

# 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.**

## Patos-Mirim Lagoon system

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Before preparing the policy options to be recommended for the chosen concern (Pollution), it should be emphasised that the success of future actions is associated with their connection to the legal policies and institutions acting in the system studied. Thus, in the case of the studied aquatic systems, for instance, those policy options selected should be in harmony with the national policy concerning water resources and, also, provide the basis for joint action with the governmental agencies and the ministries of the environment of both Brazil and Uruguay. The Policy options analysis for the Patos-Mirim Lagoon system will focus mostly on Mirim Lagoon basin, the bi-national component of the system.

### Definition of the problems

Based on the Causal chain analysis for Pollution in Patos-Mirim Lagoon system, a number of policy options to minimise the environmental problem will be proposed. Those with the best performance, according

to a checklist of criteria, will be indicated. Pollution is a selected concern for both lagoons in the Patos-Mirim Lagoon system; however, the anthropogenic activities that cause the pollution are lagoon-specific. In Mirim Lagoon, the main activities causing pollution are limited to: use of pesticides, fertilisers and other chemical products; and erosion/sedimentation dynamics caused by deforestation and conversion of land and wetland areas into rice and cattle fields, resulting in increased suspended solids in the water. Patos Lagoon basin, which is more densely populated, has many important sources of pollution, such as: those presented for Mirim Lagoon; chemical pollution by heavy metal and persistent organic compounds as a result of industrial activities such as petrochemical, metallurgical, pulp and refineries; and urbanisation and tourism. The Policy options analysis will focus mostly on Mirim Lagoon, since it is the only truly international water body, although there are indications that Patos Lagoon is more severely impacted by pollution than Mirim Lagoon, and there is more data/information substantiating the assessment made for Patos Lagoon (see Annex III) than Mirim Lagoon.

## Policy options

The policy options listed here are attuned to the root causes identified in setting up the causal chain for pollution in the Patos-Mirim Lagoon system, i.e. Knowledge, Governance and Economic. The root causes are associated to activities in different economic sectors and the immediate causes provoked by them. Based on this, some policy options are described below.

### **PO-1: Plan for the control & prevention of suspended solids/chemical pollution - PC&PP**

The proposal is to constitute a plan for the control and prevention (PC&PP) to act in the Patos-Mirim Lagoon system. This implies establishing an institutional arrangement required for its implementation as a legal/institutional apparatus. The proposal is to involve representatives of different sectors and organisations (UNCED 1992 Chapters 23-34) which act and are dependent on the system studied, directly and indirectly linked to the use of the water resources in the Patos-Mirim system Lagoon (integrating the Ministry of the Environment, National Agency of Water, Municipal and State Secretariats, NGOs, companies with a high potential for pollution, municipalities involved, class and category representatives, Universities, technical and research institutions). Such a plan will create means and strategies to minimise and mitigate the negative impacts caused by suspended solids and chemical pollution and establish consensus to minimise/eliminate these impacts. It is proposed that the PC&PP will be the legal document of reference, backed up by local, regional, national and bi-national agents, in the decisions concerning the use of the aquatic systems of the Patos-Mirim system. This first policy option would include the organisation and discussion of the Patos-Mirim system data, and a dynamic preparation of programmes to be implemented over the short and medium-term, which would have the effect both of preventing and mitigating chemical pollution during the process of their implementation. This proposed plan would be developed using two approaches: (i) a plan to control and prevent chemical pollution resulting from farming; and (ii) a plan to control and prevent chemical pollution from industry. They would constitute different policy options that once implemented, would add to the PC&PP.

### **PO-2: Plan for the control & prevention of suspended solids/chemical pollution from agriculture - PC&PP/Agriculture**

The intensive use of pesticides and agricultural chemicals on crops, especially in rice cultivation, an activity that is developed around the Mirim Lagoon, is a serious problem causing contamination of the water of this lagoon system. Thus, the idea of setting up a separate

plan is to focus on chemical pollution resulting from agriculture, for the purpose of mitigating and/or eliminating this problem. In order to control suspended solids/chemical pollution caused by land use practices, particularly agriculture, the primary polluters (farmers) should necessarily be involved in setting up this plan (UNCED 1992 Chapter 32 Strengthening the role of farmers), either directly or through their legal representatives (association of farmers), together with the other stakeholders involved in setting up the PO-1 described above. This policy option should build on common agreement with representatives from the Brazilian and Uruguayan governments. For the plan to achieve success, it is necessary that they also participate in preparing and constituting the goals and actions to mitigate and/or eliminate, whenever possible, the chemical pollution concerned. The legal/institutional character of this plan would receive favourable support when highlighting the coexistence of a potentially polluting activity and areas of environmental protection and ecological reserves, such as the Ecological Reserve of Taim. This reserve is located on the margins of Mirim Lagoon, in the extreme south of Brazil, and is an area considered as having extremely high ecological relevance, and as part of the Federal Action Plan for the Coastal Zone (FAPCZ). PO-2 is a plan that will be added to the PO-1, where a plan is outlined for the whole Patos-Mirim system, including an international vision.

### **PO-3: Plan for the control & prevention of pollution from industrial production - PC&PP/ Industry**

Chemical pollution was identified in the Patos-Mirim system mainly around Patos Lagoon, with the presence of potentially polluting industries (fertilisers, oil, oil derivatives and refinery) which, without adequate effluent treatment, contaminate a large part of the estuary of Patos Lagoon. Heavy metals and other pollutants have an impact on the environment and aggravate human health problems. The general purpose of this policy option is the same as described in PO-1, although the focus is now put on the industrial sector: close cooperation and participation of representatives of industry is required in preparing this plan (UNCED 1992 Chapter 30 Strengthening the role of businesses and industries). Among the stakeholders to be engaged, no international organisation is required (as in the case of PO-1), since the root causes are confined to Brazilian territory. The presence of stakeholders involved in the fisheries sector (industrial and artisanal) is essential in setting up this plan, since this will allow the integration between conflicting economic activities, such as industry and fisheries, which are dependent on common natural resources. Thus, increasing the synergy between the activities and setting up a plan backed by legal and institutional severity, the conditions to reduce chemical pollution due to industrial activities in the Patos-Mirim system are given.

#### **PO-4: Empowerment of the Mirim Lagoon Bi-national Commission - Brazil & Uruguay**

In the 1960s, when concern about regional development in the extreme south of Brazil became an issue, the FAO/UNO prepared Regional Program 35 "Regional Program of the Mirim Lagoon Basin", which highlighted possible investments and directions for development in the region (Borba 2002). Proposals for investments in specific projects for the whole region of the Mirim Lagoon basin were developed covering both the Brazilian and Uruguayan territories. The Bi-national Commission Brazil & Uruguay, which was set up during the 1960s to perform joint initiatives in the Mirim Lagoon, with Brazilian and Uruguayan agents, acted satisfactorily to address the problems and issues inherent to the proposal of regional development. However, the attempts at institutional activation of Regional Program 35 were frustrated, and the economic activities in the region began to be developed without planning (Borba 2002). During the years, each country has established its own agenda, as illustrated by investments throughout the period (e.g. building a lock in the São Gonçalo Channel to protect the rice crops from intrusion of saline water). Although there are occasional demonstrations of reciprocal interests of both countries in the Mirim Lagoon development, in practice, neither Brazil nor Uruguay stopped maintaining separate contacts with the United Nations Special Funds for fundraising (Borba 2002). During more recent years an attempt was made by both national governments in the spirit of the development of the Southern Common Market (MERCOSUR). Some bi-national initiatives for water quality monitoring and evaluation of fish stocks were started at the end of the 1990s. Currently, there is the Mirim Lagoon Agency, located in the city of Pelotas/Rio Grande do Sul, with focus on aspects inherent to the Lagoon in Brazil. Recently an important legal instrument to help reactivating the Commission was signed by the President of Brazil: the Act (Decree) No. 4 258, 04 June, 2002. The Decree approved the internal regulation by the Brazilian section of the Bi-national Brazilian-Uruguayan Commission for the Development of the Mirim Lagoon (SB/CLM), connecting it to the Ministry of National Integration. These initiatives indicate that there is a positive atmosphere towards reactivation of the Bi-national Commission. When analysing the difficulties experienced during the past it should be taken into account that during 1960s to 1970s both countries were under military dictatorships, which made it difficult to implement participatory decision-making processes. Another important factor that explains the difficulties of a joint initiative regarding water and land use between Brazil and Uruguay is that land ownership was concentrated in the hands of a few big landowners. The landowners were obviously connected to political power or were themselves in a powerful political position. The analysis of previous experiences with bi-national initiatives becomes important when discussing the policy

option to reactivate the Bi-national Commission. In the new political context, better results are expected from such joint initiatives, based on the participatory approach and engagement of representatives of society and agents representing the democratic governments. This would enable the Commission to act competently in the international negotiation process of common interest to both countries and to the world, since Mirim Lagoon boasts wetland ecosystems strategically important for world biodiversity. In the new context, the Bi-national Commission Brazil & Uruguay might act to support the aspects of "governance" highlighted in the previous policy options. The Bi-national Commission might influence the process of prevention and control of suspended solids and chemical pollution in the Mirim Lagoon basin, enabling the preparation of more effective projects and initiatives and therefore, fundraising.

#### **PO-5: Creation of Mirim Lagoon Basin Committee and empowerment of the Brazilian and the Uruguayan Mirim Lagoon Agencies**

This proposed policy option is to organise a Bi-national Basin Committee with sufficient political profile in terms of representation of stakeholders. The aim is to establish common agreements between polluters/users of the Mirim Lagoon system, for the future sustainable international use of the water resource. Several international agreements about sustainable use of water have been made (UNCED 1992, WSSD 2002). In the Brazilian view, this committee should be supported by and also support the Mirim Lagoon Agency, located in the city of Pelotas/Rio Grande do Sul, which was created and meant to have a strong technical/scientific profile to prepare proposals for the basin with scientific backing. A similar Mirim Lagoon Agency should be created on the Uruguayan side, both agencies being the executive agents of the Committee's strategic plan. It is worth mentioning that the formulation of basin committees associated with basin agencies is defined by the Brazilian Federal Water Resources Law No. 9 433 enacted on January 8, 1997. The existence of this Committee will give the necessary political support to the Mirim Lagoon Agencies (Brazilian and Uruguayan) in their capacities to implement measures. The Committee and the agencies are meant to be the starting point for effective reactivation of the Bi-national Commission Brazil & Uruguay (PO-4).

#### **PO-6: Implementation of an environmental information system for the Patos-Mirim Lagoon system**

In any political strategy for water resources management and sustainable development it is of paramount importance to make information available to: (i) support the assessments and assign priorities to environmental and socio-economic concerns and issues; (ii)

support research activities and development of the technical/scientific knowledge about the area studied; (iii) educational and awareness campaigns (e.g. classify and disclose lists of industries ranked by their environmental profiles); (iv) facilitate monitoring activities and enforcement; and (v) support decision making processes. The basic information included in a databank/information system should include:

- Characterisation and description of the basin with the main features mapped;
- Environmental status of the water resources, ecosystems and habitats;
- Sources of pollution geographically located in maps;
- Sources, types, patterns and levels of pollution and analysis of trends;
- Information about institutional and legal deficiencies to be solved;
- Continuous strategic impact assessment with periodic release of information;
- Links to other sources of relevant information in both countries and in the world, e.g. international programmes and projects about wetlands, biodiversity, pollution prevention/control programmes and strategies, environmental and economic sectors legislation in both countries and international environmental legislation, etc.

This item would be constructed with a broad survey of biological and ecological studies, impacts assessment, feasibility studies for engineering civil works, socio-economic aspects of different sectors (e.g. agricultural practices such as irrigation, use of pesticides and fertilisers) performed in the catchment area of the Patos-Mirim Lagoon system in both countries. The basic proposal of this policy option is the development of an efficient Information System, ranging from the Federal Government structure to the lower instances (local and municipal), creating interrelated networks concerning the cause-effect of possible actions involving the issue of environmental pollution. The idea is to supply an efficient instrument for legal, institutional and operational functions, in order to integrate the information about pollution into the decision-making process of licensing and enforcement, and making the implementation of economic instruments more efficient.

### **PO-7: Technical and professional training**

This policy option is to prepare and implement an education and training programme to fulfil the objectives of minimising/eliminating pollution. The goal is to improve the knowledge about the Mirim Lagoon basin and sustainable practices in the economic sectors, such as water and land use, soil conservation, and agriculture pest and disease

control, covering the related environmental problems and issues. The product of such a policy option is the human capital in both countries that will be able to deal with environmental problems, specifically those relevant for the Mirim Lagoon basin. The training programme should involve professionals at technical level, so that they can structure and organise themselves to foster integration, reduce conflicts and generate consensus on resolutions of aspects of soil erosion and chemical contamination. Thus, training courses would be set up for the different actors involved in these matters. Besides the technical matters, the training would include relevant topics such as establishing monitoring networks for pollution, strengthening a data base, building public awareness through public information, and establishing a dialogue with local, municipal and national governments about the matter. The importance of awareness raising and public participation is promoted by the international action plan for sustainable development, Agenda 21 (UNCED 1992 chapter 36). This policy option is associated to PO-6 (Implementation of an environment information system).

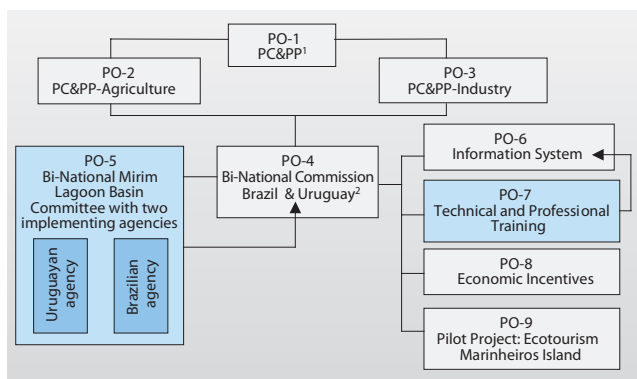
### **PO-8: Economic instruments for pollution mitigation in the Lagoon system - Incentives**

This policy option is to give support to the implementation of the “user pays” and “polluter pays” principle. The Brazilian Federal Water Law No. 9 433 enacted on January 8, 1997, institutionalises these concepts, partially removing the burden from the public coffers. The law makes it clear that water may only be used by those who have permission to do so, and charges for water use and pollution by creating a fund that might be used in the basin to carry out projects of recovery, remediation and sustainable use of the resources. As a support to the effective implementation of the law, it is proposed to specify economic incentives that can act efficiently in the Patos-Mirim system. To create market mechanisms in order to compensate for the reduction and/or elimination of pollution is an incentive that is very much the focus of the regulating agency of the Ministry of the Environment, Brazil, for applications specifically related to agricultural production. Efficiency in choosing anti-pollution economic incentives in the Patos-Mirim system will be possible, based on the use of specific information to be outlined by PO-6.

### **PO-9: Pilot Project to reorganise the productive activity (Alternative: Ecotourism) on Marinheiros Island, as a way of reducing the pollution caused by the use of fertilisers**

The Marinheiros (Sailor’s) Island is an island in the Patos Lagoon close to the cities of Rio Grande and Pelotas. The Island is inhabited by artisanal fishermen, who are also small farmers, basically producers of greens

and vegetables (Maciel 1998). These products supply a large part of the Rio Grande municipality market and also a significant part of the Pelotas municipality market. However, this production is based on intensive use of chemical fertilisers, thus contributing to pollution of Patos Lagoon. This policy option is aimed at mitigating the pollution, implementing a pilot project to reorganise economic activities on the Island and encouraging the development of ecotourism rather than agricultural activity. Besides the tourism potential identified on the Marinheiros Island, the Island presents high aesthetic value, with dunes and natural lagoons (Maciel 1998). The implementation of this project would make it possible to increase the income of the artisanal fishermen/farmers who are currently in a situation of poverty, according to the census of socio-economic statistics and surveys performed by the Brazilian Institute of Environment (IBAMA) - Rio Grande Regional Office. This socio-economic situation is linked to the slump in the economic activity of artisanal fisheries in the Patos Lagoon, and also to the high cost-benefit ratio observed in the production of vegetables and greens in this region (Maciel 1998). The idea is to propose incentives to the families living in the Marinheiros Island to stimulate investment in ecotourism projects that would be developed for this Island. It is likely that this new activity would become more profitable than the current polluting agricultural production within a short-time perspective. Additionally, this new activity would imply the substitution of conventional agriculture (intensive use of fertilisers) by sustainable practices (organic agriculture) that would be developed integrated with the ecotourism. Besides mitigating the problem of pollution (considered an environmental benefit), it would generate socio-economic benefits and improve income and health conditions for the locals. This policy option is seen as a complementary initiative to PO-2. Figure 51 outlines the policy options suggested, in order to explain the links between them.



**Figure 51** Policy options for mitigating pollution in Mirim Lagoon basin, their links and selected options to be implemented.

<sup>1</sup> PC & PP = Control and Prevention of Pollution. <sup>2</sup> Already existing structures which need support to perform.

## Recommended policy options

One set of policy options (PO-1, PO-2 and PO-3) encompasses alternatives related to the development of a bi-national integrated plan for pollution control and prevention, and documents and guidelines to deal with the problem in the Mirim Lagoon system. To elaborate and execute these plans, there is a need for strongly supported and dedicated basin committees and agencies, from both scientific and political viewpoints. International agreements such as WSSD (2002) emphasise the importance of strengthening the capacity of national and regional programmes in order to manage impacts of ocean pollution (WSSD 2002 paragraph 33b).

Policy options related to the creation and/or empowerment of those already existing organisations are described in PO-4 and PO-5. A third group is illustrated by PO-6 and PO-7, which aim to supply the organisations with updated information and trained professionals and communities that will implement sustainable practices to reduce the erosion/sedimentation rates and reduce pollution associated to land use and agriculture activities. PO-8 and PO-9 represent respectively, an additional incentive for compliance and a concrete case study where pollution is mitigated through replacement of a currently polluting economic activity by a more profitable and environmentally sustainable economic activity. The next section describes why PO-5 and PO-7 were selected as those that should receive priority for implementation, although the entire set of policy options is considered to be an integrated way to approach the problem.

The prioritised policy options (PO) are:

- PO-5: Creation of the Bi-national Mirim Lagoon Basin Committee and empowerment of the Brazilian and the Uruguayan Mirim Lagoon Agencies;
- PO-7: Technical and professional training.

These options were chosen because they address the most basic conditions required to deal with the concern Pollution in the Mirim Lagoon system, which does not detract from the importance of the other options. Considering that the main root causes identified behind suspended solids and chemical pollution were Knowledge, Governance and Economic, the implementation of these policy options will act directly toward two of these root causes (Knowledge and Governance) and will create the basic conditions for the third cause (Economic) in a second stage, through the development of PO-8 Economic incentives, as proposed in the previous section. The reasons for choosing only two policy options and why the others were not chosen at this stage are as follows:

- Participatory activities to be developed when implementing PO-5, in the process of negotiations (working on the root cause of Governance) will be dynamic and this will reflect positively on the management of these problems;
- The outcomes of the technical and professional training (PO-7) will have reflections on economic sectors causing pollution, enabling information and knowledge to flow and also constituting technical and professional support to prepare and set up the management plan for these water resources, as proposed by PO-1, PO-2 or PO-3;
- According to the diagram presented in Figure 51, PO-5 and PO-7 are likely to provide support for other options that might be implemented in a second stage, in order to render the results more efficient;
- PO-5 is essential to give strength and an executive profile to perform to the existing Bi-national Commission;
- The exclusion of PO-1 or PO-2 and PO-3 from the priority set is due to the estimated time and technical support they would require;
- The complexity of PO-4 is much greater, since it requires international negotiations. However, since the Bi-national Commission of Brazil and Uruguay for the Mirim Lagoon is already in place and, based on recent governmental initiatives demonstrating that the issue is gaining importance in the diplomatic agenda of both countries, the empowerment of the Commission will be achieved by implementing PO-5 and PO-7.

Finally, PO-7 is one of the most important options insofar as the existence of an efficient information system is a crucial instrument to control pollution in the Mirim Lagoon system. However, this option requires rigorous and systematic work to collect and organise information, infrastructure (computers, databank), paid personnel, network construction, and above all, guarantee of continuity over a period of at least a number of years. A new globally harmonised system for the clarification and labelling of chemicals is suggested to be fully operational by 2008 (WSSD 2002 paragraph 23c). Thus, PO-7 was identified as a first stage to achieve PO-6 in a second stage.

## Performance of the chosen alternatives

It is clear that the implementation of the selected policy options does not produce a complete solution to pollution in the Mirim Lagoon system, but it will produce a dynamic evolution of actions throughout the development process. These actions should be expressed in satisfactory results basically related to knowledge and governance. The options were submitted to the criteria of effectiveness and efficiency, giving the results below.

### Effectiveness

Estimating the impact of the option: It is estimated that the impact will be favourable in the skill-building and training process of different players involved in water use in the Mirim Lagoon system (PO-7) and also in the organisation of these different players and stakeholders, to establish sustainable management of water resources in Mirim Lagoon (PO-5). Quantitative values cannot be established for the policy option outlined.

Concerning risks and obstacles: Serious failures in implementing PO-5 may occur, if the basin committee is not established in a participatory manner. In this case, lack of backup of all stakeholders involved, may result in "pre-established" biased consensus. This failure may be avoided if the composition of basin committees strictly obeys the rules of representation in basin committees expressed in the Brazilian Federal Water Law No. 9 433, 1997, and its regulation, which has no counterpart on the Uruguayan side. An obstacle associated with PO-7 may be the non-attendance of a critical mass of professionals and personnel to be trained or the attendance by a non-qualified group. This problem would be minimised by a strategic programme of recruitment of technicians, farmers, representatives of local government institutions, among others. The professionals require training and maybe competent professionals from other areas of Uruguay and Brazil, and eventually from abroad would be needed.

Under favourable conditions it is expected that:

- PO-5: This option will be successful in constituting a Bi-national Basin Committee, which will act to integrate opinions from different segments of the society and will have the committee agencies from both sides to implement and execute the agreed initiatives. Its success is related to participation and capacity to achieve consensus among the polluters/users (e.g. farmers) and those who seek the abatement of pollution (e.g. environmental NGOs).
- PO-7: This option will be successful when implemented by a team of competent professionals who can recruit properly, set up high quality courses and training programmes and stimulate and encourage the participants. Providing the participants with practice during and after the training will inspire them to act according to a sustainable use of land and water resources, causing minimal pollution.

Under adverse conditions it is expected that:

- PO-5: The lack of real interest in working on the issue of pollution for the purpose of sustainable use of natural resources could lead to failure in establishing the agreements needed to control pollution. The idea of setting up a Committee that should help to reactivate and give more dynamics to the Bi-national Commission Brazil

and Uruguay may lead to scepticism in society about bi-national initiatives. It may even further delay the process of integrating environmental management.

- PO-7: There is a possibility that the professionals chosen for recruiting, skill-building and training will not be sufficiently competent. Maybe they will fail to motivate the audience in environmental issues and the replacement of polluting practices with sustainable ones. Such a failure would result in lack of interest, lack of motivation and inefficiency.

## Efficiency

Lists of probable direct, indirect, options, bequest and existence benefits, for each option, are presented in Table 22 and 23.

## Costs

The costs for each policy option are presented in Table 24.

## Equity

The net winners and net losers and their gains and losses are from a general perspective and considering common objectives, the whole society (poor and rich, rural and urban, from industry, from commerce and agriculture), which gains from the implementation of a Bi-national Mirim Lagoon Basin Committee and a Technical and professional training programme. From a more limited perspective a few winners and losers can be classified, according to both policy options PO-5 and PO-7: the direct beneficiaries will be the entire population that lives in the basin, who will recover the right to have unpolluted water, a pleasant environment, and reduced health risks due to pollution. The entire society gains with the potential opportunities for future development of new economic sectors (e.g. ecological agriculture, ecotourism). The loss could be highlighted only if justified by the internalisation of environmental costs by the potentially polluting productive activities (mostly crops), which would have to adjust to the prevailing environmental standards. In other words, landowners who use conventional agriculture productive processes (intensive use of chemical products to produce rice in the Mirim Lagoon basin) may have some economic losses, particularly in the short-term perspective during the restructuring period when new agricultural practices must be accommodated. For these types of selected policy options, it is not possible to perform quantitative estimates (physical and/or monetary units) of the gains and losses. However, from a perspective of equity and social justice (included well-being), it can be assumed that market mechanisms (Huber et al. 1998) favour fair exchanges. Therefore, based on the assumption that exchanges are fair, the benefits received by the gainers are the equivalent of costs incurred by the losers. Based on current knowledge it is not possible to measure this result quantitatively.

**Table 22** Probable direct, indirect, option, bequest, and existence benefits for PO-5.

Benefits	PO-5: Bi-national Mirim Lagoon basin Committee
Direct	Reduction in the costs of transactions by reducing international conflicts; and reduction of chemical pollution and the costs to treat water for human supply.
Indirect	Healthier and more productive aquatic ecosystems regarding fish stocks due to reduction of pollution; long-term improvement of human health, particularly regarding occupational health (farmers) due to reduction of contact with chemical products; idem to water consumers.
Option	Protection of the aquatic environment, which in the future may be of economic value, with an option for aquaculture and/or ecotourism in a system with unpolluted water.
Bequest	Protection of the historical and cultural heritage for future generations, by not modifying habitats and structures, caused by pollution.
Existence	Protection of species that might otherwise become extinct with the intensification of pollution in the Mirim Lagoon basin; and preservation of natural wetlands with high biodiversity value and that host important migratory species.

**Table 23** Probable direct, indirect, option, bequest, and existence benefits for PO-7.

Benefits	PO-7: Technical and professional training
Direct	Reduction of conflicts, optimising time and resources for pollution reduction actions; easier implementation of initiatives to reduce pollution by a qualified group of professionals.
Indirect	Healthier and more productive aquatic ecosystems regarding fish stocks due to reduction of pollution; reactivation of the fisheries by re-population practices; reduction of costs to treat water for human supply; long-term improvement of human health.
Option	Protection of the (aquatic) environment which may, in the future, be of economic value, with the option for aquaculture and/or ecotourism in a system with unpolluted waters.
Bequest	Protection of the historical and cultural heritage for future generations, by not modifying habitats and structures, caused by pollution.
Existence	Protection of species that may become extinct as the use of chemicals in the Mirim Lagoon basin is intensified; protection of ecological reserves (Taim, Peixe Lagoon National Park) that may become extinct as pollution and their adverse effects on the environment increase.

**Table 24** The costs for PO-5 and PO-7.

Policy option	Costs
PO-5: Bi-national Mirim Lagoon Basin Committee	Contract for the mobilisation team; contract for specialised consultants; costs of equipment (rental) and other costs; travelling costs, accommodation, daily allowance for consultants and stakeholders to participate in the meetings; costs of meetings (rent of rooms, contract for support personnel, material, etc.).
PO-7: Technical and professional training	Contract for professional team; contract for specialised consultants; costs of equipment (rental) and other costs (production of training material); travelling costs, accommodation, daily allowance for field visits in areas to be examined, logistics; travelling costs for the professional team and the participants in the training programme.

## Political feasibility

According to the Brazilian International Trade Ministry (MRE 2003), the diplomatic relationship between Brazil and Uruguay has been strengthened during recent decades due to three factors: (i) gradual implementation of the integration ideal illustrated by the establishment of the MERCOSUR (the South Common Market including originally Brazil, Argentina, Uruguay and Paraguay); (ii) affinities between countries regarding regional and international problems as expressed in different arenas; and (iii) revitalisation of transboundary contracts and agreements. The energy sector, primarily electricity, has been one of the important economic activities that brought the countries together. Additionally, Brazil is the main business partner of Uruguay. In

1998 Brazil imported 34.4% (790 million USD) of the Uruguayan exports. In the same year, Brazil exported to Uruguay 719 million USD, which represented 20.1% of the total imports by Uruguay. The transboundary cooperation between the countries had the General Commission of Brazilian-Uruguayan Coordination (CGC) as the institutional starting point, and then, the Commission for Joint Development of Transboundary Zones (CDZF). Among existing bi-national commissions, there is The Commission for Development of Mirim Lagoon basin (CLM). The initiative of integrated water resource management for Mirim Lagoon basin is a topic that has received attention during recent years. However, the effective implementation of an integrated and efficient management plan has not yet occurred. This favourable political scenario should overcome any eventual resistance by isolated segments of the agriculture sector in the basin.

### **Implementation capacity**

Basically, there is a potential capacity to implement the policy options proposed. This may come from the national government agencies in Uruguay and Brazil, from the state of Rio Grande do Sul, and the Uruguayan departments included in Mirim Lagoon basin, as well as research and teaching institutions, such as the Brazilian Company of Agriculture Research (EMBRAPA), Brazilian Institute of Environment (IBAMA/CEPERG), University of Rio Grande Foundation (FURG), Federal University of Rio Grande do Sul (UFRGS), and the Uruguayan National Institute of Agriculture Research (INIA) among others. Some recent initiatives of developing a participative fishing management have demonstrated that the capacity to mobilise local communities for specific programmes exist (CEPERG 2003).

## **Conclusions and recommendations**

After performing the Causal chain analysis for Pollution in Mirim Lagoon system, it was observed that pollution has three main immediate causes: suspended solids (disturbed erosion/sedimentation ratio); chemical pollution (use of pesticides); and an enrichment of the water body with nutrients, increasing the risk of eutrophication (use of chemical fertilisers in agriculture). All immediate causes are associated to agriculture as the main economic sector causing pollution in Mirim Lagoon basin, where land use is also causing fragmentation/modification of habitats in a wetland region of great importance from the biodiversity viewpoint. When searching for the root causes, three main groups of causes appeared: lack of knowledge, lack of economic incentives and governance failure, and lack of a bi-national basin

integrated management plan. The fact that one sector appears to be dominant made it easier to direct and indicate the policy options. The choice of two policy options among nine originally proposed was based on the fact that: (i) the implementation of the others depends upon preparation of the adequate institutional/governance environment for development of an integrated basin management plan; (ii) these two options represent a necessary support to strengthen and empower the existing Bi-national Brazil-Uruguay Commission for Mirim Lagoon; and (iii) less time and resources (financial and human) are required for these two options than for the others, before significant results are achieved. In analysing the feasibility criteria of the project (effectiveness, efficiency, equity, political feasibility and implementation capacity), aspects favourable to the implementation of these two chosen options were identified, as well as risks of failure. In the criteria that highlighted possibilities of failures, strategies to eliminate them were briefly mentioned.

Both policy options PO-5 (Creation of Mirim Lagoon Basin Committee and empowerment of the Brazilian and the Uruguayan Mirim Lagoon Agencies), and PO-7 (Technical and professional training), have similar characteristics of learning and developing skills in the communities and may act simultaneously, exchanging information and solving difficulties. This synergy is likely to minimise the risks of failure for both options.

Finally, if successfully implemented, these two policy options will automatically act as an empowerment mechanism for the existing Bi-national Commission for the development of Mirim Lagoon basin (PO-4). These options will also create favourable conditions and increase the feasibility for implementation of more challenging or costly options, such as PO-1/2/3, PO-6, PO-8 and PO-9.

# Doce River basin

The Policy option analysis conducted through the GIWA project should necessarily be developed within the scope of implementing the National Water Resources Policy, with the support of the Brazilian National Agency of Water (ANA) (Agência Nacional de Águas) and the Secretariat of Water Resources of the Ministry of the Environment. It should support the implementation of the Doce River Basin Committee that had its first meeting in April 2003 (Comitê da Bacia Hidrográfica do Rio Doce 2004) when the main challenges and the expectation of different stakeholders were discussed. Since then, the Committee has been preparing an agenda of initiatives in the basin. It is proposed that the policy options suggested should act together with this initiative, to initiate projects that contribute to the implementation of the agenda approved by the Committee. The agenda of the Doce River basin Committee is to propose a number of activities that may possibly be included in the projects to be described below.

## Definition of the problems

The Causal chain analysis performed and interviews with the specialists of the Brazilian National Agency of Water (ANA) (Mr. Rodrigo Flecha and Ms. Flávia Barros, personal communication) gave rise to the conclusion that the main problem of the basin in terms of socio-economic impacts is the risk to life and property caused by floods. The floods are caused by different factors that determine changes in the sediments transport dynamics such as soil erosion and siltation, with the consequent reduction of the run-off capacity of the watercourses.

They are also aggravated by the occupation of river flood plains in urban areas, causing retention of the flow with consequent flooding upstream, and danger of flash floods downstream. The policy options presented aim to solve this problem. Since the perception of stakeholders in the basin coincides with this prioritisation, any initiative to mitigate these impacts can count on their support. This is also a good criterion to be considered in the policy options analysis, since such support will increase the feasibility and probability of success.

## Policy options

### PO-1: Participatory plan for flood control

As a flood control plan is the main demand in the basin, it is proposed that it should be prepared by the same institutional arrangement that is to implement it. This should be a social organisation constituted of different sectors of society. Actions should involve environmental education, reorganisation of the territorial space and in some cases, structural measures with the financial support of the communities and/or of the government authorities. The reason for this strategy is that flood problems in the basin are aggravated by human activities, both due to inadequate management of land in the rural area and due to occupation of the flood plain in urban areas.

The attempt to involve these stakeholders in preparing the flood control plan is a way to increase the understanding of the impacts humans cause, and thus induce them to take measures to avoid causing such problems. When stakeholders from the states of Minas Gerais and Espírito Santo are involved, as well as those from the Federal Government, an experience of cooperative action is sought, which will make it possible to overcome obstacles created by the situation of multiple responsibilities and jurisdictions over the waters and the land (UNCED 1992).

### PO-2: Manual to prepare City Statutes (Ordinances)

The main problems of the Doce River basin, generated in the urban areas, are a result of inadequate land use, through the occupation of the flood plain. This contributes to the intensification of erosion processes, the pollution of water sources, increased flooding, and other negative factors. This project will aim to prepare a manual to guide the Statutes of the Cities in the basin, which can be employed by administrators for more adequate land use and zoning. It may guide the city administrations in the procedures required to control the main impacts caused by harmful land occupation, including land with excessively steep slopes, which causes erosion, those located in flood plains and, also those whose waters drain into the sources of water supply. This manual is to be disseminated by the Doce River Basin Committee, which, therefore, should participate in writing it. The participation of political leaders into the implementation process is very important (Hens 1996). This policy option is proposed as a complement to PO-1, which deals with the flood problem in a generic form. PO-2 targets one of the specific causes of the problem.

### **PO-3: Pilot project for basin reforestation, associated with the enhancement of family agriculture**

One of the main problems in the basin is the erosion of mining areas and abandoned grazing areas located in areas previously occupied by the Atlantic Rainforest. This contributes to the intensification of erosion processes, the pollution of sources of water, worsened flooding, and other negative factors. The pilot project is proposed to mitigate this problem by providing incentives for family farming that would occupy these areas with self-sustainable projects that would recover the areas at the same time as they would generate income.

PO-3 is proposed as a complement to PO-1; the latter deals with the flood problem in a generic form. PO-3 targets one of the specific causes of the problem.

### **PO-4: Green incentives application**

This policy option is part of the line of green incentives proposed in studies by the Brazilian National Agency of Water in the agricultural environment. It is intended to compensate the farmers who promote environmental protection practices, mainly those that have a potential to mitigate flood problems with practices such as appropriate land use and preservation of riparian vegetation. Thus, the polluter pays principle could be “turned around” in certain cases, generating the principle that could be called “water protector-creditor” (Irrigação e Tecnologia Moderna 2002). The viability of this approach to the basin and the incentives to be offered should be evaluated by this policy option.

### **PO-5: Information system on water resources in the Doce River basin**

The purpose of this project is to integrate the different stakeholders that have databases of interest in the field of water resources and the environment in the Doce River basin. The aim is to build a decentralised information system based on the principle of the “Clearing-House Mechanism”, made available via the Internet, in order to provide greater flexibility in seeking, collecting, compiling and disseminating data on the basin. The “Clearing-House Mechanism” is a facilitation system in which the Focal point, in this case the Brazilian Ministry of the Environment, does not necessarily need to have a centralised database, but acts as a link to the web pages that have the information. The system acts as a web in which all points interact with each other. The main function of the Focal point is to standardise the information that will be available via the Internet. This should improve and facilitate the process of management, monitoring and enforcement of the public and private actions in the basin and decision-making, and increase and further disseminate knowledge of the Doce River basin.

One of the main uses of this system will be flood control. The already existing flood alert system will be added to it. However, the system conceived is intended to go beyond simply warning about the occurrence of floods. Among other possibilities, it will map the flood risk areas, identify improvements to be implemented, make it easier to mobilise society around priority policy options, etc.

## **Recommended policy options**

The selected policy options (PO) are:

- PO-1: Participatory plan for flood control;
- PO-2: Manual to prepare City Statutes (Ordinances);
- PO-3: Pilot project for basin reforestation associated with the enhancement of family agriculture.

These were selected because they are all oriented to solving the main socio-economic impacts (see the Causal chain analysis diagram for Doce River basin, Figure 47) identified in the basin associated to the floods (PO-1) and they also act on the two main root causes: inadequate occupation of the land in the urban area (PO-2) and inadequate management of the land in the rural area (PO-3). Besides this, these options also act on three of the other root causes outlined below.

#### **Governance: Lack of basin-wide management plan**

Although the participatory plan for flood control (PO-1) is not a basin-wide management plan, it may be considered a phase of this. Since it affects everyone, this will allow the basin stakeholders to be trained to prepare a more ambitious plan, encouraged by a socio-economic impact that has a great potential for action. Because it involves farmers in seeking new alternatives for agricultural management, PO-3 will have a relevant demonstrative effect, which will enable its dissemination throughout the Doce River basin, wherever applicable mitigating the effects of land misuse. It also presents a potential for organising groups of stakeholders that are essential for the success of public policies.

#### **Governance: Lack of legitimacy in negotiations requiring decisions regarding investments**

A participatory plan such as that of PO-1, with a potential to mobilise the stakeholders to prepare it, is a safe step to ensure the legitimacy of the negotiations that will be held for this purpose. This will be an important and probably irreversible step for the stakeholders to establish a new water management paradigm, based on a participatory decision process that will reinforce the role of the Doce River Basin Committee.

### **Knowledge: Insufficient training regarding best land use practices**

PO-2 and PO-3 aim to develop and disseminate knowledge and hold training on its applications in the urban and rural areas. With these two policy options, the knowledge needed to promote changes in the current unsustainable practices regarding land use and soil occupation will be organised and structured with the participation of all stakeholders of importance in the basin, particularly the Basin Committee members. The material will be made available and will be disseminated by the Committee itself. This strategy is expected to perform better than implementing a conventional training programme planned, organised and offered by experts only.

## **Performance of the chosen alternatives**

It should be understood that the root causes originate from a process of centralised water management without stakeholder involvement. The policy options aim to modify this process and therefore their results must be evaluated not by products created, but by the substantive quality of the water management that, with their aid, will be gradually implemented in the basin. The evaluation of the effectiveness and efficiency of the policy options should be performed, therefore, not by considering the products, but by considering the actual, real modifications in the water management process.

### **Effectiveness**

The root causes identified in the casual chain analysis are to be mitigated not by achieving structural interventions, but mostly by non-structural changes in the forms of water management in the Doce River basin. For this reason, quantitative values that may estimate the effectiveness of the policy options cannot be proposed. It is understood that the policy options will have a positive impact on the process of organising society to manage water resources based on a participatory and decentralised approach (UNCED 1992).

The obstacles and risk of project failure may result from attempts to implement it in parallel with the water management in the Doce River basin, promoted by the Secretariat of Water Resources and by the National Agency of Water of the Brazilian Ministry of the Environment, and by entities from the states of Minas Gerais and Espírito Santo. These will be minimised if the policy options are developed as mentioned previously within the scope of the initiative promoted by those institutions and with their approval.

Under favourable conditions it may be expected that:

- PO-1 will be successful in promoting a Participatory plan for flood control throughout the Doce River basin, with the participation of all the stakeholders, especially the farmers who adopt inadequate management practices and the people who occupy the flood plains. The municipal governments that are sensitive to the need for the adoption of city statutes that take water demands into account participate actively in this.
- PO-2 has a technical team to prepare the manual that is joined by the stakeholders, particularly those members of the Basin Committee, with sufficient knowledge of the technical, environmental, social, legal, political and institutional aspects, which will permit the preparation of a manual to be adopted by the municipal administrations to write their city statutes.
- PO-3 has a technical team prepared for this challenge that is joined by the stakeholders members of the Basin Committee. The groups of farmers involved have already been identified. Sustainable options must be offered for family farming, generating income with appropriate management of the soil, and recovering degraded areas.

Under unfavourable conditions the scenarios could be:

- There is no interest in the participation of stakeholders in preparing PO-1, the Participatory plan for flood control. It becomes a conventional, technocratic plan, aiming to undertake projects or non-structural measures that have not been discussed and approved by the stakeholders. For this reason, no change occurs in the relationship between society and the environment, and the human activities that aggravated the flood problems in the basin continue to exist.
- The technical team prepares the manual PO-2 alone with no participation of the stakeholders and the Basin Committee does not know or finds it difficult to identify the technical, environmental, social, legal, political and institutional aspects that are involved in preparing the city statutes. The manual becomes a document that is unrelated to the reality of the basin, and is not adopted by the municipal administrations in writing their city statutes (ownership failure).
- The technical team prepares the PO-3 alone or with the participation of the Basin Committee but with no direct engagement of the main affected group, the farmers, and cannot define viable socio-economic alternatives for alternative soil management in degraded areas with the participation of family farming. Or, even if it is successful in this definition, it does not manage to attract farmers who are not ready to adopt new alternatives for land management (ownership failure).

Analysing the spectrum of scenarios, it is observed that PO-3 is the one that presents the highest risks, because besides the technical expertise and the Basin Committee participation, it requires the highest commitment of the stakeholders, particularly the farmers. PO-2 presents the lowest risks, since it requires a competent technical team and the participation of the Basin Committee, which is already organised, to prepare a qualified manual for the city statutes. This will make it relatively easy to have it adopted by the municipal administration, if necessary induced to do so by the states or the Union.

## Efficiency

The lists of probable direct, indirect, option, bequest and existence benefits, for each project, are presented in Table 25, 26 and 27.

## Costs

The types of costs for each policy option are presented in Table 28.

## Equity

Since the projects proposed are oriented towards better water management, they do not have specific beneficiaries, because all of society will benefit directly or indirectly from them. However, if we seek to focus on the most immediate beneficiaries, the following benefits may occur:

- PO-1: Participatory plan for flood control - this should directly benefit the population subjected to flood damage. However, its indirect effects, connected to sediment reductions in the watercourses will benefit the riparian population.
- PO-2: Manual to prepare city statutes (Ordinances) - this will directly benefit the urban population, which will be less exposed to flood risks if its advice is obeyed in the city statutes. The riparian population located upstream from the urban areas will also directly benefit from the reduction in water impoundment flood effects. Indirectly, the riparian population downstream from the areas improved as advised by the city statutes will also benefit from sediment reduction.
- PO-3: Pilot project for basin reforestation associated with the enhancement of family agriculture - this will benefit the farmers involved directly. Indirectly it will benefit the riparian population, due to the reduction in the amount of sediment transported in the rivers.

The selected policy options aim to generate public good, and therefore, contribute to the well-being. In all cases, investments must be made by the government, at the federal, state and municipal levels.

**Table 25** Probable direct, indirect, option, bequest, and existence benefits for PO-1.

Benefits	PO-1: Participatory plan for flood control
Direct	Reduction of damages and deaths caused by floods.
Indirect	Increased work life of reservoirs due to less siltation; reduction in dredging costs; the possibility that, eventually a waterway will become feasible.
Option	Protection of species that may acquire economic value in the future when siltation of rivers is reduced.
Bequest	Protection of the historical and cultural heritage for future generations by reduced floods.
Existence	Protection of species that might become extinct if the siltation process is intensified.

**Table 26** Probable direct, indirect, option, bequest, and existence benefits for PO-2.

Benefits	PO-2: Manual to prepare City Statutes (Ordinances)
Direct	Reduction of damages and deaths due to floods; and reduction of costs of intake and treatment of water for supply.
Indirect	Reduction of costs for changes in infrastructure as a result of the growth of cities.
Option	Protection of species that may, in future, acquire economic value to reduced siltation of the rivers.
Bequest	Protection of the historical and cultural heritage for future generations, by reduced floods.
Existence	Protection of species that might become extinct if the siltation process intensifies.

**Table 27** Probable direct, indirect, option, bequest, and existence benefits for PO-3.

Benefits	PO-3: Pilot project for basin reforestation associated with the enhancement of family agriculture
Direct	Reduction of damages caused by erosion and siltation; increased agricultural production.
Indirect	Reduction of costs of housing migrants on the outskirts of the cities.
Option	Protection of species that may, in future, acquire economic value, reducing deforestation, soil erosion and siltation of the rivers.
Bequest	Protection of the historical and cultural heritage for future generations by reduced erosion process, siltation and floods.
Existence	Protection of species that might become extinct if erosion, siltation and floods are intensified.

**Table 28** The costs for PO-5 and PO-7.

Policy option	Costs
PO-1: Participatory plan for flood control	Contract of the mobilisation team; contract for specialised consultancies regarding pertinent aspects; payment of transport and the stay of stakeholders to participate in the meetings; costs of meetings (rental of rooms, contract with support staff, materials, etc.).
PO-2: Manual to prepare City Statutes (Ordinances)	Contract with a technical team.
PO-3: Pilot project for basin reforestation associated with the enhancement of family agriculture	Contract with a technical team; investments in the areas of the pilot-policy options selected; costs of disseminating the results of the pilot-projects: leaflets, audio-visual materials, site visits, etc.

## Political feasibility

There ought to be no opposition to the implementation of the policy options. The PO-1 and PO-3 should have the participation of society, which reduces the potential for conflicts. PO-2 foresees writing a manual to prepare City Statutes (Ordinances), which also does not generate conflicts. The implementation of the city statutes may be the object of opposition, especially by those who hold interests that will be restricted. Insofar as these interests are socially legitimate, compensation may be foreseen, reducing the potential for conflicts.

## **Implementation capacity**

There is already an implementation capacity both in the basin and in the states where it is located. This occurs both in the public sphere, at the federal, state and municipal levels and in the private spheres and third sector entities (NGOs). The mobilisation process of society to create the Doce River Basin Committee during the last years created this capacity, which will facilitate the implementation of the selected policy options.

## **Conclusions and recommendations**

The policy options selected for the Doce River basin were: PO-1 Participatory plan for flood control; PO-2 Manual to prepare City Statutes (Ordinances); and PO-3 Pilot project for basin reforestation associated with the enhancement of family agriculture. The policy options were proposed to address the root causes of Pollution, which in some cases are common root causes for the concern Habitat and community modification. The options have equity, political feasibility and implementation capacity, as long as they are conceived and implemented with the participation of the stakeholders currently involved in the implementation of the Doce River Basin Committee. It is emphatically recommended that any initiative to be implemented should start by approaching the Secretariat of Water Resources (SNRH) and the Brazilian National Agency of Water (ANA), which play a relevant role in the aforementioned process of improving water management in the basin.