4

Latin America and the Caribbean

Overall, Latin America is the richest region in terms of available freshwater resources per capita. The two transboundary case studies, involving Argentina, Bolivia, Brazil, Paraguay and Uruguay, were conducted in areas endowed with abundant water resources and spectacular biodiversity. Fertile land assures food security while waterways allow transport of goods to regional and international markets. The richness of the region is, however, under increasing human and climatic pressures. Progress towards reaching water- and sanitation-related Millennium Development Goals, wide recognition of the concept of integrated water resources management, and a decrease in poverty are a few of the encouraging signs that the region will be able to overcome these pressures.

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Argentina, Bolivia, Brazil, Paraguay and Uruguay: La Plata River basin

The frequency and magnitude of extreme hydrological events have been increasing in the economic centre of South America over the last 40 years as a consequence of major land use changes and climatic variability, with significant social and economic costs.

Setting the scene

Extending over 3.1 million km^2, La Plata River basin is the second largest river system in South America and the fifth largest in the world. Shared by Argentina, Bolivia, Brazil, Paraguay and Uruguay, it covers about one-fifth of South America (Map 4.1). With over 100 million inhabitants, close to 50 big cities and 75 large dams, La Plata River basin is at the core of the region's socio-economic activities, which generate around 70% of the per capita GDP of the five basin countries.[1]

With its extensive geographic coverage, La Plata River basin is highly variable topographically, ranging from 4,000 metre high mountains in north-western Argentina and southern Bolivia to almost sea level southern plains in Argentina and Uruguay. Rainfall similarly varies, from less than 700 mm per year in the western Bolivian highlands to more than 1,800 mm per year along the Brazilian coast in the east.

The second edition of the *World Water Development Report* included a comprehensive assessment of the water resources of the basin (UNESCO-WWAP, 2006). The present case study builds upon those findings.

Climate change and variability

The regional climate is significantly affected by El Niño-Southern Oscillation (ENSO), which is accompanied by heavy rains, often resulting in catastrophic flooding. This large-scale global event produces complex variations that have a major impact on the climate and, consequently, on the basin's hydrology, and that greatly affect its population and economy.

An upward trend in rainfall has been observed in the south of subtropical Argentina since the 1960s and in southern Brazil and northern Argentina since the mid-1970s. Analysis of the mean discharge in the Paraná, Paraguay, Uruguay and La Plata sub-basins shows a similar trend. Measurements taken at Corrientes station on the Paraná River indicate increases of 16% in annual rainfall and 35% in discharge. The trend is thought to be linked partly to changes in land use, such as deforestation and increased soybean cultivation in Brazil, Paraguay and Argentina.

In addition, floods have been more frequent in La Plata River basin. Twelve of the 16 biggest monthly discharges ever recorded on the Paraná River have occurred since the 1970s; they included catastrophic ENSO events in 1982/1983, 1991/1992 and 1997/1998. Similar trends are observed for the Paraguay and Uruguay rivers. For example, two-thirds of the major floods in Paraguay's capital, Asunción, which is located near the Paraguay River, were recorded in the last quarter of the 20th century. For the Uruguay River, the 16 greatest daily discharge peaks were recorded after 1970. All these significant variations can be associated with climate change.

An important impact of climate change and climatic variation is expected to be on water availability for agriculture, with the effects varying considerably by location. For example, existing water supply problems in northern Argentina may worsen, necessitating changes in crop type and cultivation frequency, as well as better irrigation and drainage methods. Conversely, agricultural water supply in south-eastern Brazil is expected to increase (Magrin et al., 2007).

State of the resource and water use

In terms of freshwater potential, the Paraná River is the most important in La Plata River basin, with a mean annual flow of about 17,100 m^3 per second (m^3/s) at Corrientes. The Uruguay River has a mean annual flow of about 4,300 m^3/s, while the Paraguay River has the lowest capacity, with a mean annual flow of some 3,800 m^3/s at Puerto Pilcomayo (UNESCO-WWAP, 2006). The basin is also rich in groundwater resources. The Guaraní aquifer, shared by all five countries except Bolivia (Table 4.1), is one of the world's largest groundwater reservoirs, extending over 1.19 million km^2 and having an estimated capacity of 37,000 billion m^3. Of this, 40 billion m^3 to 80 billion m^3 per year is exploited, mainly in Brazil for consumption in over 300 cities.

Map 4.1 La Plata River basin

[1] Except where otherwise noted, information in this case study is adapted from the draft *La Plata River Basin Case Study Report*, prepared in 2008 by Víctor Pochat.

Table 4.1 Distribution of the Guaraní aquifer in La Plata basin	
Country	Share of aquifer (%)
Argentina	19
Brazil	71
Paraguay	6
Uruguay	4

Of the overall agricultural area in La Plata River basin, the share of irrigated land is relatively low, varying from 2% in Paraguay to 15% in Uruguay. On the other hand, in all the basin countries agriculture holds the largest share of overall water consumption: from 62% in Brazil to 96% in Uruguay (FAO, 2004). Extensive rice production, and agricultural development projects undertaken since 1996, underlie this phenomenon; rice is one of the main irrigated crops in the basin. Moreover, increased average annual rainfall, coupled with the promotion of soybeans as the key crop, has resulted in expansion of agriculture, especially towards historically arid and semi-arid zones. Total combined soybean production in Argentina, Bolivia, Brazil and Paraguay is expected to rise by about 85% by 2020. Changes in land use and the potential effects of climate change could lead to salinization and desertification in the basin.

With regard to efforts under the Millennium Development Goals (MDGs) to halve the proportion of people suffering from hunger, Uruguay met this target in 2003, but the other basin countries have yet to do so (Table 4.2).

In general, poverty indicators are trending downwards in the basin countries (Table 4.3). From a reference year of 2002, Argentina has taken a significant leap forwards in alleviating poverty. The progress made by Brazil, although modest in appearance, represents some 6 million people lifted out of extreme poverty (ECLAC, 2007b).

Industrial water demand varies among the four main sub-basins. Demand is highest in the Paraná River sub-basin due to the major industrial areas in Brazil's São Paulo state and the Buenos Aires-Rosario region in Argentina. Although large rivers like the Paraná have a high self-cleaning potential, contamination by industrial, agricultural and household effluents is causing major environmental degradation, especially along the banks of the lower Paraná.

Urbanization is one of the biggest drivers of change in La Plata River basin. From the 1960s to the early 2000s, the share of urban dwellers in the region's population increased from about 45% to 86.6%, mainly through internal migration. In general, access to safe water coverage is better in urban than in rural areas (Figure 4.1). However, the data in the figure represent best case scenarios. Problems stemming from poorly maintained infrastructure and intermittence of service provision mean actual service is generally much poorer. In Uruguay, for example, water loss ranges from 46.2% to 54.4% (Gobierno de la República de Uruguay, 2001). Urban-rural discrepancies are also observed in access to improved sanitation. The gap in access to sanitation services in all basin countries except Uruguay varies from around 10 percentage points to more than 40 (Figure 4.2). Lack of

Table 4.2 Progress towards halving hunger			
	% of undernourished people in total population		Ratio 2001 2003/ 1990 1992*
Country	1990 1992	2001 2003	
Argentina	2	3	1.5
Bolivia	28	23	0.8
Brazil	12	8	0.7
Paraguay	18	15	0.8
Uruguay	7	3	0.4

* A ratio of 0 5 or lower signifies achievement of the MDG target
Source FAO, 2006

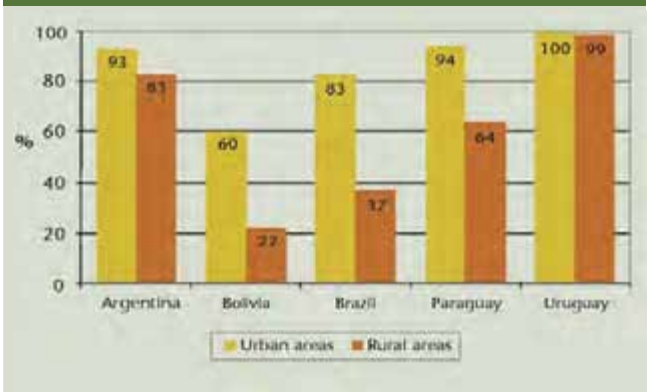
Table 4.3 Progress in alleviating poverty						
	Poverty (%)			Extreme poverty (%)		
Country	2002	2005	2006	2002	2005	2006
Argentina	45.4	26.0	21.0	20.9	9.1	7.2
Bolivia	62.4	63.9	n.a.	37.1	34.7	n.a.
Brazil	37.2	36.3	33.3	13.2	10.6	9.0
Paraguay	61.0	60.5	n.a.	33.2	32.1	n.a.
Uruguay	15.4	18.8	18.5	2.5	4.1	3.2

Note n a : not available
Source ECLAC, 2007b

Figure 4.1 Population with access to safe drinking water, 2004

Source ECLAC, 2007a

Figure 4.2 Population with access to improved sanitation services, 2004



Source ECLAC, 2007b

Box 4.1 Meeting growing energy needs with biofuel production

Access to electricity, in terms of percentages of households and persons served, is high in La Plata River basin, varying from 64.4% in Bolivia to 96.5% in Brazil (IEA, 2006). Although non-renewable sources make up the bulk of energy production in the basin, oil use fell and natural gas consumption rose between 2002 and 2005. While the use of renewable energy sources decreased during the same period, biofuel use grew, thanks mainly to the strong development of the ethanol industry in Brazil (Ruiz Caro, 2007).

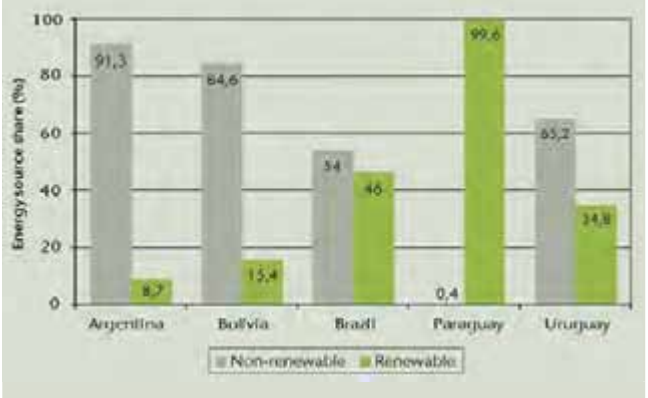
Brazil is one of the world's major biofuel producers, and the first to make ethanol from sugar cane. In 2005, Brazil accounted for 47.9% of world ethanol output (IEA, 2006). Producing ethanol from sugar cane generally puts less pressure on land and water resources than maize or other crops used for the purpose. Soil productivity in sugar cane fields is preserved by recycling the nutrients in sugar mill waste. In addition, most sugar cane production in Brazil does not require irrigation. Moreover, ethanol combustion emits 90% less CO_2 than the burning of conventional fuels such as gasoline (IEA, 2006).

sewage treatment facilities means effluents are often directly discharged into streams that are used as a water source downstream. Shanty towns in periurban areas suffer the most: water and sanitation coverage is lower or non-existent in these areas. This situation, in turn, increases the risk of water-related disease. Unfortunately, problems related to slums in the region are reported to have worsened since the 1980s (Von Cappeln, 2002).

Energy production in La Plata River basin is mainly based on non-renewable sources (Figure 4.3). However, hydropower, whose potential in the basin is huge, has a considerable share in electricity generation in all five countries. Indeed, Paraguay depends almost entirely on hydropower for its electricity generation, and dams on the Paraná River generate about 46% of the electricity used in Brazil (CIC, 2004*a*). Roughly 60% of the basin's hydropower potential is exploited. Among more than 100 hydropower plants in the basin (including those under construction), some are bilateral projects, such as Itaipú (Brazil and Paraguay), Yacyretá (Argentina and Paraguay) and Salto Grande (Argentina and Uruguay). Biofuel also plays a role in the energy supply, especially in Brazil (Box 4.1).

Waterways in La Plata River basin have been navigated since the 16th century. The Paraguay and Paraná rivers form a natural north-south transport corridor, connecting the five riparian countries to the Atlantic Ocean. The Hidrovía Paraguay-Paraná project, a waterway that would run from Puerto Cáceres in Brazil to Nueva Palmira in Uruguay, was proposed in the late 1980s because of the continuous maintenance requirements of the natural corridor.

Figure 4.3 Breakdown of energy supply: renewable and non-renewable sources, 2004



The Hidrovía would be a complex navigation system allowing year-round navigability by ships and barge trains. The aim is to promote regional development by reducing goods transport costs, improving links with commercial centres and providing landlocked Bolivia and Paraguay with a sea outlet (UNESCO-WWAP, 2006).

However, the project would entail extensive dredging, construction of dikes and levees, and channel straightening. The environmental impact of the work could prove to be extensive and diverse. In particular, the project could significantly modify the flow regime of the Pantanal, the world's largest freshwater wetland, risking serious damage to the site. Such a change would affect not only biodiversity, but also water levels at the confluence of the Paraná and Paraguay rivers. Other issues include the risk of alteration of natural aquifer systems and increased water contamination should the waterway lead to growth in the local population, in commercial and industrial activities and in irrigation (UNESCO-WWAP, 2006).

Another key navigation corridor in the region, which would be linked to the Hidrovía, is the 2,400 km Tietê-Paraná waterway in Brazil. It facilitates transport of up to 2 million tonnes per year of grain and other goods between states in Brazil and between Brazil and the other La Plata River basin countries.

Policy framework and decision-making

Since 2006, Argentina has progressed in its preparation of a national water resources plan, which involves collaboration between the central and provincial governments and that of the Autonomous City of Buenos Aires. The plan sets forth actions to improve water quality and quantity, to better manage demand from the various sectors and to mitigate the impact of extreme events. An important change in the water sector has been the renationalization of several water supply and sanitation services that were privatized in the 1990s. The move involved cancelling the contract of an international

company serving the Buenos Aires metropolitan area, home to about one-third of the country's population. To maintain continuity of water and sanitation services, the government created another company, in which it holds 90% of the stock (NotiSur, 2006).

Bolivia created the Ministry of Water (Ministerio del Agua) in January 2006 with the overarching aim of protecting the inhabitants' right to water. The move came in response to strong popular reaction against private water companies in 2000 and 2005. Henceforth, all water companies operating in Bolivia are to be public companies, and are expected to follow an efficient and transparent public model. The ministry is in charge of (a) protecting and managing Bolivia's water resources, including monitoring the cumulative impact of mining and oil production; (b) improving irrigation; and (c) providing water supply, sanitation and solid waste management services. The ministry also aims to respect traditional knowledge and customs and to protect cultural diversity. Meanwhile, the government is considering a proposed law on water and sanitation services. Under the title 'Water for Life', this new legal framework would replace the current water regulating agency with a decentralized one. It would also reform water supply provision to better integrate municipalities and users and to prioritize social values (Alliance for Democracy, 2006).

In January 2006, the National Water Resources Council of Brazil approved the national water resources plan to establish guidelines and public policies aimed at increasing the quantity and quality of the water supply and improving demand management. The plan adopts a river basin approach and considers water to be a public good, a position essential in promoting sustainable socio-economic development. The plan, which is based on broad consultation with the public and water sector representatives, establishes guidelines, programmes and goals for the period to 2020 (MMA-SRH, 2006).

In June 2007, Paraguay passed a Water Resources Law defining water as a public good. It guarantees access to a minimum quantity of drinking water per day, holding this to be a human right. The exact amount is to be determined by the Ministry of Public Health. The Law exempts water use for households and small family-owned businesses from charges. Provision of water for other purposes will depend on the availability of resources and will be taxed accordingly. The Law promotes respect for indigenous customary rights and highlights the minimum volume of water required to sustain ecosystems (Arrieta, 2007).

Discussions about water privatization in Uruguay led to amendment of the Constitution in October 2004. The charter now guarantees public access to water supply and sanitation services as a fundamental right, and stipulates that social considerations should be given priority over economic factors in setting water policy. The Constitution prohibits for-profit corporations from supplying water for human consumption (Alliance for Democracy, 2006).

The main challenges

Health: Lack of proper sanitation infrastructure and inadequate wastewater treatment are the main causes of water-related infections in La Plata River basin. Among the major waterborne diseases in the basin (Table 4.4), diarrhoea is by far the most widespread. Yellow fever re-emerged in Paraguay during the summer of 2007/2008, affected Argentina and Brazil as well, and claimed 25 lives in a month's time (PAHO, 2008*a* and 2008*b*; Secretaria de Vigilãncia en Saúde, 2008). It was the most severe outbreak since the 1960s, leading the basin countries to agree on common action criteria (CC-RMS, 2008).

Environment: La Plata River basin is rich in terrestrial and aquatic biodiversity, but it is under increasing pressure. The initial World Water Assessment Programme case study (WWAP, 2007) identified population growth, road development, expansion of agricultural land, mining and large-scale water development projects (dams, waterways and irrigation projects) as particular sources of pressure. They have resulted in a decrease in the overall quality of the basin environment and created persistent problems, such as erosion of productive land, silting of waterways and reservoirs, soil and water pollution and loss of habitat for fish and wildlife.

Table 4.4 Cases of waterborne diseases by country, 1998–2005

	Argentina	Bolivia	Brazil*	Paraguay	Uruguay
Diarrhoea	951,480 (2003)	315,786 (2005)	260,000 (2002)	41,450 (1999)	n.a.
Cholera	12 (1998)	467 (1998)	753 (2000)	4 (1998)	0
Malaria	122 (2003)	23,552 (2005)	5,514 (2003)	1,392 (2003)	90 (2003)
Dengue	135 (2003)	4,095 (2005)	21,913 (2004)	148 (2005)	n.a.
Leptospiosis	201 (2004)	n.a.	1,353 (2003)	n.a.	20 (2002)
Leishmaniasis	748 (2002)	1,735 (2000)	7,633 (2003)	86 (2004)	n.a.
Yellow fever	n.a.	56 (2005)	62 (2003)	n.a.	n.a.

Notes * Data for states of La Plata River basin only
n a : not available

Sources PAHO, 2004; Ministerio de Salud y Ambiente de la Nación Argentina/OPS, 2005; Sistema Nacional de Vigilancia Epidemiológica de Argentina, 2003; Sistema Nacional de Información en Salud de Bolivia, 2005; Ministerio da Saúde, 2004; Ministerio de Salud Pública y Bienestar Social del Paraguay, 2005, Ministerio de Salud Pública de la República Oriental del Uruguay, 2002

Problems related to eutrophication have been observed in some reservoirs. At the Salto Grande dam, for example, a significant phosphorus load resulting from the use of agrochemicals promotes algae growth in summer when discharges are lower, affecting water quality and availability (Chalar, 2006). Another serious environmental problem is that some lotic ecosystems are becoming lentic[2], or almost lentic, leading to larger ecotones, the transition areas between adjacent ecosystems a change entailing destruction of terrestrial habitats and existing ecosystems. In general, all the basin countries have regulations on the protection of water resources and associated ecosystems, but the effectiveness of implementation and enforcement varies.

Risk management: The increase in the frequency and magnitude of extreme hydrological events in La Plata River basin since the mid-20th century, resulting from changes in large scale climatic systems and in land use at regional level, has had fundamental repercussions for risk prediction and mitigation (CIC, 2004*b*).

Floods have inflicted significant socio-economic costs on the basin. In Argentina, for example, flood-related damage associated with ENSO events in the 1980s and 1990s was estimated at US$2.6 billion, and 235,000 people were evacuated (CIC, 2004*d*). In the state of Santa Catarina in Brazil, ENSO-related flooding in 1983 caused significant damage along the Paraná River and led to an 8% drop in the state's GDP. Between 1983 and 1993, flood losses in União da Vitória, a city located on the Iguaçu River in Brazil, totalled over US$110 million (CIC, 2004*a*). The El Niño event of 1983/1984 in central Uruguay affected over 40,000 people in more than 70 cities and caused losses estimated at over US$1 billion for the entire La Plata River basin (CIC, 2004*c*).

Overall, measures addressing extreme hydrological events in the region are heavily biased towards structural solutions. Non-structural measures such as warning systems are not functioning effectively. The basin countries are still attempting to reach agreement on the definition of extreme hydrological events, including rainfall and river discharges; such a definition is important for reservoir operations, irrigation regimes and flood warnings. In addition, urban planning and basin management need to be integrated with extreme hydrological event management; otherwise it is difficult to limit socio-economic damage from such events.

Conclusions

La Plata River basin has become a regional centre of attraction, concentrating the socio-economic development of the five riparian countries. However, this development comes at the cost of spreading shanty towns and increasing problems with water supply, sanitation and health in urban areas, as well as degradation of water quality and ecosystems. At the same time, climate change and climate variability pose potential risks for an agricultural sector that serves the dual purpose of feeding a growing population and providing raw materials for biofuel. Given the increased frequency and magnitude of water-related hazards, cooperation among the basin countries is vital, as is the implementation of well-planned policies supporting both structural and non-structural measures to mitigate the hazards. New legislation across the region emphasizes the social dimension of water, defining it as a public good and guaranteeing access to it as a human right, while recognizing its central role in sustainable socio-economic development. Nevertheless, additional efforts are necessary, at national and basin level alike, to address other issues in the region, most notably poverty.

[2] 'Lotic' ecosystems are characteristic of fluvial water bodies, such as rivers, streams and springs. 'Lentic' refers to the ecosystems of still water bodies, such as lakes, ponds and swamps.

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Brazil and Uruguay: Lake Merín basin

The ecological and economic riches of this region are under human and climatic pressure, while a deteriorating hydrological monitoring network makes accurate assessment complicated.

Setting the scene

Lake Merín is a freshwater body shared by Uruguay and Brazil. Covering an area of some 5,000 km² (Map 4.2), it is the second largest lake in South America, after Lake Titicaca in the Andes. The Lake Merín basin extends about 63,000 km² on the Atlantic coast of South America. It lies in the temperate zone, with a subtropical climate and annual rainfall of 1,200 to 1,500 mm. Much

Map 4.2 Lake Merín basin

of the rain falls from June to September, while November to December is usually the driest time of the year. The section of the basin that lies in Uruguay covers around 18% of the country. The part that lies in Brazil accounts for about 20% of the state of Rio Grande do Sul.[1]

The Lake Merín basin is part of a much broader region of pampas extensive flat plains typically covered by grasslands, wetlands and forests, forming an important part of the South American landscape. With an area of some 270,000 km^2, the pampas extend into Argentina, Brazil, Paraguay and Uruguay.

The western part of the basin includes five departments of Uruguay with a combined population of around 400,000. The eastern part is home to some 1.2 million people, representing 12% of the population of Rio Grande do Sul, in 15 municipalities.

Climate change and variability

Climatic data for Uruguay reveal an increasing trend in rainfall, especially in summer and spring. Also rising are minimum temperatures throughout the year, although the average temperature in summer is decreasing (AIACC, 2006). Studies of climate change scenarios for Uruguay point to likely increases in temperature, rainfall and sea level, as well as the frequency and intensity of extreme climatic events such as strong winds, heavy rains, hailstorms and other water-related hazards. The temperature could rise by as much as 0.5°C by 2020 and 2.5°C by 2050. The projected sea level rise of as much as 65 cm by 2100 would affect the lagoons and coastal wetlands of the Lake Merín basin and associated ecosystems that are vulnerable to related saltwater intrusion. The effects in the state of Rio Grande do Sul in Brazil would likely be quite similar.

From an economic perspective, Uruguay is more vulnerable than Brazil to problems induced by climate change because the region containing the Lake Merín basin generates 70% of the country's GDP. The economic activities there include extensive rice production, animal husbandry, forestry, tourism, maritime transport and various manufacturing industries. The Program of General Measures for Mitigation and Adaptation to Climate Change in Uruguay identifies agricultural production (food security), freshwater resources, ecosystems and public health as especially vulnerable to the effects of climate change (Ministry of Housing, Territorial Planning and Environment, 2007).

Research by the Brazilian Agricultural Research Corporation (EMBRAPA) and the Applied Meteorological and Climatic Centre of Investigation for Agriculture indicates a likely temperature increase of up to 1ºC as early as 2020. This could have substantial implications for agricultural output in Brazil, as coffee production could fall by between 15% and 24%, soy bean production by 14%, rice by 4% and corn by 2% (Steinmetz et al., 2007).

Aside from potential effects of climate change, existing climatic variation linked to El Niño and La Niña events have a significant impact on freshwater availability, as these cycles introduce considerable fluctuation in rainfall levels. Generally El Niño brings abundant rainfall while La Niña years are associated with drought, which affects not only crop and livestock production in the larger region where the Lake Merín basin lies, but also hydropower and wind energy generation. Here again, Uruguay is more exposed to these risks, as it relies almost entirely on hydropower for electricity generation.

State of the resource and water use: agriculture is dominant

In spite of climatic variability, the water resources in the Lake Merín basin are enough to meet demand in the near term. Making accurate long term water resources assessment is quite difficult, as the hydrometeorological monitoring network in the basin is of limited coverage and its quality has deteriorated since the 1970s because of declining funding and maintenance.

Consumption patterns can nevertheless be established sufficiently to identify agriculture as the sector dominating water use in both parts of the basin. On the Brazilian side, 97% of annual withdrawal is used for irrigation. During the summer months, especially in January, agricultural water use intensifies, reaching almost 99% of overall demand. Of this amount, 66% comes from the Merín-São Gonçalo basin, where vast paddy fields are common. The situation is quite similar on the Uruguayan side of the basin, where over 1,000 km^2 of paddies produce 70% of Uruguay's annual rice crop, and demand for irrigation water represents 99.8% of overall water consumption. Rice is the mainstay of the regional economy, generating far more revenue than livestock. It is grown not only to satisfy local needs but, in Uruguay, is among the top three exports by value.

Nationally, irrigation accounts for 59% of overall water withdrawal in Brazil, followed by households with 22% and industry with 19% (Netto, 2005). In Uruguay as a whole, the corresponding shares are 80%, 16% and 3.4% (adapted from Chao et al., 2007).

Inland waterways are an important and economical means of moving goods in the Lake Merín basin, and in the context of the Southern Common Market (Mercosur). For example, rice and forestry products from Uruguay are transported through the eastern part of the Mercosur Waterway from La Charqueada, in Uruguay's Treinta y Tres Department, to the Atlantic port of Rio Grande in the Brazilian state of Rio Grande do Sul for access to regional and international markets.

Further waterway development could help the regional economy not only by improving goods transport but also by increasing ecotourism, as waterways provide easy access to impressive wildlife habitats and other sites of environmental significance, although such development would itself have environmental implications.

Brazil and Uruguay have been successful to varying degrees in advancing water supply and sanitation coverage. Uruguay has achieved universal access to safe water and

[1] Except where otherwise noted, information in this case study is adapted from the draft *Lake Merín Basin Case Study*, prepared in 2008 by Carlos María Serrentino.

improved sanitation. In Brazil, however, sanitation coverage and, to a lesser degree, water supply continue to be problems, especially in rural areas (Figure 4.4). Thus, while the priority in Uruguay should be on allocating the funds necessary to maintain universal coverage, further steps are needed in Brazil to improve access to water supply and sanitation. A new federal water and sanitation law in Brazil (2007) aims at increasing investment so as to achieve universal access. Although no specific assessments are available for the Lake Merín basin, its water supply and sanitation coverage is believed to be similar to the national levels.

Figure 4.4 Access to safe water and improved sanitation in Brazil, 2006

Source WHO/UNICEF, 2008

Policy framework and decision-making

Brazil's 1934 Water Code provides the framework for all of the country's water-related legislation. Under the Federal Constitution of 1988, the states are responsible for all surface water resources except those lying in more than one state, which the federal government controls. This division results in implementation problems, as rivers under federal jurisdiction cannot be managed effectively without taking state-controlled rivers into consideration.

The National Water Law (Law 9.433) of 1997 established the National Water Resources Policy (NWRP) and the National Water Resources Management System (NWRMS). The Law identifies water as a public good, a limited natural resource with an economic value, and gives priority for water use in the event of drought to human and animal consumption. The NWRP takes the river basin as the basic unit for water resources planning and management. A key aspect of the policy document is that it requires decentralization of, and public participation in, water resources management (Aquastat, 2000).

The NWRMS, under the Ministry of the Environment, implements the NWRP. It is made up of the National Council on Water Resources, the National Water Agency, the River Basin Committees, the River Basin Water Agencies and relevant NGOs.

The National Council on Water Resources is the highest organization in the NWRMS hierarchy. It is responsible for formulating the National Water Resources Plan. The plan, which provides guidelines on how the NWRP is to be applied, is itself put into operation by the National Water Agency, ANA (Agência Nacional de Aguas). The ANA is an executive branch of the Ministry of the Environment but with administrative and financial autonomy.

The six national-level River Basin Committees include representatives of the federal, state and municipal governments, water users and civil society organizations. The committees promote and coordinate intersectoral actions regarding basin-related issues. The River Basin Agencies, which are still being formed, will function as the secretariats of the committees.

At state level, Rio Grande do Sul also applies the principles of access to information and a participatory approach in decision-making related to water resources. The State Water Resources System (Sistema Estadual de Recursos Hídricos), established in 1997, deals with water resources management in Rio Grande do Sul. It includes the formation of basin committees, which are involved in decision-making: one such committee deals with the Lake Merín basin and São Gonçalo channel. The system also requires the state to report regularly on the quantity and quality of freshwater resources.

In Uruguay, the Water Code of 1978 provides the general legal framework for water resources management. The code assigns responsibility for the management of surface and groundwater resources to the national government and departmental authorities. It is complemented by laws setting forth provisions specific to various sectors, such as agriculture and industry.

The Uruguayan Constitution was amended in October 2004 by national referendum to identify water resources as public property and recognize access to drinking water and improved sanitation as a fundamental human right. The constitutional reform also promoted integrated water resources management (IWRM), calling for public participation in planning and for management of water resources at basin level. A new Law on Access to Information (Law 18.381), promulgated in October 2008, is in line with this reform.

Institutions charged with elaborating and implementing water resources management policy, setting priorities for water use and establishing user fees in Uruguay include the National Water Authority and the National Water and Sanitation Administration (under the Ministry of Housing, Territorial Planning and Environment) in cooperation with the Ministry of Public Works and Transport. The National Water and Sanitation Policy, which is pending approval, is expected to include environmental preservation and protection among its aims. Like the similar policy document in Brazil, it will provide for all stakeholders, including local communities, to have a role in planning and decision-making.

Both Brazil and Uruguay are following up on the recommendations in the Johannesburg Plan of Implementation regarding IWRM and water efficiency plans. In Brazil, the 1997 National Water Law enshrined such IWRM principles as decentralized water resources

Box 4.2 Ecological importance of Lake Merín

The lake and surrounding wetlands comprise one of the major transboundary watersheds in the Americas, supporting a great diversity of flora and fauna, including a large proportion of the region's endemic species and many species of migratory birds. On the Uruguayan side, Bañados del Este is a Ramsar wetland and UNESCO biosphere reserve known for its rich biodiversity and wildlife. In addition, BirdLife International has identified the southern shore of the lake as a globally important endemic bird area. On the Brazilian side, the Taím ecological reserve is part of the UNESCO Atlantic Rainforest biosphere reserve.

In addition, the basin is the subject of a 1977 bilateral treaty on cooperation and resource use. It envisions 'harmonization ... of the studies, plans, programs and projects necessary for achievement of joint works designed to improve utilization of natural resources' (Article 3b), and 'the defense and suitable use of mineral, plant and animal resources' (Article 4e).

Since the 1970s, however, the dramatic expansion in rice cultivation has encroached on wildlife habitats. An expansion of plantation forests (pine and eucalyptus) and tourism development (on the Uruguayan side) have also had a significant impact on the ecosystems of the basin. To maintain healthy ecosystems and protect biodiversity, an integrated approach to conservation and development is urgently needed.

Source Adapted from de Sherbinin, 2005

management and stakeholder participation as a part of the National Water Resources Policy. Since then Brazil has taken concrete steps to ensure that these principles are applied in practice, and hence it has met the Johannesburg requirement. In Uruguay, although the Constitution provides for stakeholder participation, decentralization and the basin approach in water management, wide scale implementation is still lacking.

The main challenges

Environmental impact of economic development: Rio Grande do Sul is the fourth richest state in Brazil (SEMA, 2007), attracting both investment and labour with a diversified economy based on crops (chiefly soybeans, wheat, rice and corn), livestock, leather and food processing, textiles, lumber, metallurgy, chemicals, and, since the 1990s, petrochemical products and telecommunications. On the Uruguayan side of the Lake Merín basin, the major sources of income are rice, livestock and forest products. Both sides also have tourism activity thanks to the rich ecology and beach resorts in the basin.

Until recently, the pampas and other areas with rich biodiversity were relatively undisturbed, aside from livestock grazing. However, in the last 20 years the spread of irrigated and mechanized rice growing has caused extensive land transformation and led to conflicts over natural resources, while pollution from industry, agriculture and human settlements has degraded the water quality (Box 4.2). Many species of animals, especially birds, are threatened as the marshlands are increasingly converted to grazing and cultivation without any attempt to preserve wildlife. Among other species threatened with extinction are the otter, the coypu and the crocodile (UNESCO, 2008). Increased use of waterways and future waterway development plans might also have repercussions on ecosystems in the area.

Poverty and hunger: Brazil has one of the stronger economies in Latin America, yet poverty is still a socio-economic challenge: in 2006, over 30% of the population was poor (see Table 4.3 in La Plata River basin case study). Since 2002, Brazil has helped lift some 6 million people out of extreme poverty (ECLAC, 2007). Nevertheless, the incidence of poverty remains daunting, especially in rural areas, where a key factor is extreme inequality of land tenure, notably in the semi-arid north-east. In general almost 80% of the rural population about 30 million people lives in poverty. Poor rural communities face even harder challenges than the urban poor due to inferior water supply and sanitation coverage (IFAD, 2008). The situation in Uruguay stands in some contrast to that of Brazil, with poverty affecting 18.5% of the population as of 2006 (see Table 4.3 in La Plata River basin case study). Similarly, as regards the target in the Millennium Development Goals of reducing by half the share of the population suffering from hunger, Uruguay had met the target by 2003 while in Brazil that same year 8% of the population was undernourished (see Table 4.2 in La Plata River basin case study).

Thus, poverty and basic water supply and sanitation coverage are still of some concern in part of the Lake Merín basin, although rising income from rice cultivation, tourism and industry is alleviating the situation to some extent.

Conclusions

The Lake Merín basin is well endowed in freshwater resources. Agriculture, industry, ecotourism and waterway transport are helping boost the economy of the basin, creating job opportunities and improving the livelihoods of many, including the poor and disadvantaged. However, these activities also contribute to environmental degradation in the area, especially in the absence of measures to ensure that regulations are enforced. Climate change scenarios indicate risks to the socio-economic well-being of people living in the basin, mainly stemming from the likely impact on agriculture and tourism. Uruguay is more vulnerable than Brazil to the impact of climate change, as the area containing the Lake Merín basin generates 70% of its GDP. Stronger bilateral cooperation in the basin to improve integrated management of water resources, alleviate poverty and assure sustainability of ecosystems would be beneficial.

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