



D4.2: “Stakeholder vision on problems and drivers related to environmental challenges in Argentina Case Study”

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Executive Summary

Argentina has an extensive coastline with major urban centers and ports. One of these centers is located south of the province of Buenos Aires was adopted as one of the case studies in the project COMET-LA. The objective of this project is identifying the models of community-based governance for sustainable management of natural resources in different socio-ecological systems (SES). The proposal includes the case of marine and coastal areas in Argentina. The main objective for the Argentine case study is to propose models of government and community-based sustainable management in marine and coastal systems.

The study area is a region characterized by a wide range of geomorphologic, physical and socioeconomic conditions. The land is mostly privately owned and, therefore, the use of natural resources for economic activities (both artisanal and industrial) is made by the private sector. The society does not have any community-based organization. From the political and administrative standpoint, the study area is divided into three separate municipalities: Municipality of Bahía Blanca, including General Daniel Cerri (GDC) and Ingeniero White (IW), the municipality of Coronel de Marina Leonardo Rosales which includes Pehuén Co (PC) and Villa del Mar (VM), and the Municipality of Monte Hermoso (MH) with its eponymous town

During the first year of the project (2012) (Deliverable 4.1) the main goal was the *Characterization of the Socio-Ecological System (SES)*. The Argentine Team developed tools specially adapted to the particularities and cultural aspects of the Argentine case study. A significant proportion of the work was to conduct informational seminars and participatory workshops. The first step was a stakeholder (SH) mapping through community outreach with the support of the CSO AquaMarina (AQM) based on its relevant knowledge of the SES.

Different groups of actors who participated in the workshops of the first stage are: Local government stakeholders, National, Regional and Local Environmental Institutions, Academic and education institutions, NGOs, Neighbors Societies; Volunteer fire brigades, Chambers of Commerce, Industry and tourism; Lifeguards, Rangers, among others.

The result was the characterization of the Bahia Blanca SES. This shows that the sectors in which the study area is subdivided, despite having different characteristics, are strongly connected and ecological conditions in one is dependent on what happens in the other. For instance, the problems of fishing in the estuary are affected by changes in the situation of the environment, pollution and, especially, on the overfishing by large vessels a short distance from the coast. As a result, fish and other species are prevented to enter to the estuary affecting fish reproduction and rearing. This context is complicated by the lack of integration among fishermen. Therefore, a need for cooperation between the various fishing organizations becomes essential to find a way to communally manage sustainably the resources.

During the second year of the project (2013) (Deliverable 4.2., the present report) the Ostrom framework was employed in order to characterize the Argentine SES, from common management resources perspective. Evidence of weak community-based resource

management was found. Several reasons contribute to this: in particular, the institutional history, the high mobility of some resources and the difficulty to define the boundary of the system. Nevertheless, some incipient elements of collective action have arisen. The understanding of the importance of ecosystem services provided by the estuary and the dependence on resources of direct users has been useful to integrate stakeholders against some conflicts.

We developed a structural prospective study. For this, several workshops were held in order to identify the most important variables of the system, their relations and intensity. Social actors recognized and discussed the key variables of the SES characterization according to their perceptions. Control variables were defined as elements whose changes could enable an evolution of the system to a new state: *Artisanal fishery history*, *Conservation Measures*, *Community awareness*, *Changes in coastal and estuary environment* and *Tourism*. Also, variables as *Resource sustainability*, *Fishermen association* and *Artisanal fishery* were named as challenges. Some key variables as *Conservation Measures* or *Community awareness* summarize some characteristics from Ostrom framework, which drive to community-based management of resources.

Stakeholders found in COMET-LA meetings a space to discuss the common use and management of resources. They agree a "management plan" is needed to benefit all SH and to ensure the sustainability of the system. Finally, they asked for help to continue with this discussion space and acknowledged the Argentine team for setting it up.

The participation of IADO, UNS and AquaMarina, integrated with the needs of social actors and the interest of society for the sustainable use of resources in the study area, shows the need of new dialogue scenarios.

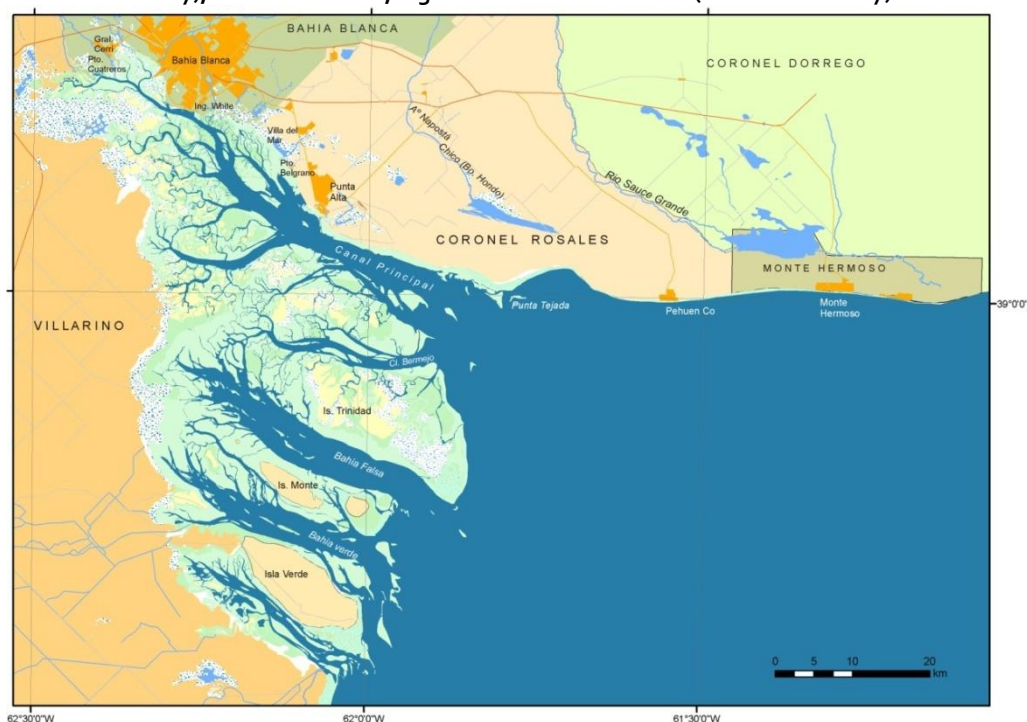
This report is divided into an introduction, six sections and two annexes. After the introduction, the second section describes the study area according to the framework proposed by Ostrom (2009). In the 3rd section, there is a description of the method used for the analysis of Prospective Structural identification of the variables through the matrix defined by the SH and the matrix of direct influences. The 4th section identifies the role of each variable within the SES according to the view of the SH. The 5th presents the results, interpretation and validation of the PSA by the MICMAC software. In the 6th section includes the discussion and conclusions. Finally two appendices can be found with the complete picture frame Ostrom and tables of the variables employed.

1 Introduction

Argentina has an extensive coastline with major urban centers and ports. One of these centers is located south of the province of Buenos Aires was adopted as one of the case studies in the project COMET-LA. The objective of this project is identifying the models of community-based governance for sustainable management of natural resources in different socio-ecological systems (SES). The proposal includes the case of marine and coastal areas in Argentina to complement the study of water and biodiversity systems in Colombia and forestry systems in Mexico. The main objective for the Argentine case study is to propose models of government and community-based sustainable management in marine and coastal systems.

The study area is a region characterized by a wide range of geomorphologic, physical and socioeconomic conditions. The land is mostly privately owned and, therefore, the use of natural resources for economic activities (both artisanal and industrial) is made by the private sector. The society does not have any community-based organization. From the political and administrative standpoint, the study area is divided into three separate municipalities: Municipality of Bahía Blanca, including General Daniel Cerri (GDC) and Ingeniero White (IW), the municipality of Coronel de Marina Leonardo Rosales which includes Pehuén Co (PC) and Villa del Mar (VM), and the Municipality of Monte Hermoso (MH) with its eponymous town (Fig. 1.1). Also from an economic and environmental point of view two well-defined areas can be distinguished: (i) an area that includes the towns of GDC, IW and VM environment within the Bahía Blanca estuary with extensive mudflats with an economy based on industrial, port and artisanal fishing; and (ii) a second zone, outside the main estuary, comprising PC and MH, which is a coastal area of sandy beaches surrounded by fixed and mobile dunes with an economy based on tourism of "beach and sun " plus artisanal fishing.

Figure 1.1. - General location of the Argentine case study including the five towns that are integrated in the SES. The geographical and environmental conditions for Pehuén Co and Monte Hermoso (offshore the Bahía Blanca Estuary), and Villa del Mar, Ing. White and General Cerri (inside the estuary) are shown.



During the first year of the project (2012) the main goal was the *Characterization of the Socio-Ecological System (SES)*. The Argentine Team developed tools specially adapted to the particularities and cultural aspects of the Argentine case study. A significant proportion of the work was to conduct informational seminars and participatory workshops. The first step was a stakeholder (SH) mapping through community outreach with the support of the CSO AquaMarina (AQM) based on its relevant knowledge of the SES. AQM facilitated the participation of other SH into the project who, in turn, suggested the invitation of others. In this way, it was possible to obtain a better and more complete coverage of the community to achieve the objective of the first year on the characterization of the SES.

Information seminars were held in each locality where the Research Team informed the participants about the purpose and characteristics COMET-LA, and gave seminars explaining the concept of Climate Variability/Change in the context of the project. From this information, participatory workshops were held in order to characterize the SES: one with the SH and the other with the Decision Makers (DM) in each locality. In total, 8 formal meetings were implemented between March and August 2012. The decision to have separate workshops for SH and DM of DM was due to the complexity of community management of natural resources: the actors and decision makers often do not coincide in their views and, in some cases, decisions on the allocation and use of resources are taken the national or provincial level restricting the input of local SH. Therefore, the social formation, the system of government and the extent of the areas under study, generally, result in strong conflicts of interest.

Different groups of actors who participated in the workshops of the first stage are: Local government stakeholders, National, Regional and Local Environmental Institutions, Academic and education institutions, NGOs, Neighbors Societies; Volunteer fire brigades, Chambers of Commerce, Industry and tourism; Lifeguards, Rangers, among others.

The result was the characterization of the Bahia Blanca SES. This shows that the sectors in which the study area is subdivided, despite having different characteristics, are strongly connected and ecological conditions in one is dependent on what happens in the other. For instance, the problems of fishing in the estuary are affected by changes in the situation of the environment, pollution and, especially, on the overfishing by large vessels a short distance from the coast. As a result, fish and other species are prevented to enter to the estuary affecting fish reproduction and rearing. This context is complicated by the lack of integration among fishermen. Therefore, a need for cooperation between the various fishing organizations becomes essential to find a way to communally manage sustainably the resources.

Coastal erosion is another problem that primarily affects the outer portion of the SES (PC and MH). This is the result of the geographical location exacerbated by urban settlements (Bustos, 2012; Huamantín Cisneros, 2012). This creates negative impacts on their main economic activity, tourism of "sun and beach". Although both the DM and the SH understand the complex problems described, the possible solutions are difficult to implement because they require large investments and may affect sectoral interests. However, it is possible to consider and define agreed strategies to mitigate this situation.

One of the main findings of the first stage was that for the first time in each town, the SH and DM could be integrated into a participatory space to reach common strategies. Despite this, each of the municipalities included in the study area generates its own rules to regulate its development; however, they often overlap with provincial and national laws that are not always in line with the local government, causing conflicts, especially in issues related to large infrastructure projects.

During 2013, the AT followed with the objectives for the second phase of the project which included: 1) to finish the characterization of the SES defining the most relevant variables according to SH; and, 2) to determine the relationships and the degree of influence/dependence between these variables. For the 1st objective, the AT employed participatory methodologies through focus groups. Workshops were held in a single location (Bahía Blanca) with SH and DM together, unlike the first year where the workshops at each town were made separately. This helped to strengthen the contributions of each SH and DM and resolve conflicts in a more consensual manner. Even though, we originally expected some difficulties and even serious discussions, all the participants kept a high level of commitment and were very enthusiastic, suggesting that such activities may be continued in the future. We consider this result as a major achievement of the project.

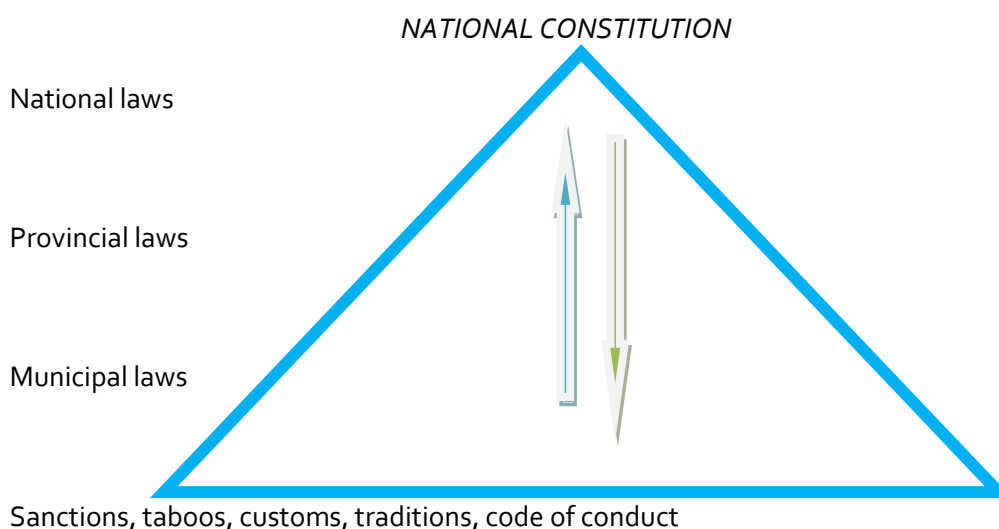
During the workshops, SH and DM were consulted about variables affecting fisheries and coastal management. Specifically, we investigated the identification of key variables previously established that emerged during the first workshops (i.e., overfishing). They were

also consulted about the identification and description of new key variables (i.e., Community Awareness and Solidarity work) and the relationships of influence/dependence and their intensity. In this way, it was possible to construct the matrix of indirect effects (MID). In subsequent meetings, this information was triangulated with SH thus defining the 21 key variables defined according to SH. From these variables, the AT wanted to determine (i) what role each plays in the system; (ii) how are the maps of influence in relation to the MID?; (iii) what are absent variables, etc. One of the main conclusions of the 2nd stage was that for the first time SH and DM could be integrated into a participatory activity for the entire study area so as to reach common strategies.

Institutional analysis is that part of the social sciences that studies how INSTITUTIONS (*the rules of game* of a society) determine the performance of a socio-economic system. In a formal sense, North (North 1990) defines institutions as “*humanly devised constraints that structure political, economic and social interactions*” to reduce the inherent uncertainty in human contracts. Constraints are devised as formal rules (constitutions, laws, property rights) and informal restraints (sanctions, taboos, customs, traditions, code of conduct), which usually contribute to the perpetuation of the *status quo* of the society. Changes in this result became from changes in the institutional design. Whoever the existent political system, all changes and all results are subject to informal restraints (the pyramidal basement – blue arrow-).

For the Argentine case study, we can represent these constraints by a pyramid, where rules are connected in a hierarchical way represented by the blue arrow in Fig. 2.1.

Figure 2.1. Hierarchical order of rules governing the Argentina case study.



Source: Own elaboration

There is a feedback between social rules (or informal) and formal rules, given by the human ORGANIZATIONS (Fig. 2.1, green arrow). This field deals with how individuals and groups construct institutions, how institutions function in practice and the effects of institutions on society. Notice that normally Institutions vary slowly in time (crisis are exceptions), and this

change depends basically on conflicts between users and the capacity of different groups to confront (Ostrom 1990, Tohmé and London 1998).

Elinor Ostrom extends the institutional analysis to the collective action for a particular case, to study the socio-ecological systems (SES), (Ostrom 1990). Any group that attempts to manage a common resource (e.g., aquifers, pastures) for optimal sustainable production must solve a set of problems in order to create institutions for collective action; there is some evidence that following a set of design principles in creating these institutions can overcome these problems. This may result in the **tragedy of the commons**: the depletion of a shared resource by individuals, acting independently and rationally according to each one self-interest, despite their understanding that depleting the common resource is contrary to the long-term best interests of the group. This concept is contrary to the concept of *sustainable development*: development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Ostrom (1990) found that groups that are able to organize and govern their behavior successfully are marked by some basic design principles:

- Group boundaries are clearly defined;
- Rules governing the use of collective goods are well matched to local needs and conditions;
- Most individuals affected by these rules can participate in modifying the rules;
- The rights of community members to devise their own rules are respected by external authorities;
- A system for monitoring member's behavior exists and the community members themselves undertake this monitoring;
- A graduated system of sanctions is used;
- Community members have access to low-cost conflict resolution mechanisms;
- For Common Pool Resources (CPR) that are parts of larger systems: appropriation, provision, monitoring, enforcement, conflict resolution and governance activities are organized in multiple layers of nested enterprises.

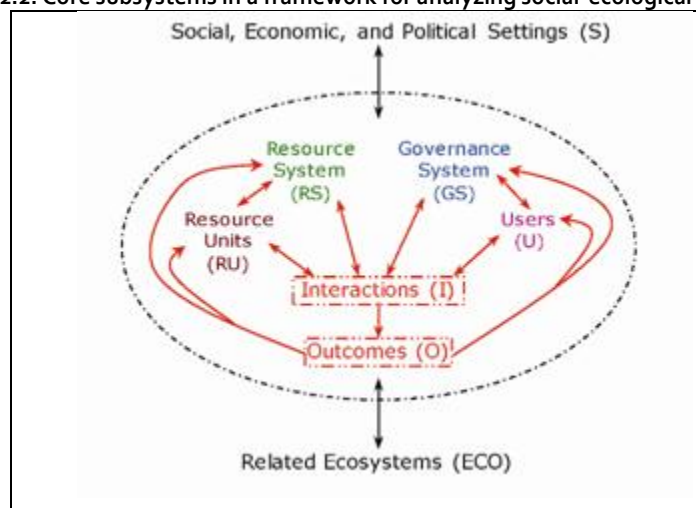
Ostrom developed a specific methodology to analyze SES and the possibility of a self-organization for sustainable development (Ostrom 2009). *"We need to build a theoretical foundation for explaining why some resource users are able to self-organize and govern the use of a resource over time in a sustainable manner and why others fail or never make the effort"* (Basurto and Ostrom 2008).

We consider a working definition of SES: *"A social-ecological system consists of a bio-geophysical unit and its associated social actors and institutions. Social-ecological systems are complex and adaptive and delimited by spatial or functional boundaries surrounding particular ecosystems and their problem context"* (Glaser et al. 2008, in Jhan et al. 2009). Then, in order to define a SES it is necessary to describe the topological structure and pattern of the relations between the system elements. *"Networks, feedback loops or causal chains are concepts that can be expressions of these relations and dynamics"* (Basurto and Ostrom 2008).

2 Study area description according to Ostrom's frame

The objective of this section is to make the characterization of the Argentine SES, under the definition considered in section 1 above and applying Ostrom's framework. Our study area is formed by 5 related SES's: General Daniel Cerri, Ingeniero White, Villa del Mar, Pehuén Co and Monte Hermoso. Following the methodology, each system will be characterized by the attributes of a Resource System (RS), Resource units (RU), users (U), governance system (GS), interactions (I) and outcomes (O). General description will be done by social, economic, and political settings (S) and related ecosystems (ECO), first tier variables. *"These eight broad variables can be unpacked into a second-tier set of variables that have been found in empirical studies to impact diverse interactions and outcomes. The second-tier variables are considered the initial core conceptual variables necessary to identify the type of SES operating at a particular location, as well as the reasons for sustainable or unsustainable outcomes"* (Blanco 2011). The Argentine Research Team used as information sources the national, provincial and regional statistics, academic works, local publications, stakeholder interviews and an *ad-hoc* survey.

Figure 2.2. Core subsystems in a framework for analyzing social-ecological systems.



Source: Ostrom 2007

Figure 2.2 shows a SES can be defined as a complex system. We must describe the set of variables and its relationships, loops and feedbacks interactions and outcomes to understand the possibility that social self-organization emerges. *"We need to build a theoretical foundation for explaining why some resource users are able to self-organize and govern the use of a resource over time in a sustainable manner and why others fail or never make the effort"* (Basurto and Ostrom 2008).

Starting with SOCIAL, ECONOMIC AND POLITICAL SETTING (S), to understand the positive and negative aspects of our SES characterization, a brief historical background is needed. Our study area is the Monte Hermoso - Bahía Blanca Estuary located on the southwestern coast of the Buenos Aires Province, one of the richest and most developed province of Argentina (Fig.

2.3)¹. It is an urbanized region with modern systems of communication and high strategic value due to its localization as “port and door” of the south. The five sub-areas under analysis are extended along the Atlantic coast over a stretch of 100 km. General Cerri is located at the inner reach of the estuary. By continuing from west to east, we can find Ing. White (15 km from Cerri); Villa del Mar (18 km from Ing. White); Pehuén Co (50 km from Villa del Mar) and Monte Hermoso (20 km from Pehuén Co). They belong to three different geo-political orders. The Municipality of Bahía Blanca includes Cerri and White, while Villa del Mar and Pehuén Co belong to Coronel Rosales and Monte Hermoso represents an autonomous municipality.

Figure 2.3. Localities associated with the Argentine SES



While Bahía Blanca was founded in 1828, White was borne as the port of the city. Cerri was established as a fort in 1876 during the war against the last natives in the area. Nevertheless, both localities grew and became relevant during the first half of the XX century due to the arrival of immigrants from Europe and other parts of the world. Nowadays, they have almost 10 000 inhabitants each. Related to economic activities, White and Cerri grew around wool and meat processing plants. Lately, the gas and petrochemical industries were consolidated as the main activities. The Petrochemical Industrial Pole represents more than half of the industrial production of Buenos Aires Province. Mechanization reduced employment in industry and in the port, diversifying employment sources. **Artisan fishery and horticulture** are the principal primary activities (S1a variable). The Port of Ing. White has become the most important deepwater harbor of Argentina through which petrochemical and rural products are traded.

¹ The Buenos Aires province concentrates 34% of the Argentine GDP, and has a Income per capita similar to Portugal or Israel (source: INDEC)

Villa del Mar and Pehuén Co were born as touristic villas of Punta Alta (head of the Coronel Rosales Municipality) and Bahía Blanca during the '40s. The land in the area of Monte Hermoso and Pehuén Co was given by landowners around the middle XX century. Villa del Mar has almost 350 inhabitants. Pehuén Co has tripled its population in the last 20 years because of the migration from urban sectors; today it has approximately 700 inhabitants. The economic activities are based on **touristic services and artisan fishery**. Monte Hermoso is a large touristic city and initiated as municipality in 1979. It has already 6000 inhabitants and receives the influence of Bahía Blanca and others urban sectors. The population of these tourist resorts during the holiday season increases several fold because of visitors.

Moreover, the local history followed the national history of extended periods with democratic practices and military coups (1930, 1943, 1955, 1962, 1966 and 1976)². One of the main characteristics of these governments was the repressive violence against any association form because of the fear of subversion. A large number of states of siege were declared (the last, even during a democratic government in December 2001). In this context, the capacity to join spontaneously groups and self-organize looking for the commons have been lost due to the fear and prohibitions suffered for long periods of time.

These characteristics are reflected at the core variable (S). In particular, our study region presents a high level of development (S₁), with a stress dispersion of the income. Stakeholders (SH) present the same characteristics of the urban population next to each community. The Political Stability (S₃) depends basically on the national law and its influences on the provincial and local rules. There are not communitarian rules, even not informal ones.

An important source of conflicts (S_{3c}) arises at the local level because of the use of the resources. The urban and industrial activity impacts over the estuary affecting the fishery activity. In the Institutional pyramid (Fig. 2.1) these conflicts show that exist the possibility of emergence of some kind of organization to preserve the fishery activity. This can be the starting point of a self-organized community. In this direction, the presence and impact of the local media (S₆) become essential.

Variables relative to the specific SES are: Resource Systems (RS), Users (U), Governance System (GS) and Resource Units (RU). As the second tier variable RS₂ and its third tier variable show, limits of resource are partially defined. This characteristic defines an important problem for the SH self-organization: cost, boundaries and monitoring activities are unclear. Even when there is a good predictability of the system (RS₇), its size (RS₃) reinforces the last conclusion: being medium/big "...are very unlikely to be self-organized..." (Ostrom 2007). Beaches and marine spaces are public, regulated by government and are open access resources. There is neither common property of resources nor community-based management for their use. In general, the appropriation is entirely private and the resource exploitation is reformed on an individual basis.

² Between the first military coup in 1930 until the last dictatorship fell in 1983, the military ruled the country for 25 years, imposing 14 dictators due to successive military-civic coups. In that period, all democratically elected government was interrupted by coups.

Describing Resource Units (RU), we can underline two main characteristics: RU₁ shows high mobility and, once again, it is a problem to common resource management: "...self-organized is less likely with mobile resource..." (Ostrom 2007). But there is a high environmental value, RU_{4b}, and it is recognized by the SH, given the incentives to work together.

To understand this possibility, the variables Users (U) and Governance (G) became essential. The SES history can be defined as "new and limited". During the last 200 years, the appropriation of land was marked by the war against nomadic natives, the extermination of pre-hispanic cultures and the implementation of a private property regimen related to rural production, being the coastal management only a secondary and unimportant subject. Along the last 100 years, the population growth of the communities was the consequence of migration flows. The outcome is the absence of a unique cultural root which has reduced the capacity to create a common cultural codes, norms and rules. We can find many heterogeneous users that do not share the commons idea. An important contrast between the ecological relevance of the area and the perspective of population was found, since historically the attention was focused more in the rural area than in the marine sector.

One of the major problems is the "community" delimitation related to the use of the coastal and marine resources. If we define "community" as a social unit that shares common values, where there exists sense of connectedness and the community "takes on a life of its own, as people become free enough to share and secure enough to get along" (Putnam 2000), then we do not study a well defined community. But if we point out Cohen's definition ("*Community is a boundary-expressing symbol. As a symbol, it is held in common by its members; but its meaning varies with its members' unique orientation to it*", Cohen, 1985, p.15), we find signs of an unifying force (Skogen and Krangle 2003) in the group of artisan fishermen and other users related to the fishery and coastal management, as we can describe at variables U₃ (history, fishery is a traditional activity) and U₅ (there exist some leaderships between fisherman). As a positive outcome, in the last periods some environmental organizations have demonstrated an increase in social capital performance (U₆). These organizations and fishermen have found in COMET-LA workshops a place of communication and discussion. While it is too early to reach conclusions, the organizational structure related to the resources management at a local level are showing marked evolution towards some collective actions.

All variables related to Governance (G) show the non-existence of common management of resources: GS₁ shows that government organizations are not communitarian, and the second tier variable GS₂, describes the fact that NGOs have a medium presence in the region. Even when there is a high presence of social and market networks (GS₃), all property-right systems are defined at National level (GS₄) and Collective-choice rules (GS₆) are inexistent. Rules become from the top of the Institutional Pyramid (Fig. 2.1), constitutional rules emerge at an aggregated level (GS₇) and there are no community rules.

In the study area, politic power is exercised through a representative democracy. There is no self-governed community with general assembly and public decision power over the use of resources or land destination, where the formal governmental norms have not been determined by using historical social norms and traditional ecological knowledge of the users, as it is the case of many examples in the literature (Basurto 2005; Basurto and Ostrom 2009;

Cinner et al. 2009). In this sense, the total population between Cerri and Monte Hermoso lack clear community-based informal rules governing their behaviour. On the contrary, legislation which regulates action and resource performance emanated from a very complex structure of government (provincial and national) are present, many times distant from the local problems and incongruent with internal norms.

Nevertheless five years ago stakeholders were invited to participate in forums before the creation of Monte Hermoso – Pehuén Co reserve to design a management plan of the use of resources. Despite of the community discussion in fora, governmental organisms from the province took into account only the opinion of few actors at the moment of defining the legislation. According to particular stakeholders (Park Rangers and Sustainable tourism actors) this course of action corresponded to the urgent need for preservation of unique paleontological resources, which are located on the beach between Pehuén Co and Monte Hermoso. Although fishermen agree with the creation of the Reserve, they disagree with the fact, that due to the reserve, they cannot longer travel along the beach as it was closed by the reserve. Nevertheless they recognize the validity of having been called to participate in the forum. It should also be noted that the management of the Reserve has not been regulated by law yet.

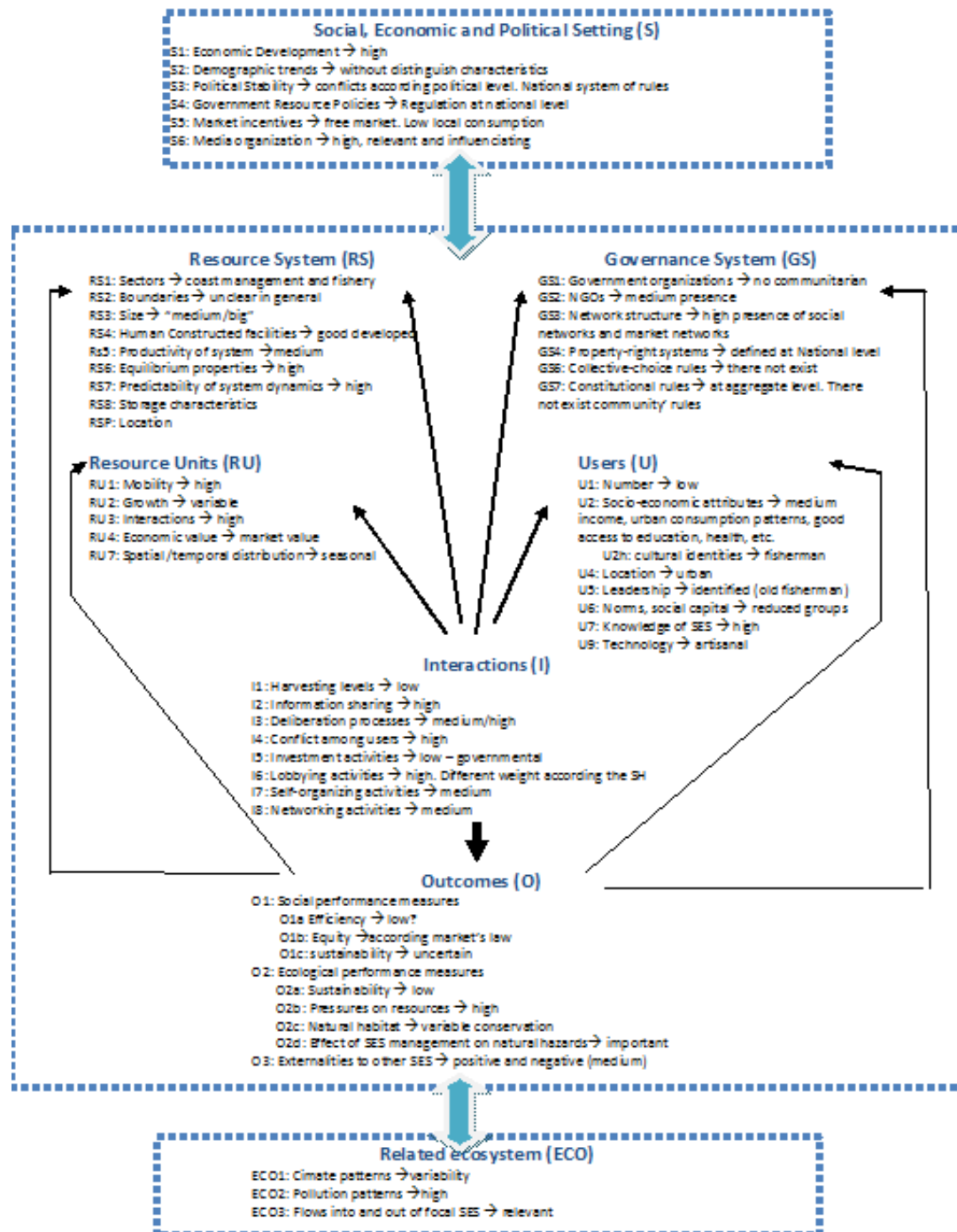
Interactions (I) describe relations between variables. I_{1b} indicates that there is not individual and collective level (there is not a differentiation) and I₃ shows that there is not collective process of deliberation. Even there is a good communication between SH (I₂), important socio-economic conflicts emerge.

Thought the variable Outcomes (O) we can obtain some conclusions about this SES. First, we assume that there is a low efficiency level, because of the inexistence of a self-organization (O_{1a}). The vulnerability of the system is high (O₂) and there is an important set of both positive and negative externalities (O₃).

A survey of this analysis is represented in Figure 2.4. The complete Ostrom's framework is in Annex I.

As a general critical thought, we can see from the previous analysis that there is no common management resource in our case of study. Nevertheless, some variables reflect the possibility of the emergence of a self-organization. Moreover, the prospective analysis made with the Stakeholders was the starting point to this, as the SH themselves recognized.

Figure 2.4. Ostrom's framework for the Argentine Study
Ostrom's framework for the Argentine case: Monte Hermoso – Bahia Blanca Estuary



Source: Own elaboration.

3 Use of Prospective Structural Analysis (PSA) to identify problems and drivers related to environmental changes identification

3.1 Workshop (WS) organization

3.1.1 Mapping of Stakeholders

The stakeholders were selected in accordance with the SES characterization. The characterization permitted to focus on the problem related to fishing and coastal management and to have a better boundary definition of the “community”, according to the Ostrom framework (see Section 2).

Two selection criteria were used during the SH mapping: pertinence and representativeness. Pertinence was assessed by the users’ relationships with resources and their capacity to affect the SES, as well as their knowledge about the SES. Representativeness was defined according to the level of how well or how accurately someone reflects upon the sample. Note that the most representative user from a group seems to be who has the best knowledge of the SES. For instance, leaders of fishermen associations were considered as the most representatives SH of the group. Relevant groups were first identified, then secondly, leader or those who had greater knowledge of the SES were invited.

According to their role in the system, SH have different perspectives and knowledge of the SES. Social actors were chosen in order to have representatives from different localities and associated with different activities of use and management of resources.

Internal and external SH (i.e., decision makers) were evaluated under the same criteria. Internal SH are those who make a direct use of the resources; while external actors are those who have some power to influence them but do not use them directly. In our case study, external actors mostly represent government agencies and decision makers. Some of the most important groups identified were: fishermen, neighborhood groups, rangers, teachers, firefighters (as internal to the SES); and municipalities, government agencies and Petrochemical Industrial Pole representatives (as external SH)

Social actors who participated in the workshops held during the first year of the project were taken into account. Some of them stopped participating since they did not identify with the main objective of the project. Social actors that were considered relevant were invited. In turn, some SH involved in the project nowadays were recommended by other SH highlighting the valuable information that could add to the project. At the time to select the stakeholders, the interest shown in previous workshops and spontaneous interest of some actors who applied to participate were taken into account.

Stakeholders that are collaborating with the project and who have attended the workshops are:

- Major of Monte Hermoso
- Public Works Secretary Monte Hermoso
- Production Secretary of Monte Hermoso

- Municipal Delegate Pehuén Co
- Aldermen of the Honorable Council of Coronel Rosales
- Production Secretary of Coronel Rosales
- Representative fishing association Pehuén Co and Monte Hermoso
- Residents Bahía Blanca Estuary.
- Representative of the fishermen's association from Bahía Blanca Estuary
- Artisanal Fishermen from Villa del Mar
- Rangers from Monte Hermoso and Pehuén Co Paleontological Reserve
- Nature reserve ranger Bahía Blanca, Bahía Falsa and Bahía Verde
- Representative of the neighborhood association, "Cerri of Pie"
- Representative of neighborhood society "Friends of Pehuén Co"
- Representatives of the Technical Executive Committee, Bahia Blanca

3.1.2 Workshops

The fieldwork in the Argentine study case was conditioned by several factors. In first place, as was mentioned in the characterization (see chapter 2), the historical conformation of the SES has limited the confidence of the stakeholders and their desire to participate in common activities. The community takes some time to integrate in projects as COMET-LA. Previous to COMET-LA, communities in the Argentine case study had no prior experience of conducting participatory work. The acceptance of the COMET-LA project had to be done in a more or less spontaneous way; nevertheless, to our surprise, SH reacted positively to the invitations and have participated enthusiastically. Our initial expectations indicated that adequate SH participation could be much harder to achieve.

Second, the lifestyle of stakeholders in urban zones implies that time and mechanisms for grouping activities are limited. Conducting several workshops over an extended time period, of excessive length and intensively could clearly undermine the participation. Users in the project live in different cities (they must travel 50 km on average to attend to the workshops if it is concentrated at only place), and relevant users as fishermen remain absent for several days because of their activity. Thus, a balance between the time spent on workshops, information requirements and the availability of attendees had to be found.

The Ostrom framework and the MICMAC methodology have a technical language and require some previous knowledge in order to be understood. A very important training process is needed if we want communities to work directly with the methodology. Thus, we decided not to introduce directly the Ostrom framework and the MICMAC methodology to SH because of the trade-off between the objectives to apply PSA and the availability of the SH. Since we perceived the complete acceptance of the project by communities during the last workshop, the MICMAC methodology will be explained at the next workshop for SH to understand our results.

It is important to note that during the first year of the fieldwork, a significant number of workshops were carried out allowing us to characterize the SES and begin to identify the relevant variables in terms of the perceptions and interpretations of SH.

Focusing on the workshops held in the month of June 2013 (Fig. 3.1), the PSA workshops were performed in Bahía Blanca City, a neutral and intermediate city among all cities involved in the study. The research group found it convenient to concentrate the field work in only one day with two separate sessions.

The objectives of the PSA workshop were: 1) to identify and define the most relevant variables that characterize the SES according to the SH perspective; 2) to establish the relationships of dependence-influence and their intensities among the key variables previously identified.

With respect to the initial objective, activities in focus groups were developed by dividing the SH per localities and per activities related to the resources system. Focus group methodology allows a greater participation by all stakeholders, avoiding monologues and discussions that could undermine the objective of the fieldwork. The focus group is justified in our case by the different problems found from the characterization. Monte Hermoso and Pehuén Co share conflicts and other interactions and outcomes that are different from those found in Villa del Mar, Cerri and Ingeniero White. SH were also divided depending on their activities and purposes in the SES (fishing, tourism, environment and external organizations). Various visions were obtained from users depending on their relation with resources system and their position on SES.

The activities were driven by the question "*which issues and matters are relevant with respect to the fishery and coastal management in our SES?*" SH worked with variables that had been identified in previous workshops and found new variables. The variable definitions were made by the SH and the research group did respect their conceptualizations, even when there is a contradiction with the scientific knowledge. The relevance of the variables was established according to the repetition in all groups (number of times the variable was mentioned during the workshop). Indirectly, the questions made by the moderators along the activity sought that all the 8 categories from Ostrom (Social, economical and political settings; Resource system; Governance system, Resource units; Users; Interactions; Outcomes; Related ecosystems) were covered during the discussion.

Mobile displays and double-entry tables were used to conceptualize relationships among variables and their degree of influence. SH identified the degree of influence as "a lot", "little", "anything", "irrelevant" and "may be". From the outcomes obtained in this activity, the researchers adapted the results to the MICMAC's framework translating concepts to numbers (3, 2, 1, 0 and P) and getting a first approximation of the Matrix of Direct Influence (MDI).

Figure 3.1. Examples of the PSA workshops in the Argentine study case.



3.2 Variables identified by the WS participants with a short description

Initially, stakeholders identified 84 variables. But some of these variables were similar or had the same role in the SES. A refinement allowed 52 well-defined variables. Finally, we worked with the 21 most important variables. As it was mentioned above, these were the most named variables by SH due to its relevance. Ostrom's classification was made by researchers respecting the SH definition. First, the key variables were identified in each of the 8 core variable categories. Second, each variable was tagged using the same order than in the Ostrom framework until the second-tier variable. Finally, those variables in the same second-tier group were named in alphabetic order (i.e., variables in Economic Development (S₁) was tagged as S_{1a}, S_{1b} and S_{1c}). The third step does not necessarily consider the Ostrom nomenclature. The variables identified by the participants of PSA workshop and its short description are introduced below (a complete description of variables is included in the Annex II).

(S) – Social, Economic and Political Setting

(S_{1a}) Petrochemical Industrial Pole: Group of industries and companies located near the Ing. White Port, between the communities of White and Cerri. The Petrochemical Industrial Pole is

perceived as an external group of power, with lobby capacity against the direct interest of users and as one of the major pollution source.

(S1b) Employment sources: Employment sources are the possible jobs for stakeholders. According to the SES delimitation, they are mainly based on fishery and tourism activities. Commerce and public sector employment are other important employment sources.

(S1c) Tourism: Tourism is the economic activity consisting of selling tourism services and products. The “beach and sun” tourism is one of the main sources of income for the communities of Pehuén Co and Monte Hermoso. This activity supposes the intensive use of coastal resources and has both complementarily and rivalry issues with artisanal fishery.

(S5) Local Market: Local market refers to the set of relations between sellers and buyers in the local context of fishery. Local market is conditional on the consumers and price determination.

(GS) – Governance Systems

(GS1a) Organizations and fishery legislation: Groups of organizations belonging to different government levels that have some legal authority over the resource, as well as groups of formal legislation and norms on controlling, monitoring and sanctioning the use and appropriation of the resource. For stakeholders, it is an external variable since they have no power to influence them.

(GS1b) Lack of political interest in environmental sustainability: This variable summarizes the attitude of external decision makers towards legislation on resource units and resource system. It depends on external stakeholders. According to SH, the lack of political interest in environmental sustainability can be seen through different actions or omissions by decision makers.

(GS3) Fishermen associations: Internal networks (associations and chambers) related to the management, use and marketing of resources. Such unions represent an increase in the social capital of users. Through these network structures, fishermen share information and develop collective actions.

(RU) – Resources units

(RU5) Catches. Number of fishery resource units extracted by artisanal fishery.

(RU7) Seasonality. Seasonality is a characteristic of fishery activity since it represents the extraction of a resource with regeneration periods. Seasonality is also a characteristic of tourism activity because of the “beach and sun” type which normally takes place in summer

(RS) – Resource Systems

(RS6) Wildlife Resource System. By wildlife resources stakeholders mentioned the relevance of animals and the equilibrium of interactions between species in a biological sense.

(U) – Users

(U2) Income. Stakeholders look at income as a measurement of their quality of life. Income is directly linked with use of the resource since the two main income sources of communities are fishery and tourism.

(U3) Artisanal fishery history. History of use of resources and conformation as group. Artisanal fishery is based on traditional extracting methods. Fathers often teach their son the techniques to fish and the traditional knowledge of SES. The history in the Argentine case is relatively new (see Ostrom characterization in point 2) and fishery is mostly related to the Italian immigrants in the region.

(U9) Artisanal fishery: Artisanal Fishery describes the type of activity carried out by small crafts and boats with traditional techniques as hand line, trammel or gill net, shrimp net funding, etc. Artisanal Fishery also has cultural and historical implications for stakeholders.

(I) – Interactions

(I4) Dredging and LNG (Natural Liquefied Gas) Project: the expansion of Petrochemical Industrial Pole and the enlargement and deepening of the Canal Principal, promoted by external users and decision makers, is an important infrastructure project consisting of building a plant to transform LNG into regular gas near Cerri. The project resulted in a clear conflict among internal and external SH.

(I5) Conservation measures: Group of activities and procedures made by users (mainly internal SH, but also external to a lesser extent) in order to achieve sustainability of the resource.

(I8) Community awareness: Ideas and perceptions about activities realized by a user may affect other users and the common use of resources. This type of thinking has become relevant and has pushed the community to think about the realization of networking activities.

(O) – Outcomes

(O2a) Changes in coastal environment and estuary: It describes a series of physical changes in coastal environment and estuary observed by users. This variable depends on human and environmental factors including climatic change and variability.

(O2b) Overfishing: It represents the excessive catches of fish and shellfish. The effects of overfishing are recognized in biological terms (reduction of the resources) and bio-economics terms (less profitable activity). From SH, the responsibility may be the offshore fishery.

(O2c) Resource sustainability: The possibility to maintain an equilibrium between the resource extraction and its regeneration, in order to achieve the ecologic and economic sustainability of SES.

(ECO) – Related Ecosystems

(ECO1) Changes in climate patterns: Changes in climate patterns perceived by users, like decrease in rainfall, extension in drought periods, increase in water temperature, increase in rotation and speed of winds.

(ECO2) Pollution: Pollution patterns affecting the SES and users' activities, like air pollution caused by toxic emissions from factories, water pollution caused by industrial waste and sewage, and so on.

3.3 Matrix of direct influences (MDI)

The PSA tool has been designed to link ideas in order to describe how a system is operating. The essential components of a system are reduced to a matrix where the relationships of influence/dependence and its intensity among variables are shown.

Once n variables were inventoried and described, SH established the relationships of dependence/influence and its weight in a matrix of order $n \times n$. The matrix must be filled line by line, evaluating how each variable directly influence the rest. Hence, the first row shows how the first variable impacts over the others. For instance, the position $\{a_{i,j}\}$ in the matrix shows how variable i influences variable j . Therefore, each column represents the dependence of a specific component on the other $n - 1$ variables. Note that this matrix is describing the current situation of the system given the actual conditions like a static photo (Arcade et al. 2004).

Only direct influence relations are taken into account and weights are qualitatively assessed as strong (3), moderate (2), weak (1), no influence (0) or potential (P). The MDI of the Argentine case is shown in Table 3.1. Cells corresponding to strong (3), moderate (2), weak (1), no influence (0) and potential (P) effects have been colored in red, yellow, green, white and blue for a better visualization.

The 21 key variables allow us to get a total of 420 relations (the matrix has 441 cells, but 21 correspond to the diagonal marked with 0 since each variable faced itself).

Table 3.1. Matrix of Direct Influence (MDI) based on SH's perceptions.

	1: ECO1	2: ECO2	3: GS1a	4: GS3	5: GS1b	6: I4	7: O2a	8: O2b	9: RS7	10: O2c	11: RU5	12: RU7	13: S1a	14: S1c	15: S1b	16: S5	17: U2	18: U3	19: I8	20: I5	21: U9
1: ECO1	0	0	P	1	P	0	3	0	2	2	2	3	0	2	1	0	2	1	2	2	3
2: ECO2	2	0	1	2	P	0	3	0	3	3	3	3	0	3	2	1	3	2	3	3	3
3: GS1a	0	0	0	1	2	1	1	3	2	3	3	0	P	1	2	1	2	2	0	1	3
4: GS3	0	0	2	0	0	3	1	1	1	2	2	0	1	1	3	2	2	3	1	2	3
5: GS1b	0	3	3	3	0	3	2	3	3	3	2	0	3	2	1	0	2	2	3	1	3
6: I4	0	2	0	3	0	0	3	0	3	3	3	0	2	0	P	0	2	2	3	0	3
7: O2a	0	0	1	2	P	0	0	0	2	3	1	1	0	3	2	0	1	1	2	2	2
8: O2b	0	0	2	3	0	0	0	0	2	3	3	1	0	0	2	1	2	2	0	2	3
9: RS7	0	0	2	1	0	0	0	0	0	2	2	P	0	0	2	P	1	2	2	2	2
10: O2c	0	0	1	2	P	0	P	0	2	0	2	0	0	2	3	1	2	2	2	3	2
11: RU5	0	0	2	2	0	0	0	1	2	1	0	0	0	0	1	3	3	2	0	P	3
12: RU7	0	0	1	1	0	0	0	0	2	P	3	0	0	3	2	2	3	P	0	0	2
13: S1a	0	3	P	3	3	3	3	0	3	3	3	2	0	1	2	0	2	2	3	1	3
14: S1c	0	2	0	1	2	0	2	0	1	2	0	0	0	0	2	2	3	0	2	2	2
15: S1b	0	0	0	2	0	0	0	0	0	P	0	0	0	0	0	0	3	0	P	0	0
16: S5	0	0	0	2	0	0	0	0	0	0	1	0	0	0	2	0	3	2	0	0	2
17: U2	0	0	0	2	0	0	0	0	0	2	2	0	0	P	3	1	0	1	P	0	2
18: U3	0	0	1	2	0	0	1	1	2	2	2	0	0	2	1	1	2	0	1	2	3
19: I8	0	2	P	2	P	3	2	0	3	3	1	0	2	1	P	0	P	2	0	3	2
20: I5	0	2	0	2	0	1	2	1	2	2	2	0	0	3	P	1	2	2	3	0	2
21: U9	0	1	1	3	0	2	3	1	2	3	3	0	0	2	3	2	3	3	2	2	0

Source: Own elaboration based on field work and MICMAC software outcomes.

For the sake of simplicity, we will explain the interpretation of one variable, but any variable can be interpreted in the same manner. The row 3 corresponds to the variable (GS1a) *Organizations and fishery legislation*. According to the opinion of SH, *Organizations and fishery legislation* has no influence on the determination of (RU7) *Seasonality* (0 is noted in cell $\{a_{3,12}\}$), but it has a weak influence on *Local market* (1 in cell $\{a_{3,16}\}$), a moderate influence on *Income* (2 in cell $\{a_{3,17}\}$) and a high influence on *Artisanal fishery* (3 in cell $\{a_{3,21}\}$).

As noted before, the direct influence of one variable over the SES can be noticed by considering the respective row into the structural matrix. A variable that has only effects on a limited number of elements or has weak influence in general, will have little influence on the system. Although this fact does not reduce its importance, a correct interpretation of the role of the variables in the SES must be done. Also the direct dependence of variables can be observed by looking at each column. Then, indicators of the total direct influence and total direct dependence with respect to the system can be obtained through the sum of rows and columns (Table 3.2)

Table 3.2. MDI: Sum of values by rows and columns.

N°	VARIABLE	SHORT LABEL	TOTAL NUMBER OF ROWS	TOTAL NUMBER OF COLUMNS
1	Changes in climate patterns	ECO1	26	2
2	Pollution	ECO2	40	15
3	Organizations and fishery legislation	GS1a	28	17
4	Fishermen associations	GS3	30	40
5	Lack of political interest in environmental sustainability	GS1b	42	7
6	Dredging and LNG Project	I4	30	16
7	Changes in coastal environment and estuary	O2a	23	26
8	Overfishing	O2b	26	11
9	Wildlife Resource System	RS7	18	37
10	Resource sustainability	O2c	24	40
11	Catches	RU5	20	40
12	Seasonality	RU7	19	10
13	Petrochemical Industrial Pole	S1a	40	8
14	Tourism	S1c	23	26
15	Employment sources	S1b	5	35
16	Local market	S5	12	18
17	Income	U2	14	43
18	Artisanal fishery history	U3	23	33
19	Community awareness	I8	26	30
20	Conservation measures	I5	27	28
21	Artisanal fishery	U9	34	48
	Totals		530	530

Source: Own elaboration based on field work and MICMAC software outcomes.

Employment sources exert the lowest level of influence on the system. Local market and Income also seem to have a low effect on SES. Moreover, Changes in climate patterns, Lack of political interest in environmental sustainability and Petrochemical Industrial Pole, in that order, show the lowest level of dependence on the system.

Lack of political interest in environmental sustainability holds the largest influence over the SES, followed by Pollution and Petrochemical Industrial Pole. Other variables with a high influence on the system are Artisanal fishery, Fishermen associations and Dredging and LNG Project. On the other hand, the most dependent variable is Artisanal fishery, which is followed by Income and Fishermen associations, Catches and Resource sustainability. Therefore, Artisanal fishery and Fishermen associations exhibit a high level of dependence as well as influence on SES.

With the highest levels of total direct influence and the lowest levels of total direct dependence: Lack of political interest in environmental sustainability and Petrochemical

Industrial Pole are the most external variables, in the sense that their behaviour could hardly be changed by internal SH actions.

4 Identification of the role played by the different variables. Presentation of Outcomes by: Influence/dependence maps and influence graphs.

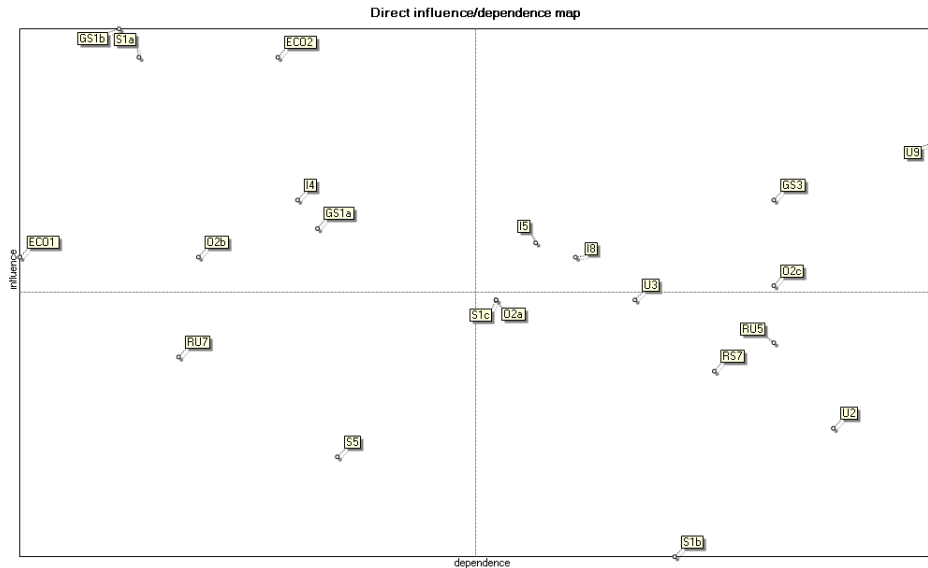
The MICMAC program also permits to get a vision of all variables through the Map of Direct Influence (Figure 4.1). This map puts the key variables on a Cartesian plane by setting up levels of dependence and influence in the horizontal and vertical axis, respectively. On this map, relevant system variables are observed as defined by the SH. The role that each variable plays into the SES can be analyzed.

In order to achieve a better understanding of the variables that are observed in the graph, the AT proposes the following distinction (Figure 4.2):

1) Inertia, Islands or autonomous variables are those variables that follow the inertia of the system. They do not heavily influence or depend on the system. Hence, any policy measure applied on them would not generate a significant change in the system behaviour.

These variables are *Seasonality* and *Local Market*, located in the first quadrant of Fig 4.2.

Figure 4.1. Influence/dependence map based on SH's perceptions.



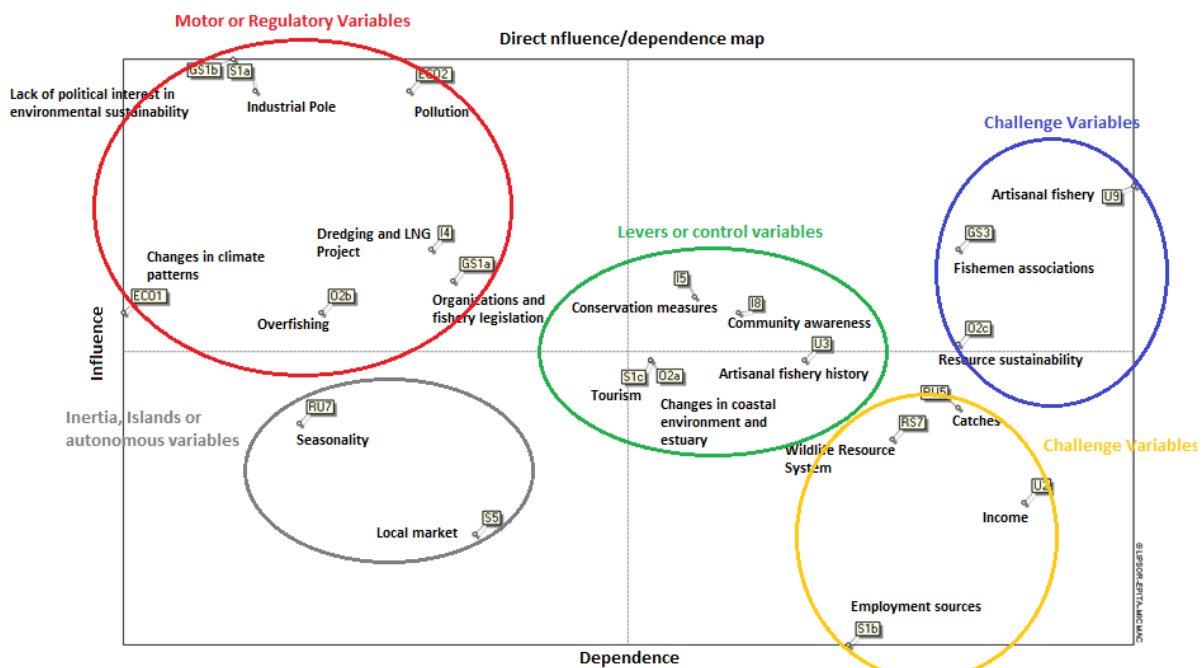
Source: Own elaboration based on fieldwork and MICMAC software outcomes.

In this group, Arcade et al. (2004) distinguish between variables disconnected from the system and secondary variables. The former seems to have a dynamic that is different from the SES dynamics; while the latter are dependent on the system dynamics and can serve points where additional measures can be applied. In our case, both variables in the quadrant are secondary variables, since they have important effects on other variables of the system.

For instance, *Seasonality* determines the fluctuation of *Income* (through its influence on catches and tourism). *Local Market* also has a strong influence on *Income* because it provides the price (economic value) determination. Note that SH could influence and change conditions on *Local Market* more directly than on *Seasonality* (related to natural factors).

2) **Evolution indicators or outcomes variables** are variables heavily dependent on other variables of the SES. Some of them do not influence the system (i.e., *Employment sources*), while others have moderate effects on the system behavior. They are especially sensitive to the evolution of other variables.

Figure 4.2. Influence/dependence map based on SH's perceptions: Variables classification.



Source: Own elaboration based on fieldwork and MICMAC software outcomes.

Employment sources and *Income* can be interpreted as evolution indicators of the economic situation of users and SES. Furthermore, *Wildlife Resource System* and *Catches* show the evolution of resource unit and resource system

4) **Challenge variables.** The variables in this group have a high dependence on system behavior as well as a great influence too, been unstable "by nature" (Godet 1994). Any political action on these variables will have repercussions on the rest of the SES. Links between these variables and the rest of the system must be carefully studied because the feedbacks can amplify or diffuse the initial impulse. Variables on the diagonal represent those that are the most risky to the system. But the variables below the diagonal can be the most important objectives of political measures because they can be modified by SH up to a certain degree while having a great influence on the rest of the SES (Arcade et al. 2004).

Within this set are *Artisanal fishery*, *Fishermen association* and *Resource sustainability*. *Fishermen association* is shown as the closest variable to the diagonal. Intuitively, *Fishermen*

association has been one of the factors that have generated more instability to the SES in the last 5 years.

5) Levers or control variables. The last set of variables is defined by those that depend on and affect the system in a moderate sense. One would expect that if any change is made in these variables, the system moves out of its current state without generating major chaos. *Changes in coastal environment and estuary, Conservation measures, Community awareness* and *Tourism* are in this group.

Moreover, the classification must not be done without specific consideration of the role that each variable plays into the SES. One variable can be a motor variable or a lever variable depending on its links with the others and the general setting.

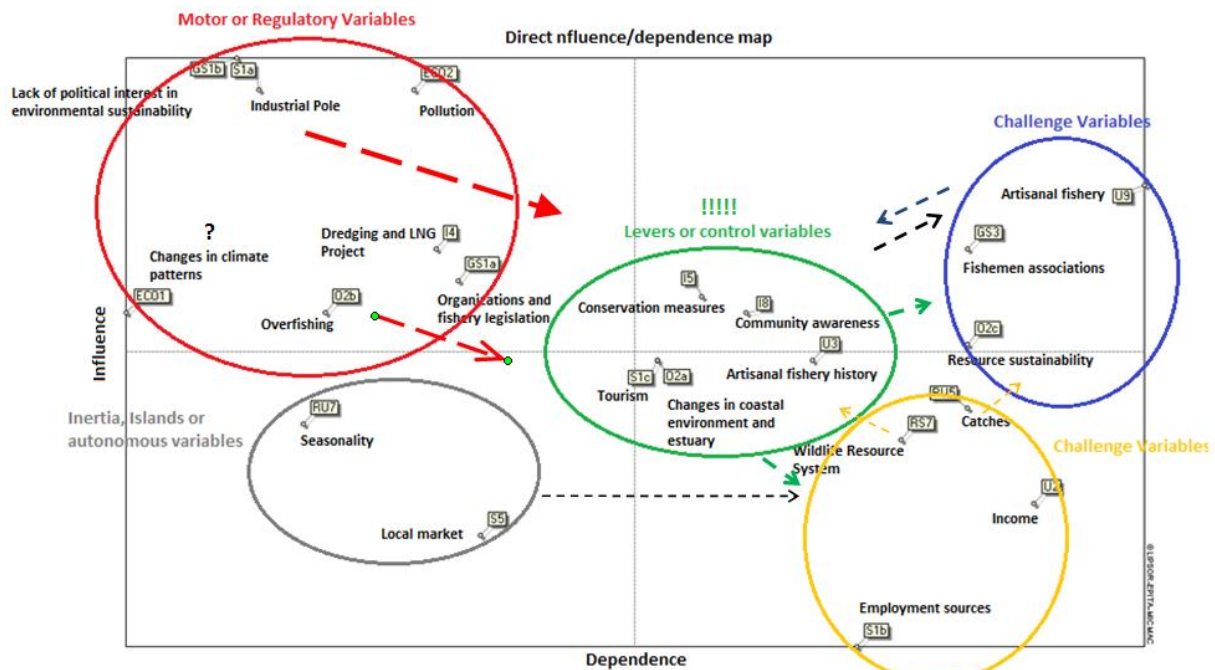
For instance, the previously characterized as a challenge variable, *Resource sustainability* could even be an outcome variable. *Resource sustainability* works as an indicator of the ecological and economic performance in accordance with the SH perceptions. Improvements in *Resources sustainability* could be seen as achievement of policy measures as well as a decreasing of the sustainability could show a deepening in problems related as pollution, erosion, etc.

Organizations and fishery legislation (GS1a) is now a motor variable because it moves the SES and receives a low influence of the SES. But it could be a lever variable if some Interactions forces (summarized in I8 and I5) and the actions of power groups (GS3) are strong enough to influence formal organizations.

Another interesting issue is the history. In communities with an extended history of the use, it is expected to be a motor variable when community traditions impose a large pressure on the SES. But, as it was mentioned in the Ostrom analyses (see chapter 2), the history of our community can be characterized as “new and limited”. The fishermen are building their history. Traditions that exceed the family setting and the driving forces to collective action are bound. Then, the history depends on multiple factors, being a variable that can be seen as outcome variable and a lever as well.

Changes in coastal environment and estuary and *Tourism* are closely located in the map as lever variables. In fact, these variables are truly related. Most of the *Human causes of erosion* are attributed to *Tourism* (waste in beaches, vehicles, sand extraction, building on the coast). Measures to promote sustainable tourism help to reduce coastal erosion. *Conservation measures* and *Community awareness* also are strongly related. The following analyses will show the link among these two key variables.

Figure 4.3. Influence/dependence map based on SH's perceptions: Variables classification.

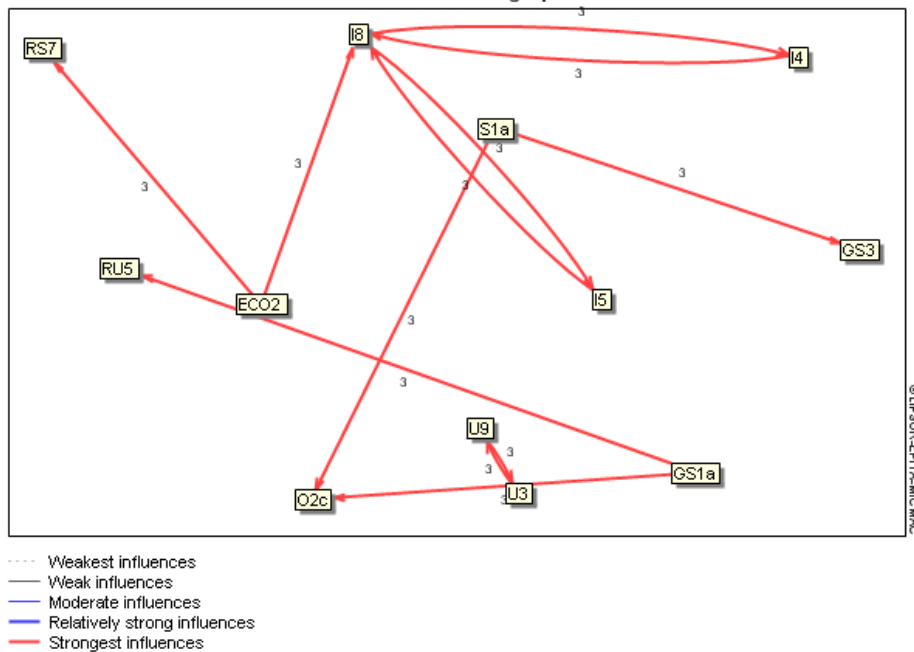


Source: Own elaboration based on field work and MICMAC software outcomes.

The MICMAC program allows building the Direct Influence Graph (DIG) to illustrate the role played by some variables in the system through their stronger influences. Employing this tool, we can identify the direction of the strongest relationships and perceive some dynamics conformation. In the DIG with a filter of 5%, three groups of variables are formed. The groups are broken down for a better interpretation in Figure 4.5.

The dynamics are relevant because there could be feedback mechanisms that reinforce themselves and virtuous cycles or vicious cycles could appear. For instance, in panel (1) of Figure 4.5 *Community Awareness* (I8) has a strong influence and dependence on the *Dredging and LNG project* (I4) and *Conservation measures* (I5). From the SH's point of view, *Community awareness* is a result of increasing problems derived from *Pollution* and the *Absence of collective action* against those groups of power pursuing only economic benefits. The *Dredging and LNG project* acted as a unifying force (Skogen and Krangle 2003) in the community while the community took actions to prevent the project. The concept of community awareness also drives users to group in neighborhood associations or other types of groups to put into practice some collective actions as *Conservation measures* (I5), which are fueled by the commons idea.

Figure 4.4. Influence graph (5% filter).
Direct influence graph



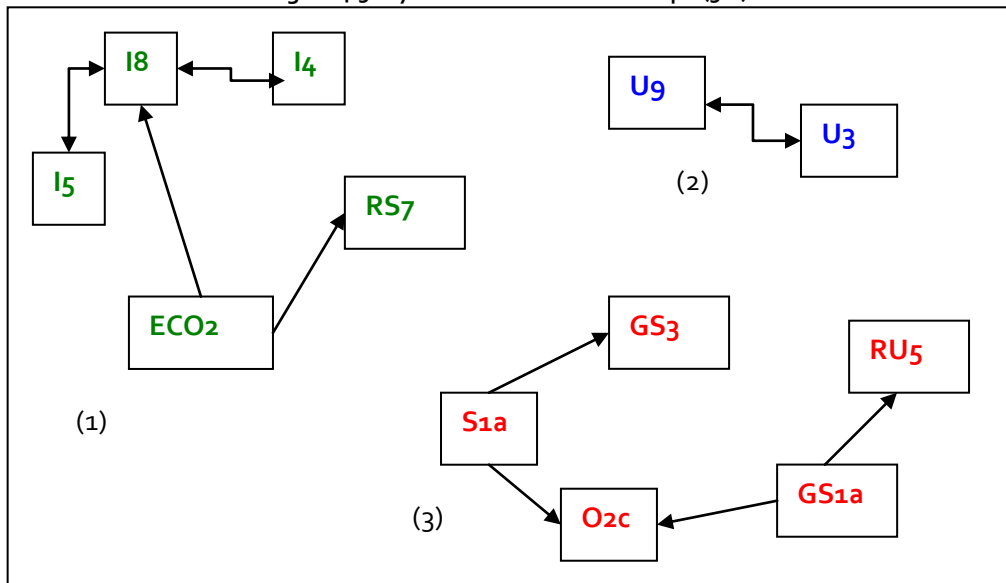
Source: Own elaboration based on field work and MICMAC software outcomes.

Community Awareness (I8) is also affected by *Pollution* (ECO₂), since response actions of the community are against pollution, and these influence (RS7) *Wildlife Resource System* at the same time.

Note again that (I8) and (I5) are lever variables and represent signs of collective action. Promoting these interactions could be a good way to move the system out of his current status with respect to the *Pollution* and *Dredging* problems.

Panel (3) (Fig. 4.5) shows that *Organizations* and *Fishery legislation* (GS1a) influences on *Catches* (RU5) and *Resource sustainability* (O2c). During the WS, users established that formal rules, monitoring and sanctioning process do not work well and exclusive fishing rights given by licenses are insufficient for the case of artisanal fishermen. The resource sustainability is damaged by the absence of a correct legislation, but also by the activity of the *Petrochemical Industrial Pole* (S1a). Once again, the negative impact of the Pole promotes the action of *Fishermen associations* (GS3).

Figure 4.5. Dynamic from Influence Graph (5%).

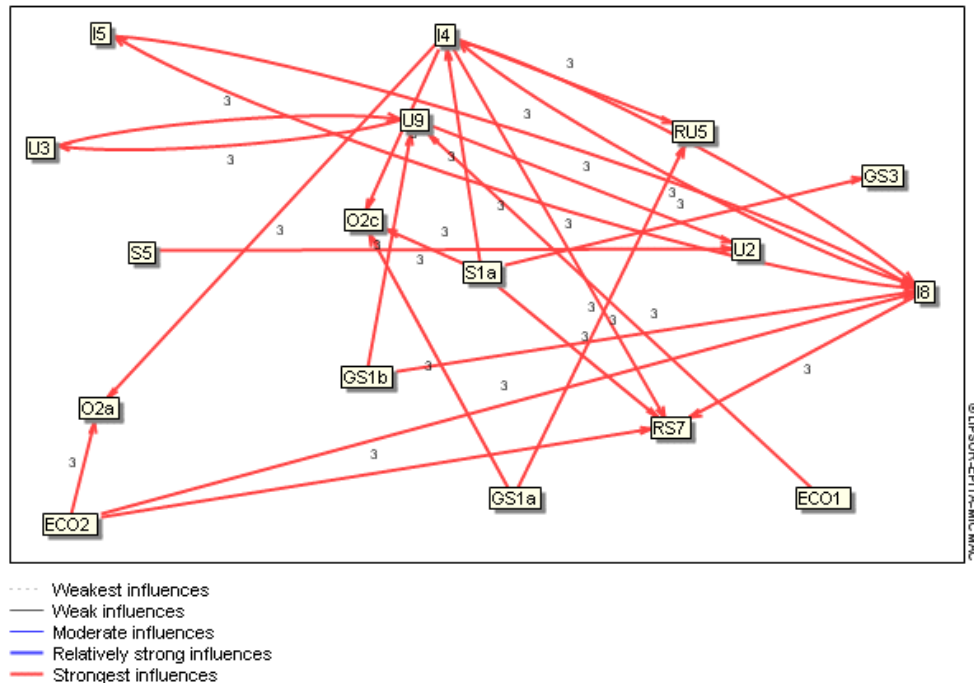


Source: Own elaboration based on field work and MICMAC software outcomes.

Artisanal Fishery (U9) is closely linked with their History (U3) (Panel 3, Fig. 4.5). Increasing the filter applied to the graph (Influence Graph with a 10% filter as in Fig. 4.6.), it is possible show that Income (U2) is also linked with (depend on) Artisanal Fishery, since this activity is one of the most important sources of income in the community. But also the artisanal fishery is conditional on the Lack of political interest in environmental sustainability (GS1b) (Panel (2) in Figure 4.6.)

Some relations that might be explaining the dynamics in reference with important conflicts on SES about the use of resources and their sustainability are shown in Figure 4.7. For example, panel (1) shows how the sustainability of the Wildlife Resource System (RS7) is linked with Community Awareness (I8) and Dredging and LNG project (I4). While the first link is positive, the second reinforce the damage on the resource system.

Figure 4.6. Influence graph (10% filter).
Direct influence graph

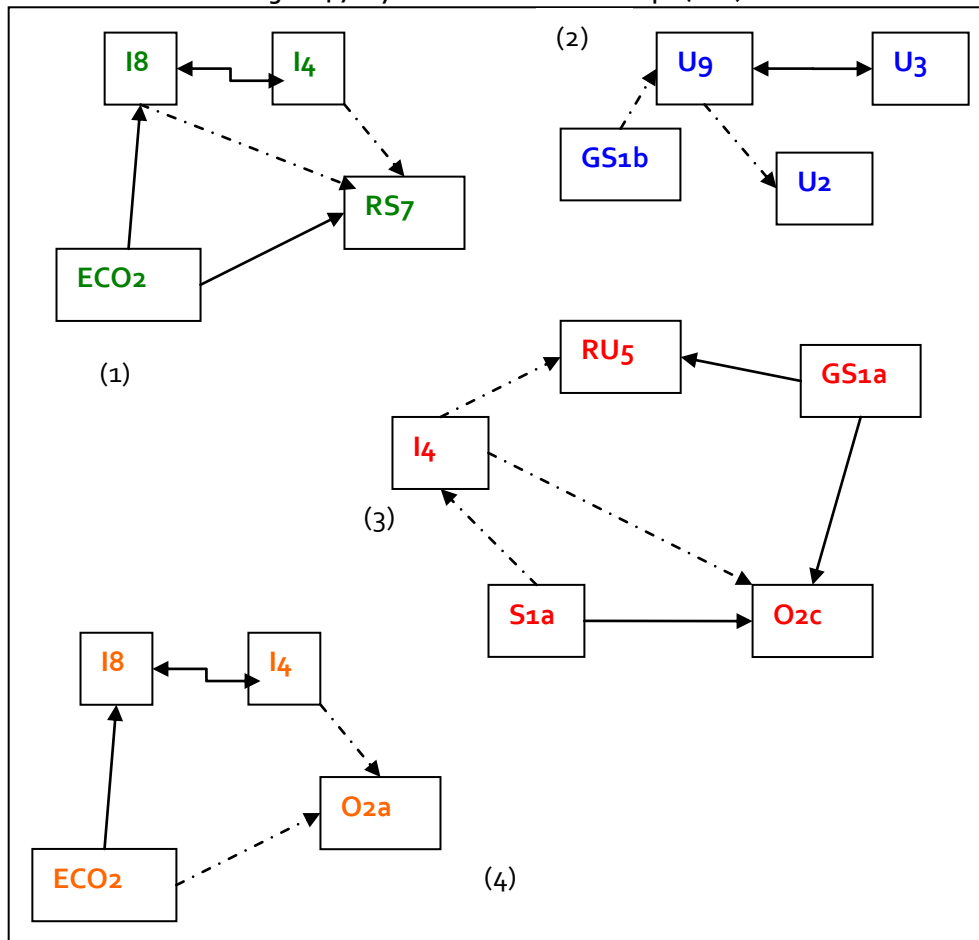


Source: Own elaboration based on field work and MICMAC software outcomes.

The Economic sustainability can be analyzed taking into account panels (2) and (3) (Fig. 4.7). Panel (2) shows how Biological sustainability could compromise the Economic sustainability of Artisanal fishermen. And the same could be interpreted from panel (3), where *Resources Sustainability* (O2c) is highly and directly conditioned on negative aspects (S1a, I4 and GS1a) which also influence *Catches* (RU5)

Panel (4) (Fig. 4.7) refers to the coastal management problem. *Change in Coastal environment and estuary* (O2a) depends on *Pollution* (ECO2) and *Dredging project* (I4). Moreover, *Change in Coastal environment and estuary* is identified as an outcome of the SES from the Ostrom framework. Probably, no policy of medium effort can change directly this variable since it is the result of several actions and relations. Nevertheless, the SES might change its position with respect to the coastal erosion by promoting *Community awareness* (I8).

Figure 4.7. Dynamic from Influence Graph (10%).



Source: Own elaboration based on field work and MICMAC software outcomes.

5 Results of the PSA analysis, its interpretation and validation by the WS participants.

A workshop with Argentine internal and external stakeholders was organized with the participation of all the COMET-LA teams, in July 2nd, 2013. The goal of the workshop was to complete the prospective analysis, validate definitions, degrees of relevance of the selected variables and their role in the SES. The activity was focused on the key variables identified during the previous workshops and described in chapter 3.

Seven days in advance of the PSA WS, the researcher team sent SH the document with the full definitions of all variables. Because of time limits, the 15 variables most frequently used by SH were selected. These variables were:

Organizations and fishery legislation

1. Dredging and LNG Project
2. Pollution
3. Changes in climate patterns

4. Lack of political interest in environmental sustainability
5. Employment sources
6. Catches.
7. Resource Sustainability
8. Tourism
9. Changes in coastal environment and estuary
10. Community awareness
11. Income
12. Wildlife Resource System
13. Conservation measures
14. Artisanal Fishery

During the workshop, the moderator made a short review of the characterization process and showed the first MICMAC results, building sets of variables as they exhibit a high level of dependence, influence or both into the SES. The moderator highlighted the clusters, indicating to the social actors that the results were the product of the interpretation of the investigators. Each variable was noted on a mobile display with their description on the reverse side, and was delivered randomly to SHs during the activity. The SH could read the definition aloud to agree on whether it was correct or not. Then, the moderator invited SH to wonder if the location of the variable in the set was correct or not. They were asked to work with each variable to corroborate or rectify the classification and obtain clusters from their point of view.

During the discussion, opinions differed according to locality, as was mentioned above. Fortunately, the opinion of the SH had been well expressed and the clusters were approved. The activity generated an interesting discussion regarding some specific variables.

The perception about the function of the *Tourism* on the SES varies by locality and by role of the SH. If it is considered as a lever variable, it could have both positive and negative consequences. Some SH highlight some negative points of *Tourism* (coastal erosion, generation of beach litter, among others), while others highlight its benefits, such as additional income and the possibilities to develop sustainable tourism.

Figure 5.1. PSA workshops in the Argentine case.



With respect to *Resources Sustainability*, some SH indicated that this variable affects and depends on the SES, referring to the need for a balance for maintaining the resource. Others SH mentioned that the ability to take a balance depends on them. On the other hand, several participants agreed that the variable should be located in the quadrant of highly dependent variables, giving a marked preponderance of political actions that are carried out and condition the sustainability.

While several stakeholders agreed that *Changes in Coastal environment and estuary* is a variable highly dependent on and influence by others, they mentioned the importance of asking why the change occurs. This variable includes physical changes caused by nature. But there are also anthropogenic causes. Man changes the environment to his own benefit, and these changes affect human decisions and activities that then make new environmental.

All stakeholders agreed that the variable *Dredging and LNG Project* should be located in the cluster of variables that influence the system. Nevertheless, SH mentioned that the dredging influence on one side negatively the system, but on the other, it can benefit the SES by creating jobs and improving the competitiveness of agriculture due to the port. On the other hand, a redefinition of that key variable was made: SH said that talking about *Dredging* is more correct since it is a continuous process in the estuary that affects the SES.

Other variable that generated an important discussion was *Pollution*. The SH established that the variable should show a higher level of dependence on the SES than the level which shows in our current analyses. Participants classified *Pollution* as a dependent/influence variable.

In summary, the activity had several objectives. One of them was that social actors corroborated the definition of the variables, which had been made in terms of the activities developed in previous workshops. Then, they confirmed if the classification of the variables in terms of high dependence, influence or dependence and influence on SES was correct. Finally, when they were asked if there was any relevant variable that has been omitted, SH indicated that there were no hidden variables, so we concluded that the selection of the key variables had been appropriate. However, we believe that this was a first approach to triangulate results. Exchanges with SH should continue to make a better further analysis.

6 [Discussions and Conclusions](#)

Following the methodology developed by UCO, the Ostrom framework was used in the first part of the analysis in order to characterize the Argentine SES. Evidence of weak community-based resource management was found. Several reasons contribute to this. A national history of military coups and democratic governments, the high mobility of some resources and the difficulty to define the boundary of the system are some of the distinguishing features. Different geopolitical and social conditions lead to a large diversity of users reinforcing the lack of a community behavior.

Nevertheless, some elements of collective action have arisen. The understanding of the importance of ecosystem services provided by the estuary and the dependence on resources of direct users has been useful to integrate stakeholders against some conflicts. The presence

of the Port, the Petrochemical Industrial Pole and other pollution sources (e.g., untreated sewage) have opened new discussion issues that could be a focus on promoting community management.

For the structural prospective study, several workshops were held in order to identify the most important variables of the system, their relations and intensity. During the process, the opinion of stakeholders was highly respected, even if it contradicted scientific knowledge

All Ostrom core-variables were identified by stakeholders. In this sense, the research group believes that stakeholders have a thorough understanding of the SES.

Social actors recognized and discussed, in some issues with intensity, the key variables of the SES characterization according to their perceptions. Control variables were defined as elements whose changes could enable an evolution of the system to a new state: *Artisanal fishery history, Conservation Measures, Community awareness, Changes in coastal and estuary environment and Tourism*. Also, variables as *Resource sustainability, Fishermen association and Artisanal fishery* were named as challenges. The indirect interactions with lever variables could show interesting outcomes. Note that some key variables as *Conservation Measures* or *Community awareness* summarize some characteristics from Ostrom framework which drive to community-based management of resources.

Stakeholders found in COMET-LA meetings a space to discuss the common use and management of resources. They agree a "management plan" is needed to benefit all SH and to ensure the sustainability of the system. Finally, they asked for help to continue with this discussion space and acknowledged the Argentine team for setting it up.

The public fora were also made in the area of the estuary, due to the pressure of social actors against the possibility of a new dredging project which involved affecting the most sensible reach of the estuary. This particular dredging is not active currently.

The participation of IADO, UNS and AquaMarina, integrated with the needs of social actors, and the interest of society for the sustainable use of resources in the study area, shows the need of new dialogue scenarios. That is why the presence of international projects such as COMET-LA encourages in-depth study of the relationship between society and environment, and adds strength to these needs of social actors, capturing the attention of decision makers.

Even though we originally expected some difficulties and even serious discussions during the integrated SH and DM in the workshops made during 2013, all the participants sustained a high level of commitment and were very enthusiastic suggesting that kind of activities to be continued in the future. We consider this result as a major achievement of the project.

The analysis of the implementation of the relationships and indirect influences, and the nonstructural prospective analysis (scenario analysis) must be deepened and strengthened to achieve a complete knowledge of the system and to make a conclusion regarding the community management of the resources. This will allow us to determine if the SES could have the possibility to promote laws and regulations allowing community-based resource management, where the opinions of all the people involved with the resources and services

provided by the system will be taken into consideration. We can also understand if social actors have the capacity and the real possibility to take the formal governance of resources and make rational use of them, ensuring the interests of them all. This organization change must come from the institutional base of the Pyramid: social rules and informal institutions. It is the only way to obtain a strong new social configuration.

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ANNEX I: SES Characterization in Argentina CS

First tier	Second tier		Third tier	ARGENTINA	
Social, Economic and Political Setting (S) Describes how all SES may affect and be affected by the larger socioeconomic, political, and ecological settings in which they are embedded	S1	Economic development - Sustained, concerted actions of communities and policymakers improving the standard of living and economic health of a specific area / the quantitative and qualitative changes in an existing economy	S1a	Description of the economic sectors in the study area	Primary sector: fishing. Secondary Sector: In Ingeniero White: Petrochemical Industry; In Monte Hermoso: fish processing. Tertiary Sector: Tourism, Trade 40% of the activity is commercial, 40% are services and 7% manufacture.
			S1b	Income per capita	4% of the population receives less than \$ 500, 5% between \$ 500 & \$ 1000, 44% between \$ 1,000 & \$ 3,000, 26% between \$ 3,000 & \$ 5,000, 8%, between \$ 5,000 & \$ 8,000, 1%, more than \$ 8,000 (8% ns /nc).
			S1c	Employment per sector (% and trends)	In General Cerri and Villa del Mar, 1,000 families: fishing. In Pehuén Co and Monte Hermoso: families live almost exclusively of tourism activity; 400-500 families: fishing.
			S1d	Subsistence activities	There are not specific data. There are other activities, such as agriculture in area of agricultural land in General Cerri which, in some cases, could be characterized as subsistence but the number is very small and there is not data available.
			S1e	Non-paid activities (related to land management)	There are not specific data.
			S1f	Income dispersion	3.3% of the total urban population in Bahia Blanca was under the poverty line (INDEC) and income inequality derived from the Kuznets relation 1:10 was 18.9 in the same year. Bahia Blanca Gini index: 0.46. INCOME DISTRIBUTION: There are differences between large vessels, where wages are paid as in any capitalist enterprise generating large differences according specialization and small boats with a crew of 4 or 5, where the "share system" can be used: profits are distributed equally among employees based on catch levels.
			S1g	Time allocation among the different economic activities carried out in the area	Fishermen usually are embarked and/or dedicated full-time to the activity during good fishing time (October to March). They can spend days at sea or, even, camping near the coast (it will depend on the type of fishing they do). In winter, the fishermen reduce the amount of hours dedicated to fishing which turns into lower fishing, such as whiting. They devote their time to repair of boats and nets. The time for alternative activities, such as masonry and others, is less. In the case of tourism, they tend to follow commercial hours, from 8 to 12 h in summer, without holidays or weekly rest periods (December to February). The high season of both activities is coincidental; therefore, those who dedicate to fishing do not usually spend their time in touristic activities as alternative.
			S1h	Specialization of stakeholders (in one of different economic activities	Fishermen do not have a formal training but they work in a traditional way. Tourism careers have been offered during the last ten years. However, the number of professionals who have this type of training is very low.

First tier	Second tier	Third tier	ARGENTINA	
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	S2 Demographic trends - Development, changes and status of the human population	S2a	Number of inhabitants	Ingeniero White 11115; General Daniel Cerri 13946; Pehuén Co 674; Villa del Mar 353; Monte Hermoso 6494
		S2b	Population density	Monte Hermoso: 24.36 hab/km ² , Pehuén-Co 22.46 hab/km ² , (n/d General Cerri and Villa del Mar).
		S2c	Gender ratio	Women %: General Cerri: 51%, Monte Hermoso 48%, Bahía Blanca 52%, Coronel Rosales 51%.
		S2d	Demographic structure	No significant data
		S2e	Population growth rate	Last decade. Cerri: 33,79%, Monte Hermoso: 77%, Pehuén-Co: without official data, 674 (last datum) to present 2000
		S2f	Migration trends	There is no statistical data. However, it has been qualitatively discussed by stakeholders. In the case of Ingeniero White and General Cerri concern about population growth in peripheral areas due to the expansion of Petrochemical Pole and the Harbour during the 80s and 90s. This attracted a lot of temporary workforce which settled in surrounding areas and now they stay in the place even unemployed. In the case of Monte Hermoso and Pehuén Co is believed that the increase of population has occurred due to migration of people from Bahía Blanca and Buenos Aires, who want to get away from the large urban centers.
		S2g	Ethnic diversity (in % per group)	No apply.
		S2h	Settlement patterns	Ingeniero White is composed of four zones or districts: urban and commercial center of Ingeniero White, Boulevard Neighborhood (oldest areas, where reside the descendants of immigrants and early settlers and many of the fishermen. This is the best socioeconomic area), 26th September Neighborhood (main worker district) and Saladero (neighborhood with the lower socioeconomic status, recognized by the people of Ingeniero White as the "Village" or "Settlement"). It is located 10 km from the city of Bahía Blanca. General Cerri is an integrated city, located 15 km to the west of Bahía Blanca. Both cities, Gral. Cerri and Ing.White belong to Bahía Blanca County. Villa del Mar: is a small seaside town. It belongs to Coronel Rosales County. It is located 5 km from Punta Alta (capital city of the Coronel Rosales County). Pehuén Co: maritime town of Coronel Rosales County. It is located at 47 km in a straight line from Punta Alta (about 70 km by road) and it has an extension along the beach of 10 km. Monte Hermoso is the capital of the homonymous county. Its coast has a general direction from East to West with an extension of 32 km.
	S3 Political stability - Eventual existence of a core regulatory	S3a	Core legal framework (national)	There are a National and Provincial Constitution. Also, there are national, provincial and municipal laws.

First tier	Second tier	Third tier	ARGENTINA	
	<p>framework for the country or area / eventual existence of defined laws / the regularity of the democratic processes</p>		constitution and core laws)	
		S3b	Level of norm compliance (norm stability, capacity of reinforcement, knowledge of norms)	Fishermen have a knowledge of formal rules concerning fishing quotas, bans, taxes, etc.. When the law is broken, there is no effective punishment and, therefore, the level of compliance is low.
		S3c	Type of conflicts	Constant disagreements between different levels of government by the main political parties, the main causes of the conflicts that arise between them. In a local level, the main conflict at the political level and in relation to the use of resources have occurred because of the dredging and deepening of the dredging projects, because of which the fishermen have had confrontation with the municipal government and CGPBB, interrupting communication routes or even placing the fishing boats before the dredge tasks zone (which means risking the lives of the fishermen).
		S3d	Security indexes (e.g. the UN Security Risk Rating Index)	At national level the rate of insecurity has increased. Argentina is considered a moderate risk country in their Political Risk Index, but increasing.
		S3e	Respect for democratic values (e.g. human rights, corruption)	The system of government is national. Local laws and regulations are subject to national laws. The Justice has local, provincial and national instances, nested in hierarchies.
	<p>S4 Government resource policies - Type of resource policies adopted by the national, regional and local governments (top-down approach)</p>	S4a	Governmental regulatory framework for natural resources management and use	The regulation, management and preservation of resources nationally are legislated in a national level in the first instance, in a provincial level in second instance and by municipal laws in third instance.
		S4b	Environmental policies at	There are laws for fishing ban at national and provincial levels, depending on the species and risk.

First tier	Second tier	Third tier	ARGENTINA	
			national, regional and local levels and the implementation level (including climate change mitigation strategies)	
		S4c	Environmental regulatory and policy frameworks compliance	National level
	S5		Market incentives - Market functioning for natural resource management and conservation	
		S5a	Influence of global/local markets in the area (e.g. levels of dependency of external markets, price definition)	Fishery resources have a price exogenously set by the market, while tourism is influenced by a national and an international tourist offer. The prices of Monte Hermoso are not very competitive, favored by local idiosyncrasies (holidays during periods established in the year to families) and affordable transport costs.
		S5b	Type of products (e.g. commodities, certified products, other kind of labeling)	The products commercialized in the study area are: services (tourism, financial services and transportation), agriculture and livestock (Port of Bahia Blanca, principal cereal exit port and derivatives such as oil), horticulture (agricultural land of Gral. Cerri, the existence of the Market of Fruits and Vegetables in Bahía Blanca, where converge the products from the areas of Mar del Plata and the Upper Valley of Negro River), industrial products (importance of Petrochemical Pole: chemical products, granular urea, fuel, general freight), fishing (industrial and artisanal). No data are more disaggregated than those presented in S1.
		S5c	Access to markets (distance, commercialization channels and	Fishery products: - Retail for private consumption through two cold-storage chambers placed in Monte Hermoso. -Sale to other processing plants with headquarters in Mar del Plata City (about 470 km northeast).

First tier	Second tier	Third tier	ARGENTINA		
			networks, marketing)		
		S5d	Demand for natural resources from local, regional, national and international markets	Local demand for fishery resources for consumption or processing. A small portion is sold to Mar del Plata. Tourism has a high regional demand and a national average demand, low % of international visitors although increasing.	
		S5e	Market incentives for natural resource conservation (e.g. existence of taxes, fees and charges, tradable permits, eco-labeling, financial mechanisms, liability and compensation schemes)	Fishing: lack of direct intervention in the market. Exception: granting subsidies to fishermen to improve their fleet or delivery of fishing boats in the context of dredging conflict occurred in 2011. Tourism: active intervention by the Ministry of Tourism of the Province in Monte Hermoso.	
	S6	Media organization - Number, diversity, freedom... of private and public media	S6a	Existence of communication networks	All the towns (except for Villa del Mar) have local radios, relay antennas and local television programs. There is liberty of expression. All social actors can afford at least radio and TV access.
			S6b	Media deterrence capability	No specific data. However, it is clear from the history of the communities involved that the influence of the media is very important.
			S6c	Interest of media in socio-environmental issues	No specific data. However, it is clear from the history of the communities involved that the influence of the media is very important. Important facts seek to be disseminated by different media and the success of the events is measured through this presence.

First tier	Second tier		Third tier	ARGENTINA	
Resource Systems (RS) Comprises the environment where the resource is produced/found	RS1	Sector(s) (e.g. water, forest, pasture, fish) - Different biological production systems	RS1	Sectors	Urban centers located in the estuarial zone (Ingeniero White and Gral. Cerri) carry out port, industrial and fishing (artisanal and sportfishing) activities. Pehuén Co and Monte Hermoso: activities related to natural resources such as fishing and Sun and Beach Tourism.
	RS2	Clarity of system boundaries - Clarity of the system's geographical, social and legal boundaries, describing if the boundaries of the studied resource system are clear, fuzzy or undefined	RS2a	Natural boundaries (e.g. rivers, mountains, specific vegetation)	In the beach zone, the boundaries for tourism are defined by the sea to the S and the northern border of the coastal cities where the change of the use of soil goes from urban to rural. Fishing activities concentrate in the estuary and up to 5 nautical miles (9 km) from the coast. Due to the high alteration of the natural space, the industrial and port activities have not ecological boundaries.
			RS2b	Anthropogenic boundaries (e.g. land use distribution, conservation areas)	Touristic activities boundary to the N start with the change of the use of soil towards farming and cattle raising activities. Artisanal fishing is limited until 5 nautical miles from the coast, while industrial or offshore fishing is after 5 nautical miles. Industrial and port activities are defined by the urbanizations to the NW and the estuary to the SE.
			RS2c	Extraction access and property boundaries	Fishing: ports of Ingeniero White and Coronel Rosales; in the case of fishermen of General Cerri, Ingeniero White and Villa del Mar. The access ports are not free because they are under the management of the Consortium generated for this purpose. Monte Hermoso and Pehuén Co: there are not such restrictions. The entry of the vessels occurs along the coast by direct access from the beach. Entry sectors to the sea are stipulated for the boats towards the margins of the urban area.
	RS3	Size of resource system - Size of each type of resource (private, club, open access or common pool resources)	RS3	Size	Big. The beach at Monte Hermoso-Pehuén Co region has open access, meaning that the use of the dune with the exception of 2000 ha that belongs to the natural reserve area. The access to the sea is more regulated; it is not allowed the descent of vehicles in the natural reserve area and urban area (4.5 km outside of Monte Hermoso). In the region of Bahía Blanca, the access is allowed for authorized areas (ports and the fulfillment of the conditions that the Consortium, Coast Guard and other regulatory agencies postulate). In this sense, the beach resource is quite delimited and it can be considered that has a regular size because of the access system and defined limits. However, once the boats enter the sea, the definition of the size of the SES is more difficult and it could be considered that the size is large
RS4	Human constructed facilities - Anthropogenic structures facilitating resource management (e.g. boundaries, access ways, storage or transformation)	RS4	Constructed facilities (e.g., roads, enclosures, field systems, boundary banks and ditches,	95% of population has electricity. In Monte Hermoso, the majority of the population has the service of potable water. This situation does not happen in Pehuén Co due to the absence of this service. The gas natural net and sewer services exist in Monte Hermoso, Gral. Cerri and Ing. White. Each locality of the study area has a good accessibility through national and provincial roads. These cities have good facilities to receive the tourists, such as: hotels, apart hotels, private house renting, campings (Villa del Mar only has campings), restaurants, etc.	

First tier	Second tier	Third tier	ARGENTINA	
	facilities)		ponds, parks and woods, wind and water mills, manor houses, moats and churches)	
	Productivity of system - General estimation of the resource system productivity	RS5a	Productivity of the resource system (high, medium, low, exhausted)	It is estimated as medium/low
		RS5b	Resource regeneration period	Fishing resources has its regeneration period mainly between spring and summer seasons, in medium and external zone of the estuary. The beach has less power of regeneration facing a great number of storms. In those beach zones that are preserved in the most natural manner, the effects of the storms are reverted in a faster way than urbanized zones.
		RS5c	Resource extraction period	For shrimps and prawns the banned season is mobile. It is fixed each year by legislation: spring. Other species: banned season between October 1 to March 31 for offshore ships. There are maximum permitted catch (fixed by law) depending on the length of ships. Artisanal fishing with line or net is permitted during all the year. The sand extraction is regulated by municipal by-laws (in Pehuén Co: Decree N° 12/07; in Monte Hermoso: municipal by-law N° 443/88). Illegal extraction of sand occurs in unauthorized sectors and through non manual ways.
	Equilibrium properties - Influences (positive and negative) on the equilibrium of the resource system (interaction between species, in social systems, or between biological and anthropological systems)	RS6a	Equilibrium properties	In Pehuén Co is registered an accumulation in the annual sedimentary balance for its entire beach with an average of 4.7 m ³ /yr (period 2005-2010). The major lost of sediment was in the West sector with -29 m ³ /yr. In Monte Hermoso the annual sedimentary balance of the beach was 6.8 m ³ /yr (period 2007-2010). The East sector of the beach was the most erodible with a maximum lost of sediment of -425 m ³ /yr.
		RS6b	Natural hazards occurrence (frequency and magnitude): e.g. flooding, fires, drought	The SW winds, of a great intensity and frequency, affect the study area eroding it. These winds exceed in almost 50% in hours of occurrence in relation to SE winds. The effects of the SE winds in the estuary in combination with high spring tides could generate floods in Ing. White; this effect may occur once a year. Along the external coast SE winds are important but have only minor effects on the coastal erosion.

First tier	Second tier	Third tier	ARGENTINA	
		RS6c	History, evidence of impacts in sub-systems and its effects	The dredging process, pollution and climatic change cause an increase in the trophic levels in the estuarine waters, modifying the species' diet and type, quantity and quality of species. Moreover, climatic variability (i.e., higher wind speeds, more frequent wind rotations, larger number of severe storms) in conjunction with anthropic actions (i.e., buildings on the coastal dune system, dredging) have modified the coastal geomorphology in the bathing areas: higher number of shoals and channels. The beach is no longer eroding in winter and accumulating in summer as before.
	RS7 Predictability of system dynamics - Capacity to estimate the evolution and dynamics of the resource system and the impact of interventions or external influences on them	RS7	Predictability of system dynamics	Wetland of Bahía Blanca: is highly vulnerable because this environment has a very high residence time. In Pehuén Co and Monte Hermoso, the system will continue in danger of erosion if the human intervention persists in the same way (forestation of dunes, urbanization of the coast, etc.).The first official department in charge of regulating fishing appears in 1898. In 1907, the Government approved a decree to regulate the fishing and maritime hunting. Besides of the establishment of the rules for these activities, it set a territorial sea with a zone 10 nautical miles (18.5 km) wide, forbidding any vessel that did not have a national registration. The law also considered, for customs purposes, an indigenous production if it had been obtained by Argentine ships outside territorial waters. Since then, along the 20th Century, there were numerous changes in legislation but always delimited by these margins. In fact, the fishing permits date from 1914. The regulation as it is known today (with minor modifications) arises with the National Fisheries Act of 1998 and Provincial Fisheries Act of 1994. Regarding the management of the dune, there were different regulations for land use. In fact, in Pehuén Co and Monte Hermoso zones, their inhabitants recognize that there are lands that were sold 50 years ago and today are "under water". Fishing: There are two new rules with contrary forces: the extension of closed season but the renovation of ships with an increasing number of offshore boats. With respect to the coastline, if dunes are reconstructed in Pehuén Co and Monte Hermoso it would be possible that coastal dynamic regenerates the beaches avoiding the erosion.
	RS8 Storage characteristics - Retention of information about the system dynamics	RS8	Storage (memory) of the effects of disturbances on a system or sub-systems	There is not information available about this subject because there are not studies that analyzed these aspects.
	RS9 Location - Geographic location	RS9	Geographical location, distribution and distribution patterns	Land use maps: Through these maps is possible to identify the touristic zones (Pehuén Co, Monte Hermoso y Villa del Mar), the protected areas (Reserva Natural y Paleontológica Pehuén Co-Monte Hermoso, Wetlands of Villa del Mar), vulnerable coastal zones to the erosion (West and Center area of Pehuén Co, East area of Monte Hermoso), industrial and port zones (Gral. Cerri and Ing. White).

First tier	Second tier	Third tier	ARGENTINA	
Governance Systems (GS) Describes the governance system affecting and affected by the SES	GS1	Government organizations - Permanent or semi-permanent organizations (or systems of rules) controlled by national, regional and local regulation institutions	GS1	Government Organizations There are the municipalities of Bahía Blanca, Coronel Rosales and Monte Hermoso which are divided into several interest areas. Bahía Blanca: 4 governance organisms: Sanitation, Epidemiology, CTE (Technical Executive Committee) and APELL Process. The APELL Process is a community experience of self-protection which requires the action of three groups of stakeholders: industries, community and decision-makers.
	GS2	NGOs - Different types of NGOs (e.g. social, environmental, technical organizations) interacting with the analyzed SES	GS2	NGOs With an environmental purpose: AquaMarina, FRAAM (Villa del Mar) and "Red de Jóvenes Líderes en Conservación". With social objectives: "Lions Club" and "Rotary Club". AquaMarina International has the mission to protect and advance in the conservation of marine biodiversity and health of coastal ecosystems and, also, promote the sustainable use of marine resources. The work of this NGO is based in Research Programs and Environmental Education. FRAAM (Foundation for the Reception and Assistance of Marine Animals) has the aim to recover, assist and reintroduce marine specimen victims of stranding, by catch, accidents, etc. From the Forum for the Conservation of the Patagonian Sea and Areas of Influence, appeared in 2010, the Training Program for Young Leaders for the Marine Conservation (to integrate the Network) for advanced graduates and postgraduate students, researchers and young professionals and any person who performs activities in the governmental and nongovernmental sectors, with experience in the field of marine conservation, either from the management, education or research. In a context of growing conflict over the use of coastal and marine areas, it is proposed to train professionals with a transdisciplinary view. The Lions Club of Pehuén Co makes supportive and other tasks in order to achieve the growth of Pehuén Co as a tourist center. The Rotary Club has as its objective the development of mutual knowledge as a chance to serve, carrying out projects that improve the opportunities and quality of life of the town, although it has a strong component towards the environmental well being of the town and its inhabitants. In particular, the RC has special programs and funds to support the local voluntary firefighters, fellowships for school students and even to support those that will study at the Universidad Nacional del Sur.

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	GS3 Network structure - Networks related to the management and use of resources inside the socio-ecological system	GS3a	Social networks	<p>Stakeholders also grouped in an informal manner are lifeguards, volunteer fire brigade, rangers, Rotary Club of Pehuén Co, Residents Association "Amigos de Pehuén Co", "Museo del Puerto" (Ingeniero White), Hola Pehuén, "Consejo del Deporte Náutico Regional" (CODENAR) and the "Club Náutico de Bahía Blanca". Within the networks formed for social purposes, the lifeguards are important for community safety in Monte Hermoso and Pehuén Co and volunteer firefighters in all areas. The lifeguards are a fundamental presence in summer, where there is usually an average of 45 lifeguards distributed along approximately 4.5 km of the beach, including the exclusive bathing area and two descents to Sauce Grande coastal city. Then there is usually a small stable group throughout the year. While volunteer firefighters play an important role in safeguarding during the year. Also, they play social functions through the development of events. The volunteer fire active group is, at this time, more than 60 members in Ingeniero White, more than 50 in General Cerri (plus a small school for 20 children and adolescents) and more than 40 volunteers each in the case of Pehuén Co and Monte Hermoso. The Yacht Club has recreational purposes and it aims to promote the use of sailing boats and the rowing and, also, water sports in general. The amount of adherent partners exceeds 400. The CODENAR is a regional organization that maintains close relationships with the municipalities of Bahía Blanca, Monte Hermoso and Coronel Rosales. It brings together the principal institutions involved in water activities in their different disciplines. It also emphasizes in the preservation of the environment, the respect for protected species and it is seeking for a regulatory control of the rules of the Coast Guard.</p>
		GS3b	Environmental networks	<p>The Residents Association of Ingeniero White and the Neighbor Forum of "Cerri de Pie", "Asamblea en Defensa del Ambiente Costero" (along the Buenos Aires coast, with influence in Pehuén Co and Monte Hermoso), "Asamblea Tucu-tucu" (from Gral. Cerri to Peheun Co), and the "Asamblea en Defensa del Medano Costero" (Pehuén Co), all of them particularly interested in environmental.</p>

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		GS3c	Market networks	<p>A decentralized and very important organism is the Consorcio de Gestión del Puerto de Bahía Blanca (CGPBB), which is on charge of the operation and management of the port since 1993, being the first semiprivate port in Argentina. Although the CGPBB is integrated by 9 stakeholders from different groups, only 2 of them represent labour associations (but none of them are fishermen). Most of the decision-makers involved in the CGPBB represent political power and large business. Another important non-governmental organism related to the industrial activity in Ingeniero White is AIQBB (Asociación Industrial Química de Bahía Blanca). It draws together Mega, Dow Argentina, Profertil and Solvay Indupa petrochemical industries. Its mission is to work towards the integration of the industry and the community, as well as to contribute to the improvement of the quality of life of people. Nonetheless, sometimes society perceives AIQBB as a pool of the largest industries of the Petrochemical Pole, whose lobbying power is turned to their own advantage.</p> <p>In the zone of Ingeniero White, there are three organizations related to the fishery activity: the Chamber of Fisheries Owners and Shipowners of Bahía Blanca Estuary, the Association of Artisanal Fishermen of Bahía Blanca Estuary and the Chamber of Artisanal and Commercial Fishermen of Ingeniero White, Puerto Rosales and Bahía Unión. While the first one represents the interest of shipowners and largest businessmen, the other two organizations reflect the interest of fishermen. People working in commerce and industries are included in particular labour unions whose influence is not completely local. In Monte Hermoso and Pehuén Co there is an Artisanal Fishermen Chamber that integrates all fishermen of both towns</p> <p>Being the tourism industry so important in Monte Hermoso and Pehuén Co, commerce, hotels and gastronomy are united in the Chamber of Commerce and Industry of Monte Hermoso and in the Chamber of Commerce and Tourism Development of Pehuén Co.</p>
	GS4 Property-rights systems - Presence or absence of formal property right systems for the resources (e.g. land property, exclusive fishing rights)	GS4a	System of property right	Natural resources are privately managed and entirely regulated by governmental institutions.
		GS4b	Excludability (i.e., possibility to exclude potential users from using the resource)	It is low due to the high informality degree that exists in the activity and the fact that it is an open access resource. Also, the formal rules of excludability are not controlled there.
		GS4c	Subtractability (i.e. whether resource appropriation by one user reduce availability)	A large scale, the subtractability is high because overfishing reduces the availability of other resources. Also, it must be important at small scale, if they do not use the suitable fishing arts.

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			ty to others)	
	GS5 Operational rules - Community rules established for the extraction, management, access and use of natural resources	GS5	Operational rules (local rules for defining Who, How, Where, When, and Why have access to local natural resources)	No exist
	GS6 Collective-choice rules - Collective-choice rules used to change the day-to-day operational rules related to the resource management	GS6	Collective-choice Rules	There is no collective-choice rule in our case.
	GS7 Constitutional rules - The background rules set at the beginning of the common use of resource organization (e.g. the constitutional or core rules of the community)	GS7	Constitutional rules	National, provincial and municipal laws determine who, how, when, and where the stakeholders must have the access to natural resources and which are the sanctions for the violation of regulations. The Constitution is the principal rule that governs all rights and, behind it, the different Codes (Civil, Mining, Commercial, Penal). At the provincial level, there are provincial laws and finally the municipal ordinances and regulations.
	GS8 Monitoring and sanctioning processes - Set of methods to monitor and enforce the operational rules	GS8a	Monitoring processes	The Coast Guard has the police power to control vessel traffic. Additionally, the Law N° 11499 proposes the collaboration of Coast Guard as auxiliary police to control fisheries and ecological changes. But many times are the same artisanal fishermen who inform against illegal ships. For the sand extraction, the provincial and local governmental organisms have the police power.
		GS8b	Sanctioning processes	No correspond.

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Resource Units (RU) Describes the natural resource units generated by the resource system (e.g. fish, water, fodder)	RU1	Resource unit mobility - Resource mobility (e.g. fish are mobile, while molluscs are static)	RU1	Resource unit mobility	The fishery resource units are mobile. Fish species can move and migrate depending on their normal behaviour, but they are affected by environmental conditions, causing fish capture fluctuations. For example, shrimp migrates outside the estuary at the end of spring to spawn in deepwater. With respect to tourism, the resource "seaside" is fix, although we can consider some mobility of dunes. Dunes have a life-cycle affected in the last years by climate change, ocean and anthropic actions.
	RU2	Growth or replacement rate - Growth/replacement rate based upon the resource unit's life cycle (e.g. reproductive age, harvesting age, growth rate)	RU2	Growth or replacement rate	According to artisanal fishermen, a decreasing of some species and the increasing presence of other has been observed. Main species and life-cycles: "PESCADILLA", "CORVINA", GATUSO", "LENGUADO", "PEJERREY", "PRAWNS" are described in full version document.
	RU3	Interaction among resource units - Resource units interaction (e.g. competition, collaboration)	RU3	Interaction among resource units	Natural interaction between resource units: 1. Fishery resource: food chains (food, competition and predation situation) Interaction at the ecological level: 1) Fish resource and climatic conditions (benefit or damage the development of the chain). 2) Dunes and tidal effects (life cycle of the dune). Effects of economic trends in the interaction: 1) Overharvesting of higher links of the food chain and loss of the lower links due to processes such as dredging and pollution. 2) Life cycle interruption of the dune due to the construction of buildings and other anthropogenic effects on the coast
	RU4	Economic value - Economic value of the resources	RU4a	Market value	Fish filet price exceeds only the chicken, whereas other meats (pork, beef) have higher prices. Most price appropriation is carried out by cold storage plant and not by artisanal fishermen. Price varies according to abundance although during the Easter time, prices are very high. In 2013, prices dropped about 50% as the industrial fishery ban in Monte Hermoso was lifted. Nevertheless, the prices paid to the fishermen are very low in comparison with price to the consumer.
	RU4b		Environmental value	The environmental value is very large due to the ecological importance of the estuary as nursery for many species and the wetland as a unique ecosystem, due to the geomorphologic and physical characteristics, the presence of archaeological and paleontological sites and the presence of endemic species . While the value of environmental services has not been studied in general for the area and there is no data, Zilio et al. (2012) note that the social cost for the loss of the nursery service if the dredging project and construction of the LNG plant on the coast Cerri were carried out, it would be about € 807.565 per year	
	RU4c		Strategic value (e.g. economic, social, geopolitical, cultural, symbolic)	The strategic value is large, given the location of the SES and its geomorphologic conditions. The estuary is the epicenter of the zone called El Rincón (see map attached), this area is central in defining the fishery seasons and regulations on fisheries and navigation. The strategic value it is also for activities in conflict with artisanal fisheries: geomorphologic conditions allow the development of a protected deep water harbor for industry and maritime services. Also important are the extent, location and orientation of the beaches in the towns of Pehuén Co and	

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)	Monte Hermoso.	
	RU5 Number of units - Total volume or amount of resource (e.g. wood volume, agriculture production volume, number of fish)	RU5	Number of resource units / amount of resource	There is no estimation of the available units, but it has been observed by fishermen that the number of prawns has increased (although they mention that this increase occurs in cycles of 10 years), and large species such as sole and gatuzo have increased as well, presumably for the extension of the fishery ban. Sand is not a resource as sand mining is forbidden at the provincial and local level.	
	RU6 Distinctive markings - Natural or artificial markings to distinguish categories in the resource	RU6	Distinctive markings	No apply.	
	RU7 Spatial and temporal distribution - Availability of the resource in space and time	RU7	Spatial and temporal distribution	Fishing and tourism: seasonality. TIMES OF CATCH: Fishermen of Ingeniero White and General Cerri area: shrimp and prawn (December to mid-June and mid-July to September), whiting (mid-August to late September, sometimes March and April); gatuzo (mid September to late November); Palometa (mid-August to late September), sand smelt (June and July at low tide and September on the marshes), sole (presence all year, with peaks from October to March); manta ray (all year), white croaker (November to March). Fishermen until Coronel Rosales area and Villa del Mar: sole (peak season from October to February); shrimp and prawn (December and January) sand smelt (May to July), between these seasons: whiting, gatuzo, palometa. There is not ban for these species, except shrimp and prawn. Tourism: December to March and weekend tourism.	
Users (U)	Describes users of the resource system under consideration	U1	Number of users	Fishery: Ing. White 1,2% of population. Pehuén Co and Villa del Mar: 3,2 (fishery) and 1 % (tourism). Monte Hermoso: 3% (fishery) and 51% tourism	
		U2	U2a	Sources of income (linked or not with the resource)	Fishing: represents a large part of the income. In banned seasons or low activity, fishermen work in building or services. A low percentage is dedicated to commerce. In Monte Hermoso a percentage (very low but growing) is dedicated to tourism.
			U2b	Consumption patterns (e.g. local resources, local/imported food,	No concrete data. Most of these populations have a moderate consumption of local resources. All are close (or belong to) important urban centers, where they acquire their consumer goods (food, clothing and others).

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			shopping)
		Uzc	Women rights (e.g. land tenure, empowerment, gender equity, private-public roles, health, education) INTERVIEW TO MIGUEL (fisherman of Villa del Mar): Women are important in household management, in fish trade and they are specialists in the development of networks. But they do not have a significant representation in the fishermen's associations. In tourism, businesses and trade associations they are well represented.
		Uzd	Access to health Low complexity sanitary rooms in Monte Hermoso, Pehuén Co, General Cerri and Ingeniero White. Access to high complexity hospitals in a radius less than 100 km.
		Uze	Access to education All cities have primary and secondary schools, at least within 10 km of distance. There are two public and national universities in Bahía Blanca and a provincial and public university in Bahía Blanca, Punta Alta and Monte Hermoso, Between 5% (Monte y Pehuén) and 8% (l. White, Cerri and Villa del Mar) of the population has no instruction at all.
		Uzf	Poverty (e.g. income, life cost, access to food) There are not discriminated data by each community.
		Uzg	Vulnerability (e.g. social, economic, institutional, environmental) Medium socio-economic vulnerability, high institutional and environmental vulnerability
		Uzh	Cultural identities (e.g. language, food, celebrations, traditions) All communities involved speak the same language, have the same consumption pattern, have the same holiday dates and traditions that the rest of the surrounding population. It is not a relevant variable or prominent in our case. However, fishermen feel as a particular group.
		Uzi	Sanitation There are not discriminated data by community.
		Uzj	Access to drinking water Ingeniero White, Villa del Mar and General Cerri: 99.2% of the population has access to potable water, 0.2% have drinking water by wells and 0.4% have not drinking water. Coastal cities: 51% of the population has access to potable water by piping, 41% of the population has access to potable water through wells and 8% of the population lacks access to potable water.
		Uzk	Access to All the community has real or potential access to electric

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			electricity	energy.
		U2l	Home gadgets (e.g. TV, washing machine, computer, telephone)	Middle-income communities, most of the families have TV, TV cable, stereo, cellular phone, refrigerator (fridge). Most of the population also has motorized transportation (at different levels).
	U3 History of use - Chronological description of resource extracting methods	U3	History of use	The artisanal fishing in the area of Bahía Blanca started as activity between the late of 19th and early 20th centuries in response to the need for survival. In 1937, the Cooperative of Fishermen: "Fishermen Society of Ingeniero White," was established which had 150 members. In 2004, they listed some 114 boats between Ingeniero White and Coronel Rosales. In 2011 reached 128 boats. In the same year, the Association of Fishermen of the Chamber is separated. In 2012, a grant agreement between the Ministry of Production of the Province and the CGPBB was signed, and the principal responsible persons of the Chambers of Ingeniero White, General Cerri and Coronel Rosales (Punta Alta), for the restructuring of the fishing fleet of Ingeniero White with the intention of moving the entire artisanal fishing to the port of Rosales.
	U4 Location - Geographical location of users of the resource system (e.g. settlements, villages, dispersion)	U4	Location/dispersion patterns	The population under study is located in the central-east zone of the country, on the Atlantic coast, to the south of Buenos Aires Province, in a band along the coast from 62.6 ° to 61 ° longitude (West) approximately. In this sense, in first place there is the locality of General Cerri and then Ingeniero White, both cities belong to the municipality of Bahia Blanca. Then, the towns of Villa del Mar and Pehuén Co (belonging to the municipality of Coronel Rosales). Finally, the locality of Monte Hermoso, which is a district by itself. The location of the users does not differ from the location of the resources to be exploited.
	U5 Leadership/entrepreneurship - Existence of, and attitude towards leadership and entrepreneurship among users	U5a	Leadership patterns (e.g. level of acceptance, prominence, leadership models)	Certain leadership exists by the older active fishermen which is observed during actions taken when there are conflicts among users and against organizations and decision makers. These persons have defended the exercise of the activity, the access to recourses and their rights and have often asked for help to government organizations. Frequently, they represents different groups of artisanal fishermen which sometimes have conflicts between them.
		U5b	Attitudes toward conservation (e.g. entrepreneurship, maintenance, sustainable use)	In general, there are conservation attitudes on the part of the natural leaders of artisanal fishermen associations, although sometimes there are conflicts because of economic interests. They are who control activities during bans and they report the presence of trawl boats in forbidden areas. They have led movements against the dredging project. There is an interest to preserve their income source.

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	U6	Norms/social capital - Levels of social interaction, reciprocity and trust among users	U6a	Social capital	In a micro level are important intra-family ties and, also, to the nearest group (friends, acquaintances of many years). They have elevated the large intra-community relations of "integration" (the sharing of information, the collaboration in the activity, etc.). Instead, the extra-groups "links" are smaller. There is mistrust between artisanal fishermen themselves belonging to different groups. In a macro level ("synergy" and "organizational integrity"), the social capital is low. Above all, there is a very elevated mistrust towards the government institutions (following the classification of Woolckoc, 1998). This issue is very marked in the zone of the estuary.
			U6b	Traditional forms of collaboration among users (e.g. norms, habits, traditions, customs)	The existing rules are formal and some informal rules are followed by most of the fishermen. Those rules have been imposed by tradition (the respect of the fishing area of the fellow, the warning against storms) or more recently have been imposed by need (the "obligation" to report illegal fishing of large vessels, respect for times and closed areas, which although are formally established, they are respected as a matter of commitment to the activity, because there are poor official controls).
	U7	Knowledge of SES/mental models - Level of knowledge among the users of the SES conditions, perturbation patterns and possible effects	U7a	Local knowledge on SES (based on traditional or scientific knowledge)	The social actors demonstrate a high knowledge of the system and the effects of certain disturbances. This knowledge is mostly traditional. Although in recent years, they have turned to higher education institutions or research for the analysis of anthropogenic effects.
			U7b	Knowledge of the effect of over-harvesting	There is a high awareness by artisanal fishermen about the consequences of overfishing and the use of aggressive techniques such as trawling. It seems that there is no accurate knowledge on the part of the people of the consequences of sand mining and misuse of the coastal dune. In this sense, the management and the proposed solutions to the problems of erosion does not seem to be correct from the conservation point of view.
			U7c	Knowledge of the effect of social attitudes toward resource management on the SES	It is clear from the information obtained in workshops that, in general, that stakeholder recognizes the effects of overuse or misuse of resources from OTHER users, but there is not a recognition of their own responsibility.
			U7d	Knowledge of the effect of biological shocks on the	The knowledge of the artisanal fishermen facing biological impacts is very good (i.e., they predict how "walks" the shrimp according to the presence of winds, how the resource reacts in periods of extreme rainfall or drought, etc.)

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			SES		
		U7e	Mental models related to SES management (e.g. conservation, exploitation, human-nature relationships)	From interviews, surveys and workshops we obtained an important level of information about the possibilities of ecosystem services from each region, of a lower level in Villa del Mar.	
	U8	Importance of resources - Users dependence on resources for livelihood	Importance of resources for livelihood	The communities depend basically on fishing and tourism resources.	
	U9	Technology used - Type of technology used to extract, harvest and manage the resource, as well as differences in access among users based on access to different technologies	U9 Type of technologies used on the SES	Fishing: There coexist different levels of production technologies. The artisanal fishing is performed by minor boats. The techniques that are used in this area are: hand line, trasmallo or enmalle net, shrimp net of dock. Two anchors are used and they are deployed in favor of the current allowing fishes to be transported by the currents. The nets are checked every two hours, approximately. Thus, the fishermen made extensive use of the tide to help in their activity. Pehuén Co and Monte Hermoso share a common feature: (up to now) there are no big tourism entrepreneurs. Most of them are family projects, although it is possible to find some medium size restaurants and hotels. Some store owners in Monte Hermoso and Pehuén Co live away from the city (mainly in Bahía Blanca) and have their shops during high season.	
Interactions (I) Describes interactions among all before mentioned variables	I1	Harvesting levels of diverse users - Quantity of the resource(s) harvested by different users	I1a	Harvesting level and effects on SES	Fishermen from Pehuén Co and Monte Hermoso declare a fleet of around 100 vessels, though the official data of 2011 (the last published) was of 40 boats enabled in Monte Hermoso and 15 in Pehuén Co. As already mentioned, the fishing line allows to extract in these regions about of 10-20 cases of product a day, while fishing trawls capture between 150 and 200 cases a day (3000 to 4000 kg).
			I1b	Free-riding	The absence of strong community controls causes the existence of free-riding, especially in fishing without permits from other localities. The sport fishing is not regulated, although this is not a real competition for the resource.
	I2	Information sharing among users - Methods of information sharing among users	I2a	Knowledge dissemination on the SES	Exchange of information through Chambers of Commerce and Fisheries. Mainly, the information shared is about best fishing areas, the presence of foreign ships, weather warnings (storms, wind rotations).
			I2b	Information/knowledge sharing about	Information about tides by radio, meetings of Camera of Fishermen, talks among fishermen. Information in fishing houses.

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			the SES variations	
	Deliberation processes - Deliberation process used among users	l3a	Deliberation processes among users	The COMET-LA project seems to be the first deliberation process among users. And they all recognized its importance as a new mechanism for deliberation. Local - Regional
		l3b	Knowledge about participation mechanisms and rights	The level of participation as well as knowledge about existing groups are medium to medium / high (depending on the proximity to the activity involved)
	Conflicts among users - Existing conflicts among users	l4	Type of conflict (e.g. conflict based on greed, grievance, scarcity, technology, access, power, information)	<p>The biggest conflict of General Cerri, Ingeniero White and Villa del Mar is related to fishery, whose problems are attributed by artisanal fishermen to the trawling fleets, the lack of control over catches (Fishermen vs. Coast Guard), pollution and sewage, but they do not consider that the problem may be the result of over-exploitation. The conflicts between users are frequent in Ingeniero White because of pollution (Fishermen vs. Industry) and their effects on the fishery resource and the conflicts to obtain the access to the port and coastal area (fishermen and the general vs. decision makers).</p> <p>Monte Hermoso and Pehuén-Co have two common conflicts between the two communities. 1) the demand for a local road to facilitate the commercialisation of fish product but it could damage the reserve area, increase the erosion and could have negative effects on tourism of Pehuén Co. 2) conflict because the use of the beach resource between artisanal fishermen and the rest of the community.</p>
	Investment activities - Investments for improving and managing the resources (investor, amount invested and destination of investment)	l5	Investment activities (investor, amount invested and destination of investment)	The governmental sector has done the biggest investment in fishery during the last years. In Ingeniero White area, it costs 3 million pesos to convert a wooden fishing boat to operate as an industrial vessel. This capital grant has not yet reached to the fishermen of Coronel Rosales. The largest investment was in Monte Hermoso with the installation of a fish processing plant, which it required an investment of 1.5 million dollars. The municipality had given lands and 7500 pesos in capital grants to pay the costs of the pre-project. The rest of the investment came from the Nation and Province. Regarding tourism, in Monte Hermoso there is a strong presence of the government of Buenos Aires Province but in Pehuén Co there is a lack of support from both the Provincial and local government, where the effort comes from particular donations and some NGOs, such as the Rotary Club.
	Lobbying activities - Lobbying activities (internal, external, influence capacity)	l6	Lobbying activities (actors involved, expected outcomes)	The lobby activities are at the basis of many of the conflicts and they are an easy achievement because of the interweaving of government institutions and NGOs. In Ingeniero White the lobby activities of the companies have resisted local initiatives about non-pollution demands and the recovery of sea access. In addition, the lobby activities are frequent in the fishing sector. In Monte Hermoso, the government employees are also fisheries entrepreneurs in Mar del Plata, where many of the vessels proceed from illegal trawling.

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Outcomes (O) Comprises results of the interactions among aforementioned variables	17	Self-organizing activities - Self-organization activities among users for extracting resources	17	Self-organizing activities (include description of any solidarity activities)	The assemblies of citizens have a principal role in General Cerri and Pehuén Co and are linked primarily to the preservation of the environment. Then the self-organized activities from the fishing industry with a strong preponderance in Ingeniero White and Coronel Rosales have demanded subsidies and aid for fleet restructuring, access to the port or resource management.
	18	Networking activities - Networking activities of the users within and outside the community	18a	Internal networks	Solidarity work activity between the fishermen community should be done. Local
			18b	External networks	The relationship of fishermen with the neighborhood association in Pehuén Co and General Cerri. The communication between fishermen and Coast Guard
			18c	Partnership and cooperation	The communication between the Camera of fishermen and government organizations that control the fishing activity.
			18d	External communication channels	Fishing National Secretary and Provincial Undersecretary. The external communication channel is underdeveloped and has generated some conflict.
	O1	Social performance measures (e.g. efficiency, equity, accountability, sustainability) - Impact of different activities on social performance	O1a	Efficiency	There is not data. It is estimated a medium/low efficiency level due to the lack of self-organization
			O1b	Equity (distribution of benefits between SES users)	The resources are distributed according to direct participation in the activity. There is not precise data.
			O1c	Socio-economical sustainability	Sustainability depends on the degree of participation in the activity and the "lobby" that may present activities (industrial, for example) that are developed in the study area (e.g. dredging inside the estuary)
			O1d	Accountability	No apply.
			O1e	Effects of deliberation processes on the SES	Incipient
O1f			Empowerment (including gender analysis)	No apply.	
O1g			Adaptation strategies to climate change	No local adopted strategies.	

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	<p>O2 Ecological performance measures (e.g. overharvesting, resilience, biodiversity, sustainability) - Impact of different activities on ecological performance</p>	O2a	<p>Environmental sustainability</p> <p>The wetland of the Bahía Blanca Estuary is highly vulnerable, because it has a high residence time. Reference Indicators (Fishing demand trend). Holistic Indicators (ecological services /heritage rating).Projective indicators (fishing demand trend / projection of the recovery of the species in periods of bans). Indicator of risk / uncertainty (Natural Vulnerability /heritage equity). Management Indicators.</p>
		O2b	<p>Pressure on resources (e.g. increasing demand, new actors, overharvesting)</p> <p>Increasing periods of fishing bans by decreasing fishing /Modification of the landscape / Increase of urbanized area (km²) / Increase of the construction over the coast</p>
		O2c	<p>Natural habitat (e.g. biodiversity indexes, species richness, connectivity, habitat conservation/degradation/fragmentation)</p> <p>Nature Reserve Pehuén Co-Monte Hermoso is a provincial protected area located in Coronel Rosales and Monte Hermoso. It is classified as "Geological, Paleontological and Archaeological Reserve". It has an area of 2000 ha. Inside the estuary there is the protected area Bahía Blanca- Bahía Falsa - Bahía Verde Natural Reserve, which includes the Wetland of Villa del Mar.</p>
		O2d	<p>Effect of SES management on natural hazards (e.g. changes in type, frequency, pattern)</p> <p>Rain storms of greater intensity and shorter duration and the presence of dust storms from the south have been detected in the last years.</p>
		O2e	<p>Structure and function of resources (e.g. changes, interactions among resource units, trophic</p> <p>A change in the capture proportion of fish species has been detected.</p>

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			chains)			
		O2f	Soil (e.g. erosion, degradation, improvement)	Urbanized areas have beach erosion problems because the lack of coastal dunes.		
		O2g	Water (e.g. quality, availability)	Drinking water quality problems are high for the areas having piping as most of this water comes from the Paso Piedras Dam (located 50 km NE of Bahía Blanca). The reservoir have a difficult to solve algae problem that the potabilization plant cannot solve adequately		
		O2h	Air (e.g. quality)	Air quality is good in general, but many stakeholders near Ing. White complain about fumes and ashes coming from the industrial plants.		
		O2i	Pollution (e.g. waste generation, frequency of occurrence)	Most of the pollution in the estuary is due to the almost untreated sewage discharge. However, there is a strong believe among the stakeholders that industrial plants are also a source of water pollution. Another important source of pollution are the many open-air garbage disposal specially in the districts of Coronel Rosales and Monte Hermoso		
		O2j	Resilience	Due to its particular condition as a highly erosive stage, the estuary has a very low level of resilience. Coastal towns have seriously affected their dune systems which prevented them to be resilience to erosion		
		O2k	Vulnerability	Potential vulnerability related to mean sea level increase is intermediate to high		
		O3	Externalities to other SES - Positive or negative impacts on other SESs without previous agreement or request	O3a	Positive externalities (e.g. CO ₂ capture, water protection, biodiversity conservation)	Positive externalities in the preservation of sea turtle species (fishermen notified when they catch one, which is monitored from this fact).
		O3b		Negative externalities (e.g. CO ₂ emissions, pollution)	Capture of mollusks, crabs and other species, contamination due to cleanup of species at the beach, noise and air pollution on the beaches of Monte Hermoso and Pehuén Co produced by the trawl machine of vessels. No accurate data.	
		Related Ecosystems	Describes the	ECO1	Climate patterns - Climate patterns affecting the considered SES	ECO1

First tier	Second tier	Third tier	ARGENTINA	
			level, extreme events, seasonal changes)	<p>temperatures. In the estuary, the air temperature presents mean daily values of 20.5 °C (maximum temperatures), 14.5 °C (mean temperatures) and 8.7 °C (minimum temperatures). In Monte Hermoso the mean temperature of 2008-2011 period was 15.2 °C. While in Pehuén Co was 14.3 °C. In Monte Hermoso variations in the annual mean temperature were observed with an increase of 0.6 °C from 2008 to 2009 and a decrease of 1.4 °C for 2010. In Pehuén Co the annual mean temperature has an increase from 12.5 °C in 2005 to 15.3 °C in 2009. The mean water temperature for the period 2000-2007 (14.5 °C) is lower than mean annual values of 15.2 °C and 15 °C registered in Puerto Cuatrerros (period 1967-1984) and in Ingeniero White (period 1979-1985), respectively. The mean water temperature in the estuary is of 7 °C in winter and 26 °C in summer. In the zone of Pehuén Co and Monte Hermoso these extreme values change between 7 °C in winter and 27 °C in summer. The maximum temperatures registered in the coastal cities of Monte Hermoso and Pehuén Co occurred in January (summer) with values up to 40 °C. The largest duration of heat wave lasted 8 days with minimum temperatures of 30 °C during the night. The historical coldest wave was registered in winter with values of – 10 °C. The strongest storms associated to winds from the S-SE-SW occurred during July (winter), December and January (summer). Winds were recorded up to 100 km/h. The period 2005 to 2011 was characterized by a drought that affected all the study area. The mean annual precipitation values were around of 100 mm. Analysis of tides records of the study area: mean sea level increase for Argentina is estimated in 1.6 mm/year from data starting in 1900. The study area is characterized by alternating wet and dry periods. The precipitations in the zone vary between 500 and 1000 annual mm. The coastal cities of Monte Hermoso and Pehuén Co were characterized since 2005 to 2011 by predominant dry periods. Monte Hermoso in 2010 registered the maximum precipitations with 525.6 mm. In Pehuén Co the rainiest year was 2007 with 490 mm. Winter and summer are longer than usual. Precipitation occurs in Autumn and Spring. Strong inter-annual variability. Precipitation occurs in Autumn and Spring. Strong inter-annual variability.</p>
	ECO ₂ Pollution patterns (water, waste, soil, air, other) - Pollution patterns affecting the considered SES (e.g. water, waste, soil, air)	ECO ₂	Pollution patterns (water, waste, soil, air, other)	<p>High levels of pollution exist in the sewer discharge zone in the estuary. The dynamic of the system dilutes these influences. For that reason, the estuary still has a high level of self depuration. The pollution in the coastal zone only could come from the groundwater that discharges into the sea because the sewer services are few or nonexistent. Although petrochemical contamination was high from the 70's to middle 90's, strong regulations and control over the industries have resulted in a significant reduction of the industrial pollution in the estuary.</p>
	ECO ₃ Flows into and out of focal SES - Flows from other SESs affecting the considered SES and viceversa	ECO ₃	Flows from other SESs affecting the considered SES and vice versa (economy)	<p>The continental flows of superficial water are few in the estuary and nonexistent in the external coastal zone. There are flows of subterranean water but they have not been estimated.</p>



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First tier		Second tier		Third tier	ARGENTINA	
					<p>c pressures , environmental effects and social effects)</p>	

ANNEX II: Description of the variables used in the Prospective Structural Analyses

Ostrom Category	(S) - Social, Economic and Political Setting (S) (S1) - Economic development)
Short label	S1b
Variable name	Employment sources
Description	<p>Employment sources are the possibilities of stakeholders to get a job. According to the SES delimitation, they are mainly based on fishery and tourism activities. Commerce and public employment are others important employment source.</p> <p>Stakeholders also refer to the employment transition along the time in the case of Cerri and Ing. White. The Pole extension during the '80s and '90s generated temporal employment promoting migration to the area and the later emergence of slums and settlements. A new migration flow is seen as a potential consequence of the Dredging and GNL project realization.</p>

Ostrom Category	(S) - Social, Economic and Political Setting (S) (S1) - Economic development)
Short label	S1c
Variable name	Tourism
Description	<p>Tourism is the economic activity consisting of the selling of tourism services and tourism products. Tourism is a very relevant activity in Pehuen-Có and Monte Hermoso, where the "beach and sun" tourism is developed as one of the main source of income for the communities between December and March. This activity supposes the intensive use of coastal resources.</p> <p>Users involving in tourism activity compete with fishermen for the use of the beach. But some complementarities exist. Tourism improves fishing activity since it represents an increase in demand for fish and in sport fishing.</p> <p>Different stakeholders give tourism a positive or negative connotation. The environmental impact of tourism was mentioned and discussed as part of the definition. Comparatively tourism could be a more sustainable activity than an extractive activity like fishery. Nevertheless, tourism has now a strong environmental impact on SES because of several aspects which should be improve to lead to sustainable tourism: 1) pollution and waste on the beach; 2) coastal zone buildings; 3) use of vehicles on the beach; among others.</p>

Ostrom Category	(S) - Social, Economic and Political Setting (S) (S5) – (Market incentives)
Short label	S5
Variable name	Local market
Description	<p>Local market refers to the set of relation between sellers and buyers in the local context of fishery. Local market is conditional on the consumers and price determination (both elements were recognized as variables in the first step of the workshops and added to local market variable later).</p> <p>The price is the economic value that the artisanal fisherman receives for his product. It depends mainly on local factors (different species and seasons, the preferences of consumers, the historical price at local market) and, secondly, on factors of other markets like Mar del Plata. The price has a great influence on the demand and the supply (by determining the quantity of fishermen in activity).</p> <p>Local market is also defined by consumers. Cold-storage plants, direct consumer and fish store are different forms by which artisanal fishery is commercialized. Most of the sale is realized in informal markets due to taxation barriers and legal and food-quality requirements. Tax burden and additional cost would make unprofitable the activity if all production was declared.</p>

Ostrom Category	(GS) - Governance Systems (GS1) - Government organizations
Short label	GS1a
Variable name	Organizations and fishery legislation
Description	<p>Group of organisms belonging to different government levels which have any legal authority over the resource and group of formal legislation and norms on controlling, monitoring and sanctioning the use and appropriation of the resource. For stakeholders, it is an external variable since they do not have any power at all to influence them.</p> <p>Stakeholders pointed out the relevance of: Regional Council of Fishery, Provincial Office for Fisheries, INIDEP and Argentine Naval Prefecture. The most important norms establish fishing bans, regulations about techniques and boats, licenses, etc.</p> <p>Users establish that organizations and fishery legislation show three weak point: 1) do not exists an artisanal fishery provincial law, frequently claimed by users; 2) monitoring and sanctioning process do not work well; 3) the exclusive fishing rights (licenses) are determined by the maximum permitted catch (per specie/per season), but they are insufficient and are given many times in doubtful cases of lobby</p>

Ostrom Category	(GS) - Governance Systems (GS1) - Government organizations
Short label	GS1b
Variable name	Lack of political interest in environmental sustainability
Description	<p>This variable summarizes the attitude of external decision makers towards legislation on resource units and resource system.</p> <p>According to SH, the lack of political interest in environmental sustainability can be seen through different actions or omissions by decision makers: 1) the contents of formal rules established for the management of resources; 2) the formal rules established with reference to other issues which may affect the environmental sustainability; and, 3) the political support given to projects with negative consequences over the environment.</p>

Ostrom Category	(GS) - Governance Systems (GS3) - Network structure
Short label	GS3
Variable name	Fishermen associations
Description	<p>Internal networks (associations and chambers) related to the management, use and marketing of resources.</p> <p>Fishermen also have tended to form coalition groups to influence policies in their favor and to face external SH as those belonging to Petrochemical Industrial Pole or government organizations.</p> <p>Such unions represent an increase in the social capital of users. Fishermen share information and develop collective actions through these network structures.</p>

Ostrom Category	(RU) – Resource units (RU5) – Number of units
Short label	RU5
Variable name	Catches
Description	<p>Number of fishery resource units extracted by artisanal fisheries.</p> <p>It depends on: 1) seasonality; 2) fishing effort and fishing fleet; 3) the quantity of licenses and other legislation norms; 4) a lot of negative aspects which reduced the stock of resource units (pollution, off-shore overfishing, dredging, among others). Income of fishermen depend directly on catches and prices. Catches have declined almost during the last ten years.</p>

Ostrom Category	(RU) – Resource units (RU7) – Spatial and temporal distribution
Short label	RU7
Variable name	Seasonality
Description	<p>Seasonality is a characteristic of fishery activity since it represents the extraction of a resource with regeneration periods. Fishing resources has its regeneration period mainly between spring and summer seasons, in medium and external zone of the estuary. During these seasons the off-shore fishing is prohibited and the greatest artisanal fishery catches are produced.</p> <p>Stakeholders also recognize the seasonality as a characteristic of tourism activity. "Beach and sun" tourism takes place in summer. The seasonality patterns of both activities are similar, increasing the potential negative effects of competition for resource uses and potential positive effects of complementarities.</p>

Ostrom Category	(RS) – Resource Systems (RS6) – Equilibrium properties
Short label	RS6
Variable name	Wildlife Resource System
Description	<p>By wildlife resources stakeholders mentioned the relevance of animals and the equilibrium of interactions between species in a biological sense. Both commercial and non-commercial species were taken into account by users in a complex system as trophic chain.</p> <p>Stakeholders also refer to the variation in native species, changes in their characteristics and modifications in its diet due to anthropic effects (such as pollution, dredging, non-native species introduced by men) and climate change.</p>

Ostrom Category	(U) – Users (U2) – Socio-economic attributes of users
Short label	U2
Variable name	Incomes
Description	<p>Income is the difference between the selling of fishery products (or tourism services), and extraction (or production) costs. The income is directly linked with use of the resource since the two main income sources of communities are fishery and tourism.</p> <p>Stakeholders look at income as a measurement of their quality of life.</p>

Ostrom Category	(U) – Users (U3) – History of use
Short label	U3
Variable name	Artisanal fishery history
Description	<p>History of use of resources and conformation as group. Artisanal fishery is based on traditional extracting methods. Fathers often teach son the techniques to fish and the traditional knowledge of SES. So, the history of artisanal fishery rely on the familiar knowledge. The history in the Argentine case is relatively new (see Ostrom characterization in point 2) and fishery is mostly related to the italian immigrants in the region.</p> <p>Today, two historical facts are relevant: 1) the maintenance of traditions; 2) the configuration of an informal norm set that rules the activity, the form to have access to local natural resources and the limits to the extraction.</p>

Ostrom Category	(I) – Interactions (I5) – Investment activities
Short label	I5
Variable name	Conservation measures
Description	<p>Group of activities and procedures made by users (mainly internal SH, but also external to a lesser extent) with the goal of catching the SES sustainability.</p> <p>Imply a serie of monetary investment activities (as the waste treatment plants) but also non-monetary investment activities as the support of old techniques with higher costs of extraction.</p> <p>Some practice are derived from the local knowledge on SES based on traditional knowledge, as informal close season self-imposed by fishermen when they think that it is needed.</p>

Ostrom Category	(U) – Users (Ug) – Technology used
Short label	Ug
Variable name	Artisanal Fishery
Description	<p>Artisanal Fishery describes the type of activity carried out by small crafts and boats with traditional techniques as hand line, trammel or gill net, shrimp net funding, etc.</p> <p>Artisanal Fishery also has cultural and historical implications for stakeholders.</p>

Ostrom Category	(I) - Interactions (I4) – Conflict among users
Short label	I4
Variable name	Dredging and LNG (Liquefied Natural Gas) Project
Description	<p>Important project consisting of building a plant to transform LNG into regular gas near Cerri, the expansion of Petrochemical Industrial Pole and the enlargement and deepening of the Canal Principal, promoted by external users and decision makers.</p> <p>The project generates a conflict between internal and external users because its implementation could produce important changes in the environment, damaging the artisanal fishery activity and other activities of direct users. For the stakeholders, the project is a clear expression of the prevalence of economic interests over environment interests.</p>

Ostrom Category	(I) - Interactions (I8) – Networking activities
Short label	I8
Variable name	Community awareness
Description	<p>Ideas and perceptions about activities realized by a user may affect other users and the common use of resources. This type of thinking has become relevant and has pushed the community to the realization of networking activities. This type of thinking has been taking an important place in the community pushing the networking activities realization.</p> <p>These ideas drive users to group in neighborhood associations or other types of groups to put into practice some collective actions as environmental education promotion or conservation measures implementation.</p>

Ostrom Category	(O) – Outcomes (O ₂) - Ecological performance measures
Short label	O _{2a}
Variable name	Changes in coastal environment and estuary
Description	<p>It describes a series of physical changes in coastal environment and estuary observed by users.</p> <p>The main changes mentioned are the coastal erosion due to beaches destruction by transit vehicles and buildings, shifts of dunes system, advance of the sea over beach; changes in the seabed by dredging and increases in salinity levels.</p> <p>This variable depends on human and environmental factors including climatic change and variability.</p>

Ostrom Category	(O)– Outcomes (O ₂) - Ecological performance measures
Short label	O _{2b}
Variable name	Overfishing
Description	<p>Overfishing represents the excessive catches of fish and shellfish. The effects of overfishing are recognized in biological terms (reduction of the resources) and bio-economics terms (less profitable activity).</p> <p>Off-shore fishery describes the type of activity which is realized in big ships and, frequently, through the use of harmful techniques as trawling. Considered as a threat for artisanal fishery, this activity usually catches large volumes of resources and is shown as the responsible of the overfishing.</p>

Ostrom Category	(O)– Outcomes (O ₂) - Ecological performance measures
Short label	O _{2c}
Variable name	Resource sustainability
Description	<p>Sustainability of coastal resources and fishery resources along time. The possibility to maintain an equilibrium between the resource extraction and its regeneration in order to achieve the ecologic and economic sustainability of SES.</p> <p>Resources sustainability is interpreted as a result of the interactions between human and biological variables.</p>

Ostrom Category	(ECO) –Related Ecosystems (ECO ₁) - Climate patterns
Short label	ECO ₁
Variable name	Changes in climate patterns
Description	<p>Changes in climate patterns perceived by users, like decrease in rainfall, extension in drought periods, increase in water temperature, increase in rotation and speed of winds.</p> <p>Such modifications affect the life and activities of users. For instance, the risk in fishery activity is higher because of the wind pattern modifications. Stakeholders also suppose that the variations in the stock of resources are related to climate variations as water temperature modifications.</p>

Ostrom Category	(ECO) –Related Ecosystems (ECO ₂) - Pollution patterns
Short label	ECO ₂
Variable name	Pollution
Description	<p>Pollution patterns affecting the SES and activities of users.</p> <p>The most important pollution patterns pointed out by stakeholders are air pollution caused by toxic emissions from factories and water pollution caused by industrial waste and sewage.</p> <p>Users also draw the attention over waste in beaches due to tourism and cleaning of fish by fishermen.</p>