

Criteria for Incorporating the Guidelines of the Integrated Coastal Zone Management (ICZM) in Territorial Land Use Planning: Study Case for the Colombian Pacific Coastal Area

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Abstract In Colombia, Integrated Coastal Zone Management (ICZM) has been implemented through the “National Environmental Policy of the Oceanic Spaces and Coastal and Insular Areas of Colombia-PNAOCI” (Acronyms in Spanish), whose guidelines have considered the need to include marine and coastal ecosystems in land use planning. ICZM, as a special planning approach, can contribute to territorial land use planning of the municipalities located in coastal areas, because it can provide guidelines for the conservation and use of ecosystems in these areas. In this work, the Colombian Pacific coastal area municipalities, which are part of the “Tropical Eastern Pacific Region” and are located between the 01°30’ and the 07°10’ latitude North and between the 77°40’ and the 82°00’ longitude West were taken as a study case. The review of their territorial land use plans was made for each one of the municipalities by means of the descriptive analysis of the biophysical, socio-economical and institutional components, seeking to explain, through the different criteria and particular and critical parameters of the coastal-marine areas, the aspects these municipalities must consider and adjust in their territorial land use planning. The criteria selected are related with aspects such as: existence of the territorial land use plan, demarcation of the coastal area, diagnosis (those aspects such as the identification of strategic marine and coastal ecosystems, high impact natural phenomenon i.e. Tsunamis, coastal erosion, oceanographic process, uses, conflicts, risk and governability aspects), zoning and prospecting. The analysis concludes that the ICZM’s principles incorporated to the territorial land use planning processes in the Colombian Pacific could be the opportunity to minimize impacts from land to sea, and generate space.

Keywords Land use planning; Integrated Coastal Zone Management; Zoning; Colombian Pacific coastal area

Introduction

In general, the deterioration processes in coastal areas are evident given the little control of the human activities and the weak zoning and planning processes which do not consider the particular characteristics of these areas (Barragán, 2003; Cicin-Sain and Knecht, 1998; Clark, 1996; Chua, 1993; Kay and Alder, 2005). This situation is not different in Colombia (South America), particularly the development of Pacific coast region has been made in an unorganized way, on topics such as: i) Location of human populations in high risk areas (coastal border areas of flooding from rivers, sliding areas), ii) growth of human populations to strategic ecosystems (e.g. mangroves); iii) Development of unsustainable production activities iv) Limited access of human populations to basic services (water, power, sanitation, health), causing impacts on

ecosystems. In this sense it is necessary to orient zoning and planning processes in which the management and sustainable use alternatives are identified so they contribute to avoid the deterioration of the ecosystems present in the area.

The Integrated Coastal Zone Management (ICZM) is defined as a special continuous, dynamic and participative holistic planning process, which contributes to the decision making regarding the use and protection of the coastal areas, recognizing the particular character of these areas (Cicin-Sain and Knecht, 1998; Clark, 1996; Chua, 1993). ICZM is sets as a tool that contributes to the territorial zoning. It considers among its goals the sustainable development of the ocean and coastal areas, the vulnerability reduction in the presence of natural threats of the

coastal areas and its inhabitants, and the maintenance of the essential ecological processes (Farris, 2002; Kay and Alder, 2005; Stewart et al., 2003).

Several countries around the world have considered the need to incorporate the guidelines of Integrated Coastal Zone Management (ICZM) into the territorial land use planning process of the coastal areas. Considering the coastal zone has specific characteristics related to natural resources, sensitive lands, hazards areas, coastal access, use priorities, and significant impacts of development (Farris, 2002; Gilman, 2002; Stewart et al., 2003; Yañez-Arancibia and Day, 2004a, b).

The purpose of this work is to identify the criteria for the incorporation of ICZM guidelines into the territorial land use planning through a study case on Colombian Pacific coastal area. The selection of the criteria was based on the analysis of secondary information on ICZM and land use planning.

1 Background

Existing knowledge indicates that territorial land use plans of the coastal areas in Colombia do not have the critical information on the Ocean and Coastal environment. A weakness in the inclusion of the marine-coastal aspects could be assumed allowing its environmental zoning in subjects such as: marine-coastal physical environment such as currents, tides, winds, El Niño phenomenon, ecosystems, fauna, vulnerability in the presence of natural threats, municipality coastal environment demarcation, pollution sources, land uses, among others. In this sense, it is necessary to address the zoning and planning processes identifying management and sustainable use alternatives to contribute for avoiding the deterioration of the ecosystems present in the coastal zones.

A number ICZM studies have been carried out in the Colombian Pacific coast. Between 1999 and 2009 it was developed the pilot project for designing the integrated management plan of the coastal areas of Guapi and Iscuandé municipalities (INVEMAR et al., 2003; López et al., 2003); on 2004 was designed the management plan for the south coastal area of the Colombian Pacific coast (INVEMAR et al., 2006; López et al., 2008). The Planning National Department prepared the handbook of "Basic Elements for Integrated Management of the Coastal

Areas", offering the guidelines for the integrated management of the marine-coastal territory in the framework of the country's territorial land use planning processes (DNP, 2008). Other important works that have contributed elements for present study are related to vulnerability due to natural threats such as earthquakes, tsunamis, El Niño phenomenon, erosion, sedimentation and sea level rise (Duarte, 1992; INVEMAR, 2003; Lacambra et al., 2003; Reyna, 1997). These studies and others in the Caribbean coastal areas have provided the information to define the criteria for the incorporation of the ICZM into the territorial land use planning.

Study area

The coastal area of the Colombian Pacific is part of the "Tropical Eastern Pacific Region" (Steer et al., 1997) and is located between the 01°30' and the 07°10' latitude North and between the 77°40' and the 82°00' longitude West (CCCP, 2002). At North, it borders with the Panama Gulf; on the south with the Ecuadorian coast waters and the Carnegie submarine mountain range; and to the West with the Pacific Ocean and the territorial waters of Panama and the Cocos mountain range (CCCP, 2002). It has a coastline length of 3 513 km, and it includes the Chocó, Valle del Cauca, Cauca and Nariño Departments and the Gorgona, Gorgonilla and Malpelo Islands (Figure 1).

2 Materials and Methods

The present work is based in a descriptive analysis of the different environmental aspects and relevant subjects for territorial land use planning of the Colombian Pacific municipalities. This methodology is focused on description and analysis of the diverse components of the system (biophysical, socio-economic and institutional) in order to establish a diagnosis and definition of the key aspects that must be taken into account in the planning of a territory (Hernández et al., 1997). This methodological framework has been applied to the development of different planning processes of territory (Becerra et al., 1998; Alonso et al., 2003).

Several approaches have been generated for dealing with ICZM. In general these processes define a series of common phases: 1) preparation and institutional arrangement, 2) diagnosis, 3) proposal or design (which includes the zoning), 4) execution or implementation and 5) evaluation and adjustment.

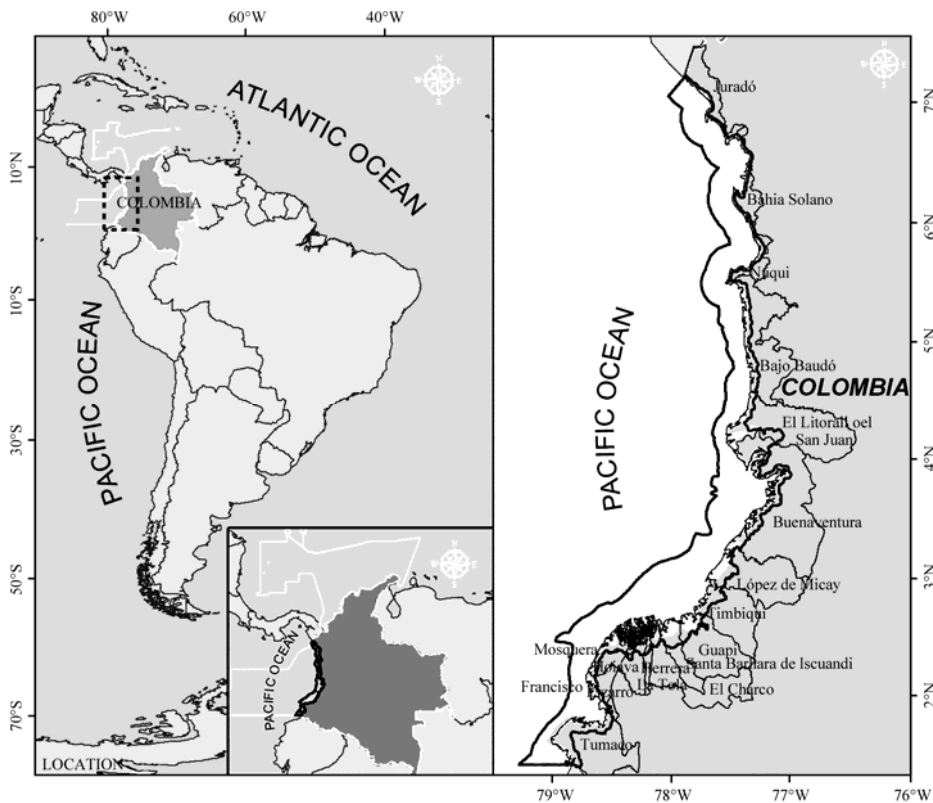


Figure 1 Study Area

In each step application of a specific methodology is possible (Barragán, 2003; Cicin-Sain and Knecht, 1998; Kay and Alder, 2005; Varghesea et al., 2008).

In Colombia was proposed a methodology to apply ICZM concepts called COLMIZC (Acronyms in Spanish). This method has been used for management plans design of coastal areas of our country, based on spatial analysis of the territory and in general developing the above mentioned stages (Alonso et al., 2003). On the other hand, the territorial land use plans which are instruments in the territorial planning and management, leads a descriptive analysis for explaining the territory structure and its dynamics, as well as situational analysis for facing a synthesis of problems and options of territorial development (Amler et al., 1999).

Present study methodology is based on description of a secondary information analysis of conceptual and methodological elements of territorial land use plans, ICZM (documents/concepts/plans) and regulations and policies. Derived from above analysis the criteria to be incorporated into the territorial land use plans are selected.

In order to generate a diagnosis of the key aspects to consider in the territorial planning of the coastal municipalities, the criteria were to define from the elements of ICZM (IGAC, 1997a; IGAC, 1997b; Becerra et al., 1998; Alonso et al., 2003, Varghese et al., 2008).

For the selection of criteria, the methodology was based on the review and analysis of bibliographic information on the spatial planning and integrated management.

According to the information analyzed, the criteria were: 1) Overview: formulation, approval, validity, review and updating, 2) Diagnosis of territory: subsystems biophysical, social, economic, cultural and institutional, 3) Zoning: Threats and ecological risks, land use and land use conflicts, 4) prospective, biotic physical landscape (fauna associated ecosystems), land use, infrastructure (Alonso et al. 2003; Barragán, 2003; INVEMAR et al., 2006; INVEMAR et al., 2003; Kay and Alder, 2005; Lacambra et al., 2003; López et al., 2008; López et al., 2003; Olsen et al., 1999). 5) Delimitation of the coastal area of municipalities, taking into account that it is a strategic aspect at the

moment of giving management orientations, is that the municipalities have clearly defined their coastal area and their marine influence area (Alonso et al., 2003; MMA, 1998a, b).

In environmental studies and overall ICZM, there are different techniques of assessment and diagnosis, which often rely on the use of matrices for analysis, with which you can evaluate different aspects and impacts of environmental problems, conflicts, effects on through a project, among others (IGAC, 1997a; IGAC, 1997b, Becerra et al., 1998, Barragan, 2003). The present study makes an adaptation of this instrument, generating a matrix of criteria and analysis

of key parameters to be considered in land use plans, to include coastal marine areas.

3 Results and Discussion

3.1 Territorial land use planning and ICZM

In order to establish the connection between the territorial land use planning and the ICZM as planning processes, we create a parallel to facilitate the identification of those ICZM elements which can contribute to strengthen the territorial land use planning processes. Taking into account that both processes have similar conceptual, instrumental and technical elements, ICZM may add those essential elements to improve the territorial land use plans (Table 1).

Table 1 Comparative elements between the territorial land use planning and ICZM in Colombia

Comparison Element	Territorial land use planning	Integrated Coastal Zone Management (ICZM)
Definition	<p>It is the policy of the State that allows an appropriate political-administrative organization of the Nation (MMA, 1998a, b).</p> <p>It is a planning instrument that contributes methods and procedures bringing the development policies nearer to the specific territorial issues. Is a prospective, democratic and participative holistic process (IGAC, 1997a).</p>	<p>In Colombia, the ICZM has been adopted from a National Policy called “<i>Environmental National Policy for sustainable development of the oceanic spaces and coastal and insular zones of Colombia</i>” (MMA, 2001)</p> <p>It is defined as a holistic, continuous, dynamic, participative process and built under consensus, through which decisions are taken for the sustainable use and the protection of the coastal area and its resources in order to reach the goals established in cooperation with the users groups and the national, regional and local authorities (Cicin-Sain et al., 2006; Clark, 1996; Kay and Alder, 2005)</p>
Principles	<p>Integrated: holistic approach considering the biophysical, economic, socio-cultural, political-administrative and space (MMA, 1998a, b). Articulator: harmony and coherence between the sectorial and environmental development policies at all territorial levels (MMA, 1998b).</p> <p>Participative: principle that seeks to give legitimacy and viability to the process by involving the different social actors (MMA, 1998a, b).</p> <p>Prospective: allows identifying the use and occupation tendencies of the territory and the impact the sectorial and macroeconomic policies have over it (IGAC, 1997a, b).</p> <p>Territorial Equilibrium: seeks to reduce the territorial unbalances and improve the life conditions of the population by means of the adequate distribution of activities and basic services, the better functional organization of the territory and its use possibilities (MMA, 1998a, b).</p> <p>Environmental Sustainability: guarantees that the current use of the natural resources does not prevent future generations its adequate use and quality (MMA, 1998a, b)</p>	<p>Integration: considers all the physical, biological, social, cultural, economic and institutional aspects in the management. To orientate the ICZM, the integration may be horizontal, among the different economic sectors and the associated government units having influence over the planning and management of the coastal resources; or may give a vertical integration, among the different government levels (national, regional and local) (Cicin-Sain and Knecht, 1998).</p> <p>Participation: it is a vital aspect for decision making that involves the actors with interests in the coastal area in a communication and coordination space, for the negotiation and agreement of the information use that is produced over such area (Cicin-Sain and Knecht, 1998).</p> <p>Prospective: through this principle, the problematic and consequent performances toward the future are set out (Barragán, 2003; Cicin-Sain and Knecht, 1998).</p> <p>Social Equity: it tends to the improvement of the life conditions of all the actors that are part of the coastal area to be managed; the benefit given by the coastal area resources as a public resource must be distributed in a fair, balanced and responsible way (Barragán, 2003).</p> <p>Coastal Resources’ Continuance in Time: the sustainable use of the ocean and coastal ecosystems implies using, taking advantage and rationally and comprehensibly maintain its resources, warrantee its permanence and the economical opportunities of present and future generations and supply the resources to improve the local communities welfare and its presence in collective territories (Barragán, 2003).</p>

Comparison Element	Territorial land use planning	Integrated Coastal Zone Management (ICZM)
Phases	<p>According to Decree 879/98, regulating Law 388/97 (article 22, chapter 6), the development of the territorial land use planning must consider the following stages: Preliminary stage: This stage covers a technical, institutional and financial feasibility analysis and the participative processes required for the preparation of the plan; the identification of the necessary resources and activities necessary for the preparation of the plan. The definition of the strategic and priority subjects of the space projection of activities in the territory in function of the Municipality or district vocation according to the social and economic policies defined in the Development Plan.</p> <p>Diagnosis: Should allow the consolidation of the current image of the territory to confront it with the desired image so it allows to adequately formulating the general development purpose of the municipality or district in spatial terms. Includes the urban-regional vision, analysis of the municipality or district and the territorial development dimensions (urban or rural, environmental, economical and social, as well as cultural and institutional).</p> <p>Zoning: consists in the spacing of phenomena characterizing the territory, the demarcation of particular features that constitutes in a management element and allows the integration of different development proposals of the social and institutional actors intervening in the territory (MMA, 1998a, b).</p> <p>Design: The design of the plan covers the basic decision making process on the territory zoning, which are translated in the general component and its structural contents, and in the urban and rural components. Likewise, it must include the actions and acting that will be incorporated in the execution program.</p> <p>Implementation: Covers the actions necessary to make a reality the zoning Plan purposes in aspects such as the financial, institutional capacity, technical development and the summoning and agreement.</p> <p>Evaluation and follow-up: This stage is permanently developed along the enforcement of the zoning plan with the participation of all the interested parties and especially of the Territorial land use planning Consultative Body.</p>	<p>In order to adopt the ICZM in Colombia, a methodological outline named COLMIZC Methodology (Alonso et al., 2003) has been proposed; this proposal was adapted from the methodology of the “Common Methodology” proposed for the coastal management (Olsen et al., 1999). The ICZM considers the following stages: Preparation: considers the definition of the process orientation as far as the area to be worked with and the reference terms under the study will be given. It also includes the definition of the institutional arrangements, the constitution of the technical team, the identification and design of the investigation problem, the identification of the actors and the demarcation of the coastal area.</p> <p>In the case of the demarcation of the coastal area, it is important to highlight that it is a participative process that though at the beginning it takes as reference the criteria established in the PNAOCI, these must be adjusted with the local actors, and the particularities of the area to work with.</p> <p>Characterization and diagnosis: In this phase the inventory and description of the system characteristics, its components, functions, resources, potentials, restrictions and in general the current situation of the territory is made. In this way, the critical problems are identified and prioritized for clearly defined areas, on which the management actions will be performed.</p> <p>In this stage the environmental zoning is developed as the space synthesis of the territorial dynamics. Part of the ecological landscape characterization (Zonneveld, 1995), in which homogeneous regions are considered from the physical and biotic aspects, to reach an environmental zoning in which the socio-economic, cultural and governability criteria, as well as the risk areas identification, among others, are integrated.</p> <p>Design</p> <p>Design and adoption stage: Consists, as the initial step in the preparation of the long term proposal for the ICZM, through the generation of lines, programs and projects. Once the plan is defined, the interinstitutional obligations to carry out the implementation of the coastal area must be established</p> <p>Implementation Stage: it consists in the implementation of the formulated ICZM plan, for which purpose an action plan, the investment programming as well as the programs and projects execution must be made.</p> <p>Evaluation Stage: being the ICZM a continuous process, it must be regularly evaluated to verify its efficiency or adopt the necessary corrective measures.</p>

The territorial land use plans become the main territorial planning instrument since they organize and

regulate the land uses. However due to Colombian legislation, territorial land use plans do not include

specific functions for municipalities on marine issues (National Constitution, Departmental Regime Code-Decree 1222 of 1986, Law 388/97, Municipal Regime Code-Law 136 of 1994). These plans determine the actions lines and activities limited by the terrestrial portion of coastal areas, including urban and rural land types, leaving the marine areas for the National Government competence.

Similar situation is showed in other coastal areas (Oregon, United States), where it has found as a weakness of the land use plans a geographical limitation as far as jurisdiction is concerned (Smith, 2002). Main problem was the elements related to the marine environment were not taken into consideration

for fundamental aspects such as ecosystems, land uses and natural and human threats.

3.2 Criteria definition

Based on components and phases of territorial land use planning and ICZM, critical criteria were defined for territorial land use planning processes and we consider they must be incorporated into the coastal municipality management process (Figure 2). The figure shows the correspondence between the components of the territorial land use planning and ICZM, indicating the criteria that should be considered in each phase and planning for the coastal municipalities, in addition to considering an additional component related to the delimitation of the coastal zone.

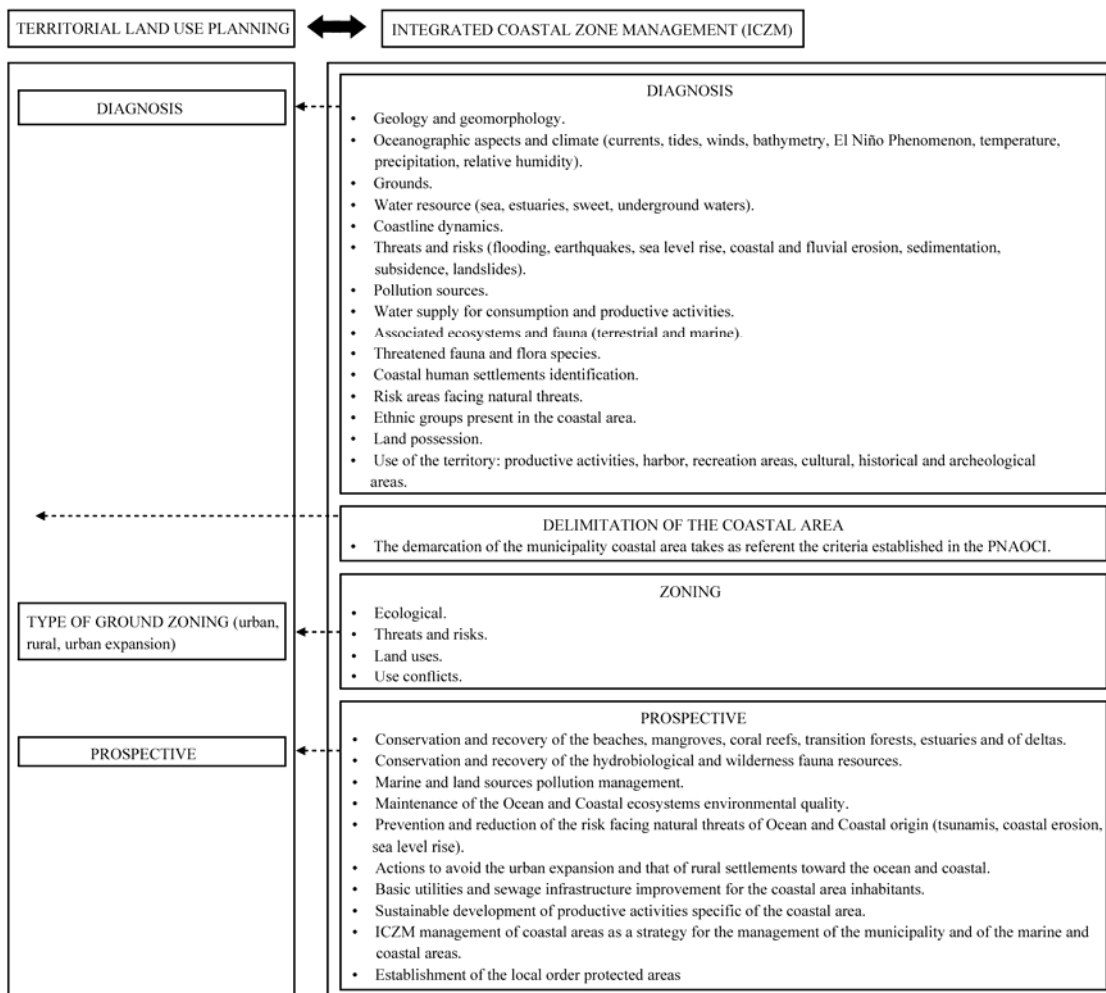


Figure 2 Criteria applied from the ICZM for the territorial land use planning

Note: The arrows indicate which part of ICZM aspects should be incorporated in the stages of land use plan. Each defined criteria was established relevant aspects to be included in the territorial land use planning of coastal municipalities of the Colombian Pacific, based on ICZM guidelines.

3.2.1 Diagnosis

The parameters considered refer to the specific information for the Ocean and Coastal zones regarding the geology, geomorphology, strategic ecosystems, uses, conflicts, environmental quality of the water, among others.

According to the evaluation of these parameters in the territorial land use plans, it was found that in the aspects in which more shortcomings are found in the plans, are related to the oceanographic conditions diagnosis especially in that referring to the currents regime and the bathymetric information of the marine area adjacent to the municipalities. Likewise, the socio-economic and governability aspects must be strengthened considering a holistic vision of the territory.

In most part of the cases the geomorphology, uses and ecosystems information is referred to the terrestrial-coastal sub-zone; the specific information on the marine ecosystems could be identified.

In general, the cartography in land use plans of the municipalities of the Colombian Pacific, reference only the terrestrial-coastal sub-zone, which is consistent with the fact that the municipalities jurisdiction is only in that specific sub-zone. However, it is basic to consider the marine-coastal sub-zone, taking into account that the actions developed by the municipality may affect these areas and, in turn, the different processes in the marine zone affect the municipality and its inhabitants. Regarding the anthropic threats subject, for all the plans there is too few information in the pollution sources and especially its space location.

Some published job about coastal land use planning and ICZM carried out in Canada and the United States, have mentioned the importance of including in the territorial planning the adjacent marine zone, taking into account the strong interaction between the physical, biological and socio-economic processes happening between the continent and the adjacent sea, making the handling to be given in an articulated way (Farris, 2002; Gilman, 2002; Portman, 2007; Smith, 2002; Stewart et al., 2003; Thampanya et al., 2006; Yañez-Arancibia and Day, 2004a, b). They stress the need of having a knowledge on the dynamics and the ecosystems conditions present in these areas such as the estuaries, mangroves, deltas, beaches and cliffs and the energy and matter exchange between the sea, the land and the atmosphere as well as the dynamics and processes in the ocean (coastal dynamics and

oceanographic aspects) and the threats evaluation to which the coastal areas are being subject.

3.2.2 Delimitation of the coastal area

The delimitation of the coastal area was defined as one of the criteria to be evaluated, considering it an essential aspect at the moment of arranging the municipalities located in this area. This criterion allows to get an idea if the whole of the municipality that corresponds to a coastal area according to the PNAOCI criteria, or if it is the case that only one part is under the coastal influence; likewise, this demarcation criterion is useful to know which are the main urban centers located in the coastal area.

According to the PNAOCI, in the demarcation of the coastal area the six main ecosystems or units of the Nation's coastal resources must be included, in view of its structural and possible functional space limit (MMA, 2001). For the Colombian Pacific these are:

Coral reefs

Mangrove ecosystems

Transition forests

Beaches and cliffs systems

Estuaries of deltas and coastal lagoons

Sedimentary soft bottoms of the continental platform

Two coastal area types are likewise established, the continental and the insular. For the Colombian Pacific coastal municipalities' case, mention is made of the continental coastal area.

The continental coastal area is constituted by three sub-zones or parallel stripes which always include the air space found above the sea or of the emerged continent, the marine bed and the land, as well as the underground for the oceanic and terrestrial dominance included in the coastal area (MMA, 2001). These sub-zones are: the coastal marine sub-zone, low tide or transition strip sub-zone, and coastal-terrestrial sub-zone.

For the Colombian Pacific, the criteria for the delimitation of these areas are: Marine-coastal sub-zone or offshore area: The limit of this sub-zone is the continental platform edge using as a referent the of 200 m isobaths. At the north of the Colombian Pacific (coastal area of the Outline), due to the fact that the continental platform gets narrower, the limit of this sub-zone is fixed up to a parallel line located 12 nautical miles of distance toward the sea. The criterion

of the 12 nautical miles is established taking into account that it is the marine territory strip adjacent to the continental emerged territory, where are taking place the maritime cabotage transportation, the amateur maritime fishing, the maritime port activities and main marine pollution impacts which are coming from land sources. Consequent to the juridical obligation of the Government to sovereignly protect the territorial sea.

Low tide area or transition strip: This sub-zone includes the strip located between the average low tide line and its width depends on the tide width rank, which for the Colombian Pacific case is of an average of 4 m.

Terrestrial-coastal sub-zone: This sub-zone covers the strip located from the average high tide line located at

a distance of 2 km inland. For the Colombian Pacific, this sub-zone must include the entirety of the mangrove ecosystems and the transition forests located behind these locally called “guandal” forests; in this case, the limit is fixed in 2 km inland from these ecosystems. Likewise all the declared protected areas in the Natural National Parks system and its absorption area and all coastal urban centers stretching 2 km from the average high tide line must be included in all their extension.

Figure 3 shows the proposed delimitation of the coastal zone and associated coverage, to the Colombian Pacific coastal municipalities.

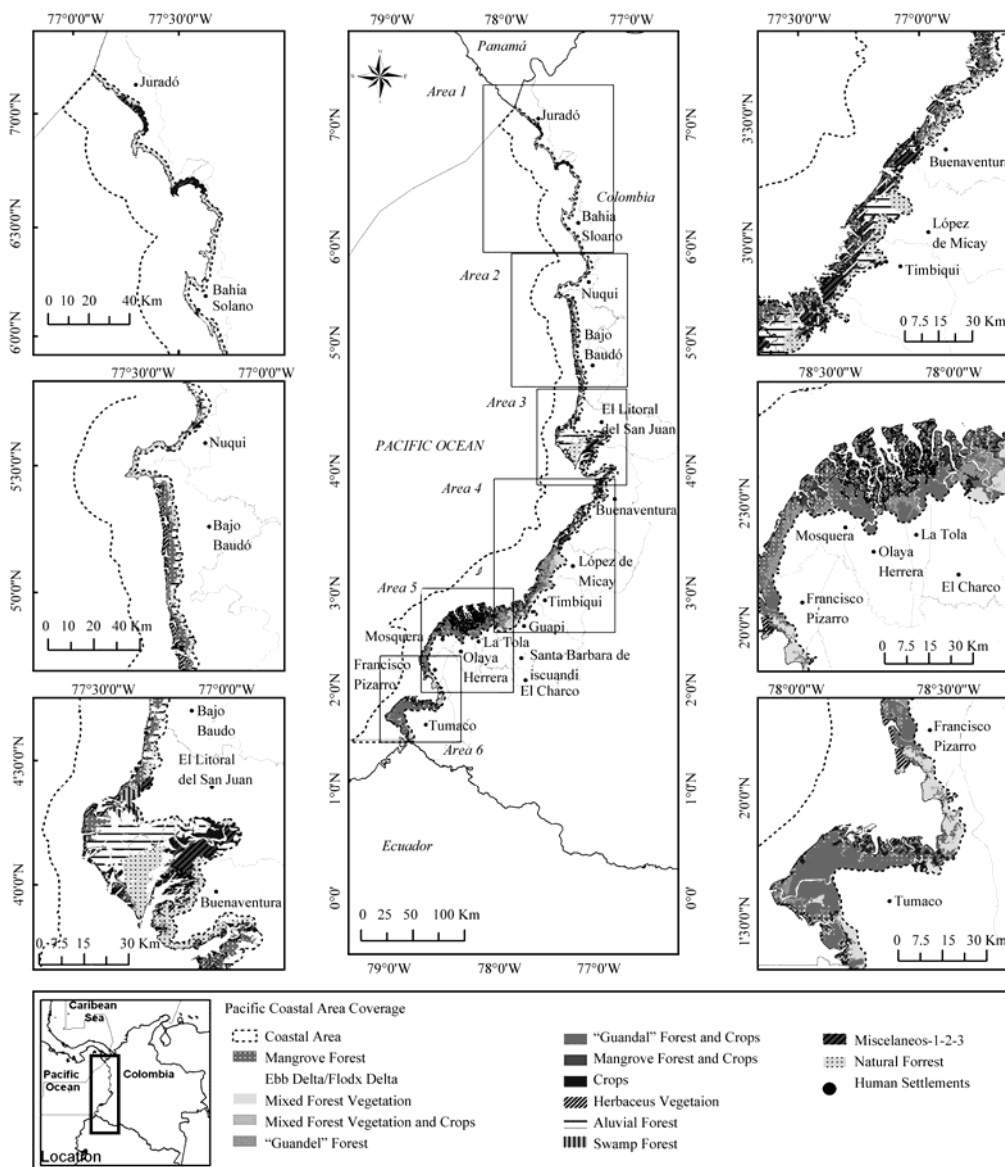


Figure 3 Delimitation proposal of the coastal area and coverage for the coastal municipalities of the Colombian Pacific based on the PNAOCI criteria

Regarding the sub-zones of the continental coastal area, it is emphasized for the coastal area municipalities of the Colombian Pacific, that more than 90% of the main inhabited centers (including the municipal seats of government) are located in the coastal area. Also in some cases, a great part of the population is settled in the transition sub-zone, where they have a high risk by affectionation in the presence of natural threats (fluvial flooding and tides, earthquakes, tsunamis, sea level rise, coastal erosion, sedimentation).

The process of delimitation of coastal areas is a critical factor in the process of ICZM (Balaguer et al., 2008). The incorporation of the boundaries of the coastal zone in the planning of municipalities will contribute to consider in this process, marine and coastal ecosystems, demonstrating the variability of habitats and ecological processes, social, economic and institutional changes that may occur in this area.

It is worthwhile to indicate that for the coastal area of the Colombian Pacific, the mangrove is one of the ecosystems with greater representation. Only in the South Pacific, it has around 50% of all the country's mangroves. It is basic to take this situation into consideration in this demarcation of the municipalities territorial land use planning, in order to establish and implement measures for the conservation of this ecosystem, considering the strategic importance for the country and for the region, which supports great part of the inhabitant's productive activities. The different studies developed on ICZM and ecosystems managements in the Gulf of Mexico, United States and Canada, indicate the importance of implementing the planning processes, develop actions oriented and based on the key ecosystems management. This case, such as the mangroves, have importance due to the use given to its associated resources (mollusks, crustaceans), coastal protection in the presence of processes such as the coastal erosion, and the water quality maintenance (Farris, 2002; Portman, 2007; Stewart et al., 2003; Thampanya et al., 2006; Yañez-Arancibia and Day, 2004a, b).

3.2.3 Zoning

The zoning has been pointed out as one of the most important tools for planning and handling of the territory zoning based on its ecological, social and economic values. The zoning may be used to separate

the compatible and incompatible uses, identify the ecological importance areas for the protection, define the growth patterns of the towns and establish the areas exposed to natural threats (Amler et al., 1999; Gilman, 2002; Smith, 2002; Stewart et al., 2003). In the same way, in the ICZM framework the zoning is seen as a tool integrating the ecological, socio-economic and institutional aspects for the management of the coastal areas (Cicin-Sain and Belfiore, 2005; Cicin-Sain and Knecht, 1998; Portman, 2007).

According to it, different types of ecological uses, threats and risks, use conflicts may arise, that must be considered in the territorial land use planning. Figure 4 shows the relevant elements for the territorial land use planning of the coastal area, for this case, municipalities of the Colombian Pacific.

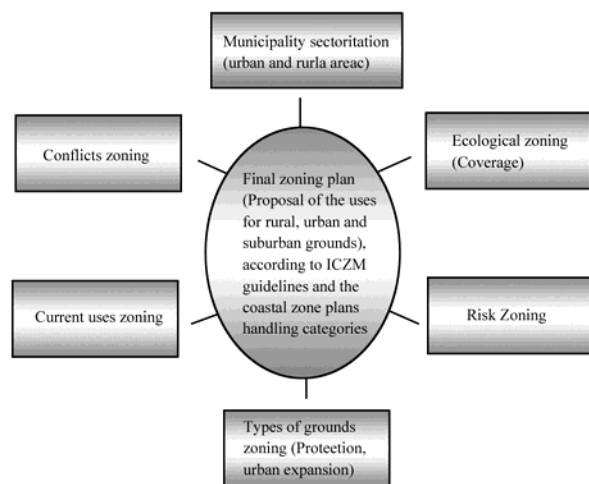


Figure 4 Elements to take into consideration in the territorial land use plans of the zoning proposal.

In general the territorial land use plans of the municipalities of the Colombian Pacific coastal area have limitations in the ecological zoning, mainly in the definition of the ecological units of marine-coastal sub-zone, in the zoning of use conflicts and in the threats, mainly anthropics.

Ecological zoning

Taking into account the ecosystems defined as part of the coastal area in Colombia according to the PNAOCI, the ecosystems existing and identified in the territorial land use planning are mentioned.

According to the PNAOCI, in the demarcation of the coastal area the six main ecosystems or units of the

Nation's coastal resources must be included, in view of its structural and possible functional space limit (MMA, 2001). For the Colombian Pacific these are: 1) Coral reefs; 2) Mangrove; 3) Transition forests; 4) Beaches and cliffs systems; 5) Estuaries of deltas and coastal lagoons; 6) Sedimentary soft bottoms of the continental platform. It can be seen that in none of the cases mention is made to the sedimentary bottoms of the continental platform, which is an ecosystem present in the entire marine area adjacent to the municipalities and has special importance because it

supports one of the productive activities of the coastal area as are the fisheries.

Uses

From the territorial land use planning point of view, the definition of the land use guidelines based on its aptitude; in this sense for the rural, urban and protection lands the main, complementary, restricted and prohibited uses. Table 2 describes the recommended uses for the different coverage that could be present in the coastal areas of the coastal municipalities of the Colombian Pacific.

Table 2 Relation of possible recommended uses for the coastal municipalities of the Colombian Pacific land

Land use class	Coverage	Recommended allowed uses	Forbidden uses
Rural	Beaches	Protection of the coast line; Landscaping; Ecotourism; Clams extraction; Investigation	Housing settlement; Residual water and waste dumping
	Mangroves	Protection against natural threats; Maintenance of the ecological balance; Fauna protection; Reforestation; Landscaping; Investigation; Mollusks and crustaceous extraction; Wood extraction for domestic use in (firewood and housing)	Forest extraction with commercial purposes; Infrastructure location; Aquiculture; infrastructure; Agriculture; Residual water and waste dumping
	Marshes	Maintenance of the ecological balance; Protection of the marshes edges; Recovery; Landscaping; Investigation; Protection of fauna larvae and juvenile stages; Transportation; Fishery	Logging at the edge of the marshes; Residual water and waste dumping
	Estuaries	Fauna protection; Fishery; Transportation	Residual water and waste dumping
	Rivers and streams	Protection on the river banks due to the risk of mass movements or landslides, flooding due to river overflowing or draining difficulties and high liquation potential and extension of seismic waves and salubrious risks; Reforestation; Fishery; Transportation; Water supply	Residual water and waste dumping
	Swamps/Transition forests	Water supply; Forest; Agricultural; Survival hunting	Residual water and waste dumping; Logging under the minimum allowed diameters
	Solid, Hills/mixed forests	Forest; Agricultural; Survival hunting; Water supply; Location and provision of aqueduct, communication, gas, electricity, networks, treatment plants and solid residues dumping places, among others	Residual water and waste dumping; Logging under the minimum allowed diameters
Urban/Urban Expansion	Beaches	Protection of the coast line; Landscaping; Tourism; Investigation	Residual water and waste dumping
	Mangroves	Protection against natural threats; Maintenance of the ecologic balance; Reforestation; Landscaping; Investigation; Wood extraction for domestic use (firewood and housing)	Residual water and waste dumping; Logging under the minimum allowed diameters
	Marshes	Protection; Maintenance of the ecologic balance; Reforestation	Residual water and waste dumping
	Solid, Terraces/hills-Mixed Forests	Residential in terraces areas; Location and provision of aqueduct, communication, gas, electricity, networks, treatment plants and solid residues dumping places, among others	Residual water and waste dumping; Residential; Recreation; Commercial and services; Institutional; Public space
	Rivers	Protection on the river banks due to the risk of mass movements or landslides, flooding due to river overflowing or draining difficulties and high liquation potential and extension of seismic waves and salubrious risks; Reforestation; Fishery; Transportation; Water supply	Residual water and waste dumping

Note: Source: Alonso et al., 2003; INVEMAR et al., 2006; Vides and Sierra-Correa, 2003

Protection land

In the Colombia's territorial land use planning, the protection lands are those areas that due to their geographical, landscaping or environmental characteristics or being part of the public use area for the location of infrastructure for public utilities supply or been non-mitigable threats and risks area for the location of human settlements, have the developing possibility restricted (Law 388 of 1997). Similar classification regarding the ground uses planning in coastal areas have been proposed in Canada (Stewart et al., 2003) and for the Oregon coasts (United States) (Smith, 2002), in which the coast line protection areas, maintenance of the water quality for human consumption in towns, maintenance of the landscape quality and conservation of the ecosystems.

One of the critical aspects in the determination of the coastal areas ground protection is the identification of the environmental interest areas that consider the strategic ecosystems found in the municipalities. The coastal ground uses planning proposals made for Canada and United States (Farris, 2002; Gilman, 2002; Smith, 2002; Stewart et al., 2003), as well as the ones proposed by ICZM (Portman, 2007; Thampanya et al., 2006; Yañez-Arancibia and Day, 2004a, b), prioritize the identification of areas for the coastal ecosystems conservation such as beaches, estuaries, coastal lagoons, low river watersheds and marshes, among others, due to their diversity, their environmental functions (i.e. protection of the coast line) and for the support they grant to the productive activities.

For the coastal area of the Colombian Pacific, it is fundamental to take into account that strategic ecosystems such as the mangroves, beaches or estuaries, must take precedence as protection grounds (that is, not available for development), tending to its conservation by means of preservation, recovery and sustainable use, and traditional actions. For the case of the estuaries and the marine ecosystems, though they are not directly under the jurisdiction of the municipalities, it is basic to consider them, taking into account that all the activities performed in the continental part may affect them.

3.3 Prospective

The results obtained indicate that, in general, the territorial land use plans of the Colombian Pacific

coastal areas, present weakness in the identification of programs and projects oriented to the management of the pollution sources, the maintenance of the Ocean and Coastal ecosystems environmental quality, the control of the human settlement expansion toward the Ocean and Coastal ecosystems, the conservation and recovery of the delta estuaries and the prevention and reduction of the risk in the presence of ocean and coastal natural threats (tsunamis, coastal erosion, rise of the sea level, etc.).

Based on the principles and guidance of the ICZM (Cicin-Sain and Knecht, 1998; Mc Clanahan et al., 2005; Portman, 2007; Thampanya et al., 2006; Yañez-Arancibia and Day, 2004a, b), as well as in coastal areas use planning proposals (Farris, 2002; Gilman, 2002; Smith, 2002; Stewart et al., 2003), the territorial land use planning for the municipalities of the Colombian Pacific coastal area, must be strengthened in the Design and implementation of programs and projects in aspects such as: a) Conservation and rehabilitation of strategic ecosystems such as mangroves, beaches, estuaries and deltas; b) Wilderness fauna protection and hydrobiological resources; c) Maintenance of the ecosystems functions; d) Management of the pollution by terrestrial and marine sources that affect the human population and the ecosystems; e) Prevention and mitigation of the risk in the presence of natural threats, especially those associated to coastal areas (coastal erosion, tsunami, sea level rise); f) Sustainable development of productive activities; g) Definition of protected areas; h) Promotion of the environmental education among the area inhabitants.

4 Conclusions

As of the analysis carried out, it is concluded that the ICZM principles incorporated to the territorial land use planning processes in the Colombian Pacific, could be the opportunity to minimize from land to sea the impacts and generate a spatial and temporary integration of the inter-institutional task in the local environment.

The coastal zone delimitation, is one the most important criteria to consider the land use planning process. This criterion allow including the marine and coastal strategic ecosystems and to define the

uses according to the particular characteristics of coastal zone.

In general all the municipalities take on only the terrestrial-coastal sub-zone as the municipalities' coastal area, without considering the marine-coastal sub-zone as an integral part of the territory, that though is not part of its jurisdiction, is closely related due to the fact that the activities developed in the continent may affect the marine part and besides many of the coastal settlements' economic activities develop on the sea.

Regarding the diagnosis, aspects such as de identification of strategic ocean and coastal ecosystems, high impact phenomena (i.e. Tsunamis), coastal erosion, terrestrial and marine origin pollution sources, oceanographic aspects, and socioeconomically and governability aspects are taken into account but they require to be strengthened from a holistic vision of the territory.

As far as the information integration for the cartographic and production, reinforcements are required in improving the work scale and the information accuracy so they are useful to the zoning, allowing the identification and solution of use conflicts and the legal appropriation of the territory.

Regarding the ecological, currently in the territorial land use planning of the coastal area municipalities of the Colombian Pacific, coastal ecosystems such as the mangroves, the beaches, the estuaries and the coral reefs (in the case where this ecosystem exists) are identified. However, the sedimentary bottom of the continental platform is not documented as an ecosystem associated to the coastal area of the municipality. In this sense, the recognition of this ecosystem must be strengthened given its importance as far as extension and support of one of the important economic activities in the Colombian Pacific, as is the case of fishery.

As far as the prospective criterion, in general it is evidenced in the territorial land use planning of the coastal municipalities of the Colombian Pacific, a more continental vision as far as the actions and projects to be developed proposal; it is necessary to identify projects in agreement with the characteristics of the coastal areas, for example, the conservation of

strategic ecosystems such as mangroves, beaches and estuaries, the protection of hydro-biological resources, the management of pollution due to terrestrial and marine sources affecting the human settlements and the ecosystems, and the prevention and mitigation of the risk in the presence of natural threats, especially those associated to the coastal areas (coastal erosion, tsunami, sea level rise), among others.

Authors' contributions

Angela López Rodríguez, principal author of the paper, the result of the work is the product of her MSc thesis. She gave the original idea and design of the article and made for the acquisition and analysis of data. Paula Cristina Sierra Correa participated in drafting the article and contributed to the design of the analysis methodology. Pilar Lozano-Rivera participated in drafting the manuscript and made revisions to the version submitted for publication.

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