

Policy options

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This section aims to identify feasible policy options that target key components identified in the Causal chain analysis in order to minimise future impacts on the transboundary aquatic environment. Recommended policy options were identified through a pragmatic process that evaluated a wide range of potential policy options proposed by regional experts and key political actors according to a number of criteria that were appropriate for the institutional context, such as political and social acceptability, costs and benefits and capacity for implementation. The policy options presented in the report require additional detailed analysis that is beyond the scope of the GIWA and, as a consequence, they are not formal recommendations to governments but rather contributions to broader policy processes in the region.

Uruguay River Basin upstream of the Salto Grande Dam

Definition the of problem

The causal chain analysis carried out for pollution in the Uruguay River Basin identified the most significant immediate causes, sectors and activities, and the root causes of problems related to pollution and the deterioration of the quality of water resources in the basin. Intensive land use, coupled with agricultural practices designed to increase productivity, have increased the concentration of chemical substances, nutrients, and suspended solids in the rivers. The presence of pathogenic organisms in some parts of the River Basin results from failure to comply with regulations related to wastewater discharges, as well as from poultry and pig production. The lack of urban wastewater treatment also increases the concentration of nutrients. It is expected that the absence of policies governing the operation of dams for

irrigation purposes during low water periods will generate conflicts over water use, which will increase the problem of poor water quality in sub-basins such as Cuareim River Basin, where water resources are shared by Brazil and Uruguay.

The analysis revealed that the impacts of pollution result from root causes which can be categorised as follows:

- Economic;
- Technological;
- Legal;
- Governance;
- Knowledge.

More specific root causes include:

- Lack of a framework for Integrated Water Resources Management;
- Lack of stakeholder participation (Governance and Legal root causes);
- Inadequate valuation of goods and services (Economic, Governance and Knowledge root causes);
- Unsustainable agricultural practices (Knowledge, Technological and Legal root causes);
- Inadequate budget of institutions in charge of management, which causes the lack of enforcement of existing agreements and policies (Economic, Legal and Governance root causes);
- Poor dissemination of scientific and technological knowledge and training (Knowledge & Technological root causes);
- Market incentives (Economic root cause);
- Poverty (Economic root cause).

The economic and technological causes of pollution in the Uruguay River Basin are strongly linked to activities in the urban, industrial, and agricultural sectors. In the urban areas, significant discharges of urban and industrial wastewater are the primary causes of pollution. In rural areas, the excessive use of fertilisers and herbicides, particularly on rice and soy crops, soil erosion, and industrial and agricultural effluent discharges are the primary causes of pollution.

Even though pollution originating from urban areas and poultry and pig production exert the greatest influences on the Basin, these activities are generally restricted to the Upper Uruguay River. Although decision-making will require the involvement of stakeholders from each of the three countries sharing the Basin, national, state or municipal authorities in Brazil will have to make very important decisions to reduce future pollution and mitigate the impacts of existing problems.

Chemical pollution due to the use of biocides is most significant in the Lower Uruguay River. In this case, Argentina and Uruguay must develop and implement policies linked to agricultural practices. In the Lower Uruguay River, eutrophication is a major pollution issue, and nutrients originate from within the entire basin. Furthermore, in the Salto Grande Reservoir, backwater conditions favour the accumulation of sediments and the nutrients they carry.

It should be highlighted that possible options for intervention at the basin level cannot be implemented by only one country. In order to address issues related to governance and knowledge, particularly the harmonisation of laws, coordination of policies, exchange of information, resolution of conflicts, and engagement in territorial planning discussions, appropriate transboundary instruments with

the capacity to implement management strategies at the sub-basin level must first be created. Although new ideas and approaches are emerging, transboundary issues are usually not considered in the social, political and economic decision-making culture of the region. Therefore, it is necessary to introduce new ways of governance and management to incorporate these perspectives.

Construction of policy options

The following section presents a list of potential policy options for preliminary evaluation, and is based on several different criteria, including efficiency, effectiveness, equity, political feasibility, and application capacity. Based on the results of this preliminary evaluation, several potential policy options will then be recommended.

Policy options for Integrated Water Resources Management

Governance

- Coordinate inter-ministerial/inter-territorial policies. This implies a real change in policy formulation and implementation. Argentina, for instance, has created different coordination instruments among the provinces, such as the Federal Council of Environment, and the Federal Water Council.
- Initiate basin management mechanisms with an integrated transboundary approach that include and extend the scope of existing organisations (e.g. the Administrative Commission for the Uruguay River, CARU). An important step could be to establish working groups with technical coordination roles according to specific topics related to the management of both the quality and quantity of water. An integrated basin institution involving Argentina, Brazil and Uruguay could be created, or CARU could be extended to include the management of the Uruguay River between Argentina and Brazil. Alternatively, CARU could be transformed into a basin institution that involves all three countries.
- Implement mechanisms that secure the participation and support of a wide variety of stakeholders, especially stakeholders from civil society and from the private sector. Actors such as NGOs and the private sector should be incorporated into discussions that promote new links between regional and local governments. Brazil's basin committees are working in this direction and could be a good start as a mechanism for social participation.
- Establish local working teams that involve the private sector, NGOs, and the public, to facilitate both the systematic evaluation

of environmental problems, and the implementation of effective solutions. These teams could be used to build knowledge, strengthen human resource capabilities, and overcome the lack of enforcement of policies and agreements caused by inadequate institutional budgets. Although such mechanisms should be strengthened throughout the Uruguay River Basin, they require special attention in Uruguay, which currently has made the least progress towards developing effective basin organisations.

Legal

- Control water use and water pollution through the imposition of taxes. The funds generated from such a policy could be used to ensure management capacity and the enforcement of compliance with recognised standards. Brazilian laws have established a fee system for the use of water, as well as economic incentives for non-polluters. The same type of system should now be developed in Argentina and Uruguay.
- Establish land use regulations that address diffuse and point sources of pollution. To reduce the likelihood that water supplies important to neighbouring or downstream communities are contaminated by pollution, critical areas to protect the quality of water could be defined near key boundaries between nations, states, or communities. The low cost of marginal land next to populated centres could be used to construct artificial wetlands that filter and control the movement of pollution through the hydrological system.
- Coordinate and harmonise water quality standards throughout the Uruguay River. Locations with existing transboundary conflicts or the potential for future conflicts should be targeted first.
- Harmonise legal tools among all three countries concerning Integrated Water Resources Management, as well as other comprehensive frameworks for managing natural resources with integrated approaches.

Economic

- Strengthen and coordinate financial mechanisms between the public and private sectors.
- Create economic incentives for non-polluters.

Policy options for wastewater treatment

- Construct and maintain wastewater treatment infrastructure on the Middle and Upper Uruguay River. In order to achieve this goal, financial support must be obtained from both public (national and international) and private sources.
- Tertiary treatment of wastewater should be pursued. However, special attention should be paid to final effluent disinfecting

systems, since the elimination of pathogens with chlorinated disinfectants could produce secondary compounds with significant impacts on biota.

- When deciding upon the method and location for the disposal of sludge that results from the wastewater treatment process, a wide range of stakeholders should be consulted.

Policy options for agricultural practices

- Impose levies on high water consumption or the excessive use of biocides.
- Implement legal mechanisms to control the use of biocides, including the establishment of penalties.
- Introduce the 'polluter-pays' legal concept in Argentina and Uruguay to create market incentives for non-polluters.
- Carry out systematic campaigns to promote awareness among farmers and the public concerning the risks associated with the use of pesticides and herbicides (biocides).
- Carry out pilot studies on alternative methods of pest and weed control.
- Educate and train farmers on more sustainable agricultural practices that improve irrigation efficiency and decrease the amount of biocides applied to fields.
- Educate and train farmers on more sustainable agricultural practices that conserve soil structure and decrease soil erosion, such as direct sowing techniques, which can significantly decrease the rate of soil erosion (IPH 1998).
- Conduct educational campaigns to raise awareness and engage stakeholders, including teachers, students, farmers, industries, and national, regional and local governments.
- Introduce technologies for the treatment and reuse of effluents that originate from livestock production, especially in the Upper Uruguay Basin. This could be facilitated through credits or subsidies.

Performance of selected policy options

Policy option 1: Improve wastewater treatment by strengthening and coordinating financial mechanisms between the public and private sectors

The lack of municipal wastewater treatment systems in the main urban centres of the sub-basin, especially in the poorest municipalities, is a basic problem that must be addressed. Wastewater treatment facilities should be constructed, and existing facilities should operate effectively.

According to regulations, governments at different levels should assume the costs of wastewater treatment. However, current practices of data aggregation makes it difficult to compare poverty indicators at the municipal level. The data that does exist indicates that basic sanitation needs are not being met, and financial resources should be sought to address this deficiency. Various funding mechanisms or other innovative approaches, such as the establishment of a special international fund, should be examined to ensure the most effective and expeditious transfer of environmentally sound technologies to developing countries (UNCED 1992).

Wastewater treatment systems could be financed either by government funds or by the private sector (concessionaire of the service). However, the re-payment capacity of the inhabitants is a problem. When this problem occurs within Brazilian municipalities of the Uruguay River Basin, this has ramifications for the whole basin, since all other areas are downstream from Brazil.

The operational costs of wastewater treatment facilities could be met by a mixed system of costs paid by water supply users according to their ability to pay, combined with public budgets through transparent subsidies. In accordance with the United Nations Millennium Declaration (United Nations 2000), bilateral and multilateral donors should increase financial and technical assistance to meet the wastewater treatment needs of developing countries. To access different financial mechanisms at the international and national levels, the construction of wastewater treatment facilities requires the formulation of plans that contain clear goals and investment evaluations.

Instrument: Construction of infrastructure for urban development/ wastewater treatment systems.

Efficacy: The policy option has a high efficacy to solve the pollution problem.

Efficiency: The likelihood of accomplishing goals depends on the availability of funds from regional (states, provinces, departments) and local governments (municipalities).

Equity: This action would have a deep impact on equity, as it would substantially improve the environment and the quality of life, especially in poor municipalities.

Political feasibility: Undoubtedly, both the municipalities and their authorities are allies. There is no evidence of previous efforts made by national governmental actors to solve this problem. If financial

resources were obtained, stakeholders would approve the construction of infrastructure.

Implementation capacity: Local capacity to manage/administrate the entrepreneurship is uncertain. Human resources from outside the municipalities involved will probably be required.

Policy option 2: Promote the adoption of sustainable agricultural practices

This policy option could be addressed taking a basin-wide or sub-basin approach. Relevant information on alternative herbicides and fertilisers is not publicly available. There is generally very little information about products currently in use or their alternatives. However, their impact on the cost of rice per hectare can be estimated as less than 10% of the total and there are alternatives to traditionally used fertilisers and biocides. The establishment of policies that promote the use of environmentally appropriate alternatives to agro-chemicals, as well as tighter controls on water use, both seem to be viable policy options. Programmes promoting direct sowing technology have also proved to be useful for reducing soil erosion in the Upper Uruguay Basin (IPH 1998).

Instrument: Enforcement of regulations for water use, and regulations governing the use of fertilisers and herbicides (including 'polluter pay').

Efficacy: The policy option has high efficacy for achieving rational use of water resources and decreasing pollution levels. This measure would raise awareness among producers, citizens and decision-makers of the causal links between the condition of the environment and agricultural and livestock production, and would encourage the adoption of agricultural methods that are more likely to be sustainable.

Efficiency: Producers who adopt sustainable technologies will eventually absorb the costs. However, costs will not be above 10% of the total investment. The success of this policy depends on the attitudes of the lobbies representing the agricultural and livestock sectors and the support of governmental authorities (not shown until now).

Equity: Responsibility for environmental degradation is linked to the obligation to pay for it or change products, which tends to generate social and environmental equity.

Political feasibility: Non-polluting producers as well as the population in general will support the idea. However, it would certainly be necessary to deal with lobbies and pressures from the entrepreneurial sector in order to carry out this policy. Also, from a cultural point of view,

the main interest of local populations is economic growth irrespective of environmental costs. Soy and rice production are undoubtedly polluting activities and alternative sustainable methods of production are not yet available. It is evident that all producers will be strongly against this option.

Implementation capacity: Initial identification of the polluters and the development of effective mechanisms are both required prior to the implementation of any economic tools. Public sector capacities should also be strengthened in order to make this policy feasible. To carry out this measure, national governments must be supported to achieve agreements with producer organisations.

Policy option 3: Carry out systematic campaigns of environmental awareness and education

It should be highlighted that there is a great lack of knowledge in the Basin concerning links between the economy, the environment, human health, and legal aspects of environmental management. Furthermore, efforts towards education and public awareness of environmental issues are central on the agenda. At the policy option level, it is necessary for the public to acknowledge that water resources are valuable and that their appropriate management is desirable.

Instrument: Environmental Education Programmes tailored for specific stakeholders and problems.

Efficacy: This policy option has high efficacy in terms of process sustainability.

Efficiency: Difficulties in carrying out this policy are foreseen if differences between actors are not considered. Different education modalities should be used according to target actors; further research is necessary.

Equity: This option promotes equity among stakeholders through raised awareness and the wide dissemination of information.

Political feasibility: The support and opposition to this option will depend on how environmental education is carried out. If education fosters development it will find allies. However, if the educational approach closes the way to production and development upon the grounds of a healthy environment, it will surely fail and it will not find enough support to justify a massive programme. The balance achieved among actors involved in education is essential to secure support and disseminate knowledge of more sustainable methods of production.

Implementation capacity: Alliances with the social, economic and educational sector must be sought in order to carry out the educational campaign. An innovative education programme should be based on specific and multidisciplinary courses. However, courses are generally too technical, or are based on an environmental approach that does not consider sustainable development. The agreements obtained and the diversity of people responsible for education is essential for the success of the environmental education policy.

Policy option 4: Treat and/or reuse wastes originating from livestock production

This policy option relates to previous options. It is difficult to build wastewater treatment systems for the small and medium-scale rural production of poultry and pigs. Therefore policy options should be linked to the industrialisation phase.

Instrument: Incorporating environmental considerations in the industrialisation of pig and poultry production. Industries that comply with environmental policies and treat or reuse wastewater could benefit from subsidies, and those that do not meet requirements could be penalised by sanctions.

Efficacy: This policy option has medium efficacy for reducing water pollution levels.

Efficiency: The success of this option depends on the attitude of lobbies associated with the production sector and the support of government authorities (not shown until now).

Equity: This measure favours equity, as sanction mechanisms would transfer financial resources to the community from polluters, in order to efficiently implement environmental policies.

Political feasibility: As in the previous policy, the majority of politicians and all social actors will be allies. Nevertheless, fears generated by economic and political lobbies, and statements about the potential negative impacts these measures will have on employment are certain to appear.

Implementation capacity: The policy's success will depend on the capacity of local, regional and national governments. The presence or absence of conflict in the implementation of policies will depend on the negotiation capacities of the production sector.

Policy option 5: Create basin management mechanisms with a transboundary and integrated approach, that includes and extends the scope of existing institutions

Some aspects to be considered with these types of initiatives include:

- Overlapping competencies and administrative and institutional fragmentation. The co-existence of competence in supra-national, national, territorial, and local governments can often lead to conflict. When faced with new basin management mechanisms, it is necessary to generate new ways of governance that include all stakeholders and management agencies.
- Cooperation between different public bodies. Mechanisms should be established that promote inter-state cooperation at various levels and in different fields of expertise. The existing administrative fragmentation is a difficult problem to solve. However, participation by all governmental actors through the appropriate administrative and management bodies should be promoted.
- The participation of local stakeholders is crucial. Territorial actors, including individuals representing provinces, states, small communities, NGOs, farmers, local governments and industries, are often competent and knowledgeable. Consequently, mechanisms that incorporate their opinions during both the planning and implementation of policies can help lead to policies that are comprehensive, equitable, and implementable.
- Although transboundary cooperation is an essential component of sustainable river basin management, historical and cultural factors have not promoted the necessary cooperation among countries within the river basin.

Instrument: A new institutional order to support the basin's governance or a Basin Agency will be created based on existing institutions. The structure of this institution would be based on national governmental levels, with the participation of local government, and a consideration of the opinions of local stakeholders.

Efficacy: The policy option has high efficacy for managing transboundary water resources.

Efficiency: The successful implementation of this option depends on the willingness of existing institutions (i.e. CARU) to harmonise and transform their roles and goals. Social legitimisation and respect of the laws will depend heavily on how well the opinions and knowledge of regional social and economic actors are included.

Equity: This option fosters equity as it encourages more participation and commitment in the decision-making process.

Political feasibility: The local governments and the main economic and social actors will be allies in the suggested policy. There would certainly be opposition from national governments, as the delegation of power on supra-national mechanisms will present resistance. There are already a few institutions working on the generation of management mechanisms with a transboundary approach, which can serve as embryonic basin authorities.

Implementation capacity: Human and legal resources will be required for the new institutional mechanism proposed for basin management. The development of a network of connections and trust among the different actors involved is also needed. The policy definition in the stated terms - negotiation, environment and mutual trust - is the key to efficiently manage the challenges and appears to be the only way to deal with the area's challenges in terms of development and environment in the medium and long-term.

Final considerations

To avoid the duplication of actions and/or conflicting objectives, the development and implementation of the policy options discussed above should be integrated with existing programmes, including: Environmental Protection of the Rio de la Plata and its Maritime Front, Pollution Prevention and Control and Habitat Restoration (Argentina and Uruguay), and Environmental Protection and Sustainable Integrated Management of the Guaraní Aquifer (Argentina, Brazil, Paraguay and Uruguay).

The causal chain and policy option analyses focused on identifying the most significant root causes of problems stemming from pollution in the Uruguay River Basin, and considered possible options to mitigate them. In recommending suitable policy options, priority has been given to those instruments whose effectiveness can be assessed in the short-term (pollution reduction measures, construction of infrastructure), as well as others that would have an impact in the short to medium-term (related to new ways of governance and environmental education).

In addition, options that recognise and address the links between production development policies and environmental problems have also been suggested. This is particularly relevant for those aspects related to rice and soy production in the Middle Basin, as well as those related to poultry and pig production in the Upper Basin.

Finally, it is important to bear in mind that all measures proposed can be effective in relatively short time frames, provided that relevant political measures are taken, and some advances have been made by the three countries involved in this direction. This, added to the creation of an institutional framework to improve basin governance, would guarantee big chances of success for decreasing pollution in the Basin.

Buenos Aires Coastal Ecosystem – Argentinean-Uruguayan Common Fishing Zone

Definition of the problem

The most important immediate causes of habitat and community modification, from a transboundary point of view, include the unsustainable exploitation of marine living resources, and pollution and habitat degradation associated with shipping activities. Transboundary impacts include the depletion of fish biomass, excessive by-catch, depletion of fauna in higher trophic levels, and habitat degradation. These impacts validate the perception of widespread unsustainable exploitation of marine living resources, and habitat and community modification within the Buenos Aires Coastal Ecosystem, as well as the Argentinean-Uruguayan Common Fishing Zone (Zona Común de Pesca, ZCP). With respect to pollution and habitat change due to shipping activities, the poor state of knowledge on the environmental and socio-economic impacts of these issues does not permit valid policy options to be developed for these issues.

Living marine resources are subjected to intense fishing pressure by both countries (Argentina and Uruguay), and currently are in a critical situation due to unsustainable exploitation practices, such as overexploitation of target species, incidental by-catch, and modification of the sea floor. Fisheries throughout the area involve mismatches between coastal and marine ecosystems on the one hand, and the institutions and markets on the other.

Fisheries should be managed sustainably to ensure that living resources are not depleted, which is analogous to spending income while ensuring that the standing stock of capital remains intact. If the resource extraction rate is higher than the renewal rate, the price of resources tends to increase as they approach depletion, fishing effort increases in response to these market forces, and wealth availability typically decreases.

Many coastal countries face problems similar to those found in this area. Fish stocks are usually regarded as a common property resource, and fisheries are often characterised by inadequate management, levels of fishing effort that prevent the sustainable reproduction of fish stocks,

intensive exploitation of only a few species, high levels of by-catch, and fishing practices that contribute to habitat degradation (Pauly 2002).

Argentina and Uruguay have appropriate internal legal frameworks and coherent bilateral regulations through the 'La Plata River Treaty and its Maritime Front'. Nonetheless, root causes associated with governance, policy, and knowledge prevent legal instruments from being applied in an effective manner.

This section presents potential policy options to address the major root causes presented in the causal chain analysis. In addition, policy options to promote improvements in technology that consider socio-cultural factors are also analysed. The importance of knowledge availability is also recognised as an essential component to ensure that adequate capacity exists for making management decisions and implementing policies.

Buenos Aires Coastal Ecosystem

The Argentinean fishing sector operates as a highly complex open system that interchanges goods and products with other economic systems, demands production factors, satisfies direct and indirect needs of the community, and influences the natural and social environments.

The Fisheries Economic System (FEP) is comprised of a complex set of rules, customs and institutions that regulate the behaviour of fishers based on resource availability. The fisheries economic system includes the primary (fishing), secondary (industrial), and tertiary (services) sectors related to fisheries, and a complex set of rules, customs, and institutions to regulate the behaviour of actors within this system. The FEP requires production factor inputs, including resources, capital, and working capacity, which affects levels of employment according to fishery cycles of higher and lower production. The fisheries sector is characterised by high-risk investments due to the degree of uncertainty associated with yields and the difficulty of fulfilling investments, which tends to lead to overcapitalisation in the long-term. Outputs of the fishery system include: employment, income generated from the sale of catches (wages, salaries and benefits for workers and entrepreneurs),

invested capital revenues, fisheries resource rent (in licensing fees, etc.), and important sources of food and protein. Fisheries development should be regulated according to criteria that promotes long-term sustainability. Criteria for fisheries sustainability should consider environmental, economic, social and political factors.

Common Fishing Zone (Argentina-Uruguay)

The FES of the Common Fishing Zone is composed of three sectors: primary (fishing activities), secondary (industrial and processing activities) and tertiary (local and foreign markets and sale of products). The theoretical framework within which potential policy options have been proposed focuses on the different sectors involved in fishing, and considers several interrelated factors, including the health of stocks and species targeted by each country's fleet, the amount of fish caught by fishing fleets, the fish processing industry, and finally, markets selling processed fish products. The performance of fisheries can be described by analyzing each economic sector. It is also possible to evaluate the possible impacts of different exploitation strategies and construct scenarios of foreseeable consequences.

Construction of policy options

Policy options developed included existing planned policy actions as well as ideas not yet discussed in traditional forums. Potential policy options were evaluated according to several criteria (efficiency, effectiveness, equity, political feasibility, and application capacity). Only those that were feasible or that would be expected to yield tangible results were advanced as recommended policy options. Proposed policy options are categorised within one of two geographical areas: the Argentina-Buenos Aires Coastal Ecosystem, and the Common Fishing Zone (ZCP Argentina-Uruguay). Policy options in each of these jurisdictions are presented in relation to prioritised immediate causes and relevant root causes.

Policy options for the Buenos Aires Coastal Ecosystem

Governance

Many aspects of the overexploitation of target species, by-catch, and habitat modification are associated with governance root causes. Environmental considerations are often not adequately integrated within public policies, there is a general lack of integrated coastal zone management plans, a lack of coordination between different institutions and different levels of government, and inadequate budget allocations for a thorough assessment of the Buenos Aires Coastal Ecosystem.

It should also be mentioned that there have been numerous efforts (research, development and monitoring), on administrative, scientific, and entrepreneurial fronts, to develop guidelines that would regulate the sustainable exploitation of ecosystems and their natural resources. State research institutes and universities carry out research and development activities to advise policy-makers, authorities, producers, and entrepreneurs. The administrative sector has on numerous occasions resolved to integrate ecosystem coordination and management. Nevertheless, there is a trend towards the formulation and application of short-term policies, which remain poorly integrated with global policies of structural type (national policies for sustainable exploitation of natural resources, environmental conservation, etc.).

There should be a distinction between aspects of governance incorporated in 'state policies' and those included in 'government policies'. State policies are structural and their design and execution involves long-term application independent of the current elected government. Government policies are based on the political orientation of the government in power, and require design and execution characterised by flexibility, opportunity, and short-term application.

Policy options related to governance could include:

- Delimit boundaries for the coastal area, and enforce restrictions for vessels operating within the defined area. For instance, access should be restricted to vessels under 25 m in length and inshore of the 50 m depth contour between the latitudes 34° S and 42° S.
- Regulate fishing effort in Argentina and respect historical rights acquired by vessels that traditionally have operated in the area. These include the smallest fishing boats (painted yellow), which operate mostly from Mar del Plata, Necochea and Bahía Blanca.
- Adopt stronger unification criteria in fisheries policies between the national, state and Buenos Aires provincial governments.
- Link fisheries development to national programmes for preserving the marine environment.
- Reorient research policies to reconcile research and development issues with state policies.
- Optimise national, provincial, and state budget allocations to fisheries management agencies.
- Develop a mechanism to finance long-term research aimed at achieving the sustainable management of natural resources.
- Coordinate and share research information obtained by different projects at the national (e.g. SECYT, INIDEP, NGOs) and international levels, in order to optimise results and maximise existing sources of funding. Implement specific actions to mitigate the impacts of fishing on biodiversity.

- Optimise communication systems among scientists, administrators and managers to facilitate the application of scientific results to fisheries management.
- Improve the capacity of land-based and on-board fisheries inspectors to undertake control and monitoring activities.
- Reformulate existing mono-specific fisheries management systems that do not recognise the importance of interactions between species (predator-prey equilibrium), and that do not assess the capacity of the ecosystem to recover from fishing activities (ecosystem resilience, population viability, etc.).
- Review the obligations of the Secretariat of Agriculture, Livestock, Fisheries and Food (SAGPyA), which is the national fisheries application authority, and the Federal Fishing Council (CFP).
- Include within the "Pluriannual National Plan" of the National System of Science and Technology (SECyT) a National Programme of Preservation of the Marine Environment that considers different development policies. Within this programme, the following national priorities should be included:
 - Identification, characterisation and delimitation of marine ecosystems.
 - Promoting awareness of the importance of top predators (i.e. cartilaginous fishes, marine mammals) in marine ecosystems, and their roles in controlling prey populations.
 - Implementation of actions aimed at reducing the number of incidental catches of cartilaginous fishes, mammals and marine birds, especially those most threatened. The goal should be to maintain the number of accidental captures below levels that will affect the health and continued existence of those populations.

Knowledge & Technology

The overexploitation of target species is often caused by inadequate scientific knowledge on coastal and shelf species, and unreliable fisheries statistics. The management of multi-species coastal fisheries is a particular challenge. In any multi-species fishery where all species are subject to the same fishing effort and death rates per catch, less abundant species risk extinction, even if dominant species are able to persist (Mussik 1997, Camhi et al. 1998). Likewise, species included in by-catch might be indirectly more vulnerable than target species because their abundance is poorly monitored and signs of declining catches may go undetected (Camhi et al. 1998).

Therefore, in the absence of basic technical standards and guidelines for sustainable exploitation, managing a multi-species fishery involves taking precautions to protect the more vulnerable species, such as cartilaginous fishes. In addition, it is essential to monitor stock (volume)

indices obtained from commercial fleets, as well as those gathered from specific assessments of the abundance of species affected by multi-species fisheries.

The goal should be to develop an adequate "model" to ensure the sustainable exploitation of both fish stocks and the ecosystem. This requires high-quality data that describes the current conditions of the fishery and ecosystem, and predicts changes to fish stocks and the condition of the environment as a result of fishing activities. The causal chain analysis identified inadequacies in data management, lack of biological knowledge for some species, and lack of knowledge of the impacts of fishing on the ecosystem as significant contributors to the inadequate management of fisheries resources. The failure to obtain the specific knowledge required to manage fish resources sustainably is directly attributable to the lack of research policies to encourage the investigation of the ecological consequences of fisheries.

It will be the responsibility of the science and technology sectors as well as academics to raise awareness and to advise authorities on the benefits of focusing on more long-term global policies, rather than the current focus on short-term policies which are poorly integrated.

Suggested specific policy options related to knowledge include:

- Continue efforts to analyse existing fisheries data (catches, landings, exports, domestic sales, etc.), and obtain additional data in order to manage fisheries resources appropriately;
- Promote studies that investigate the impacts that fishing gear has on the sea floor and benthic communities;
- Involve fishermen in the development of selective fishing gears;
- Restructure the scientific research conducted on fisheries and fish stocks to focus on investigating the impacts of fishing, and monitoring the condition of the marine ecosystem;
- Increase the number of qualified technical staff in institutions responsible for fisheries administration;
- Increase the knowledge of local scientists and managers to regulate multi-species fisheries by obtaining practical advice and assistance from experts concerning the management of such systems;
- Improve monitoring of the most vulnerable species within fishing grounds.

In order to carry out several of these policies, the main problem is that resources are partly shared with Uruguay in the Common Fishing Zone. Since a management system established by the Technical Commission of Maritime Front (Comisión Técnica Mixta del Frente Marítimo, COFREMAR) already exists, some policy options would not be fully viable under the current institutional framework.

Economic

Market performance (associated with resource exploitation) and entrepreneurial profit (achieved by market operators) were identified as economic root causes. However, the international economic environment, as well as the national market system and their operators are highly influential, and as a result, policies for addressing economic root causes seem to have low feasibility.

Nonetheless, initiatives to promote new exploitation strategies and influence markets and economic factors, could be promoted, including:

- Develop new fisheries products, based on clear scientific assessments;
- Establish a promotional organisation associated with the Argentinean Ministry of Foreign Affairs, to strongly influence the private sector and promote the diversification and acceptance of non-traditional fish products.

Policy options for the Argentinean-Uruguayan Common Fishing Zone

The overexploitation of target species, by-catch, and habitat destruction are caused by failures in regulatory frameworks, inadequate budgetary allocations for ecosystem management, and disagreement between Argentina and Uruguay on matters such as the management of shared resources (Governance). There is also a lack of scientific data on many coastal and continental shelf species, and unreliable statistics (Knowledge).

Governance

Suggested policy options to address governance problems include:

- Joint regulation of fishing activities by both Argentina and Uruguay. In this respect, a positive step has been to define marine protected areas and promote fishing gears that selectively target desired species (Mizrahi et al. 2000).

If joint regulations are considered unfeasible, it would be appropriate to:

- Institute compatible fisheries management regulations (Argentina-Uruguay) where each country retains the freedom to develop its own fishery exploitation model but the overall objectives and principles of each model are consistent.
- Carry out studies investigating the selectivity of various fishing gears to support management regulations (minimising by-catch, safeguarding biodiversity and the habitat).
- Joint assessments of the condition of resources by both Argentina and Uruguay. This would help enable the collection of more reliable scientific data. Continuity in bilateral research programmes is necessary for these assessments to occur.

If joint assessments are not possible, an alternative could be to:

- Evaluate the state of resources separately, but maintain common protocols for collecting and analysing data on factors such as catches of different species, landings, by-catch, exports, domestic sales, and imports. This would help to assimilate all of the information required for fisheries research and management.

Knowledge

- Carry out studies to investigate the selectivity of various fishing gears, in order to support management regulations that would aim to minimise by-catch and safeguard biodiversity and habitats.
- Expand research on species being discarded as by-catch.
- Involve fishermen in research and development to increase the selectivity of fishing gears and devices.
- Disseminate information throughout communities to foster public awareness about goods and services related to ocean ecosystems and the importance of proper management.
- Launch educational campaigns among the general population in order to discourage consumption of products based on living resources and species that face extinction and/or whose exploitation is incompatible with an ecosystem-based approach.
- Promote the exchange of data and knowledge among regional organisations, such as common research units and workshops (Argentina, Uruguay and Brazil) to identify shared resources. These activities should complement existing tools that specifically deal with fisheries, including the Río de la Plata Treaty (Tratado del Río de La Plata, TRP) and the Comisión Técnica del Frente Marítimo (CTFM). Other vehicles for information dissemination and participation include seminars and discussion forums.

Identification of recommended policy options

Since root causes of overexploitation are diverse, they require management policies based on a set of multiple and complex actions and tools, to be applied simultaneously.

Actions recommended for the Buenos Aires Coastal Ecosystem

- Zone coastal waters to permit only small traditional vessels in certain areas (Governance).
- Optimise criteria for national and local budget allocations to institutions in charge of management (Governance).
- Refocus research policies according to state objectives regarding research and development (Governance).

- Establish a mechanism for financing long-term Research and Development (R&D) in order to achieve sustainable exploitation of fish resources (Governance).
- Integrate research data from different projects at the national (SECYT, INIDEP, and NGOs) and international levels (Governance).
- In conjunction with other development policies, develop a programme that promotes the preservation of the marine environment within Argentina's science and technology system (SCYT) (Governance).
- Involve fishermen in the development of technologies that increase selectivity of fishing practices, gears and devices (Knowledge & Technology, Governance).
- Standardise the collection and analysis of fisheries statistics, including catches, landings, exports, imports, and local sales, in order to assimilate the information required for adequate fisheries research and management (Knowledge).
- Disseminate information throughout communities to foster public awareness about goods and services related to oceanic ecosystems and the importance of proper management (Knowledge).
- Launch educational campaigns among the general population to discourage consumption of products based on living resources and species that are at risk of extinction and/or whose exploitation is incompatible with an ecosystem approach (Knowledge).

Actions recommended for the Argentinean-Uruguayan

Common Fishing Zone

- Institute compatible fisheries management regulations between Argentina and Uruguay. Each country would retain the freedom to develop its own fisheries exploitation models, but the overall objectives and principles of each model would be consistent (Governance, Knowledge).
- Jointly assess the condition of resources and procure more reliable scientific data. This requires continuity in bilateral research programmes (Governance, Knowledge).
- Standardise the collection and analysis of information (catch, unloading, exports, imports, local sales), in order to assimilate information required for fisheries research and management (Governance, Knowledge).
- Carry out studies to investigate the selectivity of various fishing gears, to support management regulations aimed at minimising by-catch and safeguarding biodiversity and habitats (Knowledge, Technology).
- Expand research on species that inhabit similar environments as target species and are being discarded as by-catch (Knowledge).
- Promote the exchange of data and knowledge among regional organisations, such as common research units and workshops (Argentina, Uruguay, Brazil), in order to identify shared resources (Knowledge).

Performance of selected policy options

Selection of assessment criteria for policy options

Policy options proposed to mitigate the overexploitation of fish species will be assessed using available economic and social indicators (mentioned in the Causal chain analysis, Causal model and links). Indicators include the abundance of different species, catch (in tonnes per square nautical mile and/or operative unit), maximum catch per tide (i.e. between high waters), and the number of people employed in the fishing fleet and in fish processing plants. The choice of these indicators is justified for the following reasons:

- They are considered useful for the socio-economic assessment described in the causal chain analysis;
- They illustrate the magnitude of impacts on the ecosystem;
- They are obtained using a known method and are easily available.

Analysing the effectiveness of options for preventing the overexploitation of target species by changing conditions related to root causes of governance, knowledge, technology, and socio-cultural elements requires repeated monitoring of key indicators to determine whether proposed actions are achieving desired objectives. In addition, potential detrimental impacts of proposed policy options should also be identified and analysed.

Policy option 1: Regulating fishing effort in Buenos Aires Coastal Ecosystem

Effectiveness: A policy that limits fishing effort to levels that reflect the estimated annual ecosystem surplus of 80 000 tonnes would be likely to produce an increase in the standing stock biomass of inshore species along the coast of the province of Buenos Aires (Carroza et al. 2001a). Future monitoring of changes in the stock sizes of species could be used to indicate the effectiveness of actions. In connection with the successful enforcement of actions, adverse or collateral effects must be taken into account, particularly negative socio-economic impacts on the private sector (primary, secondary, and tertiary), such as those suffered by fishing operators who are excluded from certain fishing grounds (those with ships longer than 25 m).

Efficiency: The benefits derived from conservation and management are likely to build up over time, as these measures promote their long-term availability. However, in order to achieve the sustainable use of natural resources, considerable proportions of management budgets will have to be spent on monitoring and enforcement.

Equity: By preserving the ecosystem and ensuring it does not become irreversibly degraded, this would benefit everyone in the community over longer time scales. Over short time frames, operators of fishing boats shorter than 25 m, and traditional crafts sailing from the provincial ports of Buenos Aires, would directly benefit from this policy. However, the operators of ships longer than 25 m, which would be excluded from certain zones, and the land-based operations that depend on the fish caught by these larger vessels, are the groups that would stand to lose the most from this proposed option.

Furthermore, these operators would not be entitled to compensation under the current circumstances. Implementing this option is also likely to incur political costs on certain administrators and managers. However, when considering the total costs and benefits over longer time scales, sustainable management of fisheries using an ecosystem approach seems to be fully justified. Monitoring economic indicators will enable quantitative and qualitative appraisals of the impacts of the proposed option.

Political feasibility: Excluded sectors will always be opponents and may present obstacles and block enforcement. There is also a tendency towards a stubborn bureaucracy and economic and social forces that wish to maintain the status quo. These forces include political, business and union lobbies.

Implementation feasibility: Resources (human, financial, technological, and legal) are not considered sufficient for implementing the proposed option. In today's Argentina, a lack of professionalism among managers and poor leadership among politicians are seen as the main stumbling blocks. However, scientific, academic and research groups may eventually convince officials of the pressing need to exploit natural resources in a sustainable manner. However, the political will for this is currently deemed to be weak.

Policy option 2: Enhance governance and knowledge in Buenos Aires Coastal Ecosystem

Effectiveness: The objective is to strengthen institutional capacities in research, education and outreach, and enforcement, in order to propose and apply regulatory measures. Education and outreach are tied in with governance, as this will help to foster increasing awareness among fishers on the need for sustainable exploitation of the ecosystem, will build up an understanding and trust of scientific research among fishers, and will help promote conformity with regulations.

In order to achieve this objective, a key factor will be the institutional strengthening of the National Institute of Fisheries Research and Development (INIDEP). This includes employing temporary personnel full-time, increasing the budget of the institution by 25%, guaranteeing funding for research ships and campaigns, funding projects related to monitoring and control, reinstating the 12% cut from the budget in 2002, and incrementally building a 20% increase for research, while continuing current projects with at least 10 professionals in the first two years of field work.

Adverse and collateral effects: No direct risks are associated with the implementation of this option. However, there may be obstacles such as bureaucracy, red-tape, lack of planning, cultural or traditional limitations, and rising financial costs.

Efficiency: Benefits derived from conservation and management will accrue as these measures promote optimum exploitation of resources and ensure the long-term availability of resources. However, to achieve sustainable use of natural resources, a considerable proportion of management budgets must be spent on monitoring and enforcement.

Equity: Preservation of the ecosystem will benefit many stakeholders and the community. In addition, operators of smaller ships shorter than 25 m and traditional craft sailing from Buenos Aires provincial ports will also benefit directly. Operators of ships longer than 25 m, which will be excluded from the proposed coastal area, and the land-based operations that depend on the fish caught by these larger vessels will be the losers in the proposed option. Furthermore, under current circumstances, these operators would not be entitled to compensation. Certain administrators and managers may incur political costs from the implementation of this option. Losses and gains are fully justified in terms of the rational exploitation of resources and the ecosystem approach to managing fishing grounds. Monitoring of economic indicators will enable quantitative and qualitative appraisal of the impacts of the proposed option.

Political feasibility: Excluded interests will be hostile to the implementation of this option and might present obstacles to enforcement. In addition, stubborn bureaucracy and other economic or social interests, such as political, business and union lobbies, may also hinder the implementation of this option. Management capabilities and resources (human, financial, technological, legal) are not considered sufficient to implement the proposed option. However, the implementation of programmes to enhance the capacity of managers would yield medium and long-term benefits. Unfortunately though, political will is, at present, insufficient to ensure the success of this option.

Policy option 3: Overcome technological restraints and conflicts arising from socio-cultural traits in Buenos Aires Coastal Ecosystem

Effectiveness: The objectives are:

- To incorporate equipment, best practices, and technological developments that increase the selectivity of various fishing gears into fisher's practical and operative knowledge.
- To generate awareness among the general population on the importance of sustainable management of marine ecosystems.

The first objective could be achieved through the implementation of research projects on selective fishing by scientists or technicians at the INIDEP. Such initiatives should involve coastal fishers, preferably from the cooperative that gathers most small ships along the Buenos Aires shores. The second objective could be achieved through the implementation of public awareness campaigns, using television, radio and newspapers that disseminate information that describes the value of marine resources, ecosystem services, and endangered species. It would be expected that such a campaign would reduce the consumption of products produced in environmentally damaging ways, and would generate acceptance of management interventions that promote the sustainable use of marine resources.

Adverse and collateral effects: No definite hindrances are apparent. However, there may be some unforeseen obstacles caused by the cultural traditions of fishermen, which must be taken into account and treated tactfully. If not, their natural mistrust and aversion to change will prevent them from supporting managers openly, even if they usually cooperate with scientists and technicians in developing devices for selective fishing. Also, political bureaucracy and the costs associated with implementation, monitoring and enforcement may slow down actions.

Efficiency: Expected outcomes are the adoption of selective fishing practices and gears and the development of pro-environmental behaviour among all parties concerned with the sustainable exploitation of resources. Such attitudes will be perpetuated as long as stakeholders continue to be included in the development process. Projected economic and financial costs can be allocated to education and dissemination, research and development, administration, monitoring, and enforcement. It could also be divided between immediate and longer-term costs.

Equity: All members of society are winners in the long-term if ecosystem conservation can be achieved. If there are any losers over the short-term, this will be wholly justified by the sustainable use of

sea resources, and an ecosystem-based approach to approach to the management of fishing grounds. Monitoring of socio-economic indicators, such as the number of selective devices in use, their degree of acceptance among fishermen, and the success of current educational campaigns, will provide quantitative and qualitative information to describe the impacts of proposed options.

Political feasibility: A stubborn administrative bureaucracy might limit the effectiveness of this option, although this type of intervention is generally accepted and is considered by most social groups as favourable. Moreover, politicians that promote such actions present a good image and, as a consequence, secure widespread approval.

Implementation feasibility: Economic resources required for advertising, public awareness and community education campaigns are usually high. Considering Argentina's current situation, the likelihood of diverting funds from the existing scarce budgets towards areas considered less essential to people's bare needs is not very high.

Policy option 4: Address political questions, governance and state of knowledge in the Argentinean-Uruguayan Common Fishing Zone

Effectiveness: The objectives are:

- To maintain and strengthen institutional capabilities in both countries.
- To advocate and implement measures to manage ecosystems sustainable.
- To standardise data collection and analysis in the Common Fishing Zone (FAO 1995).

The success of the proposed option could be measured through the number of joint projects implemented, as well as by establishing agreements for standardising data collection and analysis within both countries. The initiation of projects to investigate selective fishing practices in the area would also be a measure of success.

Adverse or collateral effects: There are no apparent risks associated with the implementation of this option. The obstacles are bureaucracy, lack of long-term plans, problems associated with the standardisation of data collection and handling procedures, and political pressure in both countries.

Efficiency: Expected benefits would be derived from the long-term sustainable exploitation of resources and the minimisation of risks that fishing and other extractive activities will cause ecosystems to collapse. Estimated costs include the time required by teams of qualified

scientists, as well as policies to define types of actions and draft a long-term "continuity strategy". Furthermore, these costs would have to be added to the management, monitoring and enforcement costs.

Equity: In general, the populations of Argentina and Uruguay will emerge as winners from sustainable exploitation in the Common Fishing Zone. In the medium-term, operators whose fishing activity would be limited if both countries initiate conservation measures simultaneously might suffer losses. As with other proposed policy options, gains and losses result from implementation of basic environmentally sound resource management principles. Advantages would be derived from the sustainable exploitation of natural resources and the application of an ecosystem-based approach to fisheries management. Monitoring of socio-economic indicators will provide quantitative and qualitative data that describe the impacts of the proposed option. In addition, monitoring and enforcement will provide continuity.

Political feasibility: The bureaucracies and foreign offices of both countries negotiate to prevent or deal with international conflicts. Therefore, negotiation and implementation are likely to be very slow processes. However, the implementation of the proposed option is deemed to be highly feasible.

Implementation feasibility: Scientific and technical knowledge is adequate for offering advice to both governments. However, Argentina and Uruguay are both undergoing deep economic and financial crises, which may delay the implementation of proposed options.