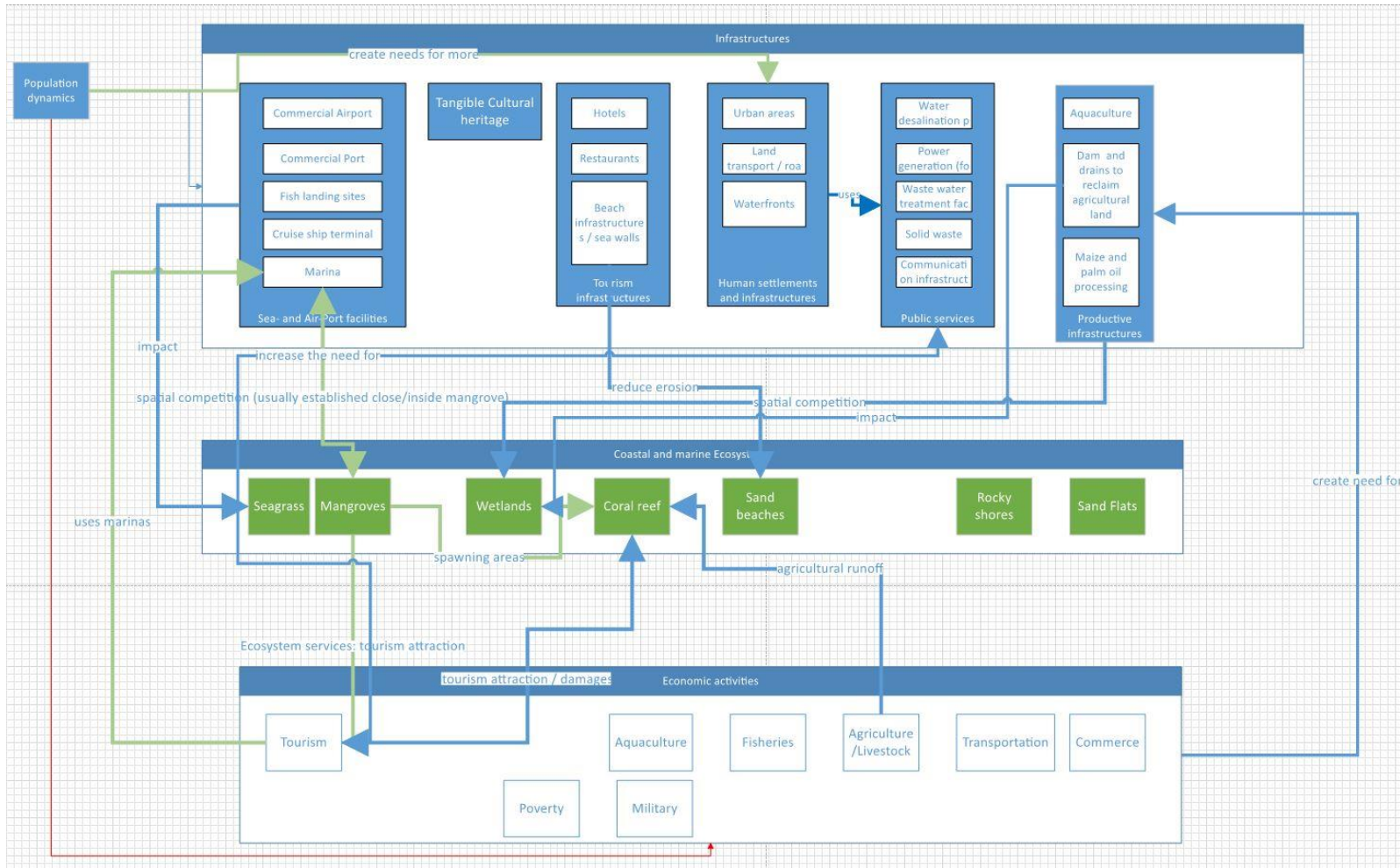


Figure 3.c. Box and arrow diagram for the coastal infrastructure component generated by working group 3.



65. During plenary and following conclusion of the simulation process, a number of comments and observations were drawn:

- How to determine which areas/sectors to focus on in generating the ecosystem context? It was clarified that this is a flexible tool, and the considerations of the multidisciplinary group are important in this context. It allows one to assess the importance of the various ecosystem components or the particular needs to be addressed by a country.
- The identification of all ecosystem components (prior to filling in a matrix) must be prepared, which would also be helpful in determining how they relate, thereby enabling comparison of information between components. It is also important to capture legal/national definitions under the ecological context to suit the needs of each country or according to their categories.
- It was understood that the tool needs high quality data, and if this is lacking it will be necessary to understand the ecological processes and determine how to better use data proxies. Common monitoring protocols and transnational cooperation would be beneficial to expand the use of EBM-DSS at the regional level.
- In order to prioritize management activities, there is a need to agree on criteria connected to the economy. These criteria may be, for example, calculated as a percentage of increase in income, or the identification of sites that would be suited for tourism, including for instance the hotel industry. It is important to secure community involvement which would benefit any planned development. The participation of the private sector and politicians is also crucial and should also be included in stakeholder panels.
- In small islands, the definition of coastal zone may cover most of the island and so all areas will be related or connected. The Caribbean is a region rich in diversity (biological and cultural) which makes it possible to establish connectivity through economic sectors such as tourism, infrastructure, and cultural heritages.

66. In demonstrating the methodology, participants learned and also contributed their own experiences, particularly regarding its application, as follows:

- a) the PROGES EBM-DSS methodology can assist in visualising the “big picture” and in better identifying the connection between different components and point to information gaps;
- b) the software can accommodate both qualitative and quantitative data;
- c) the application is a useful tool for processing information from certain areas and can inform decision makers on coastal management;
- d) it can be correlated with Marine Spatial Planning initiatives that are currently taking place in the Caribbean.

67. Some participants questioned the extensive manual work that is required in the ISP software and queried whether additional automated routines can be developed. The PROGES team acknowledged this difficulty and mentioned that given the complexity of



the relationships among so many components, the manual introduction also functions as a verifying mechanism. However, they will consider this recommendation for future software updates.

VI. THE ROLE AND ESTABLISHMENT OF REGIONAL EBM NETWORK NODES IN THE WIDER CARIBBEAN

68. Ms. Carolina Garcia from INVEMAR and Mr. Julian Walcott from CERMES introduced the two (2) recently conceptualized EBM-DSS regional nodes (for Spanish and English-speaking countries respectively). These two (2) regional nodes would serve as a coordinating mechanism for the dissemination of EBM-DSS and its future application in the Wider Caribbean, including in relation to the management of marine protected areas. Both institutions are broadly recognized in the region due to their high scientific standards and stability, and have very good communication platforms.
69. The issue of having a third regional node established was raised by Mr. Tadzio Bervoets, the lead of the Dutch Caribbean Nature Alliance and their network of protected areas. He noted the unique nature of the Dutch speaking countries of the Caribbean (e.g. St. Barts, St. Eustatius, St. Maarten, the Dutch Antilles), and efforts underway to create a cooperation platform. As such it was recommended that contact be made with these countries towards increased coordination and integration of the EBM /DSS. The CEP Secretariat acknowledged this and agreed to analyse the possibility of establishing a third regional node after evaluating the current project context and limitations, in recognition of these needs.
70. Mr. Gonzalo Cid from NOAA highlighted common regional interests and concerns about coastal and marine ecosystems. He recalled that the network of protected areas across the Caribbean should be strengthened by facilitating the gathering and access to data, through the SPAW Protocol as a vehicle to better collaborate at the regional level. It was highlighted that with the support of the SPAW Protocol, there have been regional efforts to strengthen and standardize coral reef data gathering by utilizing the GCRMN protocol. Mr. John Knowles of The Nature Conservancy endorsed these comments and mentioned that the CLME+ project and its regional workshops are also focused on data collection. It was therefore recognized that there is possibility to apply the EBM-DSS tool at the regional level across several locations.
71. It was agreed that the role of the regional nodes shall include the improving and/or strengthening of existing networks in data collection, gap analysis and analysis of future needs. The CEP Secretariat can play an important role by enhancing connectivity not only through the SPAW Protocol, but also through its CaMPAM network which includes a number of capacity building programmes such as the Training of Trainers course, the Small Grants Programme, and its active communication framework that reaches many stakeholders across the region.



VII. THE WAY FORWARD AND UP-SCALING OF EBM IN THE WIDER CARIBBEAN

72. Workshop participants considered the following as the main steps to advance project activities at the regional level, scale up lessons and experiences gathered from the pilot projects and other complementary activities:

- a) Utilize the momentum created during the workshop for the establishment of an EBM-DSS Working Group (WG). This working group can communicate internally and work through the Teamwork Platform which is proposed to be created by UN Environment-CEP. Through this online platform, the WG can communicate and share different countries strategies and information as needed.
- b) Strengthen this EBM-DSS WG by engaging, consulting, and seeking feedback with country stakeholders and other existing platforms via the recently created EBM-DSS Regional Nodes. The role for the regional nodes would be mainly to provide technical support and/or assist countries in need of capacity in the application of EBM-DSS.
- c) Increase capacity building for implementation of conservation and sustainable use of marine and coastal resources in the Wider Caribbean Region by developing new pilot projects. The location, specific objectives, and tangible realistic outcomes of such pilot projects would need to be defined, while also recognizing the need to work across the various sectors and ecosystems to more effectively guide decision-making processes. The EBM-DSS methodology presented can be used to incorporate data from numerous institutions and enhance connectivity as a new way of thinking and assisting the update of management plans.
- d) In the selection of new EBM/DSS pilot sites it would be important to evaluate data availability, the local capacities to use this data at all levels, the potential for an immediate application of recommended priority actions, and the possibility of collaboration among institutions at national and regional levels.
- e) Recommended new potential sites to be considered for application of the PROGES EBM/DSS methodology are:
 - a) Bonaire given their interest in updating MPA management plans and have explicitly requested assistance;
 - b) Colombia, Ciénaga Grande de Santa Marta, due to current processes taking place in that area, and availability of trained personnel;
 - c) Antigua and Barbuda and St. Maarten, which are seeking a simplified method to guide decision-making process after catastrophic events such as hurricane devastation.
- f) Disseminate the value that EBM-DSS application can add to existing projects and processes. For example, UN Environment-CEP is encouraged to share project results with SPAW Protocol focal points and CEP member countries.



VII. OVERALL FINDINGS AND RECOMMENDATIONS

73. In addition to the specific inputs provided above by participants to the up-scaling of EBM in the Caribbean, the workshop analysed conservation in terms of national and international processes that can be achieved with the application of EBM/DSS tools as part of the overall workshop findings – this was complemented with additional recommendations:

- a) After being familiarized with the ISP developed by PROGES, participants believed this is a flexible and adaptable tool reliant for robust data. It would be also useful for disaster management, for enhancing existing data and databases, and/or for updating management plans of MPAs (site or networks), among other processes.
- b) The flexibility of the tool may allow for applications at different spatial scales and/or different levels of development (e.g. full methodology, or only the matrices, indicators, etc.).
- c) The need was recognized for more EBM-DSS pilots which should consider existing initiatives and availability of data within the selection process.
- d) Work at the regional level would need to involve international organisations with similar initiatives (data management), and greater efforts towards identification and measuring standardized/common ecosystem performance indicators.
- e) Resource mobilization is required to develop effective outreach/communication strategies needed for transfer of information on EBM/DSS process for policy makers, and facilitating its implementation. It is important to simplify the message as much as possible.
- f) A communication strategy should engage the regional nodes improving the exchange of ideas and information and outreach to the region.
- g) The UN Environment-CEP Secretariat should contribute to the expansion of the EBM-DSS and the sharing of experiences in the region through SPAW focal points (promoting the data gathering from different agencies), and the CaMPAM tools (regional training, small grants, CaMPAM List, MPA database).
- h) There is a need to improve/strengthen data for sub-regional ecological networks where relevant (e.g. NE Dutch islands) and establish a sub-regional repository for monitoring and research data.

74. Participants valued and recognised the importance of strengthening international cooperation, and continuing work on transboundary issues in order to achieve sustainable development, and the success of conservation policies taking place in the Caribbean region. Such collaboration should focus on those actions at the national level that do not significantly impact other neighbouring countries, thus strengthening the capacities of all countries involved.



75. In addition, it was recognized that EBM-DSS applications require access to high quality data on many areas, and existing data sets will rarely be perfect, and often they are in fact absent or inaccessible. Hence, data access, availability, and repositories issues should be addressed at the regional level. Thus, collaborative agreements to share data at national and regional levels are encouraged.
76. The software ISP 5.0 developed by PROGES is a useful, flexible, and locally adaptable tool for EBM implementation.

VIII. CLOSURE

77. On behalf of UN Environment-CEP, Ms. Borobia-Hill thanked the Government of Panama for their hospitality, and all participants for their valuable inputs and expressed the hope that the exchanges can continue in the very near future.
78. She also recognized the support of the Government of Italy to the EBM-DSS Project without which this initiative could not have been carried out, as well as the Government of France for its continued contribution to the SPAW Sub- Programme, specially through the SPAW RAC in Guadeloupe and its dedicated staff.
79. The workshop also recognised the intervention of the representative of Haiti which announced that their Ministry of Environment symbolically signed the Cartagena Convention, the only legally binding environmental treaty in the Caribbean, and its three (3) protocols including the SPAW Protocol, during the UN Environmental Assembly that took place in Nairobi, Kenya (December 4-6, 2017).



ANNEX 1. Workshop agenda

REGIONAL WORKSHOP ON ECOSYSTEM-BASED MANAGEMENT AND APPLICATION OF DECISION SUPPORT SYSTEMS IN THE WIDER CARIBBEAN REGION

4-6 December 2017, Panama City, Panama
Crowne Plaza Panama Hotel

WORKSHOP AGENDA

4 December - DAY 1	
1. INTRODUCTION AND WORKSHOP BACKGROUND	
09:00-09:30 hs	1.1 Welcome Remarks
	<ul style="list-style-type: none"> • UN Environment representatives, Caribbean Environment Programme (CEP), Jamaica and Regional Office for Latin America and the Caribbean (ROLAC), Panama • Panama Authorities • Italian Agency for Cooperation and Development (IACD), Ministry of Foreign Affairs and International Cooperation
10:00 hs	1.2 Short introduction by participants
	<ul style="list-style-type: none"> • Goals and expectations
10:30 hs	1.3 Organisation of the Workshop
	<ul style="list-style-type: none"> • Adoption of the Agenda • Review of workshop objectives, work in plenary and in break-out groups, expected results
10:30 – 10:45 hs Coffee Break	
11:45 hs	1.4. Ecosystem-based Management (EBM) and Decision Support Systems (DSS)
	<ul style="list-style-type: none"> • Key features of EBM and DSS methods, tools and template • The Project: <i>“Biodiversity for Sustainable Development in the Caribbean through Ecosystem Based Management”</i> Overview, and Status (project objectives, implementation strategy and overall progress), including the application of DSS methodology through a pilot demonstration project in the Dominican Republic.
2. BASIC TRAINING ON THE USE THE EBM METHODS, TOOLS AND TEMPLATES: SIMULATION OF AN EBM-DSS PROJECT	
3:00hs	2.1 Preliminary phase: thematic scoping and establishment of EBM multi-disciplinary working group.
	<ul style="list-style-type: none"> • Identification of the key components of relevant biophysical systems, infrastructural networks and socio-economic sectors • Stakeholders analysis • Establishment of an EBM multi-disciplinary working group
13:00 – 14:30 hs Lunch	
2. CONTINUED - BASIC TRAINING ON THE USE THE EBM METHODS, TOOLS AND TEMPLATES: SIMULATION OF AN EBM-DSS PROJECT	



15:30 hs 2.2 Phase 1 - Ecosystem Context Analysis. *Recognising connections within and across ecological and human systems spanning over a focused area.*

- Drafting System Matrices: developing a set of tables listing all structural components of the relevant biophysical and human systems, together with their succinct descriptions.

This session will be introduced in plenary by a presentation of examples of System Matrices, based on the experience from the Dominican Republic pilot project, and by illustrating how to develop them.

Participants will then form three break-out groups, each assigned with the preparation of the System Matrices relevant to a given thematic sector (e.g. components of biophysical and human; infrastructural networks and economic sectors).

15:30 -15:45 hs Coffee Break

16:30 hs CONTINUED.

5 December - DAY 2

10:00 hs CONTINUED - BASIC TRAINING ON THE USE THE EBM METHODS, TOOLS AND TEMPLATES: SIMULATION OF AN EBM-DSS PROJECT

2.2.1 Plenary discussions on day 1 break-out groups

The workshop will re-convene in plenary and each group will report back and illustrate at least one of the System Matrices drafted in the break-out groups, with question, discussion and general feedback from participants.

10:30hs 2.3 Phase 1 - Ecosystem Context Analysis. *Recognizing connections within and across ecological and human systems spanning over a focused area.*

- Development of System box-and-arrows Diagram: describing the dynamics (arrows) between the biotic and abiotic components (boxes) of the natural ecosystems, the services that ecosystems provide to sustain life (boxes), and the uses that human society makes of these services (boxes).

This session will be introduced in plenary by a presentation of examples of System Diagrams, based on the experience from the Dominican Republic pilot project, and by illustrating how to develop them.

Participants will then be divided in three break-out groups, each assigned with the development of a System Diagram starting from a sub-set of the System Matrices drafted during the previous session (DAY 1).

10: 30 – 10:45 hs Coffee Break

10:45- 13:00 hs CONTINUED

2.3.1 Plenary discussions

The workshop will re-convene in plenary and each group will report back and illustrate at least one of the System Diagrams prepared in the break-out groups, with question, discussion and general feedback from participants.

13:00 – 14:30 hs Lunch

2. CONTINUED - BASIC TRAINING ON THE USE THE EBM METHODS, TOOLS AND TEMPLATES: SIMULATION OF AN EBM-DSS PROJECT



15:30 hs 2.4 Phase 2-Setting-up of an EBM Decision Support System. Development of indicators, construction of an EBM database and implementation of an EBM-DSS application.

- Drafting System Matrices: preparation of a set of tables listing all structural components of the relevant biophysical and human systems, together with their synthetic descriptions.

Participants will be divided in three break-out groups; each of these will be assigned with: i) the development of a small list of indicators to support a number of items of the System box-and-arrows Diagram (which represent the elements of the relevant biophysical and human systems); ii) the construction of database tables and GIS layers for handling the data for these indicators; iii) linking these database tables and GIS layers to the EBM-DSS software to visualize the indicators' spatial distribution and temporal trends (maps, tables, charts).

15:30 -15:45 hs Coffee Break

16:30 hs CONTINUED.

6 December - DAY 3

2. CONTINUED- BASIC TRAINING ON THE USE THE EBM METHODS, TOOLS AND TEMPLATES: SIMULATION OF AN EBM-DSS PROJECT

09:00-10:30 hs 2.5 Phase 3-Assessment of ecological risks and socio-economic stresses and identification of management interventions.

- System Cause-Effect Analysis: assessment of threats to the sustainability of ecological and human systems and development of an integrated set of management measures.

The session will be held in plenary to perform participative analyses using the EBM-DSS software to carry out an integrated quantitative assessment of: i) the conservation status of the biotic and abiotic components of the natural ecosystem (e.g. favourable/unfavourable); ii) the use of ecosystem services (e.g. untapped-potential/ sustainable use/overexploitation); iii) livelihood levels (e.g. adequate/inadequate; increasing/decreasing). These assessments will lead to the identification of an integrated set of EBM measures directly derived from (and targeted) to the relevant components of the ecological and human system (or interaction between them); the System Diagrams and the Indicators developed in the previous phases will also serve as a reference framework to monitor the performance of the EBM measures adopted.

10: 30 – 10:45 hs Coffee Break

10:45- 12:00 hs 3. THE ROLE AND ESTABLISHMENT OF REGIONAL EBM NETWORK NODES IN THE WIDER CARIBBEAN

- Presentation of the EBM Regional Nodes concept: role, institutional profile, capacities needed

12:00- 13:00 hs 3.1 Developing a Technical and Budget Template for the replication of an EBM-DSS project

- The experiences of the pilot project in the Dominican Republic

3.2 Open discussion and recommendations

14:30 hs Lunch

14:30 -15:30 hs 4. THE WAY FORWARD AND UP-SCALING OF EBM IN THE WIDER CARIBBEAN



- Plenary discussion: Conclusions, lessons learned, challenges and limitations, recommendations, next steps and road map for the sustainability and replication of the EBM-DSS approach, both at national and regional scales.

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15:30 -15:45 hs Coffee Break

15:45 -16:20 hs 4. CONTINUED - THE WAY FORWARD AND UP-SCALING OF EBM IN THE WIDER CARIBBEAN

16:20 - 16:30 hs 5. CLOSURE OF THE WORKSHOP



ANNEX 2. Detailed list of workshop participants

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EBM/DSS selected pictures



- A. Workshop introduction and welcoming. The main table is presided from left to right by Monica Borobia, Mauro Ghirotti and Alberto Pacheco
- B - C. Workshop plenaries
- D. PROGES team presentation, from left to right Francesca Pella and Edoardo Scepi
- E. Monica Borobia close-up
- F. Participation of Ruleta Camacho from Antigua & Barbuda
- G- H. Introduction to the regional nodes, Carolina Garcia and Julian Walcott
- I - K. Three working groups conducting an EBM/DSS exercise



- L. Planning regional nodes future steps
- M. Organizing team final workshop planning
- N. Set-up of the simultaneous translation for Spanish, English and French



ANNEX 3. Matrices generated on the Montecristi simulation

Matrix	Coastal Marine Ecosystem						
Components	Mangroves	Wetlands	Coral reefs	Sand beaches	Seagrass	Rocky shores	Sand Flats
Components Description (qualitative and/or quantitative)	Coastal forest comprising any of the four species of the Mangroves (red, black, white, button)	Extension of land partially or permanently covered in water	Aggregations of coral polyps forming solid structure	Coastal predominantly sandy area	Underwater prairie	Coastal area with a predominantly rocky substrate	Sandy bottom, mostly absent of vegetation
Sub-Components	Riverine Estuarine Fringing	Freshwater Brackish saltwater	Crest Fringing Etc..	Sand dunes	Monospecific Mixed Blowout	Type (karstic, rubble, mixed) Slope (steep, moderate, gentle)	Grain size Thickness
Sub-Components Description (qualitative and/or quantitative)	Riverine/mangrove forest associated with a river system Estuarine/mangrove forest present on brackish ecosystem Fringing/mangrove forest growing alongside the coastline Information of area percentage composition spatial distribution and impact	Information of area, percentage composition spatial distribution and impact	Information of area, percentage composition spatial distribution and impact	Information of area, percentage composition spatial distribution and impact	Information of area, percentage composition spatial distribution and impact	Information of area, percentage composition spatial distribution and impact	Information of area, percentage composition spatial distribution and impact



Matrix	Economics Activities								
Components	Fisheries	Tourism	Industry	Agriculture/Livestock	Aquaculture	Transportation	Commerce	Poverty	Military
Components Description (qualitative and/or quantitative)	Manly artisanal fishing by local fishermen organised in associations with regulations.	Locally managed, small scale tourism.	Limited to salt production and rice transformation.	Most of the plane lands is covered by large scale cropping (banana and rice)	It is the “cultivation” of fish, crustaceans, molluscs, plants or algae and other aquatic organisms.	Commercial, maritime and terrestrial			
Sub-Components	<ul style="list-style-type: none"> ▪ Recreational ▪ Artisanal ▪ Industrial ▪ Exports ▪ Illegal, Unregulated & Unreported (IUU) 	<ul style="list-style-type: none"> ▪ Archeo-Tourism ▪ Tourism Infr. ▪ Eco-Tourism ▪ Recreational Aquatic Activities ▪ Sunbathing 	<ul style="list-style-type: none"> ▪ Mining ▪ Energy ▪ Factory ▪ Sub-marine cable ▪ Communication ▪ Salt Production 	<ul style="list-style-type: none"> ▪ Intensive cropping ▪ Animal farming ▪ Agriculture/Home gardening ▪ Encroachments ▪ Sustainable Agriculture 	<ul style="list-style-type: none"> ▪ Family or subsistence aquaculture ▪ Commercial aquaculture ▪ Industrial aquaculture 	<ul style="list-style-type: none"> ▪ Marine Traffic ▪ Airport ▪ Road Transportation 	<ul style="list-style-type: none"> ▪ Illegal wildlife trading ▪ Trading (local and international) ▪ Shops ▪ Restaurants ▪ Smuggling ▪ Good & Services 		
Sub-Components Description (qualitative and/or quantitative)	<p>Recreational: Offshore Sport Fishing (Foreign), Spear fishing</p> <p>Artisanal: Local fishermen using nets and long line for fish catching; for crustaceous catching traps.</p> <p>Illegal, Unregulated & Unreported (IUU): Primarily foreign but with a local component.</p>	<p>Eco-Tourism: mangroves, bird watching, hiking, snorkelling, cetaceous watching,</p> <p>Recreational Aquatic Activities: windsurfing, sailing, Diving, swimming,</p>	<p>Energy: Infrastructures</p> <p>Salt Production: Production, Storing, Trading</p>	<p>Animal farming: medium scale for pigs, goats and cows.</p> <p>Agriculture/Home gardening: small scale for subsistence agriculture</p> <p>Intensive cropping: Rice and Banana (processing, packaging and storing)</p>	<p>Family or subsistence aquaculture: small scale performed into the mangroves area (crustaceous and fish)</p>				
Relationship with other components			Agriculture and Livestock						
Matrix	Coastal Infrastructures								



Components	Sea- and Air-Port facilities	Productive infrastructures		Tourism infrastructures	Human settlements and infrastructures	Public utilities	Tangible Cultural heritage
Components Description (qualitative and/or quantitative)				Ecologically compatible / not compatible			Legacy "Infrastructures" that cannot be altered
Sub-Components	Commercial Airport Commercial Port Cruise-ship terminal Marina Fish landing sites	Aquaculture Dam and drains to reclaim agricultural land Maize and palm oil processing		Hotels Restaurants Beach infrastructures / sea walls	Urban areas Land transport / road network Waterfronts	Water desalination plants Power generation (fossil / renewable) Waste water treatment facilities Solid waste Communication infrastructures	
Sub-Components Description (qualitative and/or quantitative)	Commercial Airport Sea plane bases Commercial Port Aids to navigation Anchorage areas Jetties, piers Dredging channels Cruise ship terminal Marina Fish landing sites Concrete jetties Storage / market facilities			Hotels Restaurants Beach infrastructures / sea walls	Urban areas Land transport / road network Inland / coastal / mangroves Waterfronts	Water desalination plants Power generation fossil / renewable fuel storage & transport Waste water treatment facilities Communication infrastructures	
Relationship with other components	Public services => fuel transport		Public services => fuel transport	Ecosystems: Sand dunes	Population dynamics => needs for more infrastructures, services & economic development	Tourism (=> more public services) Human settlements and infrastructures (=> more public services) Population dynamics => needs for infrastructures, services & economic development	