

Executive summary

Regional definition

GIWA region 39 Brazil Current is a tropical/sub-tropical ocean margin governed by western boundary currents, a passive continental shelf, and moderate continental run-off (Walsh 1988, Ekau & Knoppers in press). It extends along the Brazilian coast from the São Francisco River estuary (10° 30' S, 32° W) in the northeastern Brazil, to Chui (34° S, 58° W) in the southern Brazil. Its length, excluding contours of bays and islands, is 4 150 km, or 58% of the Brazilian coastline (GERCOPNMA 1996). The Brazil Current region's catchment area inside Brazil is 1 403 million km² and the portion inside Uruguay, corresponding to approximately 52% of the Mirim Lagoon Basin (and 2.3% of the Brazil Current continental area), is 33 000 km². The Brazilian component of the Brazil Current catchment area includes the entire states of Espírito Santo (ES) and Rio de Janeiro (RJ) and from northeast to south, part of the states of Pernambuco (PE), Alagoas (AL), Sergipe (SE), Bahia (BA), Minas Gerais (MG), Goiás (GO), São Paulo (SP), Paraná (PR), Santa Catarina (SC) and Rio Grande do Sul (RG).

Uruguay is divided in 18 departamentos (political/administrative units). Five of them are partially or entirely included in the Mirim (Merín in Spanish) Lagoon basin and subsequently part of the Brazil Current region. These five departamentos are: Cerro Largo, Lavalleja, Maldonado, Rocha and Treinta y Tres. Two of them (Rocha and Maldonado) also form the Atlantic Basin of Uruguay with a coastal zone with high potential for tourism, that hosts livestock and rice plantation as the main economic activities.

The Brazil Current region encompasses geographical portions of "three Brazils" as revealed by the UNDP Human Development Index (UNDP 2001): the northeastern, southeastern and southern Brazil. In Brazil, the poorest 20% have only 2.6% of the total national wealth; the richest 20% have 65% (IBGE 2001). This extremely uneven wealth distribution has been historically associated with the contrasts

between the undeveloped northern Brazil, the often drought-affected northeastern Brazil, and the much more prosperous and industrialised southeastern and southern Brazil. The southeastern and the southern Brazil are together responsible for more than 75% of the Brazilian GDP. Therefore, although Brazil Current region is almost 100% Brazilian territory (excepting 2.3% that belong to Uruguay), it shows an extremely high diversity regarding social, cultural and economic aspects, which in turn, reflect on the nature and severity of the impacts.

In the Brazil Current region, a typical developing economy situation has been established: economic and demographic growth exceed development of necessary urban and industrial infrastructure (Lacerda et al. 2002). Littoralisation, a variant of urbanisation with the movement of people from the countryside to the coastal cities, is the predominant trend in Latin America, which the Brazil Current illustrates quite well. Anthropogenic pressures exhibit two major features; large cities either affect the coastal waters or estuaries directly when located on the coastline, or contribute to coastal change indirectly through their location in catchments which carry the urban waste load. In the Brazil Current, the main pressures/driving forces and the respective environmental issues generated by them are:

- Urbanisation: consumption of water, microbiological pollution, eutrophication, suspended solids, habitat and community modification;
- Industry: consumption of water, chemical pollution;
- Agriculture: consumption of water for irrigation, increased nutrient and suspended solids loads, chemical pollution, eutrophication, habitat and community modification;
- Power generation: stream flow modification due to damming, habitat and community modification;
- Mining: chemical pollution, suspended solids, habitat and community modification;
- Fisheries: reduction of fish stocks, pollution;

- Aquaculture: eutrophication, habitat and community modification;
- Transport: spills.

For the purpose of the GIWA assessment, Brazil Current was divided in three regions: South/Southeast Atlantic Basins, East Atlantic Basins, and São Francisco River Basin. Medium-sized basins or groups of small basins in the sub-regions were numbered according to the former classification by the Brazilian National Agency of Electric Energy (ANEEL) and not the newer sub-division of the Brazilian basins, according to the Brazilian National Agency of Waters (ANA) (PNRH 2003). This presentation is intended to help those readers that are not familiar with the Brazilian or Uruguayan geography to locate, on the map, the basins mentioned in different sections and to identify the areas in Brazil Current where the issues and impacts are occurring.

Assessment

The assessment of the Brazil Current region identified the following priority concerns in the three individual sub-regions assessed: South/Southeast Atlantic Basins and East Atlantic Basins, Pollution with suspended solids as the main causative issue; São Francisco River Basin, Freshwater shortage with modification of stream flow as the main causative issue.

Changes in the suspended solids transport/sedimentation dynamics due to deforestation and erosion is the main cause of silting, modification of stream flow and periods of water scarcity and flooding in South/Southeast Atlantic and East Atlantic Basins (e.g. Itajaí Valley and Doce River basin respectively). Diversion of water from one basin to another to meet the demands for consumption (e.g. transfer of water from Paraíba do Sul River in East Atlantic Basins to supply the Rio de Janeiro littoral basin in South/Southeast Atlantic Basins) has caused increased sedimentation/silting in the estuary that receives the transposed water (Sepetiba Bay in East Atlantic Basins), which generates pollution and habitat modification. At the same time, significant reduction of sediment transport in the original basin due to damming has caused extensive erosion of the coastline, destroying fringes of mangrove forests, dunes and small villages around the Paraíba do Sul River estuary, and promoting depletion of fish stocks.

Eutrophication in lagoons, estuaries and bays along Brazil Current coast placed downstream densely occupied urban areas, industrial activities and agriculture fields is currently a serious environmental issue. In reservoirs for water supply, eutrophication is becoming a serious issue in both South/Southeast Atlantic as well as East Atlantic Basins. Few, but extremely severe episodes of human intoxication due to hepatotoxins released in the water after algal blooms have been recorded, as has

the fact that eutrophication has become a common phenomenon in reservoirs (Azevedo 1996, Costa & Azevedo 1994, Teixeira et al. 1993, Prouença et al. 1996, Diário do Vale 2001). More frequently recorded has been the association between water pollution and water-borne diseases such as microbiological and parasitic infections (CETESB 1990 in Governo do Estado de São Paulo 2002, IBGE 2001, COPPE & UFRJ 2002, Governo do Estado de São Paulo 2002). Increasing gastrointestinal symptoms related to the time of exposure to polluted beaches was described by CETESB (1990), in Governo do Estado de São Paulo (2002). In Paraíba do Sul River basin (East Atlantic Basins), the incidence of microbiological infection and parasitic diseases varies among municipalities, from 0-30% (IBGE 2001) and it seems to be related to the average income. As regards risks to human health, cases of schistosomiasis have been registered all over the São Francisco River Basin. In the upper portion of the Basin, there are health problems resulting from microbiological factors and problems resulting from chemical pollution are suspected, but not confirmed, due to lack of proper investigations. While the percentage of the population affected is small, the degree of severity is high, due to the poverty level among those affected.

Episodes of temporary freshwater scarcity have been registered, mostly due to chemical pollution caused by industrial activities in some populated basins. In 2003, an accident in a paper-pulp industry located in Minas Gerais state, on a tributary of the Paraíba do Sul River, which flows through Rio de Janeiro state, caused a transboundary issue due to pollution of the downstream portion of the basin, resulting in interruption of the water supplies during weeks, which affected about 600 000 inhabitants of northern Rio de Janeiro state. Therefore, the causative link between Pollution and other environmental concerns assessed as equally severe supported the decision of selecting Pollution as the most important concern for the Brazil Current region. The combined assessment of the three sub-regions resulted in the following ranking of concerns:

1. Pollution;
2. Habitat and community modification;
3. Freshwater shortage;
4. Overexploitation of fish and other living resources;
5. Global change.

Causal chain and policy option analyses

The Causal chain analysis methodology was developed specially for the GIWA project and was previously tested in selected aquatic system in Brazil Current (Marques 2002, Marques et al. 2002). The Causal chain and policy option analyses were carried out for two selected aquatic systems: the transboundary bi-national water body Mirim Lagoon (South/Southeast Atlantic Basins), shared by Uruguay and Brazil and the

Doce River basin, a medium-sized transboundary basin shared by the Brazilian states of Minas Gerais and Espírito Santo (East Atlantic Basins). São Francisco River Basin, a natural candidate for further analyses due to the high importance such river has in the national context, has already been the focus of an important GEF/UNEP project (Diagnostic analysis and strategic action program for the integrated management of the São Francisco River basin and its coastal zone), and only for this reason, was not included in the list of selected aquatic systems. Through these case studies, the causative links and the main root causes responsible for pollution in Brazil Current were addressed. In the particular case of the Patos-Mirim Lagoon system, although the main focus in terms of causal chain and policy options analyses was put on pollution in Mirim Lagoon, a causal chain analysis for the overexploitation of fish was also constructed for the Patos Lagoon. In the case of the Doce River basin, the causal chain was analysed for pollution and the habitat and community modification. It was thus possible to find out that both concerns have some root causes in common. In this model, policy options tailored to reduce one of these concerns will also reduce the other, which represents a desirable win-win situation.

Mirim Lagoon, a truly international freshwater body, is a shallow Atlantic tidewater lagoon on the border between Brazil (state of Rio Grande do Sul) and Uruguay. It is approximately 190 km long and 48 km across at its widest point, covering an area of 3 994 km². A low, marshy bar containing smaller lagoons, separates the Mirim Lagoon from the Atlantic Ocean. It drains northeastward into the Patos Lagoon. Mirim Lagoon is considered one of the most important water resources in Uruguay. The main economic activity in the basin is agriculture, mostly rice plantation, which is highly dependent on water from the Mirim Lagoon for irrigation. The main environmental concern is pollution due to the use of chemical fertilisers and pesticides. Root causes behind agricultural practices are: (i) Governance (lack of full implementation of the bi-national basin integrated management plan and lack of autonomy and authority of the control agencies to face pressures from economic development); (ii) Knowledge (insufficient information regarding environmental functions of wetland and lagoon system and insufficient training regarding sustainable use of water and soil); and (iii) Economic (lack of efficient economic instruments to promote sustainable use of water and land).

Nine complementary policy options were proposed for Mirim Lagoon, among them, two were selected as the best candidates to be implemented in a first stage: (i) creation of the bi-national Mirim Lagoon Basin Committee and empowerment of the Brazilian and the Uruguayan Mirim Lagoon Agencies; and (ii) technical and professional training on pollution minimisation and control associated to agriculture activities.

In Doce River basin the major environmental and socio-economic impacts due to pollution have a transboundary nature, since deforestation and land uses practiced by the state responsible for the upstream portion of the basin (Minas Gerais) during decades has caused severe environmental and socio-economic impacts to the downstream portion of the basin, which belongs to another state (Espírito Santo). In brief, the main environmental problems that lead to socio-economic impacts in the basin arise from the following factors (Gerenciamento Integrado da Bacia do Rio Doce 2003): (i) generalised deforestation and mismanagement of agricultural soils that led to loss of fertility and speedy erosion, and consequently, to loss of agricultural productivity, increased rural poverty and migration to the outskirts of large cities; (ii) siltation of riverbeds caused by erosion, leading to reduced stream flow during the dry period and increased problems during floods, with effects on urban supply, irrigated agriculture and public safety; (iii) floods, resulting from natural conditions but worsened by the human flood plain occupation, deforestation, soil erosion and siltation; (iv) vulnerability of reaches where domestic supply intake points are located, considering previous accidental toxic pollution events, in several regions in the basin, with potential risks to public health; and (v) the precariousness of basic sanitation (networks, sewage treatment, disposal of solid wastes) and the lack of drinking water supply in several urban agglomerations and rural communities, reflecting on public health and on the economy. The main root causes for Doce River basin are: (i) Governance (basin-wide management plan not implemented yet, and lack of legitimacy in negotiations commanding decisions regarding investments); (ii) Knowledge (insufficient training regarding best land use practices); and (iii) Economic (existing economic distortions, such as non-correction of negative externalities resulting in pollution and inefficient use of water).

Five policy options were proposed and three of them were selected as those that should be implemented in the first stage: (i) participatory plan for flood control; (ii) production of the manual to prepare City Statutes (Ordinances); and (iii) pilot project for basin reforestation associated with the enhancement of family agriculture.

Challenges and recommendations for future actions

The ranking of environmental concerns and issues in Brazil Current region or any other GIWA region in the world, regarding the severity of their impacts is likely to change as time goes by and also as a result of policies and initiatives implemented and the development of different economic sectors. The transformation of the GIWA assessment from the status of a project into a continuous assessment would represent: (i) significant and continuous support to the decision making process towards a more sustainable use of water and associated living resources;

(ii) better understanding of the environmental problems with updated and easy-to-access information for increasing cooperation between the governments that share the water bodies; and (iii) a valuable source of information/data for development of advanced knowledge and awareness among stakeholders regarding the importance of rational land occupation and use of water resources, costal zones and their associated living resources.