

biggest river in the basin, is shared with Switzerland. In order to meet the energy requirements of developing industry, the construction of hydroelectric power plants (HEPP) was started in 1946, and by 1986, eighteen HEPPs were installed on the Rhone River. Overall, the dams installed in this basin generate 64 percent of the national hydroelectric production and 8 percent of the total national energy production. Today, hydropower ranks as the second biggest (after nuclear) source of energy production in France. The dams built for energy production also serve different purposes, such as flow regulation and water supply for drinking, irrigation, navigation and recreational activities. However, the dams divert more than 80 percent of the river flow and so have a direct impact on the aquatic environment by preventing fish migration and altering the natural flow regime. These problems are being addressed by specific action plans that aim to increase water flow in the bypassed sections of the river. Consequently, a reduction of eutrophication and an increase of flora and fauna diversity has occurred. However, the measures taken to restore the free movement of fish have not been successful, due to a lack of monitoring and enforcement.

The Seine-Normandy River Basin

The Seine-Normandy River Basin accommodates 17.5 million people, which corresponds to 30 percent of the overall population of France.

The capital city, Paris, and other big urban settlements such as Rouen, Caen, Le Havre, Reims and Troyes, are also located in this basin. Of the 1.5 billion m³ water used in the basin, 40 percent comes from surface waters and 60 percent from groundwater resources. The main problem in the basin remains improving water quality under the strain of increasing pollutant concentrations, particularly nitrates and pesticides. Given this problem, it is anticipated that despite the current action plans and high capacity wastewater treatment plants, meeting the targets required by the WFD will not be possible for many years to come (see **WWDR1 case study**).

Conclusion

France's great productivity in agricultural and industrial products has caused complex environmental problems, stemming from the pollution of surface and groundwater resources by agricultural, domestic and industrial wastes. Water legislation reform of 1992 laid out the principles for a balanced management of water resources with the aim of keeping the needs of humans and the environment in balance. Furthermore, the WFD has already been integrated into French law. However, finding a compromise between the needs of ecosystems and other water uses continues to be a real challenge for the six basin agencies.

5. Japan

Located off the East Asian coast in the North Pacific Ocean, Japan is comprised of a chain of 6,852 islands. The four largest islands – Hokkaido, Kyushu, Honshu and Shikoku – make up 98 percent of Japan's total land area of 377,899 km² (see WWDR1 case study for a discussion of the water challenges of the Greater Tokyo region).

Japan receives abundant precipitation, due to regular monsoons. Nevertheless, water shortages are frequent, due to the spatial and temporal variation of rainfall, marked topographic differences, small river catchments and sudden drops in altitude causing short and swift rivers. This situation is further aggravated by severe droughts. The amount of available water resources per capita is 3,300 m³/year.

Total annual water use is approximately 85.2 billion m³, 88 percent of which is obtained from rivers. The agriculture sector makes up more than 65 percent of annual water abstraction, followed by domestic and industrial uses (20 and 15 percent respectively).

Ensuring drinking water supply and access to sanitation

Based on the 1961 Water Resources Development Promotion Law, comprehensive water resources development (including infrastructure like water supply reservoirs) and efficient use of water resources have been advanced in order to ensure a stable supply of water resources over a wide area to respond to the rapid development of industry and increase in urban population. Nearly 100 percent of the population in Japan is connected to safe drinking water supplies. The average per capita daily

water consumption of 320 litres (L) has remained unchanged since the 1990s. The total population connected to public sewerage was estimated to be about 68 percent in 2004, whereas the rate in towns and villages with population less than 50,000 is only 36 percent. The government's target for 2007 is to expand the coverage of the public sewer system to 72 percent and increase the proportion of population served with advanced wastewater treatment from 13 to 17 percent. Thanks to the adoption of proper waste management techniques, water-borne diseases have been drastically decreased.

Safeguarding ecosystems

Japan's varied landscape and climate provide a rich but fragile natural environment for thousands of different plant and animal species, which has been deteriorated by industrialization and urbanization. In order to prevent further degradation of freshwater sources and the surrounding environment, the government strictly regulates effluent from the industrial and public sectors and imposes regulations on agricultural chemicals. Accordingly, the environmental quality parameters (e.g. biological and chemical oxygen demands) of rivers, lakes and reservoirs are improving.

BOX 14.3: ENSURING THE KNOWLEDGE BASE

The Law for Enhancing Motivation on Environmental Conservation and Promoting Environmental Education was established in July 2003 and enforced in October 2004 to promote environmental education in schools and community workplaces and enhance public awareness and education about the different issues of environmental protection and the conservation of natural water bodies. Some of the programmes and campaigns aimed at public

education are National Water Day on August 1, the Annual Forum on the Water Environment and the Disaster Prevention Poster Competition, among other local activities.

In addition to universities, there are several high-level research institutes and centres that focus on issues concerning water resources, environmental protection and disaster prevention. These institutions not only pursue

scientific research and development but also actively make policy recommendations for better management. The National Institute for Land and Infrastructure Management (NILIM) and the Public Works Research Institute (PWRI) in Tsukuba City are the leading water-related research institutes in the country, the latter of which hosts the International Centre for Water Hazard and Risk Management (ICHARM) under the auspices of UNESCO.

The Sediment-Related Disaster Prevention Law was enacted in 2000 with the aim of implementing comprehensive non-structural measures that would protect people from sediment-related disasters. Measures included raising public awareness on high-risk areas prone to sediment-related disaster, the development of a warning and evacuation system, the restriction of new land development for housing and other purposes and the promotion of relocation for some existing houses. After the revision of the Law in 2005, new regulations to prevent housing development in hazardous areas were introduced and the preparation and dissemination of hazard maps for smooth evacuation mechanisms made obligatory.

The development of advanced forecasting and warning systems in Japan is backed by the dense network of rain gauges and water-level telemeters. These observation points, in combination with twenty-six radar systems, provide high precision information concerning the spatial and temporal distribution of rainfall (see **Chapter 10**).

Conclusion

Risk reduction and the mitigation of water-related disasters is considered as one of Japan's main challenges. Accordingly, it has revised and amended disaster-related legislation. To ensure the sustainability of water resources, comprehensive water resource development plans have been put into action and the efficient use of water resources have been promoted in all sectors. In the sanitation sector, the government is attempting to expand the coverage of the public sewer system. In order to combat environmental degradation caused by human activities new legislation to regulate the use and discharge of effluent has been brought into action. Water-related decisions and policies aim to increase public prosperity by integrating the needs of modern life into a well-functioning healthy ecosystem. In the light of these facts, the Government of Japan is continuously striving to overcome current and future water challenges.

6. Kenya

Kenya is a water-scarce country. Located in East Africa, Kenya sits on the coast of the Indian Ocean, which serves as an important outlet. Surface waters cover only 2 percent of Kenya's total surface area. The climate varies from tropical along the coast of the Indian Ocean to arid in the interior, and two-thirds of the country is covered by semi-desert or desert land. As a result, only about 160,000 km² of land, most of which is situated in the wetter southwest area, is suitable for the current population of approximately 33 million. Per capita available water is about 650 m³/year. Future projections show that by the year 2020, per capita water availability will drop to 359 m³ as a result of population growth.

The uneven distribution of rainfall in addition to temporal and spatial variations often lead to recurring droughts in the north and east and flooding during rainy seasons. More than 50 percent of annual water abstraction is used for domestic purposes and livestock production, and the remainder is used for irrigated agriculture. The demand management strategies are lacking, and water resources allocation decisions related to surface and groundwater abstractions are made without adequate data. It is estimated that more than 50 percent of water abstractions are illegal. Water metering systems are used in few projects; as a result, revenue

collection is very low and corresponds to just 55 percent of the total operation and maintenance costs.

Major challenges: Poverty, access to safe water and sanitation, food and energy

Due to a steady decline in economic performance during the last two decades, the level of poverty in Kenya is steadily increasing, especially in semi-arid and arid areas. The welfare monitoring survey indicated that between 1994 and 1997 the poverty level rose from 47 to 53 percent in