

# Stakeholder Analysis and Social-Biophysical Interdependencies for Common Pool Resource Management: La Brava Wetland (Argentina) as a Case Study

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**Abstract** This article gives an account of the implementation of a stakeholder analysis framework at La Brava Wetland Basin, Argentina, in a common-pool resource (CPR) management context. Firstly, the context in which the stakeholder framework was implemented is described. Secondly, a four-step methodology is applied: (1) stakeholder identification, (2) stakeholder differentiation-categorization, (3) investigation of stakeholders' relationships, and (4) analysis of social-biophysical interdependencies. This methodology classifies stakeholders according to their level of influence on the system and their potential in the conservation of natural resources. The main influential stakeholders are La Brava Village residents and tourism-related entrepreneurs who are empowered to make the more important decisions within the planning process of the ecosystem. While these key players are seen as facilitators of change, there are other groups (residents of the inner basin and fishermen) which are seen mainly as key blockers. The applied methodology for the Stakeholder Analysis and the evaluation of social-biophysical interdependencies carried out in this article can be seen as an

encouraging example for other experts in natural sciences to learn and use these methods developed in social sciences. Major difficulties and some recommendations of applying this method in the practice by non-experts are discussed.

**Keywords** Common pool resource · Environmental management · Stakeholder analysis · Wetland

## Introduction

Common pool resources (CPRs) are natural or manmade resources where one person's use of the commons subtracts from its use by others but there is a difficulty in excluding access (Ostrom 1986; Quinn and others 2007). Hardin (1968) described how each user of the commons would act to maximize their benefits from open access commons while the costs of their use were shared amongst all users. As a result, the commons would be subject to overuse and this would lead eventually to degradation and the collapse of the resource. Wetlands could be seen as CPR when they exhibit both excludability and rivalry conditions.

Wetlands provide a wide range of essential ecosystem functions, which are defined as "the capacity of natural processes and components to provide goods and services that satisfy human needs, directly or indirectly" (de Groot 1992). These include regulation (water supply, water regulation), habitat (species refugium and nursery), production (food and raw materials), information (recreation, science and education) and carrier functions (cultivation, mining and tourism-facilities) (de Groot 1992, 2006; de Groot and others 2002). Therefore, their sustainable utilization for the benefit of mankind in a combined way, compatible with the

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maintenance of the natural properties of the ecosystem is necessary.

We use the term ‘stakeholders’ to mean any group of people, organized or unorganized, who share a common interest or stake in a particular issue or system (Grimble and Wellard 1997). Natural resource management typically deals with conflicting interests of various stakeholders since they use the same resource for different purposes. It is therefore important to understand the different perspectives of the actors involved in the system (Reed and others 2009).

Stakeholder analysis (SA) is a powerful tool for policy analysis and formulation, and has considerable potential in natural resource policies and programme development. It is an approach to understand a system, and changes in it, by identifying key actors or stakeholders and assessing their respective behaviour, intentions, interrelations and interests in that system (Grimble and Wellard 1997; Brugha and Varvasovszky 2000; Varvasovszky and Brugha 2000).

Local citizen partnerships are necessary to ensure broad-based planning and management of their water resources: to help resource managers avoid setting priorities on some needs and neglecting others. Citizen involvement is essential in broadening the conceptualization of wetland values and in implementing integrated management plans (Klessig 2001; Sheil and Liswanti 2006; Gurung 2007; Conrad and Daoust 2008).

La Brava Wetland is one of the most important shallow lakes of the south-eastern of Buenos Aires Province, contributing to the equilibrium of physical and biological systems among several ecosystem services (i.e. nutrient cycling, water and climate regulation, recreation). Intensive human use of this ecosystem leads to a disruption in its equilibrium, becoming a highly vulnerable system. Furthermore, the wetland is a valuable natural resource which contributes to the life quality of the population, including both close and distant residents (near 750,000 inhabitants), representing a multitude of social and ecological benefits.

Wetlands management is typically approached from a biophysical perspective, while their social value is usually given less attention (Klessig 2001). It is well known that a geologist or biologist has not been taught at university to assess social aspects, when working in a concrete environmental issue (e.g. wetland management). Basic tools for understanding the social dynamic of a place are necessary for these natural sciences professionals. In general, this information explains significantly the success or failure of a management proposal. The aim of the present study was both to provide an analysis of the stakeholder involvement in an aquatic common-pool resource and to evaluate sustainable management alternatives within the area. This study applies a methodology to analyze stakeholders and the social-biophysical interdependencies in a CPR management context, carried out by natural sciences

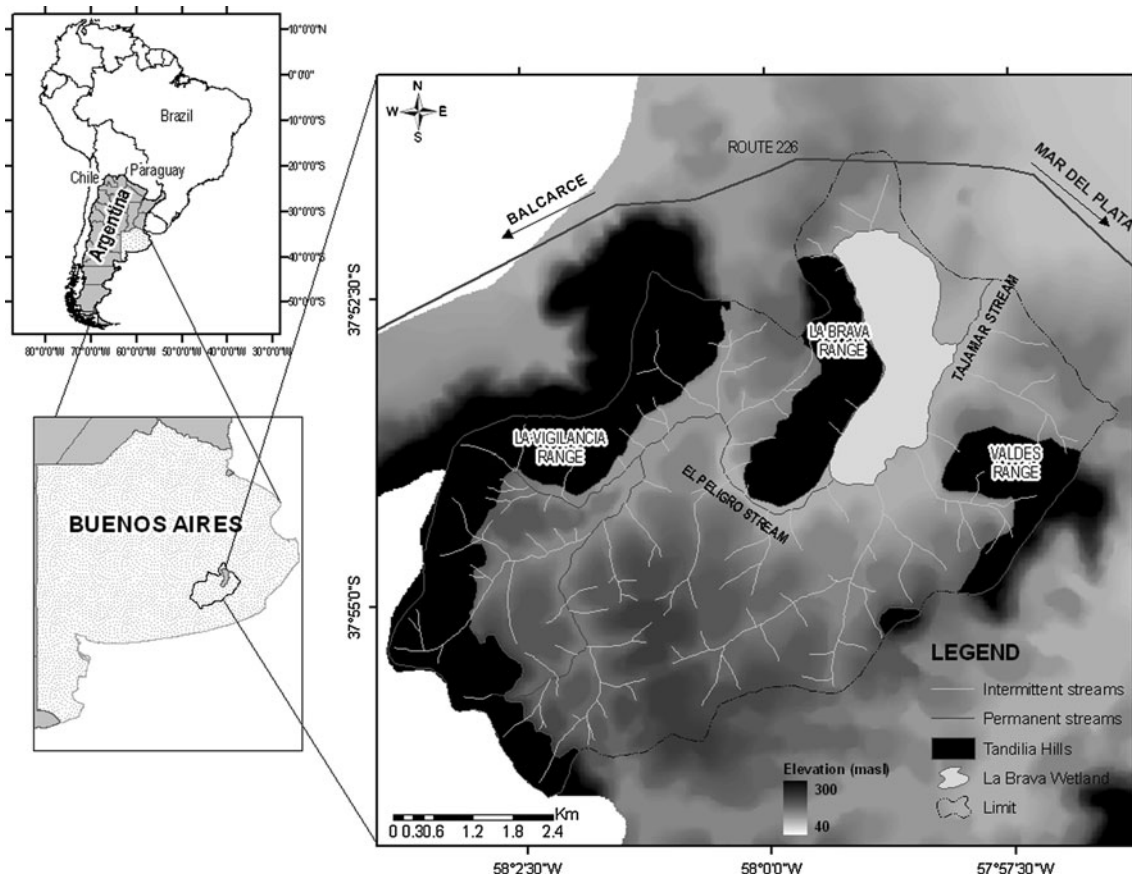
professionals (biologists and geologists) and non social ones (especially sociologists). It shows how the method can be utilized by experts outside the field of social science to a better understanding of the stakeholder involvement in an environmental issue. The article gives an account of the implementation of this stakeholder analysis framework at La Brava Wetland Basin, in Argentina.

### Problem-in-Context

La Brava Wetland Basin (from 57°56'25.06" and 58°03'55.55" W to 37°51'19.76" and 37°56'33.06" S) has an area of 53.37 km<sup>2</sup> and is situated in the Balcarce district, in the south-eastern of Buenos Aires Province, surrounded by ranges of the Tandilia System (Fig. 1). La Brava Wetland is a shallow lake (maximum depth 4.75 m) with an area of 4 km<sup>2</sup> (Grosman and Sanzano 1999; Lirio and others 2007). It has only one inflow stream, El Peligro Stream, located in the SW sector of the wetland; and one outflow stream, Tajamar Stream in the E area. La Brava Basin is a complex area given that it constitutes a multi-purpose zone used for recreational, residential and intensive agricultural activities. Its water resources are also considered as CPR.

Six land cover categories have been identified in La Brava Basin (Fig. 2) (modified from Zelaya and Maceira 2007). Their primary characteristics are the following: *Crops*: (soybean, zea may, wheat and sunflower) their grown in the area requires the application of fertilizers and pesticides. Farming methods have modernized and intensified over the years directed towards increasing commercial production; *Pastures*: in the area there is land permanently used for herbaceous forage crops (pastures). Pastures are a mixture of legumes and grasses (Jarrige and Béranger 1992); *Grassland*: native grasslands of the Southern Pampa were mostly replaced by annual crops, except for some small isolated fragments that still remain near the Tandilia ranges (Murillo and others 2007); *Forest*: there is a reduced sector of land under natural or planted stands of trees; *Ranges*: the Tandilia Ranges are the unique semi pristine area in the basin, containing forest, shrubs and the only two autochthonous plant species “anchor plant” (*Colletia paradoxa*) and “tala” (*Celtis tala*); *Village*: corresponds to La Brava Village; *Wetland*: in this ecosystem, as in most Pampean shallow lakes, the silverside (*Odontesthes bonariensis*) is the fish that dominates the aquatic system (Grosman and others 2001); and, *Bulrush*: the litoral zone of La Brava Wetland is mainly dominated by the “giant bulrush” *Schoenoplectus californicus*. Approximately 80% of the coastline is covered by bulrushes.

These land cover categories are associated with five main land uses (1) Agricultural use (related to crops and



**Fig. 1** Location map of La Brava Basin

pastures), (2) Native Nature preservation (coincides with ranges and grassland areas), (3) Residential use (town, corresponding to La Brava Village), (4) Recreational use (5) Educational and cultural use and finally (6) Commercial/economical use. The latter three uses are mainly related to the wetland and ranges. The natural characteristics of the Tandilia System are preserved in the range area.

La Brava Wetland, located in an agricultural area, is considered an important place for recreation and nature education. Like the rest of the wetlands of the Pampa plain, this lake has a fundamental role in the conservation of biodiversity by providing habitat for resident and transient species, allowing their survival, feeding and reproduction [Millennium Ecosystem Assessment (MA) 2005; de Groot and others 2006]. In its northern sector a residential zone (La Brava Village) has been developed, with important permanent population growth over the last years (171 residents without running water or sewage), and a consequential pressure on the system. Moreover, it receives a constant influx of visitors especially from the nearby cities (Mar del Plata and Balcarce). Several tourism-related enterprises are also located along the basin.

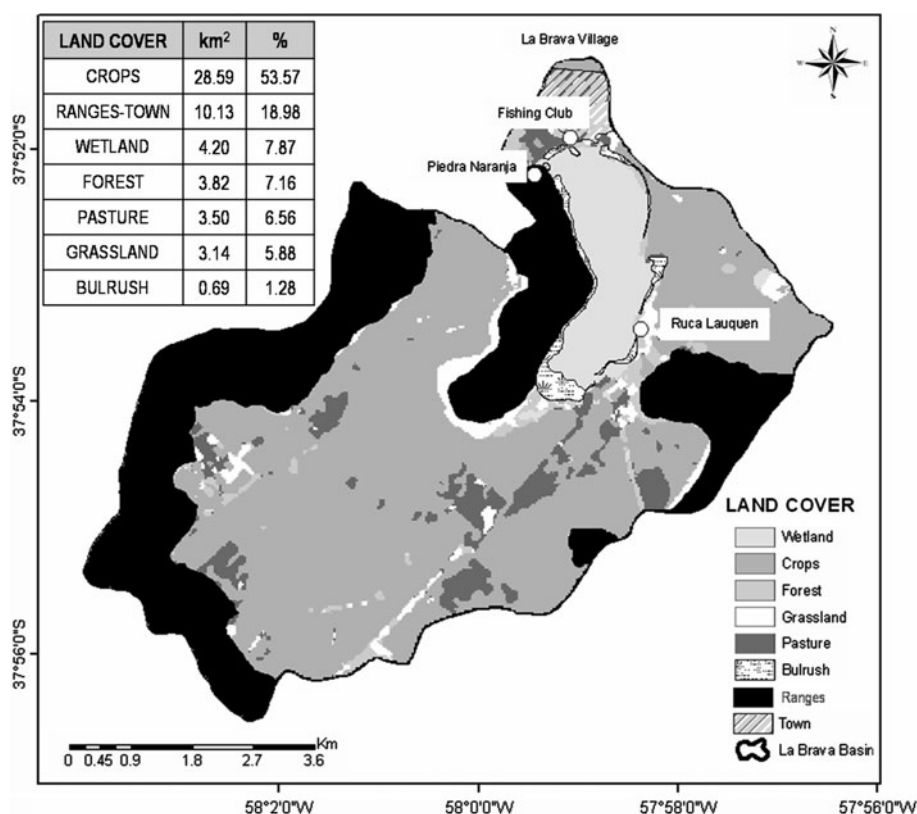
As most of the Pampa wetlands, La Brava lake has abundant organic matter and high nutrient concentrations

which determine its high eutrophication level since its origin. The expansion of agricultural activity in its drainage basin, technification, urbanization and the waste increase from different origins (sewage, industrial effluents, etc.), among others, have generated a negative impact on water quality, to the detriment of current and potential uses. The acceleration of the eutrophication process threatens the conservation of such environments (Grosman 2008). As a consequence, a management plan for adequate use of the resource is needed.

Despite the important influence of human activities on the catchment area of La Brava Wetland, it still retains its potential as an environmental service provider. Particularly the naturality and support services make it an ideal instance for the generation of a legal form of protection. The lake itself has shifted from a eutrophic to a hypertrophic state in recent years, proving the need to both incorporate regulations and implement some form of protection.

With respect to the ownership status, the area of La Brava Wetland is complex, since the provincial and municipal governments, two businesses (Fishing Club and Ruca Lauquen Rest and Camping), the inhabitants of La Brava Village and the landowners, who own most of the shore of the lake, are involved. This makes an interesting

**Fig. 2** Land-use and land cover in La Brava Basin



example of a CPR, where the “Tragedy of the Commons” (Hardin 1968) can be applied. Therefore, the implementation of any alternative that promotes the sustainable management of the wetland as a CPR should be of mutual consent between the social actors involved, keeping in mind their personal interests. At the moment, a proposal to declare La Brava Wetland Basin as a “Protected Landscape of Provincial Interest” (Act No 10907) is being evaluated by the Buenos Aires Provincial Agency for Sustainable Development (OPDS). This project focuses on ensuring the conservation of this aquatic ecosystem and its surroundings by developing a system of a wetland-basin protected area which adopts an integral approach for water resource management. An urban planning plus a territorial ordination plan in the area have not yet been applied.

## Materials and Methods

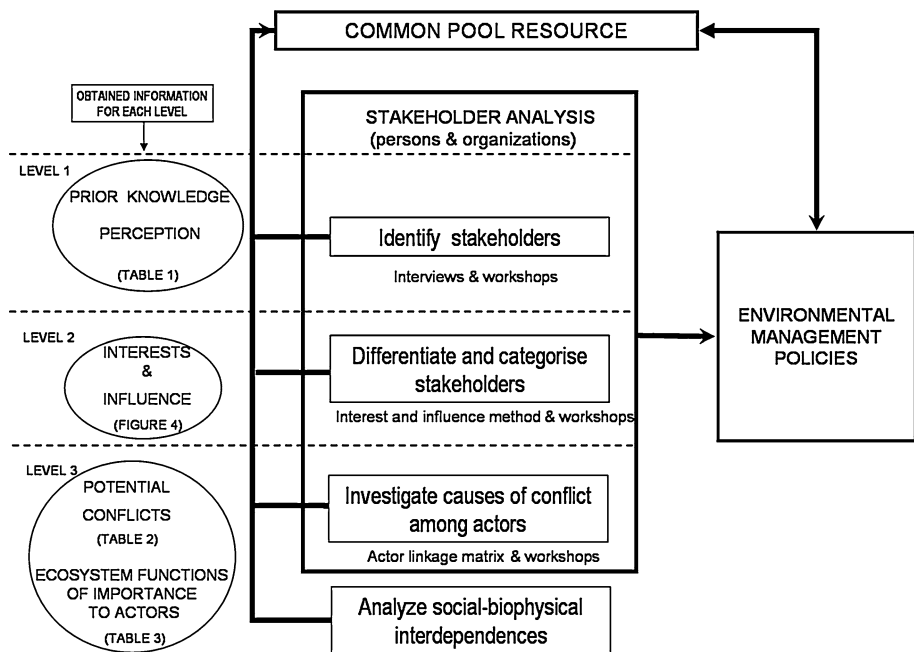
Stakeholder analysis in natural resource management research consists in three key methodological steps: (i) identifying stakeholders (level 1); (ii) differentiating between and categorising stakeholders (level 2); and (iii) investigating causes of conflict among them (level 3) (de Groot and others 2006; Reed and others 2009). Several analysis methods for each step are applied according to the case circumstances.

The applied methodology to assess stakeholders in La Brava Wetland Basin, in a CPR management context, is synthesized in Fig. 3. The three main steps of the SA were followed in this work. The utility of this tool is that SA can be used to generate knowledge about the relevant actors (level 1) so as to understand their behavior, intentions, interests and influence on the planning and management process of an environment (level 2). Moreover, SA helped to understand synergies and conflicts between the stakeholders and their demand for the ecosystem services delivered by the wetland basin (level 3).

## Identification of Stakeholders

SA must ensure that all the interests in a defined area are considered within the planning and decision-making process. Therefore, potential organizations and individuals who might have interests in these resources were identified mainly through (1) participant observations in 3-day government workshops and several public meetings, (2) semistructured interviews with the involved actors, and (3) the recommendations of interviewees, i.e., “snowballing”. Thus, a representative sample of the relevant population in La Brava Basin was collected in order to obtain information about stakeholders (residents, users, entrepreneurs, decision-makers, schoolchildren).

**Fig. 3** Methodological synthesis for the analysis of stakeholders and their interdependencies with the environment



Interviews were 15–25 min in length and conducted in a semistructured format in order to be “open enough for unanticipated value judgments and unorthodox world views, but structured enough to permit comparisons among respondents and obedience to the discipline of a more detached and abstracted understanding” (MacMynowski 2007). The semistructured form was chosen because the analysis and presentation of results was easier than applying open questions. Interview guides included issues concerning five main themes: (1) issues related to stakeholders’ perceptions and interests in the area, (2) issues pertaining to the sustainable use of the resource (trade offs), (3) issues regarding the implementation of environmental management policies, (4) attitude towards behavioral changes in some common practices within the wetland basin, and (5) an open question in which respondents could define freely what the wetland represented for them. Additionally, there were questions on background information (age, occupation, place of residence and family composition).

The proposed questionnaire was an inexpensive and efficient way of gathering data from a potentially large number of respondents. A total of 79 interviews were carried out in order to both obtain a deeper insight into opinions and knowledge of the different stakeholders and test the questionnaire model proposed for this work. Interview efforts were concentrated on inhabitants of La Brava Village, landowners and residents of the nearby area, members of Balcarce Fishing Club (users), tourism-related entrepreneurs (Piedra Naranja Rest Place, Ruca Lauquen Rest and Camping and La Brava Old Farm), and Balcarce District authorities (decision-makers), obtaining a total of

34 adult interviews. A second group of interviewees was selected from the local elementary-secondary school, located 2 km from the wetland. Forty five children from the 5th to 11th grade (50% of the total schoolchildren) were chosen randomly to participate. The age of the interviewees ranged from 9 to 16. Schoolchildren were selected as another stakeholder group since young citizens play an important role in promoting environmental care, and they can express diverse experiences and knowledge about a specific bio-physical feature (Hart 1997; Matthews and others 1999; Panelli and Robertson 2006). The schoolchildren interview had the same main issues as the adult questionnaire, but, it was adapted and simplified for the sake of children’s better understanding.

#### Stakeholder Differentiation-Categorization and the Investigation of Causes of Conflict Between Them

The method proposed in this work to characterise and classify stakeholders followed the top-down analytical categorization approach. This approach includes a set of methods in which classification of stakeholders is carried out by those conducting the analysis, based on their observations of the phenomenon in question and embedded in some theoretical perspectives on how a system functions. We used the method of interest and influence to classify stakeholders into “Key players” (high interest and influence over the phenomenon), “Context setters” (high influence, little interest), “Subjects” (high interest, low influence) and “Crowd” (little interest in or influence over the phenomenon) [Overseas Development Administration

(ODA 1995; Grimble and Wellard 1997; Reed and others 2009].

Finally, we investigated the causes of conflict that exist among stakeholders with the actor linkage matrix. This requires stakeholders to be listed in rows and columns of a table creating a grid so that the interrelations among them could be described using key words (Biggs and Matsuert 1999; Reed and others 2009).

### Social-Biophysical Interdependencies

The ecosystems framework was used to identify and classify stakeholders according to their interest in the goods and services provided by the regulation, production, habitat, information and carrier functions of La Brava Basin (de Groot and others 2002, 2006). In this article ecosystem functions are grouped into five primary categories based on de Groot and others (2002) and de Groot (2006): *Regulation functions*: related to the maintenance of essential ecological processes and life support systems; *habitat functions*: Natural ecosystems provide refuge and reproduction-habitat to wild plants and animals and thereby contribute to the (in situ) conservation of biological and genetic diversity and evolutionary processes; *production functions*: associated to the provision of natural resources; *information functions*: natural ecosystems contribute to the maintenance of human health by providing opportunities for reflection, spiritual enrichment, cognitive development, re-creation and aesthetic experience; and, *carrier functions*: these functions involve the provision of a suitable substrate or medium for human activities (e.g., cultivation) and infrastructure (e.g., tourism-facilities). The use of carrier functions usually involves a permanent conversion of the original ecosystem. Here, the analysis developed by Galbraith (1983) was used, which proposed three sources of

power: personality (individuals), property (their material resources), and organization (the most important source of power in modern societies).

### Environmental Law Analysis

Possible environmental management policies in La Brava Basin were analyzed and assessed. Moreover the relevant environmental laws in Argentina and in Buenos Aires Province, with regard to water resources and proper use of wetlands, were discussed. Previous environmental baseline data of La Brava Basin (Kruse 1987; Romanelli and others 2007, 2009; Massone and others 2009) was necessary before the analysis and assessment of possible environmental management policies.

## Results

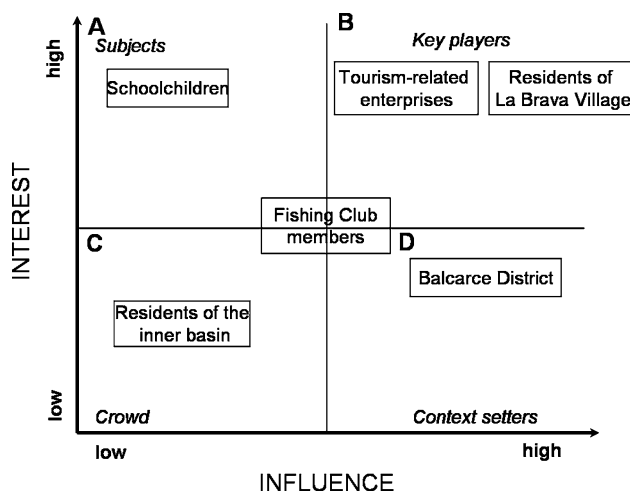
### Stakeholder Analysis in La Brava Basin

The number of interviewed people represented the 26% of the whole population in the basin (near 300 inhabitants), with a wide range of ages (9–81). According to the preliminary analysis, and also to the similarities of their concerns, opinions and interest, the stakeholders of La Brava Basin could be classified into six primary groups: “La Brava Village” residents, residents of the inner basin, members of the Balcarce Fishing Club (public wetland users), tourist-related entrepreneurs, students of the local school and Balcarce District. Table 1 shows a brief description of the stakeholder groups.

Stakeholders were categorized according to their relative influence and importance: importance refers to those whose needs and interests are the priorities in the CPR,

**Table 1** Brief description of the stakeholders involved in La Brava Basin

Stakeholder	Brief description
La Brava Village residents	Near 200 inhabitants. Mostly work in Balcarce City while others in Mar del Plata City, just 30 and 37 km away from the La Brava Wetland, respectively. Due to the scenic attractions and the quietness of the place, an increasing of permanent population from these cities and also from Buenos Aires Capitol City is evident during the last years in La Brava Basin
Residents of the inner Basin	Related to the agricultural activities in the basin, generally farmland employees. Owners used to live in a non permanent way
Members of Balcarce Fishing Club	Mainly live in Balcarce. Mostly work out of the wetland’s area but use it for recreation. The club head office is located in Balcarce. An area that offers you camping, fishing, boating, picnicking, parking of motorhomes and other outdoor fun is administrated by the club
Tourism-related entrepreneurs	Small tourist entrepreneurs located in Sierra La Brava’s piedmont (Piedra Naranja Rest place), along the wetland shore (Ruca Lauquen Rest and Camping) and also near the basin (La Brava Old Farm)
Local schoolchildren	Students from a rural government school. The 78% live 5 km far away from the wetland. 55% use the area for recreation
Balcarce District	Political-administrative responsible of the 90% of the basin, including La Brava wetland



**Fig. 4** Interest–influence matrix showing stakeholders within La Brava Basin

while influence is associated to the power certain stakeholders have over the system. The use of a matrix for assessing the influence and importance of stakeholders can be transposed into a graph (Fig. 4). Stakeholders in box B are of central importance to the system, with high local influence or power; those in box C have high influence but are not the main target. The key stakeholders in La Brava Basin are the residents of La Brava Village and the tourism-related entrepreneurs, who take a central position in the environment and have a continued participation in the prevention and conservation planning of natural resources. Moreover, they are actively grouped within a Non Governmental Organization (NGO). The acceptability of strategies to these key players should be an important consideration in the evaluation of new strategies. Members of the Balcarce Fishing Club have a neutral position, recognizing the importance of the ecosystem but without clear involvement in the basin planning process and in environmental issues. Residents of the inner basin were classified as “Crowd” since this stakeholder group is able to participate with minimum cost and effort, and little interest in the process. On the contrary, crop production and harvest activities are the main economical priorities for it. Students are “Subjects” with high interest in the ecosystem but little power over the system. Balcarce District is a “Context setter” that keeps itself informed but has low government effort.

In addition, the identification of causes of conflict between actors in La Brava Basin, based on the opinions of experts and the performed interviews, was carried out. Environmental conflicts in the area manifest themselves as consequences of political, social, economic or territorial conflicts or conflicts over resources or personal interests. These conflicts are characterized by the principal importance of degradation in one or more of the following fields:

overuse of renewal resources, overstrain of the environment’s sink capacity (pollution) and impoverishment of the living space (Table 2).

The main environmental problems mentioned by the stakeholders involved in la Brava Wetland are shown in Fig. 5. These problems are environmental pollution, scarcity of water resources monitoring, lack of a clear local regulation related to the authorized uses in the wetland basin and also the absence of a legal figure controlling them. Most of the actors considered that the use of fuel injection motors in boats and nautical sports, lake water pollution due to agrochemicals and sewer disposals (from tourists and residents in general) are the principal degradation factors of the aquatic ecosystem

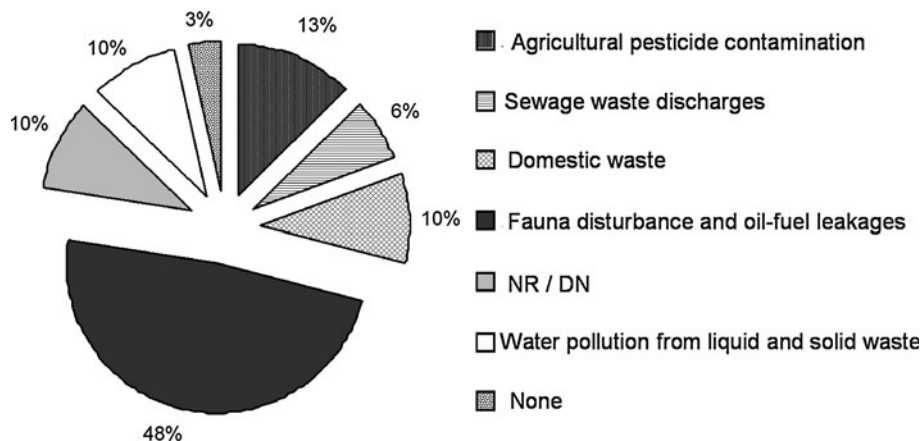
According to the recorded data, fishermen and residents of the basin would modify their everyday practices performed in this wetland so as to preserve it for future generations. In the first case by controlling that fish activities only take place during the fishing period with fishing license and with the correct daily number and length of catch per fisherman. They would also avoid littering and solid waste discharges to the wetland from users. In the second case, more efforts would be made towards educating visitors to the wetland of the environmental effect of their visits and they would avoid littering and solid waste disposals in the wetland. Most stakeholders expressed how important their wetland is. After field investigations, interviews with local citizens, regular meetings and careful consideration, a significant interest and awareness of the need for the monitoring of biophysical processes and environmental changes in the study area could be seen.

Information obtained showed the significance of aesthetic values given to the wetland by most of the stakeholders. Changes and impact on the natural conditions of La Brava Wetland were mainly detected during the last years by inhabitants of La Brava Village, residents of the inner basin, members of the Fishing Club and local schoolchildren. These actors strongly agreed that it is necessary to restrict or control the use of this aquatic ecosystem. A lack of knowledge related to both environmental aspects and the responsible authority of the wetland area was evident in most of the students.

Social and biophysical interdependencies existing among stakeholders and natural resources of La Brava Basin are shown in Table 3. Each stakeholder is associated with different ecosystem functions, holding several levels of interest and power which indicate the weak or strong interdependence with the environment. The main interests have focused on regulation (water supply), habitat (for biota and human society) and information services (recreation, science and education), with limited attention given to other ecosystem services. This table shows that most of the stakeholders are interested in regulation services, while the ones interested in

**Table 2** Causes of conflict between the different stakeholders in La Brava Basin

From	To				
	“La Brava Village” residents	Residents of the inner Basin	Balcarce Fishing Club	Tourism-related entrepreneurs	Balcarce District
“La Brava Village” residents	–	–Use of agrochemicals –Prevent free access to the wetland shore	–Presence of the camping –Lake water pollution from liquid and solid waste disposal –Lack of control over the use of the wetland	–Allow the use of fuel injection motors in boats, –Lack of adequate sewage system	–Lack of awareness on wetland importance due to its distance to the Balcarce city –Request the change of La Brava Village from rural category to urban area
Residents of the inner Basin	Despite the proximity, most of them ignore the wetland. It has no special attractions for them and residents do not use it. They do not interact with the rest of the actors				
Balcarce Fishing Club	–Lack of neighbourhood knowledge related to the club issues	Not detected. No interaction with the other actors	–	–Competition for fishermen arrival	–Lack of economical resources to exert the police power assigned to it
Tourism-related entrepreneurs	–Against the mass influx of tourists	Not detected. No interaction with the other actors	–Competition for fishermen arrival	–	–Allow free access to the wetland shore
Balcarce District	Four community workshops were organized together with the Province during 2007. New district authorities have assumed in December of 2007. At the moment no formal declarations related to the wetland were done				

**Fig. 5** Main environmental problems mentioned by the stakeholders involved in La Brava Basin

habitat services were mainly key players, holding property rights obtained through land-ownership. Production (fish supply) is related to social actors with a neutral position and carrier service (cultivation and tourism-facilities) is associated to actors with an economic interest in the ecosystem, as residents of the inner basin (landowners) and tourism-related entrepreneurs.

#### Analysis and Assessment of Possible Environmental Management Policies in La Brava Wetland Basin

Only after the 1994 constitutional amendment, the legal principle of environmental protection became a federal rule

in Argentina. This regulation states that people have a right to enjoy a healthy environment and are duty bound to preserve it because “all inhabitants have the right to a healthy and balanced environment that is suitable for human development”. Moreover, Article 41 of this Constitution incorporates a new “environmental right” by establishing that “the authorities will care for the protection of this right, the rational use of natural resources, the preservation of natural and cultural patrimony and of biological diversity”. Article 124 of the Argentine Constitution establishes the provinces’ authority over their natural resources and thereby the authority to regulate the use, development, and conservation of these resources.



**Table 3** The framework analysis developed to evaluate the different stakeholder “interest” and “influence” in the ecosystem functions of La Brava Basin

	Interest					Influence			Main ecosystem services of La Brava Basin
	Ecosystem functions					Sources of power			
	Regulation	Production	Habitat	Information	Carrier	Personality	Property	Organization	
Residents of La Brava Village	++		+++	++			+++		–Local and regional climate regulation
Residents of the inner Basin	++				+++		+		–Water regulation (hydrological flows)
Fishing Club members		+++	++	+++				++	–Watersupply –Fish supply
Tourism-related enterprises	++		+++		+++		+++		–Recreational and educational opportunities
Local schoolchildren				+++				+	–Source of inspiration. (aesthetic value)
Balcarce District			+					+++	–Species refugium –Groundwater recharge/discharge

Note: high (+++), moderate (++), low (+), or insignificant (*empty cell*) level of interest or access to source of power

Law 12.257 (1999) called “Water Code” establishes the system of protection, conservation and management of water in the Buenos Aires Province. It regulates the planning and inventory of this resource as well as the rights and obligations of its users. This Water Code sets up protection, conservation and management of water resources.

Buenos Aires Province has several legal figures to protect its natural resources. The different categories of protected areas are included in Law 12.704 and Law 10.907. The implementing authority in both cases is the Provincial Agency for Sustainable Development (OPDS). Protected areas declared by Law 12.704 do not receive technical or financial support from the provincial government. In an international level, the International Union for the Conservation of Nature and Natural Resources (IUCN 1994) also defines several management protected areas. Table 4 summarizes these major laws and their content.

## Discussion

An advantage of the interest-influence matrix is the visual representation of stakeholders, giving the possibility of finding patterns according to their positions in this stakeholder mapping, i.e. their capacity and willingness to mobilize resources toward a particular goal, their potential for developing alliances with each other, the dynamism of their stance, etc. One can then start characterizing and prioritizing stakeholders for future involvement in the process. In La Brava Basin, it is evident that stakeholders

with interests in cultivation are generally less influential than those with habitat interests (“Crowd” actors). People who live in the area and/or have tourist interests are the stakeholders with more power over the system and are actively grouped in a NGO (residents of la Brava Village and tourism-related entrepreneurs). These key players feel the wetland as theirs, maybe because of the nearness to the coastline, so they are involved in the ecosystem planning process. On the contrary, actors with interests in cultivation are not really interested in the system since they neither interact with the rest of the actors nor assist to the organized workshops-public meetings (where concerns, opinions and personal interests are discussed in order to avoid future conflicts); instead, they are focused on their own productive lands. It may have been expected that these social actors related to crop lands were the key players of the system, since the area is mainly agricultural land.

According to the low interest and influence of agriculture and farmers on the natural system, the applied methodology did not identify them as key players in La Brava Basin. However, if considering the activity developed by them (agriculture), these actors should be considered as key players since nutrient load from the agriculture probably has an important impact on the status of the wetland.

Each stakeholder group is mainly associated with a land use and cover category in La Brava Basin. According to these land-stakeholder relationships, multiple ecosystem functions are significant in the area. Residents of the inner basin are related to agricultural use (crops and pastures), tourism-related entrepreneurs and Balcarce Fishing Club to

**Table 4** Summarize of the major laws and their content in regard to provincial and international protected areas categories

Regulation level	Regulation name	Definition of protected area	Categories	Description
Provincial	Law 12.704 (2001)	Those natural or anthropogenic environments with scenic, cultural, ecological, or other, with native species and/or exotic flora and fauna, or resources requiring environmental protection	Protected Landscapes and Green Spaces of Provincial Interest	Natural or artificial processes which ensure harmonious man–environment interaction. Local authorities are responsible for establishing management methods and financial support. Multiple uses are allowed
	Law 10.907 (1990)	Lands or water bodies with a scientific, economic, aesthetic or educational interest which must be subtracted from human intervention to ensure its existence or perpetuity	Provincial Parks Integral Natural Reserves Mixed Nature Reserves Natural Reserves of Defined Objects Multiple Use Reserves Wildlife Refuges	Ecosystem conservation. Restricted access zones Maintenance of natural ecosystems and restoration or recovery of degraded environments. Only scientific activities are allowed Territory belonging to more than one entity (provincial and/or municipal governments or private owners) Protection of soil, botanical, faunal, geological, paleontological or scenic resources. Human activities may be permitted, however, it is tightly controlled Protection of two or more resources listed above Conservation of fauna
International	International Union for the Conservation of Nature and Natural Resources (IUCN) (1994)	An area of land and/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means	Strict Nature Reserve Wilderness Area National Park Natural Monument or Feature Habitat/Species Management Area Protected Landscape/ Seascape Protected area with sustainable use of natural resources	Strictly protected areas. Human visitation and use are strictly controlled Preservation of the natural condition of an area. Without permanent or significant human habitation Protection of ecological processes, species and ecosystems. Spiritual, scientific, educational, recreational uses are allowed Small protected areas. Protection of a specific natural monument (landform, sea mount, submarine cavern, geological feature, etc) Protection of a particular species or habitats. Active management Significant interaction of people and nature. Protection of ecological, biological, cultural and scenic values Conservation of ecosystems and habitats together with associated cultural values. Sustainable use of natural ecosystems

recreational and commercial/economical use (wetland and ranges), villagers to a residential use (town), while students to an educational and cultural use of the area (wetland and ranges).

The main challenge of implementing a management action in Argentina is to articulate and distribute responsibilities among the three levels of government (federal, provincial, and municipal). The Constitution gives the

federal government the responsibility for establishing the basic (or minimum) guidelines for environmental protection. The provinces can supplement these guidelines as long as the “minimum or threshold guidelines” set up to implement the protection of natural resources do not alter (or conflict with) local jurisdiction. Moreover, each municipality also has local prerogatives with regards to the regulation and control of water resources. All this leads to a certain overlapping of actions that may render operational functioning difficult.

The positive aspect of the Argentine model is that the chain of responsibilities for the creation, planning and use of the water resource is clear, since 1999 in the Buenos Aires province. The aspects that could be considered negative are the following three: First, despite the fact that the legislation has formally incorporated the protection concept in 1960, the focus on water management is mainly placed on its use, to the detriment of the protection and quality of the resource. This can be verified in the new provincial water codes, such as the one enacted for Buenos Aires province in 1999, which, despite of having the purpose of protecting water resources in the province, it does not contain a special chapter on water quality and its protection. Second, the lack of state control mechanisms to guarantee that the already established rules and regulations are followed; thirdly, the lack of user participation in the process of water management (Polemio and others 2007).

The collected data could be useful for evaluating the environmental management perspectives of this CPR area. The water management measurements proposed for applying to these types of areas are: (1) Water quality evaluation, (2) Aquifer, streams and wetland monitoring, (3) Construction of buffer zones including the wetland and inflow stream (which acts as a source of recharge to the wetland) and biotope corridors to connect natural spaces and habitat for species, (4) Stakeholder analysis along time since they could play different roles and/or their roles could evolve over time, (5) Guidelines on agrochemical management and utilization, and finally, (6) Promotion of environmental education and awareness in order to involve key blockers and neutral actors in the planning process. Wetlands can only provide optimal social benefits if management decisions recognize the full set of potential contributions that wetlands can make to society, and those management decisions are integrated to provide a balanced attention to all values that wetlands provide. Citizens' involvement in attempting to manage a CPR in a complex area is essential.

Several barriers in the implementation of a provincial managing figure in La Brava wetland are evident. These include: (a) institutional and governmental constraints for integrated management protected areas; (b) uneven and deficient operating procedures for the conservation of

aquatic habitats; and (c) weak financing mechanisms and insufficient funding capacity for long-term sustainability.

To preserve the natural conditions of the study area, it is necessary to predict the dynamics and quality of natural resources and also its relationship with the individuals or groups who depend on the ecosystem. Even though the best situation would be the participation of social sciences professionals in the environmental problem, this is not always possible. Therefore, this is a difficult task for geologists and biologists that perform environmental studies and are not specialized in social issues. In view of these facts, a methodological approach for the assessment of social-biophysical interactions and stakeholder analysis seems a valuable tool for predicting future scenarios in the presence of natural or anthropic events. Setting management tools in order to maintain reasonable balance between stakeholder interests and water resource use is required in CPR areas like La Brava Basin.

The utility of SA for predicting and providing information about actors' behavior in the management process is time-limited because stakeholders may play different roles simultaneously and/or their roles may evolve over time. As a consequence, actors must be evaluated for the deeper understanding of social relations among stakeholders as the managing process proceeds; otherwise the results may lead to simplistic decisions about stakeholder involvement in natural resource management. For example, Balcarce District initiated the planning process in La Brava Basin contacting the Provincial government, but lately little effort in a continuation was evident. The other stakeholders still remain with their initial role in the process, but this does not mean that their interest and influence can change over time, thereby, changing their stakeholder category. Interest and power are not static, and as stakeholders change position, tensions can arise when key players have conflicting interests (Reed and others 2009).

Difficulties of applying the method to real-life cases by non experts in social sciences exist: (1) Some interview questions might not be clear enough to several interviewees so they might not be able to answer them correctly; (2) a scaling method to measure the items in the questionnaire, as the Likert scaling method (items can be rated on a 1-to-5 Disagree–Agree response scale), could be helpful for a better quantification of the results; (3) Face to face surveys usually provide more reliable results than questionnaires and they can include observational and visual aids; however, it is an expensive method, especially when large areas are covered, and (4) It is the subjective perception of the researcher which ultimately decides the position of the stakeholder in the system and its relationship with the other actors. In this sense, a team can compensate for and neutralize individual biases providing a more objective perspective of stakeholder positions and interests. Considering

all these difficulties, it would be valuable to work closely with a social sciences professional group which can evaluate interim conclusions and propose follow-up steps in data collection in order to obtain an accurate analysis of the results. A mixed team (social and natural sciences professionals) can provide a more balanced analysis.

## Conclusions

Stakeholder analysis produced considerable new information about stakeholders' interests and influences in the area and was especially helpful in the decision making process of policy makers. The presence of stakeholders in La Brava Wetland Basin who aim at keeping the ecosystem planning process running was detected. According to the obtained data, the most influential stakeholders are La Brava villagers and the tourism-related entrepreneurs who are empowered to make the most important decisions within the planning process of the ecosystem. While these key players are seen as facilitators of change, there are other groups, such as residents of the inner basin and fishermen which are seen mainly as key blockers.

The applied methodology for the SA and the evaluation of social-biophysical interdependencies elaborated in this article can be seen as an encouraging example for other experts in natural sciences to learn and use these methods developed in social sciences. This approach, as a generic one, would be applicable to certain types of problems: (1) stakeholders with different interest-influence in an area with a complex ownership status (provincial and municipal public domain and private domain), (2) multiple land use areas, (3) overlapping responsibilities in environmental management among the different levels of government (national, regional and local), and (4) natural resources used for recreational and touristic purposes, near urban settlements, among others.

This study attempts to show how these methods can be utilized by other natural sciences professionals to better understand the stakeholder involvement in a CPR management context, giving the necessary information to identify four basic aspects: (1) recognition of the main stakeholders involved in the area, (2) their interests and influence on the ecosystem functions; (3) the potential conflicts among them and 4. social-biophysical interdependencies. The knowledge and implementation of the basic guidelines of the SA constitute a useful tool for natural sciences professionals, since they allow a better comprehension of the study problem and an efficient approach to the study of complex systems, such as CPR.

Social and biophysical interdependencies existing among users of an area and among the resources they manage provide an important and often essential basis for

solving or at least ameliorating common problems. In this sense, stakeholder analysis, as well as, land-use/land cover information of the CPR will ensure the long-term quality of the resource for human use and the prevention or resolution of social conflicts related to the use and conservation of the ecosystem. In La Brava Wetland Basin the main interests in the ecosystem functions have focused on regulation (mainly water supply and water regulation), habitat (for biota and human society) and information, with limited attention to other ecosystem functions. Stakeholders interested in habitat functions were mainly key players, holding property rights obtained through land-ownership. Production (fish supply) is related to social actors with a neutral position and carrier function (cultivation and tourism-facilities) is associated to actors with an economic interest in the ecosystem, as residents of the inner basin (landowners) and tourism-related entrepreneurs.

The obtained information from the biophysical and social systems was considered when the possible environmental management categories for La Brava Basin were proposed. Considering its complex ownership status and that it provides both species habitat and an environment for the development of multiple activities (educational, recreational, cultural, touristic and agricultural), the proposed categories for environmental protection in this area are: "Mixed Nature Reserve", considering the existence of private property lands, areas of provincial domain and areas of municipal domain through private administration in the basin, "Natural Reserve of Protection" (for soil and drainage basin conservation), "Scenic Nature Reserve" (for its aesthetic value) (Law 10.907) or "Green Space of Provincial Interest" (Law 12.704) (allowing multiple uses of the site compatible with man activities and the environment). According to the international framework, La Brava Basin could be defined as Category V area: *Protected Landscape/Seascape* (UICN) because of its local features. Although the implementation of a management plan is necessary for the wetland, those categories which consider restricted access zones within the protected area should not be adopted. On the other hand, due to the local conditions, categories with considerable flexibility in the management objectives for the area would be appropriate.

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## References

- Biggs S, Matsuert H (1999) An actor-oriented approach for strengthening research and development capabilities in natural resource systems. *Public Administration and Development* 19:231–262

- Brugha R, Varvasovszky Z (2000) Stakeholder analysis: a review. *Health Policy and Planning* 15:239–246
- Conrad C, Daoust T (2008) Community-based monitoring frameworks: increasing the effectiveness of environmental stewardship. *Environmental Management* 41:358–366
- de Groot RS (1992) Functions of nature: evaluation of nature in environmental planning, management and decision-making. Wolters Noordhoff BV, Groningen
- de Groot R (2006) Function analysis and valuation as a tool to assess land use conflicts in planning for sustainable multifunctional landscapes. *Journal of Landscape and Urban Planning* 75:175–186
- de Groot R, Wilson M, Boumans R (2002) A topology for the classification, description and valuation of ecosystem goods and services. *Ecological Economics* 41:393–408
- de Groot R, Stuij M, Finlayson M, Davidson N (2006) Valuing wetlands: guidance for valuing the benefits derived from wetland ecosystem services. Ramsar Technical Report No. 3, CBD Technical Series No. 27, Gland
- Galbraith JK (1983) *The anatomy of power*. Hamish Hamilton, London
- Grimble R, Wellard K (1997) Stakeholder methodologies in natural resource management: a review of concepts, contexts, experiences and opportunities. *Agricultural Systems* 55:173–193
- Grosman F (2008) Espejos en la llanura. Nuestras lagunas de la región pampeana [Waterbodies in the Plain. Our Pampaeen lagoons]. Ed. Universidad Nacional del Centro de la Provincia de Buenos Aires, 174 pp
- Grosman F, Sanzano P (1999). Estudio ictiológico Laguna La Brava, Partido de Balcarce, Provincia de Buenos Aires [Ictiological study in La Brava wetland, Buenos Aires Province]. Informe Final. Facultad de Ciencias Veterinarias. Universidad Nacional del Centro
- Grosman F, Sanzano P, Agüería D, González G (2001) Gestión del pejerrey *Odontesthes bonariensis* en una Pesquería periurbana de Argentina [Silverplate *Odontesthes bonariensis* Management in a perturban fishery of Argentina]. *Revista AquaTIC*, no 14, July 2001
- Gurung T (2007) Restoration of small lakes through cooperative management: a suitable strategy for poverty-laden areas in developing countries? *Lakes and Reservoirs: Research and Management* 12:237–246
- Hardin G (1968) The tragedy of the common. *Science* 162:1243–1248
- Hart R (1997) Children’s participation: the theory and practice of involving young citizens in community development and environmental care. Earthscan/ UNICEF, London
- IUCN International Union for the Conservation of Nature and Natural Resources (1994) *Guidelines for Protected Areas Management Categories*, Cambridge and Gland
- Jarrige R, Béranger C (1992) Beef cattle production. Vol. C5 in the *World Animal Science Series*, vol 5. Elsevier Science Publishers, 487 pp
- Klessig L (2001) Lakes and society: the contribution of lakes to sustainable societies. *Lakes & Reservoirs: Research and Management* 6:117–125
- Kruse E (1987) El agua subterránea en el régimen hidrológico de Laguna la Brava. [Groundwater in the hydrological regime of La Brava Wetland] Informe 40, Comisión de Investigaciones Científicas de la Provincia de Buenos Aires
- Lirio JM, Núñez H J, Chaparro MA, Sinito A M, Irurzun A, Gogorza CS (2007) Laguna La Brava, Provincia de Buenos Aires. Relaciones paleoclimáticas con Patagonia y Antártida. VI Simposio Argentino y III Latinoamericano sobre Investigaciones Antárticas. Buenos Aires
- MacMynowski DP (2007) Across space and time: social responses to large scale biophysical systems. *Environmental Management* 39(6):831–842
- Massone H, Darwich P, Romanelli A, Josens L, Menone M, Miglioranza K, Gonzalez M, Parietti M (2009) Gestión participativa de recursos naturales. Una experiencia comunitaria en Laguna La Brava (Provincia de Buenos Aires). [Participative management in natural resources. A comunitary experience in La Brava Wetland]. III Congreso Nacional de Extensión Universitaria, Santa Fe, Actas, pp 1–12. ISBN 978-987-657-086-2
- Matthews H, Limb M, Taylor M (1999) Young people’s participation and representation in society. *Geoforum* 30:135–144
- Millennium Ecosystem Assessment (MA) (2005) *Ecosystems and human well-being: wetlands and water synthesis*. Millennium ecosystem assessment report to the Ramsar convention. World Resources Institute, Washington
- Murillo N, Laterra P, Monterubbianesi G (2007) Post-dispersal granivory in a tall-tussock grassland: a positive feedback mechanism of dominance? *Journal of Vegetation Science* 18:799–806
- Ostrom E (1986) *Governing the commons: the evolution of institutions for collective actions*. Indiana University-Cambridge Press, Cambridge, p 54
- Overseas Development Administration (ODA) (1995) *Guidance note on how to do stakeholder analysis of aid projects and programmes* [online]. <http://www.oneworld.org/euforic/gb/stake1.htm>. Last accessed July 2010.
- Panelli R, Robertson G (2006) Catchment contrasts: comparing young people’s experiences and knowledge of a river environment. *Geoforum* 37(4):455–472. doi:10.1016/j.geoforum.2005.02.008
- Polemio M, Massone H, Dragone V, Bocanegra E (2007) Groundwater utilization and protection: the experience and the comparison of Argentine and Italian regulations. In: XXXV IAH Congress ‘Groundwater and ecosystems’. 17–21 Sep 2007, Lisbon
- Quinn CH, Huby M, Kiwasila H, Lovett J (2007) Design principles and common pool resource management: an institutional approach to evaluating community management in semi-arid Tanzania. *Journal of Environmental Management* 84:100–113
- Reed M, Graves A, Dandy N, Posthumus H, Hubacek K, Morris J, Prell C, Quinn C, Stringer L (2009) Who’s in and why? A typology of stakeholder analysis methods for Natural Resource Management. *Journal of Environmental Management* 90:1933–1949
- Romanelli A, Massone HE, Escalante AH (2007) Línea de base ambiental en la Cuenca de Laguna La Brava, Buenos Aires, Argentina. [Environmental Baseline of La Brava Basin, Buenos Aires, Argentina]. 6° Jornadas Geológicas y Geofísicas Bonaerenses, Mar del Plata
- Romanelli A, Lima M L, Massone H, Escalante AH (2009) Caracterización hidroquímica subterránea y su relación con la cobertura del suelo en el Corredor Mar del Plata-Balcarce, Prov. de Buenos Aires [Hydrochemical characterization and its relationship with land cover in Mar del Plata-Balcarce Corridor]. In: XXII Congreso Nacional del Agua (CONAGUA), Trelew
- Sheil D, Liswanti N (2006) Scoring the importance of tropical forest landscapes with local people: patterns and insights. *Environmental Management* 38(1):126–136. doi:10.1007/s00267-005-0092-7
- Varvasovszky Z, Brugha R (2000) How to do (or not to do) a stakeholder analysis. *Health Policy and Planning* 15:338–345
- Zelaya K, Maceira N (2007) Avance de la agricultura en la Cuenca Hidrológica de Mar Chiquita, región pampeana argentina [Agricultural advances in Mar Chiquita Basin, Pampaeen Region, Argentina]. En Congreso de Teledetección, Herramientas para la gestión sostenible. Ed. Martín. ISBN 978-987-543-127-0