CMAPS: AN USEFUL TOOL FOR IMPROVING A NATIONAL ENVIRONMENT MONITORING SYSTEM DESIGN

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Abstract. In this paper are presented the results obtained using concept maps, created with CmapTools software, in order to improve the design of a National Environment Monitoring System (NEMS). The initial design of the NEMS, described in a document called "Strategy" was mounted on conceptual maps and discussed with representatives from information-producing entities and target audiences (scientists, decision makers, stakeholders and public), before being presented to the competent authorities for its approval. Among the main lessons learned in this process are the following: concept maps facilitate to identify gaps in the programmatic documents; the possibility of visualize the whole NEMS within a PC screen and the use of colors for differentiation of concept-propositions categories and its hierarchy, facilitates the understanding of the proposal by producers and users; the apparent "schematic and informal" nature of concept maps promotes the exchange and elicitation of expert knowledge; CmapTools software is an appropriate tool for collecting, representing, preserving and sharing with wide public scientific knowledge.

1 Introduction

Decisions for the sustainable use of the environment should be based on high quality and opportune environmental information. The Environment Agency (EA) began working on the design of a National Environmental Monitoring System (NEMS) in 2006. The initial design of the NEMS was described in a document called "Strategy" and began the search of a way for representing the system that allowed the easy understanding for different actors. In 2007 the NEMS was represented as concept maps, using CmapTools. The election was based on the possibilities of this software to represent visually a complex system (for the amount of integrating elements and for the diversity of Natural Sciences fields that they belong to), in a compact and relatively simple manner (Cañas, 2000; Coffey, et al., 2004; Novak and Cañas, 2006). Starting from this moment a process of consultations began with producers of environmental information and with diverse users (scientists, decision makers, stakeholders and public), before being presented to the competent authorities for its approval. The results of the employment of CmapTools and the main lessons learned are presented.

2 The Case

The design of the National Environmental Monitoring System (NEMS) was based on the ecosystem approach by means of which the environment is analyzed by components (land, water, biodiversity and atmosphere), like management units (water sheds and coastal zones), (UNEP, 2008).

The NEMS concept maps facilitated identification of information gaps in the programmatic document of the system, called "Strategy".

Every session for presentation of NEMS to the environment information producers and users became a knowledge elicitation process (Bowen, 2007), probably propitiated by the apparent "schematic and informal" nature of concept maps.

The structure and function of the NEMS are represented in the Figure 1. Three categories of concepts and propositions were included:

a) Structure (based on nodes);

b) Outstanding information (Strategy, Concept framework, Objectives);

c) Outputs (Operational products and Users).

The structure of the Complementary and Main Nodes is shown in Figure 2. The Monitoring Protocols for land, water, biodiversity and atmosphere are added to each concept map.

An important characteristic of the NEMS is that it is oriented to meet the user's needs. That is why the outputs of the system are organized by sectors and by territories (Figure 3).

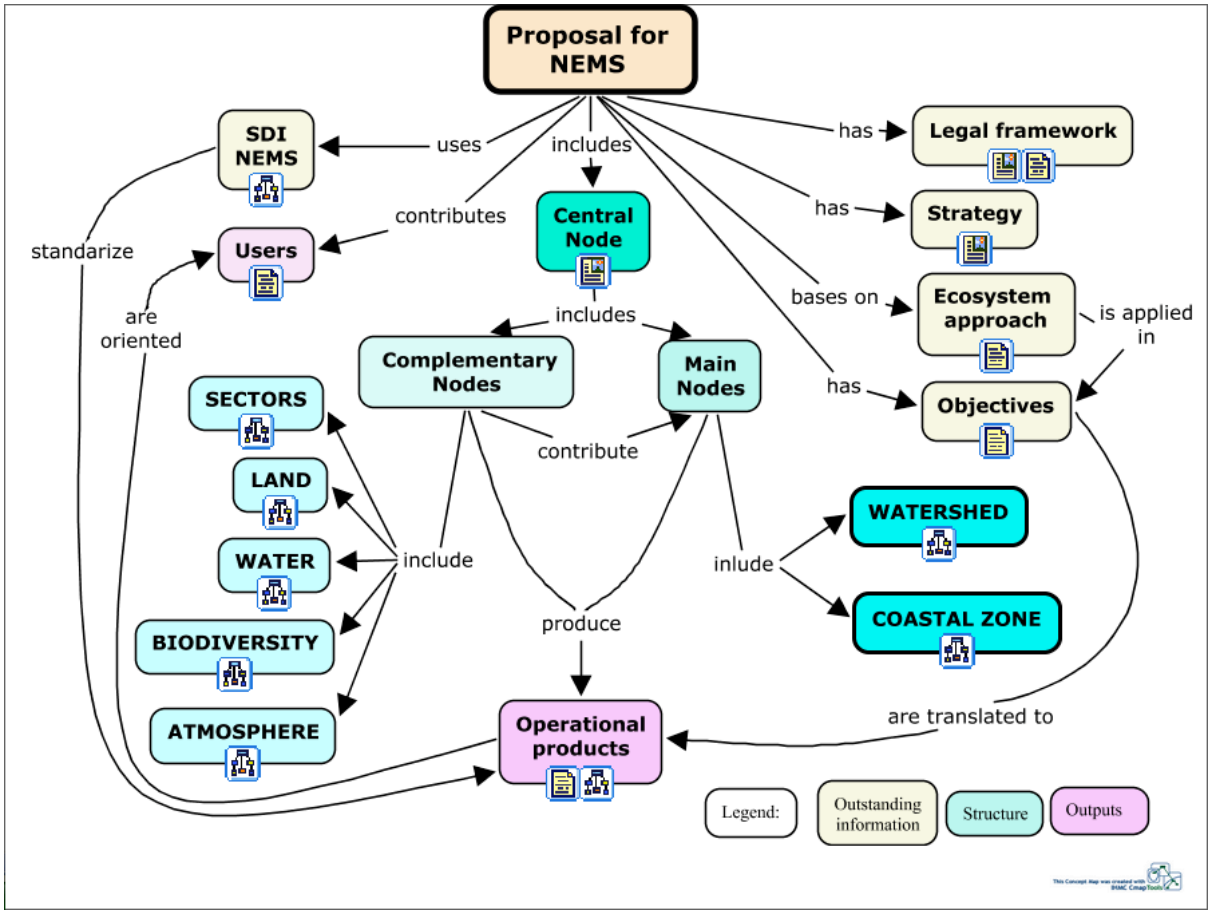

Figure 1. Structure and Function of the National Environment Monitoring System (NEMS).
Legend: SDI: Spatial Data Infrastructure

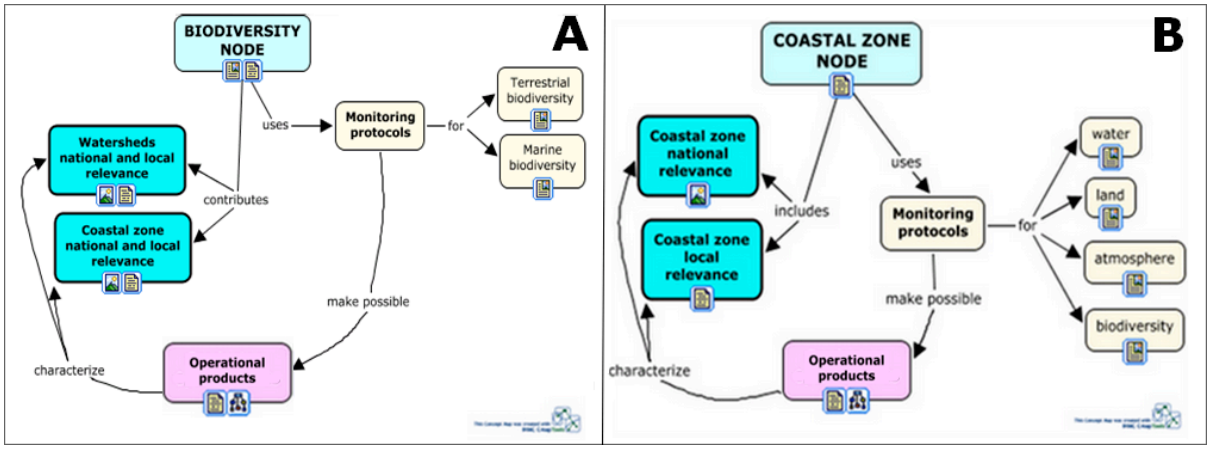

Figure 2. Structure and Function of the Complementary Nodes (A) and Main Nodes (B).

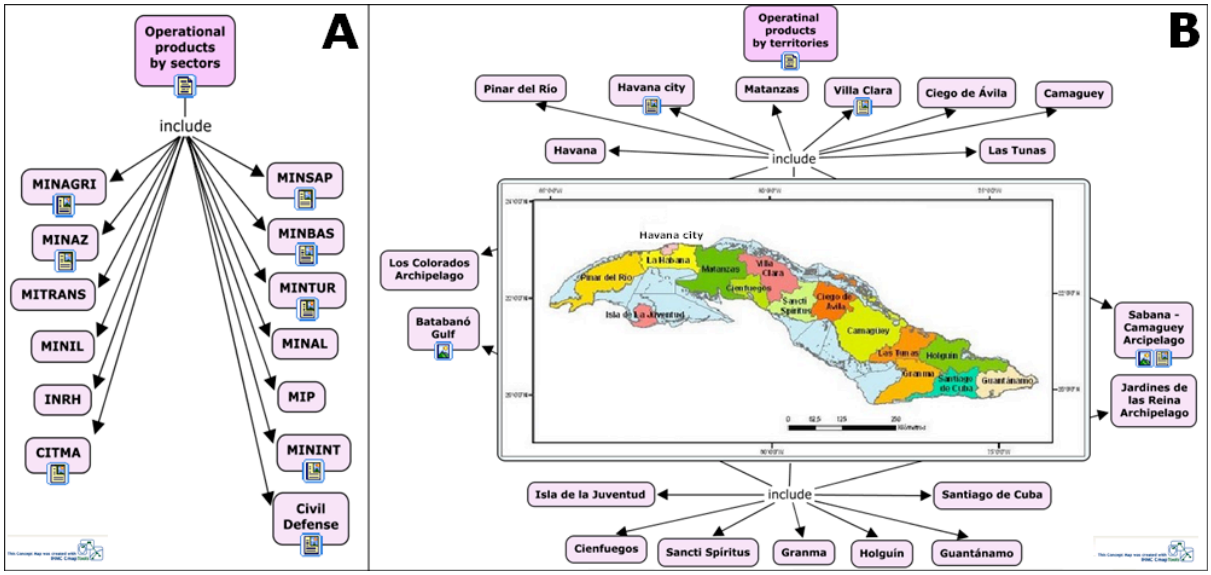

Figure 3. Output of the NEMS, by sectors (A) and by territories (B).

Legend: MINAGRI: Ministry of Agriculture; MINAZ: Ministry of Sugar Industry; MITRANS: Ministry of Transport; MINIL: Ministry of Light Industry; INRH: National Institute for Water Resources; CITMA: Ministry of Science, Technology and Environment; MINSAP: Ministry of Public Health; MINBAS: Ministry of Heavy Industry; MINTUR: Ministry of Tourism; MINAL: Ministry of Food Industry; MIP: Ministry of Fisheries; MININT: Ministry of the Interior

3 Lessons Learned from the Study

- There are some characteristics inherent to CmapTools software that facilitate the understanding of the monitoring system proposal by producers and users:
  - The possibility to visualize the whole NEMS within a PC screen, which facilitates understanding of inter-relationships among system components, the essential component for sound environmental systems assessment and planning
  - The use of colors for differentiation of concept-propositions categories and their importance.
  - The options to export and visualize the cmaps as web pages or images.
- Concept maps facilitate the identification of gaps in the programmatic documents.
- The apparent "schematic and informal" nature of concept maps promotes the exchange and elicitation of expert knowledge.
- Is not necessary to be previously familiar with the concept map theory to understand them.
- Although the web environment (html format) was used in most of the cases to present the obtained Cmaps to the actors of the system, in some cases it was necessary to insert the Cmaps images (jpg format) in more well-known Power Point presentations.
- CmapTools software is an excellent tool for collecting, representing, conserving and sharing with wide public scientific knowledge.

4 Summary

This paper presents the results obtained using concept maps, created with CmapTools software, in order to improve the design of a National Environment Monitoring System (NEMS). Concept maps facilitate the identification of gaps in the programmatic documents; the possibility of visualize the whole NEMS within a PC screen and the use of colors for differentiation of concept-propositions categories and its hierarchy, facilitates the understanding of the proposal by producers and users; the apparent "schematic and informal" nature of concept maps promotes the exchange and elicitation of expert knowledge; CmapTools software is an appropriate tool for collecting, representing, preserving and sharing with wide public scientific knowledge.

5 Acknowledgements

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References

Bowen, B (2007). Concept Maps: A Tool for Representing, Sharing and Retaining Expert Knowledge. International Human Resources Information Management Journal, October/November 2007. 28-29. http://www.ihrimjournal.com/about.php

Cañas, A. J., Ford, K. M., Coffey, J., Reichherzer, T., Carff, R., Shamma, D., & Breedy, M. (2000). Herramientas para Construir y Compartir Modelos de Conocimiento basados en Mapas Conceptuales. Revista de Informática Educativa, 13(2), 145-158.

Novak, J. D., A.J. Cañas (2006). Theory Underlying Concept Maps. IHMC, Technical Report. http://cmap.ihmc.us/Publications/ReseachPapers/TheoryUnderlying Concept Maps.pdf

UNEP (2008). Global Environment Outlook, GEO4. Environment for Development, 572 pp.

Coffey, J. W., T. C. Eskridge, D. P. Sanchez (2004). A case Study in Knowledge Elicitation for Institutional Memory Preservation using Concept Maps. Proc. of the First Int. Conference on Concept Mapping. A. J. Cañas, J. D. Novak, F. M. González, Eds. Pamplona, Spain 2004