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The Perception of Public Actors respecting the processes and imbalances in the Management of the Maullin River Estuary, Los Lagos Region, Chile: A Conceptual Model for the Political and Technical Decision Making Processes *

Modelo Conceptual para a Gestão do Estuário do Rio Maullin (Região de Los Lagos, Chile): processos, desequilíbrios e percepções dos envolvidos

Galicia Stuardo-Ruiz [@,1], Fernando Peña-Cortes [2], Francisco Ther-Rios [3]

ABSTRACT

The purpose of this research is to present a conceptual model for the integrated management of the Maullin River Estuary. The methodology used in this work was based on literary reviews of coastline management, sustainability, critical prospective methodology, and the system dynamics practical approach and field activities including interviews of key informants, professionals, and technicians from the Local Government using the Likert Scale Survey. The qualitative and quantitative variables taken from the study allowed the identification of critical variables and aided in the design of the frame of the analysis. The results showed five critical variables for the area: 1) competition for natural resources of commercial importance, 2) the need for environmental regulations at the local level 3) the need for education in sustainable development, 4) competition between local fishermen and indigenous communities for the use of coastal territory, and 5) the diversity of institutions and local agents with jurisdiction over the coastal territory. In addition, there are three recognizable systemic archetypes in the region which are an expression of the territorial dynamic and a projection of the desirable future of the territory. These systemic archetypes are ¨Shifting the Burden, Eroding Goals and ¨Success to the Successful¨. As a result of this work a conceptual model has been constructed whose main discovery is the need of generating an agreed participative process not only technically correct in the management area but with a political orientation based on the transversal axis of the local plan.

Keywords: integrated management; coastline sustainable development; estuaries; conceptual model; territorial management; dynamic systems; systemic archetypes.

RESUMO

Neste trabalho é proposto um modelo conceptual para a gestão integrada do Litoral do rio Maullín. A metodologia utilizada baseou-se na revisão da literatura especializada na temática da gestão costeira e sustentabilidade numa perspectiva crítica e dinâmica de sistemas, e actividades de campo com aplicação de entrevistas a informantes chave de entre os profissionais e técnicos do governo local (município), utilizando a Escala de Likert. Após o cruzamento de variáveis qualitativas e quantitativas foram definidas as variáveis críticas e estabeleceu-se o quadro de análise. Os resultados mostraram cinco variáveis territoriais críticas: 1) competição por recursos naturais de importância comercial; 2) necessidade de normas

@ - Corresponding author
1 - Master in Planning and Territorial Management Program - Catholic University of Temuco. E-mail: galiana23@gmail.com
2 - Territory Planning Laboratory, Core of Research on Environemtal Studies - Catholic University of Temuco. E-mail: fpena@uct.cl
3 - ATLAS Program – Los Lagos University. E-mail: fther@ulagos.cl

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ambientais municipais; 3) educação para a sustentabilidade; 4) competição pelo uso da terra entre os pescadores artesanais e as comunidades indígenas; e 5) a diversidade de instituições e representantes locais com jurisdição sobre o litoral. Foram identificados três arquétipos sistémicos: ¨Shifting the Burden", "Eroding Goals" e ¨Success to the Successful¨, como expressão das dinâmicas territoriais e projecção dos cenários futuros desejáveis para o território. A partir deste trabalho foi possível gerar o modelo conceptual cuja principal conclusão é a necessidade de estruturar um processo concertado e participativo, não somente técnico e de gestão, mas técnico-político com base nos eixos transversais do planeamento local.

Palavras-chave: *Gestão integrada, sustentabilidade do litoral, estuários, modelo conceptual, gestão territorial, dinâmicas de sistemas, arquétipos sistémicos.*

1. INTRODUCTION

Nowadays the coastal problems are closely linked to the repercussions of human activity. According to World Bank statistics (1996) 50% of the world's population lives within 150 km of the coast; moreover 12 of the 15 largest cities in the world are situated in coastal regions. Unfortunately, there are significant studies proving that coastline management programs, which have been implemented have had a small impact on these regions. A study by Olsen (2006) indicates that in Europe the coastal problems are related to waste disposal, urbanization processes, erosion, resource depletion, and contamination. In the same way, the Commission of the European Communities (2000) informed the European Parliament and the Council of the European Union about the integrated coastline management issues. The report identified the main problems affecting these coastal regions such as: coastal erosion produced by inadequate construction practices (including structures built for "coastal defense"), destruction of habitat, problems associated with inefficient territorial planning, biodiversity loss, deterioration of coastal spawning and the contamination of soil and water resources (Lopez, 2008; Jorquera *et al.*, 2012). These problems also have social and cultural repercussions such as unemployment, social instability, competition for resources, destruction of cultural heritage, dissolution of social networks caused by uncontrolled development, decreasing possibilities of social and economic development, and low rates of long term job opportunities. Furthermore, as resources become depleted the percentage of marginalization of the population and emigration increases. This is made worse by the lack of adequate infrastructure such as means of transportation and communication systems.

Another important aspect to consider is the lack of coordination between different sectors of the public administrative organizations which generates inefficient territorial management (Arriola *et al.*, 2006; Araya & Cerpa 2009).

The picture that has been described here shows the fragility of the coastline and how the decision process, planning process and regulations of the governmental institutions affect the territory and create tension between the actors involved.

In Chile, the situation is no different than that at the global level. One of the biggest problems affecting coastal areas is dumping and solid waste pollution caused by factories and the mining industry (Castro & Alvarado, 2009). In 1990 the coastline management practices in Chañaral Bay were forever changed when the court, through a mandatory resolution, ordered the construction of a tailings dam at the El Salvador Mine which avoided 35.000 tons of industrial waste per day (OCDE & CEPAL, 2005). Likewise, the Superintendent of Sanitary Services informed that until the year 2000 only 21% of wastewater in the country was properly treated, the rest was discharged into rivers and the ocean. This situation improved in 2009 when 82% of the wastewater was properly treated before being discharged. On the other side, Castro & Alvarado (2009) identified problems such as biodiversity loss and benthic and pelagic resource depletion caused by fishing regulations established by the National Fishing Service.

The complex network of relationships that occurs in coastal areas have also been affected by the salmon and aquiculture industries which are responsible for contamination, biodiversity loss and species shortage. There are also other problems associated with the salmon and aquiculture industries such as changes in traditional fishing and local agriculture practices (Medina & Ramos, 2009).

In parallel fashion to the aforementioned European case, the coastline of central Chile has been affected by expanding urbanization. This results in dune ecosystem fragmentation, wetland disintegration and the disruption of biological corridors (Castro & Alvarado, 2009; Peña *et al.*, 2008).

Many actions, both public and private, have been proposed as a response to the global coastline issue. According to Andrade *et al.* (2008), shifts in the management of coastline in Europe towards sustainable development didn´t start until the 70's and 80's. For example, the Norway coastal Plan of 1971 the Great Britain plan of 1972 and the coastal plan implemented in France in 1973. According to Olsen *et al.* (2006) and Jorquera *et al.* (2012) it is assumed that because of the problems associated with population growth and the consequences of economic growth, industrialization and urbanization, the design of an integrated coastline management is extremely complex and requires tremendous effort. This situation is particularly complicated in estuary coastlines due to contamination and untenable natural resource depletion (Olsen *et al.*, 2006).

In Chile, the Coastline Use National Policy created in 1995 (PNUBC in Spanish initials) was put into use when the country started free trade treaties. This showed the need for new regulations regarding coastline management. These regulations were also present in the Aquiculture and Fishing Law of 1992 which included Benthic Resources Management Areas (AMERB in Spanish initials). As a result, the migration of local fisherman was restricted, the sea areas were compartmentalized and cultivated, and intertidal areas were reserved for shellfish and sea plant collectors.

Since the creation of the PNUBC, the planning

and sustainable management of the coastline has been strengthened by visualizing these territories as commercial trading zones, touristic interest areas, housing projects, and the production and re-production of natural resources of high commercial interest.

Due to variations in proposals regarding both problems and solutions, the Coastal Technical Department, which is part of the Division of Planning and Regional Development, has been carrying out a procedure that implements a macro zoning of the coastal territory (2009). The purpose of this macro zoning is to determine the potential of the coastline through the promotion of a harmonic, balanced, and integrated development of the territory.

Along the same lines, the Environmental Policy for a Sustainable Development (Bolivarian University 1998) promotes the design of measurement standards for sustainability in order to contribute to the political and environmental decision making processes (Blanco *et al.*, 2001). The definition of these standards contributes to the design of accurate methodologies for the development of the coastal territory. Additionally, the creation of an environmental court and the extension of citizen participation are improvements from the Regional Strategy for Conservation and the Sustainable Use of Biodiversity Initiative in the Los Lagos Region (Environmental National Committee, 2002) and the Environmental Law N° 20.417 of the General Secretariat of the Presidential Ministry (2010).

The reference for all these regulations and processes is based on the Millennium Development Goals and Agenda 21 which were proposed in 1972 at the United Nations Conference on Environment and Development in Stockholm (Quiroga, 2001, 2009).

In this complex scenario the system dynamics model is presented as a relevant tool to project development in both the medium and long term. This model combines territorial elements from the public and private perspectives, the local community, cultural aspects, and environmental components (Martinez, 1989; Forrester, 2000). A dynamic system such as the one found along the coastline of the Maullin estuary needs the construction of a conceptual dynamic model that integrates sustainable management, conceptualization and modeling processes (Diaz, 2008). Senge (2005) used a set of tools of systemic thinking called systemic archetypes to mark the difference between subsystems whose purpose is to study the problem through profound reflection and analysis.

The systemic archetypes permit the formulation of system dynamics representing hypothesis, chains of cause and effect diagrams, and the mobility of the variables of the model in a causal diagram.

The purpose of a conceptual model is not to describe or explain situations; it is conceived as the possible representation of a thing or event. In general, this representation is incomplete, approximate and inaccurate, and is simpler than the event itself. But by viewing this model solely as a means to achieve our goal it gives us a better understanding of the problem. In this way the model traces a "map" of a social structure, where different futures, advance scenarios and variables can be visualized and planned into the system (Concari, 2001). The potential of systemic thinking lies in the incorporation of intangible behavioral elements such as attitudes and beliefs and by understanding them holistically (Gomez & De Groot, 2009; De La Maza, 2009; Peña, 2008). For Gomez & De Groot (2009) the use of a dynamic simulation model can contribute to experimentation, hypothesis testing, and the measurement of effects which all support the making decision process. In the same way, Schaffernicht & Madariaga (2007) stated the importance of dynamic systems in clearly showing the turning points and weaknesses of public policies and providing opportunities to change them. To this extent, dynamic systems are useful to focus public and private investments and to define development foci for the territory. In particular, the immediate importance of this proposal is to identify the effect that humans are having on the imbalance of the territory. This proposal also shows the importance of looking at the problem not just from a technical or political standpoint, but a combination of the two (Barragan *et al.*, 2008; De la Maza, 2009).

In this context, the design of a conceptual model makes the main problems in the Maullin coastal territory evident and shows how it can be improved through integrated management. This idea is founded on the precariousness of the planning and management of Governmental policies and zoning lawsof the area. Aspects such as rural area management are not considered in the planning process and the lack of integrated tools for management is ignored as well (Cordero 2011; Arenas, 2003; Andrade *et al.*, 2008).

The perspective of this study, both sustainable management of the coastline territory and the design of adequate planning tools require a model that builds the concept of future and the reflection about possible futures and not desirable outcomes in the territory (Gomez & De Groot, 2009; Medina & Ramos, 2006).

In particular, the ecosystem in the areas surrounding the city of Maullinis especially fragile and the problems affecting the species of the area are becoming increasingly serious (Gore, 2009). One of the main reasons this area is so important is that the characteristics of the estuary make it a strategic location for fish, mollusks, sea plants and other species to reproduce. For some of these species the estuary becomes an important nursery ground (Arriola *et al.*, 2006; Olsen *et al.*, 2006). According to Escobar (2002) and Toledo (2008) the commercial appeal of the area made it an ideal location for human groups to settle which consequently affected the economic and cultural development of the region. The Maullin coastline has also become a center of aquiculture activity and over 395 aquiculture permits have been given to local fishermen to cultivate Gracilaria chilensis.

Regarding social organizations, there are more than twenty fishing unions and guilds present in the Maullin estuary which demonstrates the important role the estuary plays in the region. The area comprised of the north river banks, Carelmapu, and the Quenuir and Amortajado Coves represents one of the largest concentrations of commercial fishing in the region. The estuary is also home to one of the largest crops of Gracilaria chilensis in the region with both local fishing organizations and private entities taking part in its cultivation.

An important element to consider in this investigation is the Maullin City Development Plan (2005).This plan was proposed in order to attract special interest tourism to the

area with particular emphasis on bird watching and river tourism activities. The Development Plan (2005) also states that its objectives are: to promote the Maullin Area as a touristic destination for regional, national and international tourists and to create and promote a touristic consciousness in the local community. In addition the plan establishes a set of regulations to improve the joint management of the coastline related to the extraction of natural resources from the estuary and the administration of local fisheries.

The city of Maullin also instituted the Pacific Ocean Coastline Productive Strategy which focuses on tourism, the agro forestry sector, and local fishery and territory management. The majority of this strategy revolves around the tourism sector and improving the city´s touristic services while also placing an emphasis on improving the ports infrastructure to promote competition between local fisheries and maximizing profits involved with the value chain of their products. In this context, this strategy concentrates on economic growth as its development target.

Finally, another important component in the Maullin estuary scenario is the 2008 Lafkenche Law N° 20.249 which delegates the administration of certain marine areas for indigenous groups EMCPO. Under this law marine areas are distributed to indigenous communities for their administration under the customary use declaration. In this process indigenous communities must apply for the rights to the marine areas by presenting a management plan to the Sub secretary of Fishery. Currently there are eight indigenous communities applying to the EMCPO in Maullin.

In this fragmented picture of actions, interests, actors and pressures over the coastline territory it is possible to recognize the local territory in a context of its interrelationship networks (Ther, 2006).These networks are linked to their economic, productive and conservation activities (Escobar, 2002; Aramayo & Moraga, 2006; Olsen *et al.*, 2006; Toledo, 2008; Gore, 2009).

As a whole, the interrelation between the processes described above shows the managerial discord in the coastal territory which could generate different conflicts between its main actors. For instance, the conflicting regulations produced by Law N° 20.249 2008, which was created for indigenous communities, and the Fishing and Aquiculture Law N° 20.091 2005, which was created for local fishermen. Both laws benefit the whole community, but the local fishermen complain that these laws unfairly benefit indigenous communities by allowing them to apply for aquiculture concessions under both regulations.

On the other hand, the guidelines in PLADECO (2005) and the Special Interest Tourism Plan are oriented toward Tourism and Bird Watching which focus on conservation while the interests of local fishermen and indigenous communities revolve around economic and productive activities.

The previous analysis shows an evident discrepancy between the organizations and conservation agencies of the area and the PLADECO (2005) guidelines. On top of this, the Macro Zoning for the Maullin territory doesn't consider the indigenous component in its proposal. Likewise, the quantitative focus of the planning undermines the management structure because it fails to recognize the comprehensive processes involved in the management of the territory.

For all these reasons, this study offers a conceptual model for a comprehensive understanding of the problem which can lay the foundation for an integrated management of the Maullin Estuary. It also contributes an adequate reflection of the local reality through identification of critical variables and an analysis of the decision making process of both public and private actors which play roles in the management of the coastline.

2. MATERIAL AND METHODS

2.1. Study area

Maullin has an estimated population of 15,580 inhabitants (CENSO, 2002). 55.74% live in rural areas (about 8.684 inhabitants) and 44.26% live in urban areas (6.896 inhabitants) according to PLADECO (2005) statistics. Maullin is part of the Llanquihue Province in the Los Lagos Region of Chile. The most populated areas in Maullín are the city of Maullín, Carelmapu, and Quenuir Cove. These three areas were designated as a cove by the Ministry of Defense (1998). Fishing, tourism, and aquiculture are the main contributors to the local economy. (Fishing and Aquiculture Concessions Office, 2011). The infrastructure available for local fishermen includes the Port of the Maullin Cove which has a pier, two ramps and the Cariquilda dock. Both the Lepihue and Quenuir coves have landing docks for fishing products and passengers. Meanwhile, the National Fishery Service (SERNAPESCA in Spanish initials) notes that the extraction of benthic resource through diving constitutes one of the predominant activities for the area. Additionally, the Toledo and Cariquilday Coves also serve as loading docks for ferries and boats carrying people from the north side of the Maullin river banks. Close by, the Lepihue and Quenuir Coves are dedicated almost exclusively to the extraction of Gracilaria sea plants, mussels shucking (Mytilus chilensis) and clam extraction. Numerous private operators participate in these activities with the number of participants reaching 395 in 2012 according to the Fishery records of the city hall.

The local fishery efforts are focused on sea bass fishing (Eleginops maclovinus), the extraction of "piures" (Pyura chilensis) and mussels (Mytilus chilensis) as well as "pelillo" farming (Gracilaria chilensis). This is due to the large amount of marine permits given by the government for the cultivation of this sea plant.

The social union organizations are divided into more than twenty fishing unions and guilds in the area. Currently the entire area which has been designated for aquiculture activities has been divided between local fishing organizations and private farm owners.

2.2. Perception of key actors

The field work was completed between August and December of 2011 to accurately observe and record the local dynamics of the area. The objective of the field work was to learn the dynamics of daily life and to inventory the main activities of the coastal territory (Arvide, 2001). Later, a semi structured survey (Montañes, 2009) was given to nine

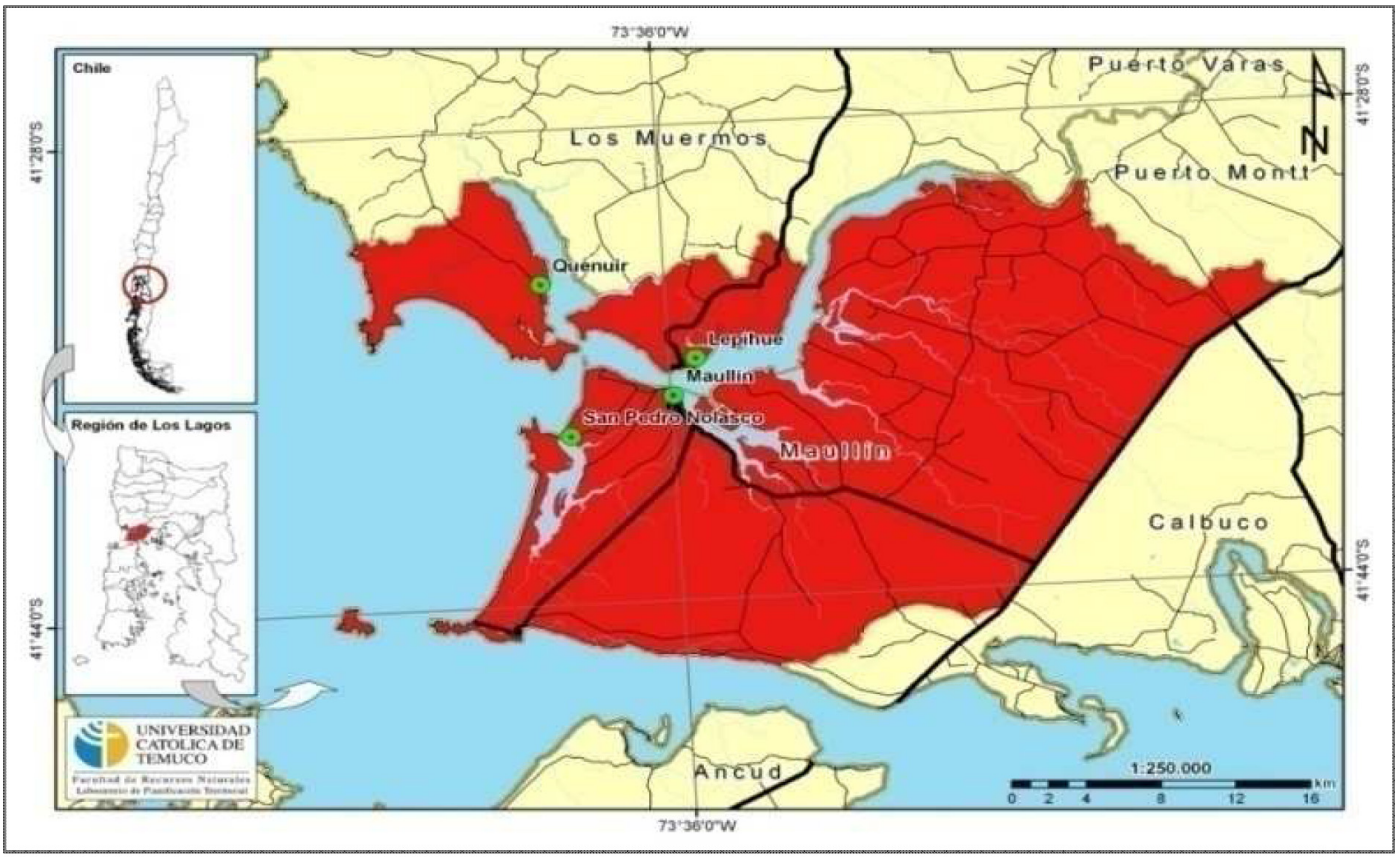

Figure 1. Maullin Area of study.
Figura 1. *Área de estudo (Maullín).*

departments of the City Hall including the Local Planning Department, the Tourism Department, the Environmental Department, the Health Department, the Social and Community Organizations Division, the Department of Indigenous Affairs, the Local Fishery Office, the National Fishery Service and the Chamber of Tourism. The purpose of the survey was to conduct research regarding the management of the coastal territory and discover its importance in the agenda of the local authorities. The survey was designed involving critical variables according to the following topics: a) structure and functions of the natural features of the territory; b) the manner in which natural resources are used; c) the perception of sustainable development in the local decision making process; d) the appreciation of the area in terms of conservation achievements and the excellence, meaning, and function of elements and processes; e) the potential of the area to support human life and activities as a result of the natural resources provided and its ability to handle the wastes associated with those activities f) The vulnerability of the area resulting from human activities g) the natural risks of the area and its implications for human activities; h) Problems and conflicts derived from the territory limitations and its current and future use; i) Territory inventory which includes activities, institutions, infrastructure, problems and cause and effect chains. The objective of the study was to identify the critical variables which shape the current reality and contribute to an integrated management model being implemented in the future for the estuary territory.

After, the same public officers were interviewed using a Likert Scale survey. The information obtained was useful to evaluate the predisposition and political willingness of the authorities towards implementing an integrated coastline management with a focus on sustainable development. The survey identified the public officer´s attitude towards new and adequate initiatives for a better coastline management. The variables considered in the survey were: 1) competition for natural resources of commercial importance; 2) the need for environmental regulations at the local level; 3) the need for education in sustainable development; 4) competition between local fishermen and indigenous communities for the use of coastal territories; and 5) the diversity of institutions and local agents with jurisdiction over the coastal area. Each variable contained a group of closed questions with five answer options: M/DA: Strongly agree; DA: Agree; N: Neutral; ED: Disagree; M/ED: Strongly Disagree (Initials in Spanish).

2.3. Construction of the conceptual model

With the information obtained from the survey (the next step was to build) a conceptual model was constructed for the development of a system for management of the coastline. The model construction involved the projection of desirable futures in the territory in the medium term (3 to 5 years) using the methodology of systemic thinking,

in concrete accordance to the dynamic modeling software Vensim PLE along with Sterman (2000) adjusted methodology and contributions from Andrade & Lopez (2012), Gomez & Zuluaga (2007) and Zamorano (2006). The model construction also considered two methodological axes: a) Articulation of the problem: this phase involved the definition of the variables and problems. The main problem identified was the lack of coordination in the management of the coastal territory; b) Dynamic conceptualization of hypothesis: in this phase the variables were linked in a cause and effect represented in a causal diagram, which constitutes the proposed model of integrated management. This model shows the main variables that are related graphically and conceptually to each other as well as the diagram of the systemic archetypes evidenced by the territory. Considering these elements ensures that the feedback process is closely related to the identified problem.

The relation between cause and effect elements was placed into a positive and negative cause diagram to determine the influence the each one had on the other. The cause-effect chain of events scenario was viewed through the following conditions:

The relation between variables was represented in loops of feedback of close cause-effect chains. There is a positive loop of feedback and a negative one. The positive loop, also known as the reinforcing loop (R) showed an even number of negative correlations; while the negative loop or balancing loop (B) showed an odd number of negative correlations bringing stability to the system;

At the same time, the system archetypes methodology proposed by Senge (2005) was used in the representations of the scenarios. Senge (2005) identifies eight system archetypes: 1) Growth and underinvestment; 2) Limits to growth; 3) Shifting the burden; 4) Eroding goals; 5) Escalation; 6) Success to the successful; 7) Tragedy of the commons; 8) Fixes that fail. From these eight archetypes, three were developed to represent the critical scenarios of the territorial management, which were then used to build the dynamic hypothesis- conceptual model. The archetypes are: Shifting the burden (Figure 4); Eroding Goals (Figure 5) and Success to the successful (Figure 6). The three system archetypes represent possible solutions in future management scenarios (Medina *et al.*, 2006). The importance of using System Archetypes lies in the possibilities of synthesis that is offered between the exposition process of the insights and the study analysis.

3. RESULTS

3.1. Interview analysis – perception of key actors

The critical variables and their interactions were: 1) competition for natural resources of commercial importance; 2) need for environmental regulations at the local level; 3) need for education in sustainable development; 4) competition between local fishermen and indigenous communities for the use of the coastal territory; and 5) diversity of institutions and local agents with jurisdiction over the coastal territory. Whereas the key actors´ perception identified different interactions between the critical variables such as: a) strengthening the identity; b) long term territory perspective; c) competitiveness and conflict in the management of the coastal territory; d) sustainable development strategies; e) the touristic approach of the communities; f) empowerment of actors; g) social control; h) improvement of management abilities in the local government; i) success in the macro and micro zoning process; j) success in the EMCPO application process; k) fragmentation in the management of the coastal territory; l) weaknesses in the sustainable development of the coastal territory and finally; m) integrated and sustainable development of the coastal territory.

3.2. Likert Scale survey analysis

The information obtained from the Likert Scale Survey (Ospina *et al.*, 2005) reinforces the results related to the critical variables: 1) competition for natural resources of commercial importance; 2) need for environmental regulations at the local level; 3) need for education in sustainable development; 4) competition between local fishermen and indigenous communities for the use of coastline territory; and 5) diversity of institutions and local agents with jurisdiction over coastline territory. The analysis showed that people find the lack of supervision by the local government as one of the main problems. This element is directly related to the competition for natural resources and the deterioration of these resources caused by human activity. The analysis suggests a more emphatic control in the extraction of natural resources and calls for the diversification of economic activities in the estuary to include an emphasis on Tourism of Special Interest. On the other hand, the subjects of this study show a tendency to accept regulations and penalties. This critical variable highlights the lack of regulations on the part of the City Hall towards the efficient management of the coastal territory. However, the establishment of regulations could

Positive Causal relationship

1) The growth in variable A influences the growth in variable B.
2) The reduction in variable A influences the reduction in variable B.

Negative Causal relationship

1) The growth in variable A influences the reduction in variable B.
2) The reduction in variable A influences the growth in variable B.

Figure 2: Causal relationships between variables.
Figura 2: Relações causais entre variáveis.

become a "Fixes that fail" system archetype. Furthermore it is understandable that these regulations could be seen as an immediate instrument to achieve the vision of development sought by the City Hall for its territory.

Critical variable number three, the need for education in sustainable development, is one of the most relevant aspects associated to the deterioration of natural resources(benthic and pelagic resources, as well as natural heritage and ecosystems in general). These imperatives are apparent in the lack of information about ecosystems, lack of general information about environment from responsible public offices, and the ignorance about biological cycles by the community. These conditions cause potential conflicts and competition for the use of natural resources in the coastal territory (Figure 3).

Critical variable number four, the competition between local fishermen and indigenous communities for the use of coastal territory, was perceived by the public officers that were interviewed as a negative perception. However, the officers associated overfishing with local fishermen but not with indigenous communities. They expressed positive attitude towards the micro zoning process as a possible contribution to reduce the conflict between the parties. Despite the positive attitude of the public officers, necessary agreements have not been possible between fishermen and indigenous communities because both parties refuse to participate in territorial workshops.

Finally, critical variable number five, the diversity of institutions and local agents with jurisdiction over the coastal territory, showed that many feel that these institutions are incapable of generating an adequate management strategy for the coastal territory. Those surveyed felt that the solution to the project will be a regulatory instrument which is able to articulate and coordinate the different entities present in the territory.

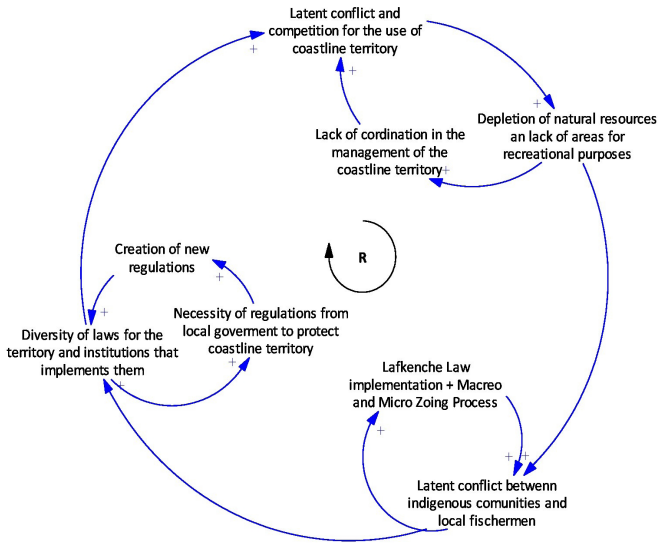

Figure 3. Conceptualization and articulation of the problem.
Figura 3. *Conceptualização e articulação do problema.*

3.3. Diagram of the articulation of the problem, dynamic hypothesis and system archetypes (SA)

The conceptualization of the articulation of the problem (Figure 3) shows the relation between the causes that reinforce the current situation in the territory. The reinforcing loop shows the relation of the actors involved between the variables in the territory and its influences as well as the evident imbalance in the management of the Maullin River Estuary.

The reinforcing correlation shows the feedback between each variable. In this case, the reinforcing correlation is negative due to the contribution of each variable to the continuity of the problem.

The causes of the lack of coordination in the management of the coastline territory are reinforced by the loop composed by the variables depletion of natural resources and lack of areas for recreational purposes; this loop is also surrounded by the constant competition for the use of the coastline territory. On the other side, the conflict between indigenous communities and local fishermen is aggravated by the Lafkenche Law 20.249 and the micro and macro zoning process. Opposite as thought, both regulations had had a negative effect in the management of the territory mainly because both regulations create confusion about the real political and managerial contributions they make. This is especially true for indigenous communities that don´t foresee the benefits of the customary use of the coastline (which is the main objective and purpose of the Lafkenche Law).

Another problem, identified by the interviewed subjects, is the creation of environmental regulations by Local government. New regulations, put on top of the preexisting ones, will only contribute to create a deeper fragmentation in the coastline territory.

Figure 4 shows the pattern of behavior of the system archetype "Shifting the burden"; which occurs when those responsible for the decision making process shift the burden of an essential solution to a problem to another solution which is easier to achieve and which only reduces the symptoms. This structure shows three variables. The first reveals that the lack of coordination in the management of the territory gets gradually worse due to the lack of agreement between the parts involved in the micro zoning process started by the local government. This is also true for the macro zoning process started in 2009 and the Lafkenche Law as well. In the same way, the lack of agreement and resources becomes a barrier for the better design of a tightly bonded community, as well as sustainable development in the community, and the efficient management of it (Figure 5).

The chain of events shows how the general system is fragmented by implementing quick fixes. These quick solutions are express in the variable "diversity of regulations in the territory". The fundamental solution of the system is deteriorated over time by its constant dependence on symptomatic solutions. In the external loop of the diagram we can see the negative consequences that occur when quick fixes are applied. The process of fragmentation in the management of the coastline undermines the organizations hopes to achieve a better future when the organizations´

claims are not considered. As result they don´t feel as though they are part of the decision making process of the territory.

It is important for the authorities in charge to consider the correlation showed by this archetype. Otherwise, there is a constant risk of depending on quick fixes for the problem which reinforce the superior loop displayed in figure 4.

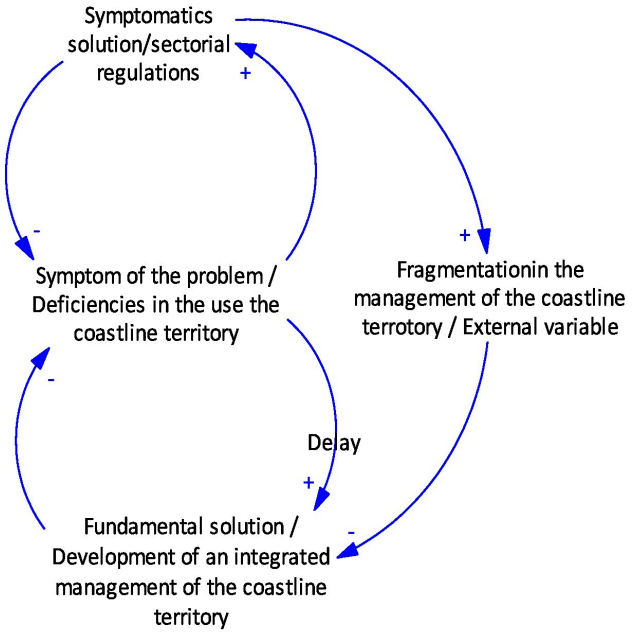

Figure 4. "Shifting the burden".
Figura 4. *"Shifting the burden".*

Figure 5 shows the Eroding Goals Archetype which occurs when the organization delays the achievement of a goal due to the pressure of solving immediate situations, which little by little "erodes" the fundamental goal. This archetype relieves the major turning points in the local management of the territory, where the fragmented planning and the lack of resources are evident.

In this context, the Eroding Goals Archetype diagrams the gap between the vision of development for Maullin and the current scenario in the territory, which is expressed when the city´s actions towards development are divided into different sectors.

The intention of the diagram is to show the importance of the creative tension related to the accomplishment of goals and how this is delayed by the solution of immediate goals through quick fixes, all of which erodes the achievement of the final goal.

The solution of the diagram is expressed in the pressures and delays as part of the territorial planning process to achieve that vision in the long term. The risk of this decision is that a burden shift might occur and the vision of desirable development might be permanently reduced because of the pressure to remedy the immediate problems of the territory.

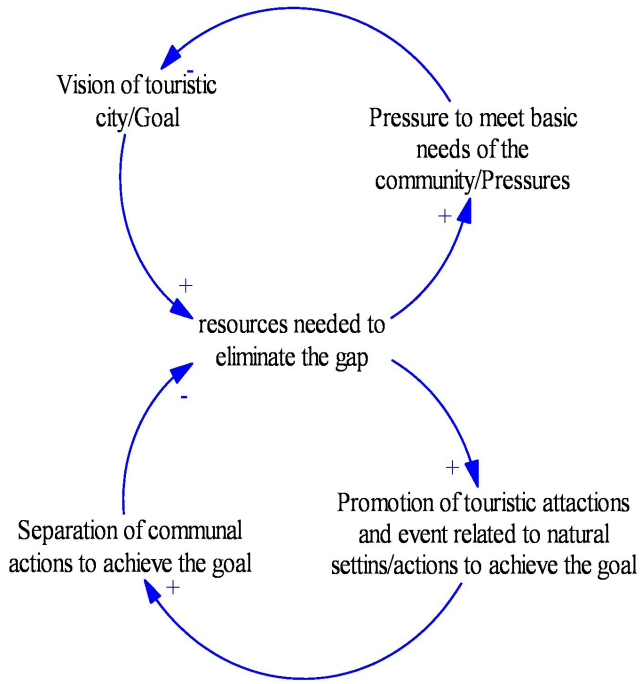

Figure 5. Eroding Goals.
Figure 5. *"Eroding Goals".*

Figure 6 represents the system archetype "Success to the successful", expressed by the constant of "success for those who have it", and shows the competition between indigenous communities and local fishermen. This competition is caused by the incorporation of the Lafkenche Law 20.249 that defines certain Marine and Coastline Areas for Indigenous Communities (initialized EMCPO in Spanish). The conflict is produced by the lack of productive development instruments for these areas and biased viewpoints of its regulation, while the spirit of the Law seeks the opposite effect.

The imbalance is shown in the center of the diagram where the extraction of natural resources is regulated by a set of formal rules that allow local fishermen and people dedicated to the extraction of benthic resources and Gracilaria chilensis farming to do these activities. Meanwhile there are no operational rules existing for the indigenous communities.

The difference in the distribution of resources for different actors impacts the success reached by local fishermen and the possible success for the indigenous communities. These differences create a vicious cycle that includes imbalances, conflicts and competition for resources.

The challenge of this complex scenario involves the incorporation of both entities and requires them to consider their differences at the organizational level in terms of the physical distribution of the territory. In other words both communities need to compete under equal conditions and fair regulations while still having equal sets of rules.

The funding structure of the conceptual model is based on the system archetypes presented as dynamic hypothesis and representations of critical variables which were demonstrated by the field work and the interviewed subjects.

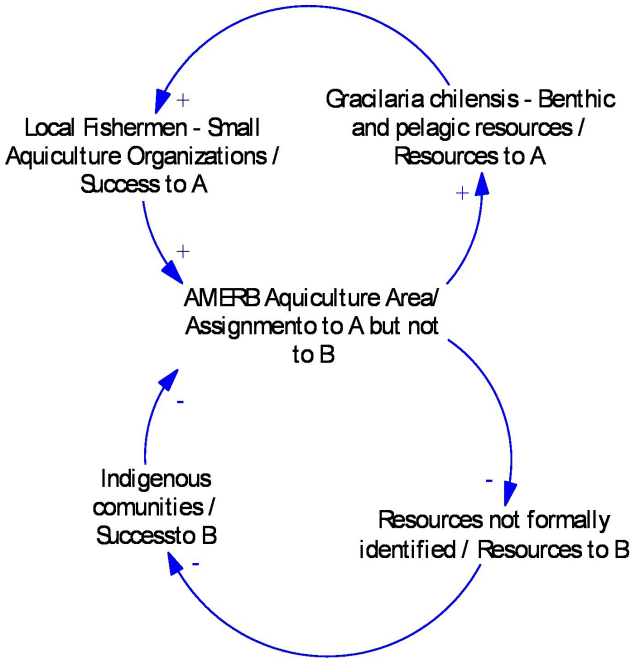

Figure 6. "Success to the successful".
Figura 6. *"Success to the successful".*

4 . CONCEPTUAL MODEL

The conceptual model for the integrated management of the coastline territory represents the current scenario of development and designs desirable future scenarios in the medium term (three to five years).

The construction of the conceptual model begins with the system archetype "Shifting the burden" located in the left superior side of the figure. The superior loop shows that quick fixes (fragmented management of the coastline territory) are not enough to provide solution to the symptom of the problem (deficiencies in the management of coastline territory). This superior loop reinforces the external loop (lack of coordination in the management of the coastline territory) which has a negative impact on the long term solution (development of an integrated and sustainable management of the coastal territory).

This archetype includes variables that reinforce the inferior loop such as the development of managerial abilities in both local government and public officers. The archetype also reinforces joint managerial abilities in productive organizations of the coastal territory. This process also promotes empowerment in local actors, strengthening the local identity towards the consolidation of a shared vision which will contribute to solve the diagnosed conflict.

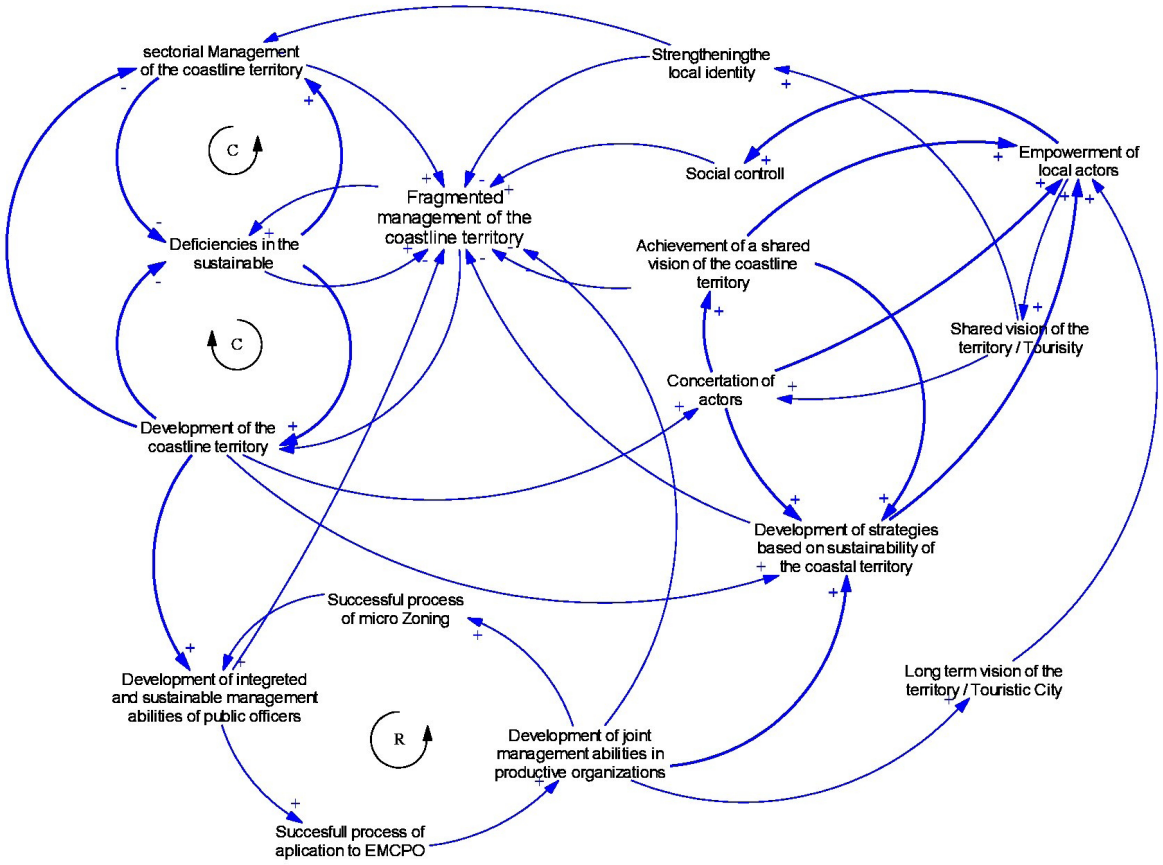

Figure 7. Conceptual model for the integrated management of the coastline territory of the Maullin River Estuary.
Figura 7. *Modelo Conceptual de Gestão Integrada do Estuário do Rio Maullín.*

The proposed model of management places us at a local level scenario which considers the coastal development from a holistic point of view, including the political willingness of the local government. This also allows the identification of virtuous circles generated in the mutual influence of variables over each other.

In the center of the diagram it is possible to observe how the agreement between key actors in a shared vision of sustainable and integrated development in the medium term can place the territory in a successful scenario. The components of this scenario are the same as the components the community currently has, but driving the conscious interactions of variables under the right influences. This shared vision needs commitment from the community, local government, and local actors to influence the development of the coastal territory.

The dynamic hypothesis in figure 6 "success to the successful" shows the palpable conflict between local fishermen, aquiculture groups and indigenous communities related to the use of natural resources of commercial importance. The conceptual model for an integrated management of the coastline territory considers the repercussions from this conflict and integrates them into a proposal for a solution based on local reality. This proposal uses the same human resources from the Local Government while including two important aspects. The first is training on sustainable management for public officers from the Local Government. This training includes issues such as environmental regulations, territory regulations and indigenous community topics. The second aspect is the necessity of developing joint management abilities in productive organizations. In the same loop the relation between variables are expressed in a positive correlation which reduces the conflict and contributes to the design of more adequate strategies of development.

Two other strong points of the model are the variables of Citizen Participation and Social Control. These variables influence the model by minimizing the effect of the superior loop in the diagram over the system archetype "Shifting the burden". The interaction between these variables connects the community's empowerment to the expansion of the discussion about sustainable management to all community spectrums which contributes to the positive reinforcement of the variables responsible for a shared vision of Maullin as a touristic city.

This model takes the permanent interaction between the variables identified as cause and effect of the problem to place the modeling system as a legit option when planning the integrated management of the coastal territory. It also includes new variables that allow greater flexibility to the whole Maullin Estuary System making it capable of absorbing the impact of conflicts through interactions of variables consciously organized to reduce the problem. However, the model also assumes that the variables responsible for the problem will constantly exert pressure over the entities in charge of the making decision process so they tend to search for quick fixes for the problem. This constant tension requires the permanent monitoring of the system because spontaneous and quick fixes only work in the short term period according to casuistry method, leaving the system in a position of negative stability in the long term which at the end maintains the system in status quo.

Ultimately, the interaction described above shows the dynamic balance of the system by moving itself towards the incorporation of new variables or incorporating short term measurements.

5. DISCUSSION

The analytic structure proposed for the conceptual model for the management of the coastline is based on sustainability as the main focus of its development. The proposed model represents a projected vision where the time between phases is seen as a virtue of conceptualization which describes the manner in which the decisions that are made create scenarios (Medina & Ortegon, 2006; Zamorano, 2006) of sustainable management for the estuary. This construction is the result of the dialog and feedback of social, cultural, political, and economical variables which are visualized in the conscious pattern of management for the territory.

In this manner, the model responds to a comprehensive approach that consolidates management to local reality concerning the community and whose principle is the integrated and sustainable management of the coastline territory. In this way, the dynamic systems model is situated in a place between theory and practice which allows the observer to observe him / herself while observing (Zamorano, 2006).

As part of this discussion, it is interesting to consider the influence of both the Lafkenche Law 20.249 (2010) and the micro zoning initiative (2010) as relevant elements in the territory. De la Maza (2009) states that the analysis of the public policy highlights the need for training of public officers. By doing this, the model considers training for public officers as an external variable that contributes to the partial dissolution of the conflict.

Similarly, the lack of professionals at the local governmental level can be perceived as a conscious problem because their presence could result in the technical goals of the community being reached in less time than expected. The anthropological approach of the State and De la Maza proposals (2009) are fundamental for this analysis because they reach the critical point of the structure in charge of implementing regulations. When analyzing the Lafkenche Law it is necessary to note the aspects that have not been correctly socialized. These aspects leave the Law useless in its application to reality (regardless the existing regulations). In this way, public officers, citizens and the general community are unaware of the scope of the Law.

The details of the Law are certainly a matter of a more diligent review which is not the purpose of this research. However, it is appropriate to note the perception of Lafkenche Law maintains that it is the definitive solution for the plights of indigenous communities. On the contrary, the Lafkenche Law has become a quick fix that "fails". Until now, the Lafkenche Law has no operational set of rules for indigenous communities or adequate procedures for productive activities in the schedule established for its regulation. On top of this the law requires a necessary understanding of the instruments and political issues involved when indigenous communities try to apply for the use of Marine Areas.

Additionally, the variable "agreement of actors in a shared vision of the territory" is shown as a factor of dynamic balance for the proposed model (Dourojeanni, 2000; Garcia *et al.*, 2011). This variable itself can contributes to the disintegration of the conflict and turns the scenario towards the incorporation of variables related to social and cultural elements that has low appreciation in coastal communities (Berkes & Turner, 2005; Garcia-Allut 1999; Gajardo & Ther, 2011). These variables are promotion of the value of self-identity relating to the inhabited territory; social control related to citizen participation and the conscious exercise of democracy when controlling the local authorities in charge of representing the community´s ideas. This way the local Government and Municipality can strengthen their managerial abilities when solving problems which would lead the territory to a successful scenario (Arenas 2003, Martinez 1989). In this context and according to Dourojeanni (2000) to solve the practical problem of coordination it is necessary to conceive a managerial process that will allow the human being - the main actor- to make his/her own decisions to achieve sustainable development in the territory through economic growth, social equity and environmental sustainability.

In public policy matters, the coastal territory has been highly intervened by human activities (Olsen *et al.*, 2006; Berkes 2005; Barragan *et al.*, 2008) as a product of the population growth in the coastal regions; the use of natural resources, and the development of port's infrastructure, among others. In addition there is a set of zoning laws and regulations which are being established to shape the way the coastal territory is inhabited.

Maullin is not free of the vicissitudes of its complex nature. That is why the proposed model takes into account the infinitive needs of the area by presenting an integrated development for the coastal territory. In this process the development of managerial abilities of the human resources such as training for public officers, having more professionals in the local government level, the formation of effective leadership in productive organizations, and the identification of synergetic needs is essential. All of this refers to the identification of the "need" and the "satisfaction of that need" (Max-Neff *et al.*, 1986) which triggers the positive reinforcement of the system. As it follows, this way is possible to debilitate the "need" of solutions and provide elements that satisfy the needs associated to the reinforced system.

In the same line Gravano (2007), Jorquera *et al.* (2012) states the necessity of working at the community level to strength then the local identity and to develop citizen participation as a mean of social control which is imperative in the democratic exercise of the citizenship.

Finally, it is appropriate to emphasize the importance of creating an instrument that organizes and integrates the whole coastline territory at a national level. However it is imperative to have political willingness to define the technical criteria for this development (Barragan *et al.*, 2008).

Medina & Ortegon (2006) states that the new generation of critical prospective approaches add the concept of social construction of the future which implicates the display of imagination and social, technical and political capabilities of the Maullin area. At the same time it shows the possible vision of a rational and desirable future projection of the territory. In this sense, the proposed model creates a space in time with elements from the past and the present, projecting scenarios of a more efficient management of the coastline Estuary in a context of prospective exploration (Medina & Ortegon, 2006).

6. CONCLUSIONS

Approaching the conflict in a fragmented manner does not allow one to see the relations that emerge from the conflict itself. This weakens the ability of the people in charge of making the decisions to identify synergetic solutions for the problems in the coastal management. In addition, the lack of ability in joint management of productive organizations increases their dependence on productive policies from the Local Government which maintains the status quo of the relationship Government-Organizations. That is why it is relevant to promote the independent management of the organizations own resources.

On the other hand, the fragmentation of the identity of the territory places the indigenous communities and local fishermen organizations in a complex scenario where is easy to identify the dual membership of indigenous people when participating in both Unions and Indigenous Communities. In this way the conflict is aggravated because the same actors are the focus of a benefit under similar regulations such as the Lafkenche Law and the General Law of fishing and Aquiculture.

The lack of technical consultation for relevant organizations of the territory contributes to the lack of dialogue in political and technical aspects. This situation is expressed when indigenous communities refused to participate in the board that works on the micro zoning process. In this sense the problem also is the necessity of consolidation of a shared vision of development. This problem becomes a barrier for the effective coordination of relevant actors to achieve the goals described in the City Plan (PLADECO, 2005).

The dynamic modeling as a useful tool for diagnosis and planning allowed the delimitation of the problem in the territory, representing the main critical variables and its interactions in the system. It also allowed the identification of synergetic needs of the system to foresee the positive interactions that reinforce the system and that will carry it to the dynamic balance. This instrument has the virtue to project future scenarios more easily and answers the question What if?

Under the light of these conclusions, having a consolidate criteria is essential towards the integrated and coordinate management of the coastline territory. It is also important to generate trust between the relevant actors in terms of the technical knowledge they have. It is imperative that this knowledge reach the community because they inhabit the territory and define their history.

This model finally shows the integration between the variables that are product of this investigation. However it is yet an open and flexible model, capable of integrate variables and principles that could eventually move or add to new ones. This way, the model proposed in figure 6 doesn´t

pretend to reduce possible scenarios, but to show a set of fundamental variables to determine the analysis frame where the current situation and other eventual situations could be expressed, so they can be used as basis for the proposal of an integrated management of the Maullin River Estuary.

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