

## **Topic: Integrated Water Resources and Coastal Areas Management.**

### **“Capacity building with a new paradigm in environmental management: The Integrated Watershed and Coastal Area Management in Cienfuegos, Cuba”.**

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### **ABSTRACT:**

The application of Integrated Coastal Zone Management (ICZM) is necessary for the sustainable development of these areas in Cuba. However, to approach with success the environmental management of these areas, it is indispensable to overflow the conceptual frame of the ICZM toward a new vision, the Integrated Watershed and Coastal Area Management (IWCAM), also integrating the environmental and social perspective. This vision have been inserted in a growing way inside the Program of Capacity Building of the ICZM in Cienfuegos executed by professors of Cienfuegos University, the Centre of Environment Research of Cienfuegos (CEAC) and others universities since 2002 and sponsored by University Partnerships in Cooperation and Development and the Canadian International Development Agency. The objectives of the present paper are: i – to argue the importance of the vision of IWCAM for the formal education (through Master in ICZM) of specialists, functionaries and decision-makers; making them more conscious of the environment-society relationship and educating them for an active participation in the decision-making process and ii- to define how this process was executed varying the original programs of the mastery. At present 25 Master in MIZC had been graduated with this vision; they are impacting with their work in the environmental management of socio-economic sectors in Cienfuegos province and the vision had been spread of the IWCAM approach in the Villa Clara and Matanzas provinces. The results in the mastery program allow to elaborates a diploma course in IWCAM in 2008 for specialists and functionaries of Cienfuegos province; it was implemented in CEAC with the graduation of 26 students from 12 different enterprises, 7 of these graduated are now coursing the Master in ICZM.

### **INTRODUCCIÓN.**

Anthropogenic activities while necessary for social and economic development affect watersheds and coastal areas. In many cases the decision making process not done in an integrated manner. Scientific knowledge about the watersheds as well as about the marine and coastal environment, including the processes that guide their functioning, are not in correspondence with the high level of exploitation and use that humans do; it is a very complex

subject under scrutiny by very few researchers. The use of natural resources is the source of many environmental problems and exhausts the available resources.

The introduction of Integrated Coastal Zone Management (ICZM) concept is today a necessity to contribute to the sustainable development of these areas in Cuba. However, for successful environmental management it is indispensable to know and to evaluate the existing complex dynamic interdependence, in qualitative as well as quantitative terms, between the coastal area and the river basins. This interactive approach makes it to overflow the conceptual frame of the MIZC toward a new vision, the Integrated Watershed and Coastal Areas Management (IWCAM). This approach overcomes the fragmentation of the knowledge about the coastal area and the hydrographical basins, imparted separately in different educational institutions in Cuba.

The antecedents of this integration in educational terms in Cienfuegos are related to the offer of the Masters Program in Integrated Coastal Zone Management (ICZM) in the province for professors of the University of Cienfuegos, with the cooperation of researchers from Centre of Environment Research of Cienfuegos (CEAC) and professors of the Universities of Havana and Oriente and other centers of the CITMA (Ministry of Science, Technology and Environment) and the Universities of Dalhousie and Saint Mary's of Canada. The courses began in 2002, sponsored by the project TIER II "Education for the Integrated Coastal Zone Management in Cuba" with funds of University Partnerships in Cooperation and Development (UPCD), Canadian International Development Agency (CIDA) and administered by the Association of Universities and Colleges of Canada (AUCC). After the first version of the Master course and the conclusion of the project two other versions were realized by the University of Cienfuegos and the cooperation of CEAC and a four version is executing since 2009.

Watershed aspects for the coastal management were introduced into the Master course in ICZM from the beginning as the Academic Committee of the Master Program was convinced it was an important aspect. It also the impetus for the development of a project in Cienfuegos in 2004 to insert into the GEF-PNUD regional project "Integrating Watershed & Coastal Areas Management in the Caribbean Small Island Developing States (IWCAM)". The IWCAM approach has been inserted in a growing way into the Master Program for ICZM.

The objectives of the present paper are: i—to argue the importance of the vision of IWCAM for the formal education (through Master in ICZM) of specialists, functionaries and decision-makers; making them conscious of the environment-society relationship and educating them for the active participation in the decision-making process and ii - to defines how this process was executed varying the original programs of the mastery.

## **MATERIALS AND METHODS.**

A documentary and bibliographic search on the importance of the IWCAM approach for the country and the students of the Master program in ICZM in Cienfuegos was carried out.

Three versions of Master in ICZM were developed from 2002 to 2008; a fourth version is in progress. The first two were executed in the Cienfuegos University area and the Architects National Union (Cienfuegos Office), the third version was developed in the School of Tourism in

Varadero, Matanzas Province and the last one was carried out in installations of Centre of Environment Research of Cienfuegos (CEAC).

Facilities at the Cienfuegos University under the project TIER II “Education for the Integrated Coastal Zone Management in Cuba” were used initially. The facilities were a computer laboratory, classroom and professor’s office, use of textbooks bought by the project and access to University library for students. In the last version was used also the facilities created by the GEF-PNUD project. The project had also the cooperation of professors from CEAC and other Cuban Universities, research centres and Law office in Cienfuegos.

The Academic Committee makes periodicals analysis of the course curricula and introduces the necessary changes to assure the integration between the subjects covered in different courses; with the approval of all the professors. It was also discussed the master theses themes and their relevance to the objectives of the Master Program.

The impact of the Master Program in Cienfuegos Province was investigated through a survey of course alumni and staff within their workplaces.

## **RESULTS**

### **Importance of the vision of IWCAM**

The importance of the vision of IWCAM for Cuba is based in the three following analysis:

1- The condition of insularity of Cuba and the lengthened form of the country with a division of the waters in longitudinal form that divides the island in two slopes, the south and the north, with distances under 60 Km from the coastline to the division of the waters and characterized by 632 hydrographical basins of superior extent of 5 Km<sup>2</sup>, 85% of which do not surpass 40 Km in length (CIGEA, 2003), with a total area of 75.5% of the national territory. The little treatment given to the organic and inorganic pollutants discharged within the basins affect the quality of the water, many of these polluted short streams run to the coast making the coastal and marine waters final sink of these wastes.

2- The problems experienced in the watersheds are correlated with drought on one hand and the floods due to hurricanes and extreme rainy events, necessitated government investment in the construction of reservoirs and hydraulic systems since the decade of 1960. It has been possible to build a hydraulic infrastructure that is able to dispose 57% of the water resources existing in the county and store 9000 million m<sup>3</sup> in 241 reservoirs administered by the INRH (National Institute for Hydraulic Resources). But this infrastructure has caused another problem to the environment since many of the rivers have greatly reduced flows with subsequent negative impacts on dependent ecosystems.

3- Three key coastal ecosystems in the Caribbean, mangrove, sea grass and coral reef, are tightly linked via the interchange of energy flux and different materials. Coastal ecosystems also interchange with the hydrographical basins and are impacted when the land based sources of

contaminants impacts the freshwater streams. It had been proven that the main four basins with rivers that flow towards Cienfuegos Bay intervene directly in their environmental degradation due to the drag of sediments and pollution from several land based sources located in the area of the basins. One of the ultimate main causes of these problems is the poor knowledge of environmental issues, not only on the part of the general population and interested parties, but by the specialists and decision makers of different institutions that pollute and whose activities directly impact on freshwater and the marine waters. An environmental management plan of the bay without considering the integration of the watershed management would not adequately resolve the environmental problems.

All this reasons pushed the Academic Committee to consider the necessity of integration among the management that is carried out in the river basins and in coastal areas. The application of Integrated Coastal Zone Management (ICZM) is necessary for the sustainable development of these areas in Cuba; however, to approach with success the environmental management, it was critical to merge the conceptual frame of the ICZM toward a new vision, the Integrated Watershed and Coastal Area Management (IWCAM). There a great need to educate professionals with this current environmental paradigm . For this reason the IWCAM has been inserted incrementally inside the Program of Capacity Building in ICZM in Cienfuegos.

### **How the IWCAM vision has been integrated into the Master in ICZM Program.**

Using the baseline of the project TIER II “Education for the Integrated Coastal Zone Management in Cuba”, the Academic Committee of the Master Program decided to include an elective course on hydrographical basins in the first version of the master course in ICZM (2002-2004). Also, inside the basic courses “Current Issues on ICZM” and “Components and processes of the Coastal Areas”, were included conferences about the importance of the basins for the coastal area and about the implication that it has for Cienfuegos bay.

The preparation of a project on the IWCAM for GEF-PNUD in 2004, by researchers of CEAC, and participation of professors from University of Cienfuegos in the Component 7- “Public education and awareness” of the Demonstrative project GEF – IWCAM “Application of concepts of integrate management in a demonstrative area of the province of Cienfuegos, Cuba”, was an incentive to guide a thesis theme about the decision making process for the integrated management of the bay and the hydrographical basins connected to this coastal area with the name “The taking of decision for the integrated management of Cienfuegos Bay and their tributary river basins” (Rey, 2004). This was one of the most important theses of the first version of the Mastery Program because the alumnus that elaborate this thesis was vice-president of the provincial government at that time, so he helped to introduce the concept of IWCAM to the government decision makers in 2004; the thesis produced institutional changes in the province because the Provincial Popular Power Assembly approved the “IWCAM Committee of Cienfuegos Bay” in April 2004. Other student’s thesis on the “Use of GIS as a tool for the decision makers in the process of IWCAM in Cienfuegos” (Figuerola, 2007) has been used by the Civil Defence of Cienfuegos as base study to update the plans again risk of flooding by coast rise and severe rains.

In the second version of the Master of ICZM (2004-2006) basic courses on “Current Issues on ICZM” and “Components and processes of the Coastal Areas”, conferences that include the importance of the basins, their management and their relationship with the coastal areas were introduced. Six students selected by the Academic Committee of the Master Program were guided toward the realization of theses related with the main hydrographical basins of the county and its interaction with the coastal area as a method to guarantee a more effective environmental management and to obtain more updated information that could help plan IWCAM in the territory. The selected students were from entities related to the hydraulic resources or to the Company of Design and Engineering of the province. They could have accessibility to databases and information related with the basins of the territory and they were interested in this type of work. One of the theses, although it would be based in one of the main river basins of the territory as a case study, was guided to make a comparison fundamentally among the methodology of the “magic cube” (Dourojeanni, 2000) and other methodologies in use in the country the thesis was called “Proposal of methodology for the integrated management of hydrographic basins. Case study: Arimao Basin” (Mikulenka, 2006), the rest of the theses would try to apply the “magic cube” methodology in different basins of the province.

The method of the “magic cube”, in their first original version, was elaborated in 1976 and applied since 1977 to programs of Basins and Rural Development Management in the Height Andes in Peru, and from 1990 it was proposed by United Nations as a guide for the orientation of management process for development. In order to provide information to the management processes, were making applicable procedures to define clearly the geographical areas; this suppose the participation of all the involved actors. Also, alternative ways were suggested to solve the conflicts that arise about the economic growth, the social justness and the environmental sustainability, in agreement with the principle that declare the sustainable development as function of the simultaneous achievement of these three objectives in a certain area.

This methodology is carried out for phases or iterative cycles:

1st phase- Perception: where information is gathered about what the actors know by experience, intuition or direct observations about environmental problems and solutions.

2nd phase- Consolidation: in this phase the opinions are verified in the practice.

3rd phase- Formulation: studies are made and proposals are detailed formulated at the proper level.

It was decided that the students worked on the first phase because the others phases required the direct intervention of the provincial government for their execution. For the elaboration of the theses documents the more conspicuous results were selected in the province. The studies, carried out in selected basins for the theses, are useful for IWCAM information and they have intended actions to diminish environmental problems in an area that embraces 47.6% of the province and a 39.7% of the population. These theses executed, for the first time in the province, an integrated diagnosis of the rivers basins Damují, Salado and Arimao, tributaries of Cienfuegos Bay and the basins of rivers Hondo and Yaguanabo, in the south slope of Guamuaya mountains group in the east part of the province (Fig. 1); the last theses gave an idea of the mountain basins condition and their interrelation with the south coast.

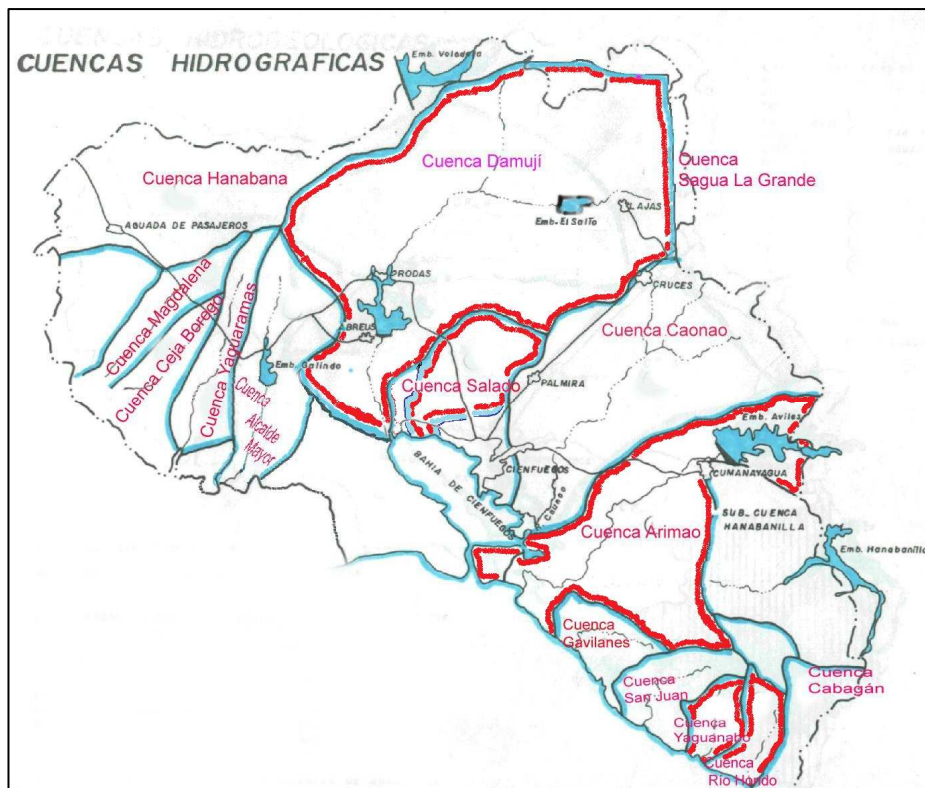


Fig. 1- Rivers basins under Master in ICZM these studies in Cienfuegos Province (limits of basins double marked)

A seventh thesis of this second edition, related to IWCAM, was the thesis with the name “Integrated Management Program of the water resource for the Sugar Enterprise José María Pérez, a contribution from IWCAM” that offers solutions for the management of the watershed in a sugar industry unit in the neighbor province of Villa Clara (Menejías, 2007).

The third edition of the Master in ICZM finished in Varadero beach, Matanzas Province, in 2008 but a few students still have not defended their theses. It was supported by entities as Playa Office of Ministry of Science, Technology and Environment (CITMA), Tourism Ministry (MINTUR) and inverters of tourism facilities in Varadero Beach. This edition also incorporates concepts of IWCAM, but in general, this course is biased to beach quality conservation and tourism environmental problems.

At present 25 alumni from Master in ICZM are working in different enterprises mainly in three central provinces; Cienfuegos, Matanzas and Villa Clara.

The last edition is carried out in Cienfuegos, using the facilities built with the funds of the GEF-PNUD project, with the inclusion of the IWCAM concepts. A model elaborated for the better comprehension of the IWCAM process in Cienfuegos province, by the students was explained for the first time in class. Corona et al., (2002) consider that “in the process of building a model, the knowledge seem to be temporally transform from the object of interest, to the investigation of a *cuasi-object* intermediate and auxiliary; the model”. In the inquiry to the students of this

edition, 100 % of them consider that this model reflex and interpret the IWCAM process in Cienfuegos.

### **Diploma course in IWCAM.**

With the intention of amplifying the diffusion of this knowledge to a wider group of specialists and decision-makers, a Diploma course in IWCAM was offered using facilities obtained with funds of the GEF-PNUD Project. The diploma course was carried in 2008, this time under the direction of CEAC specialists and researchers, because CEAC was nominate as Authorized Center for Postgraduate Courses assign to the InSTEC (Higher Institute of Technology and Applied Sciences). The general object of the Diploma course in IWCAM was “to understand the essence of the IWCAM approach in function of the sustainable development”. The final goal is to contribute to the formation of a “critic mass” of educated persons with a change in the mentality, necessary in the society to achieve an interaction society-nature more equilibrate and with a higher tendency towards a sustainable development.

As a result of the Diploma course in IWCAM, 26 students from 12 institutions in the province were graduated and 7 of them are now pursuing the Master course in ICZM in Cienfuegos.

### **Future work.**

The quality of postgraduate courses in Cienfuegos on ICZM with the incorporation of IWCAM concepts is known by different institutions. Petitions of execution of Master in MIZC had been made by the special municipality of Pines Island (the second biggest island of Cuban Archipelago) and the Sabana-Camaguey Project (in the north of central provinces). A Diploma course in “Perfection with emphasis in training in Integrated Coastal Zone Management: Concepts and instruments” finished in May 2010 in the International Maritime University of Panama by professors of CEAC, it includes IWCAM perspective; petitions for the confection of a second diploma course has been made. A new version of the Diploma course in IWCAM is in preparation to offer to tourism sector in Cienfuegos Province.

### **Net of knowledge in themes related with the IWCAM.**

Other collateral results of the application of the GEF-UNEP program are that the themes of IWCAM have now been spread trough the “Ibero-American Net of Traditional Knowledge Management in Hydrographic Basins and Coastal Areas” (GESTCON) coordinate by specialist of CEAC and Cienfuegos University, with the participation of universities and institutions from six Ibero-American countries financed by the Ibero-American Program of Science and Technology for the Development (CYTED). This net was developed since 2008 with General Coordination in CEAC; it was formed thanks to the interpersonal and inter-institutional relationships raised in previous knowledge nets like the ICZM Net, formed by the universities included in the TIER II project; the Community Based Coastal Resource Management (CBCRM) Net and the Healthy Coastal Communities (HCC) Net which standing formative processes at community levels, with the object of extend the ICZM approach to a wide sector of the population and contextualize the real implementation of this approach at local level (Miranda et al., 2008).

## **CONCLUSIONS.**

The capacity building in ICZM considering the concepts of IWCAM has positively influenced environmental management in the province of Cienfuegos by increasing the quantity of specialists, researchers, functionaries and decision makers of several state entities that could have applied and spread this new form of integration.

Studies executed by these theses themes in the selected provincial basins of rivers have gathered valuable information for IWCAM and proposed remedial actions of environmental problems to an area of 47, 6 % and around 39, 7 % of the population of the province.

The development of this concept of integration between river basins and coastal areas allow elaborating a model, as a didactic tool, for the teaching of the IWCAM process in the postgraduate courses about these themes, offer by University of Cienfuegos and CEAC.

The regional “Integrating Watershed & Coastal Areas Management in the Caribbean Small Island Developing States (IWCAM)” project, incentive in a great manner the development of the concepts of integration through the demonstrative projects in Cienfuegos that improve the facilities and teaching of basic concepts about the IWCAM approach.

This IWCAM approach is already incorporated within an international net on environmental management; the “Ibero-American Net of Traditional Knowledge Management in Hydrographic Basins and Coastal Areas” (GESTCON) conformed by six Ibero-American countries.

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