

very cold climate and recent disasters. The Government of Mongolia is committed to implementing reforms in water resources management and environmental protection, but due to lack of financial resources and the limited number of trained personnel, policies cannot be implemented, and laws and regulations cannot be enforced. Improving the implementation of

legal frameworks and policy coordination in the water sector are dire necessities. Sectoral interests have prevented the adequate protection of water resources and the environment. The decentralization of water pricing has promoted economic growth by providing low-cost water to business and industry but has disregarded the needs of the poor.

12. La Plata River Basin

The La Plata River Basin is the fifth largest river basin in the world, extending over 3.1 million km², and its surface area is second only to the Amazon River Basin in South America. It covers an extensive part of central and northern Argentina, southeast Bolivia, almost all the southern part of Brazil, the whole of Paraguay and a large part of Uruguay (see Map 14.12).

With over 100 million inhabitants, close to fifty major cities, seventy-five large dams and an economy that represents 70 percent of the per capita GDP of five countries, the basin has enormous economic and social importance for the region overall.

The La Plata River Basin has four main sub-basins: the Paraná, Paraguay and Uruguay River systems and the La Plata River sub-basin itself. The Paraná River system is the biggest of the three, constituting 48.7 percent of the basin's overall surface area. The Paraguay and Uruguay River systems respectively comprise 35.3 percent and 11.8 percent of the basin. The remaining 4.2 percent corresponds to the La Plata River sub-basin itself.

In terms of discharge, the Paraná River System is the most important in the basin, with a mean annual flow of about 17,100 cubic metres per second (m³/s) at Corrientes.⁸ The Uruguay River system has a mean annual flow of about 4,300 m³/s, while the Paraguay River System has the lowest capacity with a mean annual flow of approximately 3,800 m³/s at Puerto Pilcomayo.⁹

Long-term measurements over a large part of the La Plata Basin show certain trends in climate and rainfall patterns. For example, annual minimum temperatures are increasing by about 1°C per century. Furthermore, hydrological records show evidence of an increase both in rainfall and runoff in the La Plata Basin after 1970. El Niño has also had an impact on stream flows in the basin. For example, in the middle section of the Paraná River, the four largest discharges on record followed the four El Niño events of 1905, 1982–1983, 1992 and 1998. In 1982 and 1983, more than 40,000 people were affected in more than seventy towns along the reach of the



Map 14.13: Overview of La Plata River Basin

Source: Prepared for the World Water Assessment Programme by AFDEC, 2006.

Uruguay River within the Brazilian state of Rio Grande do Sul. Severe flooding, with extensive damage to infrastructure and economic production, are frequent occurrences, especially in the Paraná and Uruguay sub-basins. The Paraná River and its tributaries have many riverside towns that are frequently flooded. This is the case in the Argentinean cities of Resistencia, Corrientes, Rosario, and Santa Fe. In the La Plata Basin as a whole, losses associated with El Niño events were estimated at more than US \$1 billion.

Water and environment

Thanks to climatic conditions, rainfed agriculture is common in the basin. In fact, the proportion of irrigated land to the overall agricultural area is relatively low, varying between 0.3 percent (in Paraguay) to 16.8 percent (in Uruguay). Soybean, maize and wheat are widely produced in the basin, and animal husbandry and fisheries are other important sources of food and income.

However, soil loss from agricultural areas and organic and chemical contamination stemming from agriculture and animal husbandry are also

8. Located on the left bank of the Paraná River (Argentina), after its confluence with the Paraguay River.

9. Located on the right bank of the Paraguay River (Argentina), after its confluence with the Pilcomayo River.

sources of pollution. Furthermore, pollutants and heavy metals from mining operations and inadequately treated urban sewage are other causes of environmental concerns in the basin. Increased tourism is also leading to overfishing, damage to flora and fauna and the illegal exportation of endangered species. In addition, it is argued that the Hidrovia project, which has been proposed as a means of facilitating the transport of agricultural products, might negatively affect the extremely rich array of wildlife in Pantanal ecosystem (see **Box 14.9**).

With the support of the World Bank, the Government of Brazil initiated the Pantanal Project in 1991. The resulting Plan for the Conservation of the Upper Paraguay River Basin (PCBAP, Plano de Conservação da Bacia do Alto Paraguai) employed an environmental zoning approach to delineate general and site-specific guidelines for the conservation, rehabilitation and preservation of degraded lands; created a geographic information system (GIS) to facilitate the dissemination of available physical, biological, social, legal and economic information; and proposed the operation of a real-time flood warning system.

Environmental problems are not only limited to Pantanal. In the last few decades, rapid population growth, road development, expanding agricultural frontiers, mining and large-scale hydraulic engineering (including dams, waterways, and irrigation projects) have resulted in a decrease in the overall quality of the basin environment and created ongoing problems, such as siltation of waterways and reservoirs, intense deforestation and degradation (e.g. in the Chaco semi-arid woodland), tropical forest loss and fragmentation of the rainforests of Argentina, Brazil and Paraguay.

Severe erosion on the eastern slopes of the Andes has caused agricultural land loss in Bolivia and Argentina, as well as a devastating siltation process on the Bermejo and Paraguay rivers, which extends into the Paraguay, Paraná and La Plata rivers. A large part of fertilizers and pesticides used in farming are carried by runoff into watercourses. This toxic pollution puts the populations that depend on the rivers' productivity for their livelihoods at risk and threatens the biodiversity of the maritime front of the La Plata River.

Levels of poverty

Important economic crises at the beginning of this decade have affected all basin countries and had a negative impact on the success of poverty reduction strategies. The poverty rates in Argentina and Uruguay decreased rapidly in the 1990s and then increased again between 1999 and 2002, more than doubling in Argentina. On the other hand, poverty decreased rapidly in Brazil between 1992 and 1995 and has remained more or less stagnant since then. Lately, poverty has also been on the rise in the urban areas of Bolivia and Paraguay.

People with low incomes often live in informal settlements established in marginal areas where safe water and sanitation infrastructure is either

insufficient or non-existent, increasing the percentage of people suffering from diseases that stem from a lack of water and sanitation. Problems related to informal settlements in the region have aggravated in the last twenty years.

Table 14.2: Percentage of urban and rural populations with access to drinking water and sanitation services

Countries	Safe water (%)		Sanitation (%)	
	Urban areas	Rural areas	Urban areas	Rural areas
Argentina	85	30	89	48
Bolivia	93	44	82	35
Brazil	96	65	94	53
Paraguay	70	13	85	47
Uruguay	99	93	95	85

Access to safe water and sanitation

Access to safe water and sanitation varies significantly between urban and rural areas in the La Plata Basin. In all the countries, urban areas have better access to safe water and sanitation services than rural areas. In fact, between 70 and 99 percent of the urban population has access to safe water and 82 to 95 percent has access to sanitation services. Meanwhile, in rural areas between 13 and 93 percent of the population have access to safe water and 35 to 85 percent have access to sanitation services (**Table 14.2**).

Water and health

Biological contamination stemming from a lack of proper sanitation infrastructure and inadequate wastewater treatment facilities constitutes a severe problem in several urban and rural settlements in the basin. Consequently, occurrences of waterborne diseases such as diarrhoea, cholera, malaria and dengue are quite common in certain regions. Other diseases of fewer occurrences are leptospirosis, leishmaniasis and yellow fever. Diarrhoea is by far the most common waterborne disease, affecting children especially. In 2003, in Argentina alone, over 900,000 people suffered from diarrhoea.

In different zones of Argentina, among several other Latin American countries, the population has to constantly utilize water resources with naturally high arsenic content, surpassing acceptable limits for drinking water standards. Arsenic is a naturally occurring element found in the earth's crust (see **Chapter 6**). Water resources that are in contact with rock layers that are rich in arsenic get polluted by this carcinogenic mineral. Arsenic is also utilized in some industrial processes and can leak into water bodies if not handled with care. Significant efforts are made to minimize or eliminate arsenic contamination in urban drinking water by chemical treatment. However, although low-cost methodologies for removal of arsenic at home level have been tested with success, some rural communities continue using groundwater resources that are contaminated with arsenic.

Water and industry

The La Plata River Basin comprises a great potential for economic activities. In this regard, there are several industrial centres in the five countries situated along numerous tributaries. However, the most significant industrial centres are located in Brazil, in the São Paulo metropolitan area, and in Argentina, along the industrial strip on the Paraná River and in the metropolitan area of Buenos Aires. Mining sector is prominent at the upper part of Paraguay River sub-basin and in Bolivia close to the Pilcomayo River tributaries.

The greatest industrial water demand occurs in the Paraná River System (20 percent), where the industrial sector is mostly concentrated. In the La Plata River sub-Basin, almost 98 percent of the water abstracted is utilized along the Argentinean bank by factories located in the Buenos Aires metropolitan area.

The industrial centres, although providing employment and contributing to the national GDP, are a source of pollution in the basin. Consequently, depending on the type and extent of industrialization and the absorption capacity of rivers, the level of contamination varies in the four river sub-systems. However, there are localized cases of contamination where big urban settlements, industrial zones and mining pits are located. In order to curb industrial pollution, the five countries of the La Plata River Basin are drawing policy guidelines and implementing programmes for promoting cleaner industry.

Water and energy

Growing population and industrialization necessitate an increase in energy production. Given an estimated potential of 92,000 MW, the production of

hydropower has thus become a regional priority. So far, approximately 60 percent of this potential has been put to use.

More than 90 percent of the energy used by Brazil comes from hydropower, the greater part of which is generated by dams on the Paraná River and its tributaries. By taking into consideration the environmental and social impacts that the dams cause, a financial compensation tax has been placed on the hydroelectric sector for the utilization of water resources. By law, 6 percent of the value of the electric energy produced is channelled back to the areas where the facilities for energy production are located or areas that have been flooded due to the dam reservoirs. Furthermore, a certain percentage of these funds is allocated to the Ministry of Environment for the implementation of the National Water Resources Management System.

Hydropower development projects are not only national in character. Riparian countries have implemented joint projects such as the Salto Grande (Argentina and Uruguay), Itaipú (Brazil and Paraguay) and Yacretá (Argentina and Paraguay) dams to further improve their energy production.

Sharing water resources

There are substantial underground water resources in the La Plata River Basin. The Guaraní Aquifer System (GAS), for example, is one of the world's most important fresh groundwater reservoirs, due to its extent and volume. It underlies portions of Argentina, Brazil, Paraguay and Uruguay, stretching over an area of approximately 1.2 million km², with almost 15 million inhabitants. The capacity of the GAS is estimated at around 40,000 km³.

BOX 14.9: THE PARAGUAY-PARANÁ WATERWAY (HIDROVÍA) PROJECT

The waterways of the La Plata Basin have been navigated since the early sixteenth century. The Paraguay and Paraná Rivers are natural transport corridors extending in a north-south direction, connecting the heart of South America to the Atlantic Ocean. Although they remain an important transportation artery linking the five riparian countries, the continuous maintenance of those waterways poses a problem to riparian countries.

The Hidroviá waterway, as planned, runs from Puerto Cáceres (Brazil) in the north to Nueva Palmira (Uruguay) in the south, following the Paraguay and Paraná rivers over 3,000 km. The aim of the project is to expand the five countries' navigation possibilities, promote development of the region by reducing the cost

of transport of goods and improve links with commercial centres, while granting an outlet to the sea to landlocked Bolivia and Paraguay.

However, the project's construction and operation may have a number of severe and complex impacts on the environment of the region, particularly the Pantanal, an immense plain located in the Upper Paraguay River Basin, considered to be one of the world's largest wetlands (with an estimated area of 140,000 km²). This large and rich ecosystem, which has so far remained relatively untouched, might be seriously damaged due to a significantly modified flow regime, whose repercussions might not only be limited to a decrease in biodiversity but might also lead to significant

changes in water levels at the confluence of the Paraná and Paraguay rivers. Other concerns include the alteration of natural aquifer systems, increased water contamination due to expected growth in local populations and increased commerce, industry and irrigation.

As a result, this project is under debate by scientists and conservation organizations. A more in-depth environmental impact assessment is necessary to address the various social, environmental and economic aspects of this development project.

Sources: Modified from Bucher and Huszar, 1995; Gottgens et al., 1998; and Petrella and Ayuso, 1996.

A joint project is currently under way to support GAS countries in implementing a common institutional framework for managing and preserving the GAS. The project also aims to expand and consolidate the current knowledge base through monitoring and evaluating water resources, in order to promote stakeholder participation in decision-making and control pollution.

An international legal framework for the management of transboundary groundwater resources currently does not exist. However, transboundary groundwater management is necessary in regions that are subject to water scarcity and fierce competition among users (see **Chapter 11**). In the case of the GAS, helping to shape an institutional framework regarding transboundary groundwater can make a contribution that could serve as a potential model for other countries and regions.

With respect to surface water, the main concern is the sustainability of the resources in the long term. For this purpose, many bi- or multilateral projects are currently in progress. Some examples are the integrated management and master plan of the Pilcomayo River Basin (Argentina, Bolivia, and Paraguay) and the strategic action programme for the Bermejo River Binational Basin (Argentina and Bolivia). Through these projects, basin countries aim to promote better utilization of water and land resources while conserving and rehabilitating ecosystems. These projects also facilitate information exchange in addition to providing a basis for strengthening regional information systems.

Managing the resource: Institutional frameworks

The first step towards the initiation of a comprehensive basin-wide study was taken in 1967, as a decision of the Ministers of Foreign Affairs of the five countries. The direct outcome of this decision was the establishment of the Intergovernmental Coordinating Committee of the Countries of La Plata Basin (CIC). In 1968, the committee was entrusted to draw up a treaty in order to enforce the institutionalization of the basin. Approved in 1969, this treaty provides the basis for further bilateral and multilateral agreements concerning jurisdictional matters, navigation, fishing, pollution prevention, scientific research, etc.

Currently, the CIC has a new 'Program of Action' and is preparing a Framework Programme, with the support of the Global Environment Facility (GEF), through the United Nations Environment Programme (UNEP) and the Organization of American States (OAS), in order to implement the environmentally and socially sustainable economic development of the La Plata Basin, specifically by protecting and managing its water resources and adapting to climatic change and variability.

Conclusion

The La Plata River Basin is the fifth largest river system in the world and has enormous economic and social importance for the region.

Due to a series of economic crises affecting the countries of the basin, rising poverty remains the most important social issue to be addressed. Given limited funds allocated, meeting safe water and sanitation needs of the people, and especially the poor, is a big challenge. As a result, water-borne diseases stemming from lack of water and sanitation continue to be among one of the major causes of morbidity in the basin.

The basin is blessed with a rich array of wildlife and extensive ecosystems, however, rapid population growth, expanding industrial, agricultural and mining activities and large-scale hydraulic engineering have caused extensive environmental deterioration in the basin.

Basin countries share the common vision of sustainable development through bilateral and multilateral cooperation in utilising the extensive surface and groundwater resources in an optimal fashion. For this purpose, many joint projects are currently in progress. through these projects, basin countries aim to promote better utilisation of water and land resources while conserving and rehabilitating ecosystems. The La Plata Treaty, based on a basin-wide institutional framework, provides the foundation for such efforts towards the protection and integrated management of water resources and adaption to climate change and variability.