## 8. Lake Titicaca Basin

**The Lake Titicaca Basin is composed of four major basins: Lake Titicaca, Desaguadero River, Lake Poopó and Coipasa Salt Lake. These four basins form the TDPS System, the main element being Lake Titicaca, the largest lake in South America and the highest navigable lake in the world. The TDPS System stretches approximately 140,000 km² and is located between 3,600 and 4,500 m.a.s.l.**

### Poverty and conflict: Persistent challenges

The initial case study report presented in WWDR1 (see **WWDR1 case study**) concluded that poverty was the most critical social problem in the TDPS system, affecting both rural and urban populations and undermining attempts to implement solutions to various problems. Unfortunately, in the past three years, no significant progress has been made to improve the situation.

In January 2005, the inhabitants of El Alto, Bolivia (located near La Paz), the main city of the TDPS System with 800,000 inhabitants (Instituto Nacional de Estadistica, 2005), protested the contract with Aguas del Illimani (Waters of Illimani), a subsidiary of French Suez Lyonnaise des Eaux that was running a thirty-year concession for the water and sewage services in La Paz and El Alto. A week of civil disturbances finally came to an end with the resignation of the Constitutional President of Bolivia and the government's unilateral decision to end the water concession with Aguas del Illimani. The political transitions occurring in some Latin American countries since the 1980s have further added to the complexity of finding a solution to poverty. Peru was among the first Latin American countries to shift to a democratic regime. However, an increasingly authoritarian regime led to public outrage and caused the president to flee the country in 2000.

These events can be linked to structural poverty (see WWDR1 for more information), which stems from the combination of several socio-economic factors. Some of these factors are land property fragmentation (causing the under-utilization of land resources and thus low productivity) and indigenous cultural patterns leading to social exclusion. The effects of these factors are more pronounced in rural areas. Consequently, migration to urban settlements becomes the only choice for the rural poor, who hope to find better living conditions and mostly end up in crowded degraded districts. These migrants, the inhabitants of the Bolivian urban TDPS System, were the real actors of the social upheaval that took place in October 2003.

### The impact of climate change on glaciers

During dry seasons, glaciers are the main source of drinking and irrigation water for many urban dwellers and farmers living in Peru and Bolivia. However, the climate variability and associated changes in ambient temperatures have started affecting the tropical glaciers of the region. The loss in volume of these unique tropical glaciers is alarming, and continuing melting trends will translate into drought for thousands of people. **Figure 14.1** illustrates the impact of climate change on the availability of water resources in the TDPS System. The consequences of glacial melting for local populations are serious. Acting as reservoirs, glaciers regulate stream flow and diminish seasonal discharge variation. This effect is vital, especially between September and November, when ice melting (and water demand) is at its maximum. Discharges in glacier basins are important during those months, since the flows of other rivers in the Altiplano Basins reach minimum levels.


**Map 14.9: Overview of the Lake Titicaca Basin**

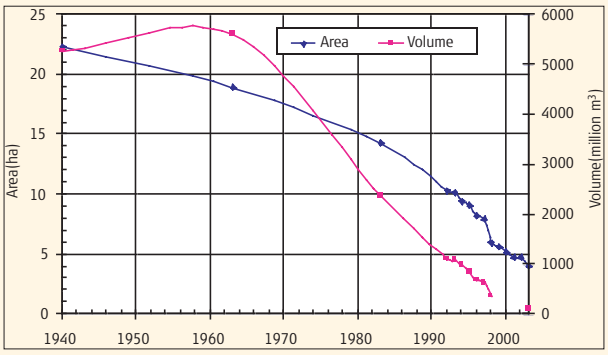
*Source*: Prepared for the World Water Assessment Programme by AFDEC, 2006.

To counterbalance the negative effects of glacial melting, more dams and reservoirs will have to be constructed, increasing the cost of the water supply to Andean cities. It can be expected that the additional cost will be transferred to urban users by means of tariff increases, particularly in El Alto and La Paz, where the urban water supply is under private administration. Judging from recent social movements, any tariff increase would likely trigger potential conflicts, particularly in the poorest areas of El Alto. The additional costs of flow regulation in glacier basins could also be hard to afford for small and medium-sized irrigation systems, rendering rural poor more vulnerable.

## Conclusion

Poverty remains the underlying cause of many social problems experienced by both rural and urban populations. Since the first WWAP case study was conducted in 2003, there has unfortunately been no improvement in living conditions. The poor are still struggling to meet the most basic of food and water needs. The expectation of better living conditions tempts young people to migrate to the cities; however, most of these people find themselves living in degraded crowded informal settlements, which lack even the most basic of utilities. The poor, even if they have physical access to water and health services, can only marginally take advantage of them due to poverty. In this context, the water-related problems of basin countries cannot be isolated; they must be addressed within the greater social framework. Better management of these countries' land, water and gas resources is the only means to break the vicious circle of poverty.

**Figure 14.1: Areal and volumetric variation of the Chacaltaya Glacier**



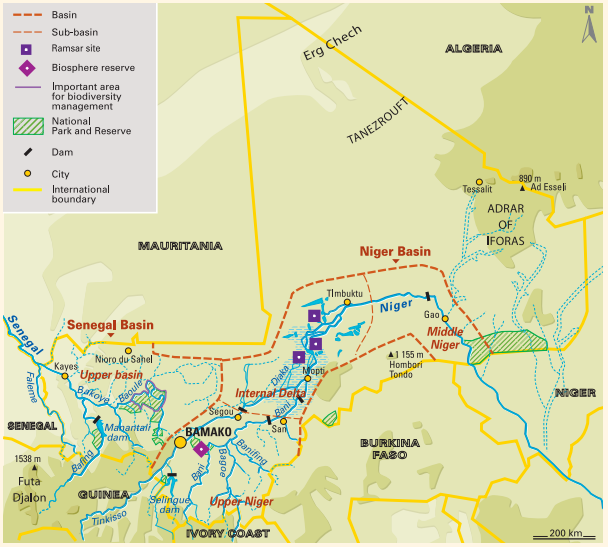

The data collected in the TDPS System shows the receding trend of tropical glaciers. Between 1991 and 2003, Zongo and Chacaltaya glaciers suffered both areal and volumetric losses. In fact, the accumulated mass balance, expressed as water depth, was -11.02 m for Zongo and -15.06 m for Chacaltaya. Chacaltaya glacier, a small glacier located at a medium altitude, lost 97 percent of its mass between 1960 and 2003 and is expected to disappear completely by 2010. This figure clearly shows that the receding trend started in the 1960s and has accelerated in the last twenty years.

## 9. Mali

**Located in the heart of western Africa, Mali has a surface area of 1,241,000 km$^2$, over 50 percent of which is located in the Sahara Desert. More than 1,000 km away from the sea, the country is completely landlocked. Mali's location means that the country's climate can sometimes be quite unpredictable: years of abundant rainfall and years of extreme drought.**

Three climatic groups can be discerned: arid desert in the northern region, arid to semi-arid in the centre and savannah in the south. The Sahara region, in the northwest tip of Mali, covers up to 57 percent of the national territory with an arid and semi-arid desert climate (rainfall usually does not exceed 200 mm per year). At its centre, the country's climate is characterized by the Sahel, encompassing about 18 percent of the land. The humid rainy season (June to October) usually brings between 200 and 700 mm of rainfall per year. The Niger River is an important part of this region, as the annual flooding of the river makes the surrounding land fertile for agricultural production. In the southern region of Mali, the rainy season generally brings over 1,200 mm of rain per year. This region and climate covers approximately 25 percent of the country. It is by far the most fertile area, where the majority of the population resides and where most agricultural activities take place.

Despite its northern desert, Mali has a number of important water resources. Two major rivers – the Niger River and the Senegal River – run through Mali. These two rivers constitute the majority of Mali's perennial surface water resources, providing the country with 56 billion m$^3$ of water. Important non-perennial surface waters are estimated at a volume 15 billion m$^3$. Mali also has seventeen large lakes situated near




**Map 14.10: Overview of the river basins in Mali**

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

the Niger River, and renewable groundwater resources from aquifers have been assessed at 66 billion m$^3$. The volume of renewable water resources per capita per year is 10,000 m$^3$.

However, these water resources are geographically dispersed and not always available when needed, greatly limiting their exploitation and economic development: overall, only 0.2 percent of Mali's potential water resources is put into use. Furthermore, the country has had many droughts in the past, compounding problems of water shortage issues.