NICARAGUA- Management Plan for the Gran Lago Cocibolca (Great Lake Cocibolca)

Application of IWRM criteria in the development of the management plan

The "Commission for Sustainable Development for the Water Basin of Lake Cocibolca and the San Juan River" ("Comisión de Desarrollo Sostenible de la Cuenca del Lago Cocibolca y el Río San Juan") was created in Nicaragua in accordance with Law 626 and the National Policy for Water Management which was made official in 2001.

The key responsibility of this commission is to "elaborate and approve the Plan of Action and Territorial Organization for the Management of the basin", as well as to "implement and provide follow up" to the same.

1 DESCRIPTION

A technical and administrative model will be developed for water, soil and forest governance as well as for municipal development at the basin level as part of a land management unit. Additionally, the Commission's work seeks to comply with Article 97 of Law 620, "General Law of National Waters", for the protection, conservation and destiny of waters from the Great Lake of Nicaragua or Cocibolca, designating it a "National Reserve of Potable Water…of the highest interest and national priority for national security..."

Despite the dramatic changes that have taken place in the last few years, the Great Lake has maintained its average water levels since the end of the nineteenth century, even with the permanent discharge of its waters through the San Juan River. However, the ecosystem and quality of its waters have experienced progressive deterioration due to the lack of basin management. This is evidenced by soil erosion, contamination by sewage from neighboring populations, local industrial effluent, irrational application of agrochemicals in nearby cultivations (rice, sugarcane, banana, cattle, etc.), and the discharge of a variety of contaminants from its basin's tributaries.

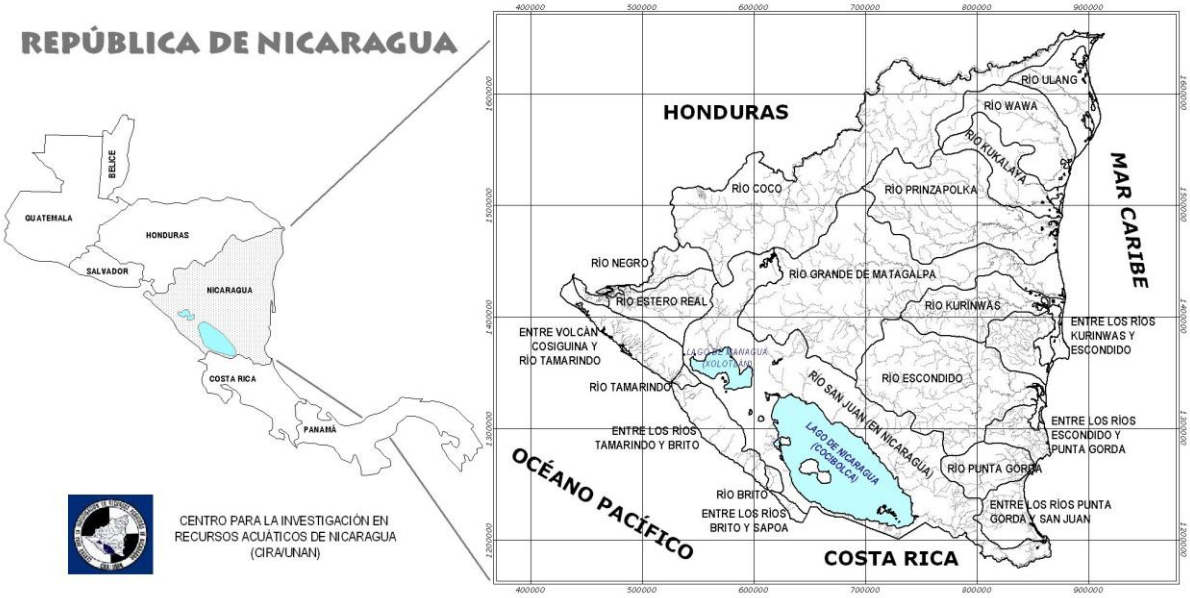
The concerted actions on the part of the central and municipal government, private producer associations, non-governmental organizations as well as the reconciliation of water and soil use interests will clearly only be possible through Integrated Water Resource Management in which the natural, political and administrative systems within the lake's territory intersect.

1.3 KEY WORDS: IWRM, Nicaragua, Lago Cocibolca.

2 DESCRIPTION OF THE PROBLEM.

The Gran Lago Cocibolca or Lake Nicaragua is part of Basin No. 69, in which Lago Xolotlán (or Managua) and the San Juan River are also located. The basin's total surface area is 41,600

km^2, and is shared between Nicaragua with 29,000 km^2 and by Costa Rica with 12,600 km^2. Figure 1 shows the location of Basin No. 69, from the Great Lakes of Nicaragua and the San Juan River.



This lacustrine lake system developed over a tectonic plate designated as the Nicaraguan graben, where Lago Cocibolca occupies approximately 8,144 km^2 at an elevation of 31, 4 m.a.s.l. Cocibolca's oval shape extends for a length of 160 km and a width of 70km. In its interior it is possible to identify various volcanic islands, among which is the Ometepe (277 km^2) and Zapatera island (55 km^2). Towards the south, one can observe the Solentiname archipelago (38 km^2). To the northwest, at the borders of the city of Granada is the formation of approximately 350 small islands of Granada which are important tourism attractions. Cocibolca is the largest tropical lake in the Americas.

The bathymetric studies carried out by the Instituto Geográfico Nacional, (now the Instituto Nicaragüense de Estudios Territoriales, INETER) in 1972 indicate an average depth of 13 meters with a maximum depth between 60 and 70 meters to the southeast of Ometepe Island. The average annual rainfall varies between 1200 mm, around Río Malacatoya, to 2,000 mm in San Carlos.

Tributary rivers discharge into the Cocibolca, and their water carries suspended sediments and waste substances derived from the activities of the population located in its drainage areas, including residual waters, and agrochemical runoff (especially pesticides). Figure 2 shows Lago Cocibolca's sub-basin. Due to its water volume (~104,000 hm^3) the lake is considered the most important water source in Nicaragua. INETER has estimated that at San Carlos, the only surface water discharge location, where the San Juan River begins as an outlet of the Gran Lago Cocibolca, has an average volume of 475 m^3/s, the equivalent of 41 million cubic meters of daily discharge. Various cities in its basin, such as Juigalpa and San Juan del Sur, have developed initiatives to take advantage of its water for potable water use.

2.1 INTERNAL INDICATORS OF EUTROPHICATION IN LAKE COCIBOLCA

In the last fifteen years (1993-2008), evidence of eutrophication has been found in the biological aquatic communities. The phytoplankton's biomass is a fundamental indicator since it can interfere with potable water uses, and it has been increasing in the lake progressively. The biological communities have also suffered a structural simplification process in the last decade, and changes have also been observed in the contribution of large taxonomic groups of phytoplankton, zooplankton and zoobenthos to species richness. This continual impoverishing of the biological diversity or structural simplification of the biological communities is seen to a greater degree in the phytoplankton. This is evidenced by the presence of two dominant species, *Microcystis aeruginosa* and *Cylindrospermopsis raciborskii*, which make up more than 98% of the biomass, pose sanitary risks and are also indicative of the poor environmental conditions.

It is very important to analyze the changes in the communities jointly with the presence of organic nutrients since their increase is specifically responsible for the eutrophication process. The deterioration of Lago Cocibolca as a result of the accelerating eutrophication process has

been primarily caused by human activities in its basin, which have promoted an increase in sedimentation and nutrient input; this endangers plans for using the lake as a national potable water reserve.

Research results indicate that Lago Cocibolca is not being utilized for some of the most fundamental uses and instead its deterioration is being accelerated due to inappropriate uses to which it is subjected, and which should be controlled and reduced progressively until they are eliminated. These include:

2.1.1 Receiving sediments from deforested and eroded sub-basins.
2.1.2 Receiving inflows of subterranean and superficial contaminated water from Lago Xolotlán.
2.1.3 Receiving agrochemical residues, particularly pesticides
2.1.4 Receiving untreated sewage, industrial waste, biodegradable and non-biodegradable solids and other urban waste.
2.1.5 The impact and waste from uncontrolled invasive tourism.
2.1.6 Receiving agricultural and livestock waste, nutrients from extensive cattle ranching, waste from intensive bovine, poultry and pig breeding, as well as from internal lake aquaculture in floating cages.

The surface connection of Lago Managua with Lago Cocibolca through the Río Tipitapa occurs intermittently. Throughout the twentieth century, the Tipitapa River has discharged the waters of Lago Xolotlán to Cocibolca four times, all four which were tied to torrential rains. During Hurricane Mitch in October l998, Lago Managua overflowed, flooding bordering lands and releasing its waters into Lago Cocibolca. The poor quality of the water of the contaminated Lago Xolotlán's (or Managua's), represent an additional risk to the water quality in Lago Cocibolca.

3 DECISIONS AND ACTIONS FOR THE RESTORATION OF THE GREAT LAKE AND ITS BASIN.

3.1 With the technical assistance of the Nicaraguan Research Center for Aquatic Resources of the National Autonomous University of Nicaragua (Centro para la Investigación den Recursos Acuáticos de Nicaragua-Universidad Nacional Autónoma (CIRA/UNAN), the Association of Municipalities of the Great Lake Basin (Asociación de Municipios de la Cuenca del Gran Lago (AMUGRAN)) was created on May 14, 1998 by mayors of the basin municipalities of Lago Cocibolca and the San Juan River. The objectives of the association were defined as follows:

a) Promote the integral and sustainable development of the municipalities which are members of AMUGRAN, contributing to the development and implementation of corresponding strategies.
b) Contribute to reversing the environmental degradation process within the municipalities in the great lake basin.
c) Support environmental education in the municipalities of the great lake basin.
d) Promote capacity building for environmental management and local development.

The association later transformed itself into the Asociación de Municipios de la Cuenca del Río San Juan (AMUCRISANJ), which maintained the objectives of AMUGRAN.

In 2002, AMUGRAN pronounced the Public Declaration of the Mayors of the Basin Association of Lago Nicaragua which established:

For the basin and waters of Lago Cocibolca, there should be desirable and compatible uses which are environmentally-friendly and founded on social development and economic well-being for basin inhabitants, working in harmony to create Policies for Basin Use and Protection which are in line with the following uses:

a) Potable Water
b) Irrigation for cultivation
c) Artisan and sports fishing
d) Reservoir for biological diversity.
e) Tourism

Extreme poverty and the environmental degradation in Lago Cocibolca and its basin are products of the absence of land planning measures in the corresponding municipalities. These measures include, for example, a rational mechanism for the use of natural resources such as forest, fauna, soil and water, as well as for their environmental services. It is important to implement measures that allow for the sustainable use of the lake and its resources as well as for the preservation of its riches. These measures should be converted into Protection Policies for Lago Cocibolca and its basin. Some examples of these measures, among others, are listed below:

a) Protection of water quality of Lago Cocibolca in accordance with the criteria for potable water use, through the effective control of toxic substance uses and their residuals in agricultural soils within the basin; adequate treatment of urban residues (of domestic wastewater as well as for agro-industrial wastewater) and the treatment of solid wastes, both biodegradable and not biodegradable which drains into the waters of the Cocibolca until the waste is rendered harmless.
b) Rehabilitation of soils and forests in accordance with their land use vocation.
c) Biological diversity protection within the basin and its waters, controlling degradation processes which reduce diversity in the composition of species.

3.2 Together with the efforts of municipalities and civil society, the central government of Nicaragua, through the Ministry of the Environment and Natural Resources (MARENA, by its Spanish acronym), highlighted the need to resolve contamination problems in the Lago Cocibolca and San Juan River basin which originate in trans-boundary lands. This interest brought regional attention to the problem.

The governments of Costa Rica and Nicaragua requested funding to develop the Strategic Action (PEA) Plan for Integrated Water Resource Management and Sustainable Development of the San Juan River and its Coastal Zone (PROCUENCA by its Spanish acronym), with the technical and financial help of the Organización de Estados Americanos and through the Sustainable Development and Environment Unit (OEA/UDSMA), the World Fund for the Environment (FMAM by its spanish acronym) and the United Nations Environment Programme (PNUMA by its spanish acronym), agreed upon in different high-level Fora

(December 1992 - XIII Summit of Central American Presidents, Panama; October 1994 – Central American Alliance for Sustainable Development (ALIDES); Managua, November 1999 - to prepare the Project Document in order to develop the Strategic Action Plan (PEA) for the water basin to be presented to FMAM). This initiative with PNUMA as its executing agency was implemented by the Secretary General of the Organization of the Americas States, through Costa Rica's Ministerio del Ambiente y Energía (MINAE) and Nicaragua's Ministerio del Ambiente y Recursos Naturales of Nicaragua (MARENA).

This initiative proposed as the final objective of the PEA, to guarantee the availability of goods and services provided by water resources in order to maintain natural ecosystems and socioeconomic development with the goal to satisfy all present and future demands determined in consensus by all stakeholders. Consequently, conflicts related to the use of numerous goods and services of the ecosystems available in the water basin would be reduced to a minimum through a program of action carried out jointly by the two countries. The principal components of the development of PEA included: i) the strengthening of a basin information system that would provide organization and diffusion of information adequate for decision-making for an integrated management of the water basin; ii) The creation of a planning process coordinated between the two countries for the basin area; iii) the implementation of a public participation process with a gender-based focus; iv) the strengthening of public institutions and private organizations with a focus on the local area and v) the formulation and implementation of environmental education activities.

Although the implementation of the PEA provisions have, unfortunately, been awaiting funding since 2006, there exists a political will as announced by both governments for the initiation of the process, and the active search for projected funds. The proposed activities for the formulation of the PEA are based on the results of the Análisis de Diagnóstico Transfronterizo (ADT) which was carried out during the preparation of the Project Document. A summary of the document is outlined below:

3.2.1 Accelerated degradation of trans-boundary ecosystems

Given the traditional uses of the principal ecosystems, a series of human activities have shown their aggregated effects, placing pressure on them and increasing the conflicts among different users of the goods and services they provide. This has negative consequences for the conservation of the quality of water resources. These activities include inadequate urban, industrial and agro-industrial sanitation services; migratory agriculture, extensive cattle production and the consequential expansion of the agricultural frontier; timber production with widespread deforestation; unregulated ecotourism; agricultural production without a conservation focus; introduction of invasive exotic species, such as *Tilapia mossambica*, and uncontrolled fires in the driest forests and in prairies.

3.2.2. Over exploitation of valuable natural resources

Problems are derived from improper use of soils in hillside and wetland agriculture, the construction of roads with inadequate design, uncontrolled fishing and the excessive exploitation of valuable tropical rainforest species and the degradation of fragile soils due to the destruction of forests.

3.2.3. The contamination of bodies of water

The principal causes are the indiscriminate use of pesticides and fertilizers, especially where intensive agriculture practices are used, as well as agro-industrial and industrial effluents and

urban domestic waste. The bodies of water which receive these contaminants in Nicaragua are Lago Nicaragua, the San Juan River and the marine coastal zone, as well as the wetlands south of Lago Nicaragua.

3.2.4. Degradation of soils and increasing sedimentation

Part of the sedimentation process has occurred naturally. However, sedimentation problems are exacerbated by road construction, the expansion of the agricultural frontier and agriculture without conservation techniques, open pit mining and the extraction of materials for construction.

3.2.5. High vulnerability to natural disasters

This is evident in the devastating incidence of hurricanes and tropical storms on populations that live in precarious housing, on the infrastructure and cultivation areas in deforested areas with fragile soils which have high propensity for landslides caused by hurricanes, tropical storms, earthquakes and volcanic activity. These natural disasters can have a drastic and dramatic effect on the course of water flows in the region.

3.3. LEGISLATION DEVELOPMENT:

3.3.1. APPROVAL OF LAW 620

The welcomed approval of the General Law of National Waters on May 15, 2007, aims to establish integral legislation for national waters in accordance with the National Water Resource Policy, which will allow water rights to be secured within an appropriate institutional framework and in the interests of the country's future development. And in turn its purpose is to establish "an institutional legal framework for the administration, conservation, development, use, sustainable and equitable exploitation, and the preservation of quantity and quality of the existing water resources in the country. (C. García, President - Comisión Medio Ambiente Asamblea Nacional). Fortunately, Title VII "Of Protection of the Waters" includes article 97: "the protection, conservation and destiny of the waters of the Gran Lago of Nicaragua is responsibility of the State with the participation of Municipal Governments, Associations within the Municipalities, Nongovernmental Organizations and the population in general." "This lake should be considered a natural potable water reserve of highest interest and a priority of the country for national security. Specific mechanisms and regulations should be established which ensure and regulate water productivity, and, at the same time, ensure maintenance and increase of flow volumes which allow for the development of economic activities without compromising water production, neither in quantity or quality, while also prohibiting the introduction and cultivation of invasive exotic species, as well as avoiding contamination of the resource and the deterioration of the system due to domestic and industrial effluents"

3.3.2. Approval of Law 626.

The previous legal provisions have been reinforced with the approval of the "Law that creates the Commission for the Sustainable Development of the Water Basin of Lago Cocibolca and San Juan River" which was approved on June 12, 2007 and published in La Gaceta No. 159. This law has a directive to form the Commission for the Sustainable Development of the Water Basin of Lago Cocibolca and San Juan River "with the goal to coordinate the application of policies, environmental plans and actions and the development for their protection and conservation with the participation of Governmental and Nongovernmental Institutions,

Municipalities and Indigenous and Farmer Communities" in order "to impulse plans and measures to halt the contamination of the watershed as quickly as possible." The fundamental role of the Commission is to "Elaborate and approve the Plan of Action and Territorial Organization for the Management of the Watershed…which should include the necessary economic, social and environmental measures."…

The aforementioned elements require the elaboration of a public instrument which facilitates planning, execution, management and correction of the actions that will be carried out in the basin. Most of all, the idea is to have an executive body (the Technical Secretariat of the commission) whose primary function will be to harmonize and conciliate efforts and intentions of the sector Agencies of the central government, local governments, civil associations, producers, users and communities for the rational exploitation of the resources taking into consideration compatible uses and all possible users as well as the protection of the water basin.

It is essential to emphasize that the first step in the transparent development of the management plan starts with creating the image of the desired objective in the basin, that is, to generate consensus on the objective of rehabilitation and strengthening for the basin in general as well as for each of the sub-basins that form part of it. It is also important to simultaneously identify the indispensable information needs for this work, which means that the scientific research plan will produce the information for the programs of conservation, economic development, environmental restoration and resource use. The decentralized entity, acting as the Basin Authority, will make a proposal which ensures the compatibility of the work between the central government agencies and that of the municipal governments and civil society organizations.

The commission has met formally four times in 2008, clearly identifying the necessity to convert Integrated Water Resource Management into the focus for the Management Plan's development.

4 RESULTS

There is a strong national awareness of the fact that the restoration process for Gran Lago Cocibolca depends on the management of the processes that are developed in the water basin's territory. While the Management Plan has not yet been approved and the discussion of drafts continues, the local governments, municipal associations, municipalities, producer associations, farmers, nongovernmental organizations, universities, academic and research institutions, professors and students, governmental institutions, civil defense, ministries and sectorial organizations are represented in the Commission for the Sustainable Development of the Water Basin of Lago Cocibolca and San Juan River. The commission presented a request to the National Assembly for the operating expense budget of the Technical Secretariat for 2009, and the Nicaraguan Government has presented solicitudes to external cooperation agencies for financing of components for intervention in the basin territory.

A remarkable result of the public interest in this process is the ownership taken by stakeholders of civil society and private initiatives to contribute to the implementation of some of the

Management Plan components. An example is the participation of the Fondo Nicaragüense para la Conservación de la Naturaleza (FONDONATURA).[1]
FONDONATURA has included in their strategic plan, the topic of the Conservation of Lake Nicaragua with the following work strategies:

a) Monitor the conditions of the Lake's natural environment in prioritized sub-basins: the Mayales, Ochomogo, Malacatoya and Tepenaguasapa rivers.
b) Support public-private initiatives that provide incentives for the lake's basin management.
c) Support actions that involve the industrial private sector in the reduction of the lake's contamination.
d) Contributions to the development of public policies that improve the integration of productive activities.
e) Develop environmental education campaigns geared towards the conservation of Lake Nicaragua.
f) Support municipalities in projects or programs that have objectives related to waste collection, disposal, and management.

5 LESSONS LEARNED AND REPLICABILITY

The central objective of the processes that have been initiated for the development of the Basin 69 Management Plan is the restoration for the use and protection of the Gran Lago Cocibolca. The processes towards achieving this goal are facilitated by the provisions contained within the General Law of National Waters, despite the fact that they have not yet been implemented by the end of 2008. These include, more specifically, the appointment of the Autoridad Nacional del Agua (ANA), the constitution and launching of the Comisión Nacional de Recursos Hídricos (CNRH) and the creation of the Basin Organisms and Basin Committees. Access to the instruments of the National Registry of Water Resources is of importance for the administration of soils, forests and water in the other twenty national watersheds which will make it possible to control the issuing of licenses, concessions and authorizations; the Canon Law for the use and exploitation of water resources and effluents and the Special Law for Environmental Service Payments of Water Resources will also be important.

6 CONTACTS.

Centro para la Investigación en Recursos Acuáticos de Nicaragua, (CIRA/UNAN), PO Box 4598 Managua Nicaragua Telephone numbers: ++ (505) 278 6981, 278 6982, 278 69 6767, Fax 267 8169, Prof. Salvador Montenegro Guillén, Director. salmon@cira-unan.edu.ni .

Comisión Medio Ambiente y Recursos Naturales, Asamblea Nacional de Nicaragua. Ing. Carlos García Bonilla, President garciakar@yahoo.com .

FONDONATURA, Telephone numbers: ++(505)276 2556, Fax 276 2554. Dr. Jaime Incer Barquero, President. fundenic@fundenic.org.ni .

[1] Dr. Jaime Incer Barquero is currently FONDONATURA's president. Dr Incer is the recipient of the National Geographic Society's 2006 Latin American Conservation Leader award.

Ministerio del Ambiente y Recursos Naturales de Nicaragua, PO Box 5123, Managua. Lic. Juana Argeñal Sandoval, Ministry. jargenal@marena.gob.ni

OEA/UDSMA, 1889 F Street, N.W., Washington, D.C. 20006, USA. Pablo González, Project Director. pgonzalez@oas.org

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