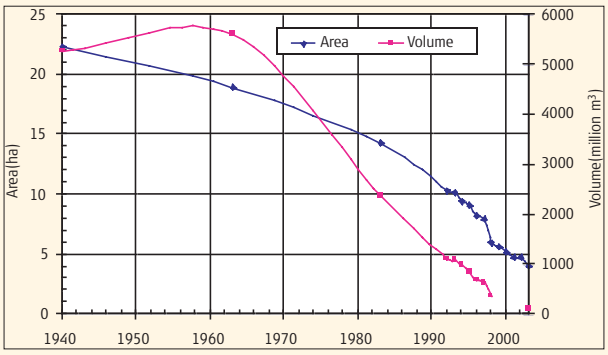
Conclusion

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



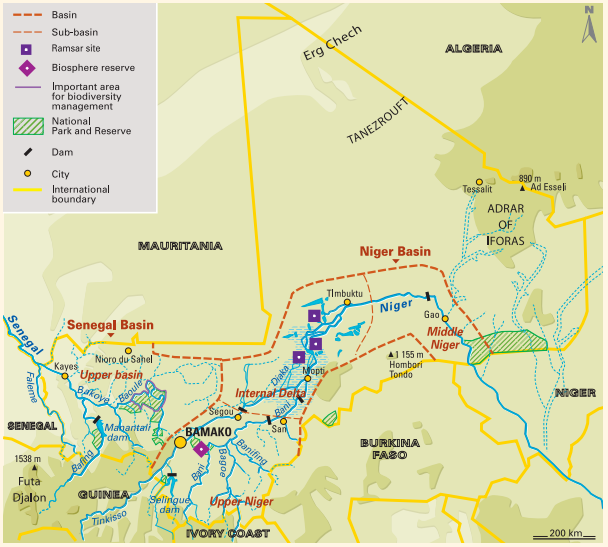
The data collected in the TDPS System shows the receding trend of tropical glaciers. Between 1991 and 2003, Zongo and Chacaltaya glaciers suffered both areal and volumetric losses. In fact, the accumulated mass balance, expressed as water depth, was -11.02 m for Zongo and -15.06 m for Chacaltaya. Chacaltaya 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.

Poverty, increased irrigation, access to safe water and environmental degradation

Mali is one of the world's poorest countries, with a per capita GDP of US $296, where over 90 percent of the population lives on less than US $2 a day. Like many other African countries, Mali's economy is heavily dependent on agricultural production, as well as on herding and fishing, with more than 80 percent of the population working in agro-pastoral activities. The agricultural sector represents 40 percent of the country's GDP, whereas the industrial sector represents 16 percent and the service sector 40 percent. Mali's agriculture is largely rainfed, but irrigation also plays a major role for some crops, such as rice. A number of droughts have devastated agricultural production and livelihoods in the past.

As of 1998, Mali had approximately 9.8 million inhabitants and over 10,000 villages with a population growth rate of 2.2 percent. Population density was around 8 inhabitants per km^2, with notable disparities between regions. Ninety percent of the villages are situated in five regions that occupy approximately 38 percent of the country's surface area. Although all these regions have at least one major urban centre, the areas are still largely rural. In fact, almost 70 percent of all Malians live in rural areas.

Approximately 30 percent of the population lives in urban settlements. There are seven major cities in Mali, the largest being the capital city Bamako, with a population of about 1 million inhabitants. In 1992, only nineteen urban centres were equipped with water facilities, whereas today twenty-seven centres out of thirty-three have been set up. Recently, much water infrastructure work has been implemented to improve access to safe water. National studies indicate that the percentage of rural and urban populations with at least one point of access to water has risen from 55 percent in 1998 to about 84 percent in 2002, based on one modern point of access to water per 400 inhabitants.

As these statistics indicate, a concerted effort has been made to provide drinking water to cities with populations of 10,000 or more inhabitants. However, the disorderly development of housing settlements has influenced the availability of water infrastructure in urban areas over the last two decades. This situation is further aggravated by the rapid growth of drinking water needs. The shortage of functioning infrastructure also continues to be highly problematic in rural areas. Additionally, mounting pollution combines with these factors to seriously impact the quantity and quality of water available to residents, dramatic affecting Malians' health.

Mali's main environmental challenge is the continual degradation of natural resources and the environment as a whole. Desertification and deforestation are two particularly menacing environmental problems for the country. Population growth, increasing desertification, soil degradation, intense firewood and charcoal production as well as a lack of a waste treatment system for the industrial and other sectors have seriously contributed to growth of environmental problems. In addition, deforestation and desertification have decreased the area of the natural habitats of numerous plant and animal species and contributed to an increase in human migration further south. An increase in population growth in these areas has quickly led to an over-cultivation of the soil and increase in pollution. After the United Nations Conference on Environment and Development in Rio de Janeiro in 1992, legislative and regulatory measures were set up as guidelines for the protection of water resources in Mali. However, few of these guidelines have been implemented, and the country's water resources are being increasingly polluted by industrial urban and agricultural pollution.

Challenge areas: Health, food, and energy

Water-related diseases, such as cholera, diarrhoea and the guinea worm disease, represent more than 80 percent of all illnesses in Mali. However, other water-related diseases stemming from poor hygiene and parasites also frequently occur. For very young children, malaria and diarrhoeal problems are very common. Furthermore, 11 percent of children under the age of 5 suffer from acute malnutrition and emaciation, and 33 percent of all children are underweight – the latter being more pronounced among children aged twelve to twenty-three months (48 percent), children born with a frail build (48 percent) and children living in a rural environment (37 percent). Though access to water is, on the whole, increasing, access to adequate quantities of quality water remains highly problematic in both rural and urban areas.

The ability to ensure the continual provision of food for the population of Mali remains a major challenge. Droughts in the 1970s and 1980s were particularly harmful to food production. However, more recently, a number of diverse actions, including enlarged irrigation schemes, have been carried out to address the challenge of food security. Accordingly, annual grain production reached an average of 2.26 million tons (between 1990 and 2002) compared to an annual average of 1 million (between the years 1964 and 1990), signalling a two-fold increase in production in approximately twenty years time.

Currently, 270,000 ha of land is irrigated. Water abstraction for irrigation is about 4.5 billion m^3, 98 percent of which is obtained from surface water resources. However, it is estimated that in order to ensure food security, the amounts of irrigated land and water allotted for irrigation both need to be expanded at least two-fold. The current shortage in food supply is mainly due to the inability of agricultural production to keep up with the rapid growth of the population and greater climatic volatility. However, the water sector suffers from a lack of coherent national pricing policies and causing serious difficulties in collecting the amounts owed by consumers leading to a poor track record for attracting private investments.

According to the data presented in 2002 by the National Energy Commission, Mali has an energy potential of 1,119 MW, which could allow it to produce 4,849 gigawatt hours (GWh) per year. Out of this

identified potential, 378 MW could come from the Niger River and 740 MW from the Senegal River. Currently, two large dams (the Selingue and Manantali) provide 980 GW per year, which represents 20 percent of the identified potential and 98 percent of what is actually produced. Despite the country's sizeable energy potential, hydroelectricity only represents 1 percent of total energy consumption at the national level, whereas 90 percent of basic energy needs are met through firewood and charcoal. The dependence on firewood is one of the main causes of deforestation, which contributes to the process of desertification in fragile environmental zones. Until the economic advantages of pursuing alternative energy sources become clearer in practice, firewood will continue to be the main source of energy for households.

Management responses and stewardship

Since the early 1990s, Mali has been managing its water resources according to the Water Resources Development Framework. This strategy focuses on decentralizing water and sanitation administrative bodies between the central government and local communities involving a multitude of government agencies in water resource management. At the national level, the water sector falls under the responsibility of the Ministry of Mining, Energy and Water, which operates under the structure of the National Water Directorate (DNH, Direction Nationale de l'Hydraulique). Sanitation is the responsibility of the DNH and the ministries of Environment and Health. At the local level, over 700 communal councils have been created to share the responsibility of water management and infrastructure maintenance. These communal councils are funded by national authorities and help to ensure that implemented water infrastructure and service costs are recoverable through fee collection.

Increasing the knowledge base and technical expertise of water resources remains a major challenge in Mali. There has been limited progress made in the development of strong assessment indicators, namely the density of hydrologic and hydro-geologic stations, the quality of the information available about the water sector and the quality of the training and research institutions operating in the sector. Still, some knowledge has been accumulated and monitoring processes have been established and implemented in several projects. Unfortunately, however, the overall development of indicators is still fairly limited. Measures are being taken to correct this, but it will take time and money before they produce concrete results.

Conclusion

Many of Mali's water problems can be characterized as problems of access, largely provoked by an uneven temporal and geographical distribution of water combined with an under-exploitation of available water resources. In recent decades, the Government of Mali has taken a number of steps to ameliorate the situation in an attempt to meet the population's basic needs. However, a great deal of work remains, notably in the provision of infrastructure for safe drinking water and sanitation. Other enormous challenges for the country include controlling the level of pollution, developing alternative energy sources and decreasing deforestation and desertification. Mali's ability to address these issues will depend on a number of factors: namely, the country's capacity to raise the level of national technical expertise through increased educational programmes and research institutions, to develop strategies to better utilize available national water resources, to decrease the negative impact of urban population growth on water resources, as well as to attract investment for sustainable future water schemes.

BOX 14.6: SHARED WATER MANAGEMENT

Mali shares two large transboundary rivers, the Niger and Senegal rivers, with many other countries and is highly dependent upon these two large basins, particularly the Niger River Basin, as it is where most of the country's economic activity is centred and where more than half of its population resides. These basins are managed by two basin organizations, in which Mali participates. Since the United Nations Conference on Environment and Development in Rio de Janeiro in 1992, these two organizations have functioned on the principles of integrated water resources management. Continued cooperation in both organizations seems crucial to the development of future sustainable water projects.

Mali's Niger River Agency aims to safeguard the Niger River, its tributaries and catchments, as well as the integrated management of its resources. Under the aegis of the organization, Mali has recently participated in a project to reverse damage done to the Niger and its surrounding land area. Pollution of the Niger has been a significant problem, since large amounts of wastewater stemming from the capital city, Bamako, flows back into the Niger.

Mali also participates in the Organization for the Development of the Senegal River. A 1972 Convention and 2002 Charter established the organization's legal and regulatory framework and clearly state that river water must be allocated to each of the various sectors. There is no agreement allocating the river's water to riparian states in terms of volumes of water to be withdrawn, but rather to use as a function of possibilities (i.e. agriculture, livestock-raising, hydroelectric energy production, drinking water supply, navigation, environment, etc.). The Senegal River Basin and its organization was presented in WWDR1 (see **WWDR1 case study**).