

Research is also carried out by universities and other institutions, as well as government-subsidized science councils, including the Council for Scientific and Industrial Research, the Agricultural Research Council and the Human Sciences Research Council.

### Conclusion

In South Africa, water scarcity is a limiting factor for development. The value of water is therefore high in all aspects of society, the economy and the environment.

South Africa is a country emerging from a history of political oppression to become a nation of democratic values for human dignity, equality and freedom. Poverty is the foremost social concern, and the government aims to address the needs of the poorest in society by ensuring access to basic services through dedicated programmes for infrastructure and free basic water services. The social value of water is founded in the desperate need of the 3.6 million people (8 percent of the population) who currently do not have access to any water supply infrastructure, and the 9 million people (39 percent of the population) who do not receive minimum basic water supply services.

Securing household food security is a common concern, as many families live a subsistence lifestyle and depend on rainfed irrigation to produce their own food. Although irrigation plays a strategic role in providing food security during dry years, water scarcity impedes irrigation on a wider scale.

The industrial and mining sectors are major contributors to the overall wealth of South Africa. To support economic growth and development, South Africa must reconcile the growing demands of the different uses with limited water availability, while ensuring the sustainability of ecosystems.

To address these challenges, South Africa has undertaken a comprehensive policy and legislative reform and is in the process of implementing these through various national programmes. This goes hand-in-hand with institutional reform and capacity-building programmes in order to ensure that IWRM is implemented and sustainable effective service delivery is ensured.

## 14. Sri Lanka

**Over a surface area of 65,600 km<sup>2</sup>, 19.5 million people live in Sri Lanka. Water bodies, a considerable portion of which are man-made, cover about 4 percent of the land. The terrain of the island is mostly made up of coastal plains, with mountains rising only in the south central part.**

Sri Lanka has more than 100 water basins, varying from 10 km<sup>2</sup> to over 10,000 km<sup>2</sup> in size. The Ruhuna Basins,<sup>10</sup> which are located at the southern part of the island, were featured in WWDR1 (see **WWDR1 case study**).

The climate of Sri Lanka is tropical and heavily influenced by monsoons that bring rain throughout the year. The mean annual rainfall volume is approximately 120 km<sup>3</sup>. Rainfall totals range from under 1,000 mm to over 5,000 mm. Sri Lanka's groundwater resources are considered minor compared to its surface water resources. The estimated groundwater potential in Sri Lanka is 7.8 km<sup>3</sup> per annum and is widely used for domestic, small-scale irrigation, industrial and other uses. However, in recent years, due to increased irrigation and population growth, both shallow and deep aquifers have been subject to over-extraction. Consequently, the drying up of domestic wells during dry periods has become more common.

### Water and ecosystems

There is a rich diversity of ecosystems in Sri Lanka, including wetlands, natural forests and marine and coastal ecosystems. Sri Lanka is considered one of the world's twenty-five 'Biodiversity Hotspots' (i.e. very rich in biodiversity). Overall, there are three Biosphere reserves, one World Heritage site, three Ramsar sites (see **Chapters 5 and 12**) and

forty-one wetland sites included in the Asian Wetland Directory. Coastal ecosystems are diverse, but their fragmentation, in addition to that of forests, is extremely high (UN, 2002). In 1999, the Government imposed a ban on logging in all natural forests in order to curb deforestation.

Sixteen of Sri Lanka's coastal lagoons are classified as threatened and constitute nearly half of the country's threatened wetlands. Environmental degradation of the coastal zone is a major hazard faced by Sri Lanka as an island state. During the last two decades, there has been increasing pressure for development in the coastal zone, particularly for tourism and recreational purposes, near shore fisheries, fish farming, industrial development and housing. Communities have exploited the use of natural resources, such as sand and coral, on a commercial basis. Development pressures have also led to the reclamation of estuarial, lagoon and marsh waters and the unrestricted disposal of untreated sewage, leading to major pollution problems. The main threat to natural ecosystems, however, is population growth and migration, reducing the available habitat for ecosystems to thrive. Some other threats to the island's biodiversity are natural disasters, soil erosion, sedimentation and large-scale sand mining.

10. See [www.unesco.org/water/wwap/case\\_studies/ruhuna\\_basins/](http://www.unesco.org/water/wwap/case_studies/ruhuna_basins/) for more information.



**Map 14.15: Overview of the river basins in Sri Lanka**

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

In order to address these concerns, the Ministry of Environment was established in 1990. This was followed by the creation of two legal instruments, namely the Environmental Impact Assessment (EIA) and Environment Protection Licence (EPL). All approved development projects are required to obtain EIA and EPL clearance. These legal instruments ensure the integration of environment protection measures into development projects at the early stages of planning. Environmental concerns are being addressed through ongoing government programmes

with active support from NGOs. However, the limited annual budget of the Ministry of Environment necessitates external sources of funding for any substantial progress to be made (UN, 2002).

### Poverty

Over 45 percent of the population lives on less than US \$2 per day, and the percentage of the population living below the national poverty line is 19 percent. The estimated number of preschool children suffering from stunting<sup>11</sup> is 330,000, while 210,000 are wasted<sup>12</sup> and 540,000 are underweight.<sup>13</sup> Furthermore, 620,000 preschool children and about 36 percent of pregnant women were found to be anaemic. Although the nutritional status shows a slight improvement from the 1990 levels, it is necessary to enhance food production in the country and improve the accessibility of food for the poor and other vulnerable populations at the household level. This can be done through the efficient mobilization and equitable allocation of land and water for food production.

### Water and health

Approximately 78 percent of the population in Sri Lanka is rural. Although the availability of safe drinking water varies, on average, 75 percent of the rural population and 95 percent of the urban population has access to safe water resources. Furthermore, the percentage of households with safe sanitation is between 85 and 90 percent. However, it should be noted that there are considerable population groups in the peripheral areas of urban centres where water supply and sanitation facilities are generally poor.

About 70 percent of the urban population is served by piped water systems, whereas drinking water for rural populations are mainly supplied by dug and tube wells. However, studies have shown that deep wells in fractured crystalline rock yield water containing excessive amounts of fluoride, which can lead to dental problems (fluorosis) among children (see **Chapter 6**). The Government aims to provide 100 percent of the urban population with a piped water supply by 2010 and all the major urban areas with piped sewerage systems by 2015. The target is to provide safe drinking water for the entire population by 2025. Diarrhoeal diseases are still one of the ten leading causes of hospitalization in Sri Lanka. In recent years, there were several outbreaks of diarrhoeal diseases, but better medical practices have helped to decrease the diarrhoea-related mortality rate. Vector-related diseases, such as malaria and Japanese encephalitis, still continue to be a major public health problem and socio-economic burden in Sri Lanka. However, effective vaccination programmes and spraying of host areas have reduced the number of incidences.

### Water and food

For the past 2,500 years, Sri Lanka has remained mainly rural and agriculture-based. Agriculture is practised over 1.8 million ha of land, or 28 percent of overall surface area. Rice is the major agricultural crop, and paddy land, 80 percent of which is under irrigation, covers 40 percent of agricultural land. It is estimated that approximately 85 percent of the overall water extraction is used for agriculture.

11. A child is stunted if his or her height-for-age is two standard deviations or more below the median of the reference population.
12. A child is wasted if his or her weight-for-height is two standard deviations or more below the median of the reference population.
13. A child is underweight if his or her weight-for-age is two or more standard deviations below the median of the reference population.

Women make up 40 percent of the agricultural workforce, but are rarely allowed to take part at the decision-making level, serving instead mostly as cheap labour. Studies in minor irrigation systems show that 75 to 85 percent of women are involved in considerable physical activities, such as land preparation, on-farm water management, sowing, transplanting, harvesting and selling products. More than 70 percent of the women agricultural workers render their services without receiving anything in return. On the other hand, there are few female landowners (4 to 8 percent) who play major roles in agricultural activities.

National capital investment in irrigation and drinking water supplies, as a ratio of total capital investment, declined from 7.7 percent in 1993 to 2.2 percent in 2003. Since the 1980s, the irrigation sector has stressed better water resources management and planning, which partially justifies the declining trend of the proportion of public investment, especially in the construction and restoration of irrigation infrastructure. However, there is still need for investment in the water sector.

Considering the limited nature of Sri Lanka's water resources, demand management has become a necessity. Demand management in the irrigation sector involves the adoption of a cultivation calendar and an irrigation schedule. Active community participation in decision-making is customary in Sri Lanka, and farmers, through their institutions, participate in the planning processes with formal irrigation officials.

### Water for energy

There are over 10,000 dams of varying sizes in Sri Lanka (of which eighty are classified as large dams), but hydropower contributes only 9 percent to annual energy production. The country's major energy sources are petroleum (41 percent) and fuel wood (50 percent). The contribution of hydropower to electricity generation has decreased from about 100 percent in 1990 to about 42 percent in 2000. This drop was mainly due to the fact that there was an inability to produce enough energy during frequent droughts, especially in the late 1990s and early 2000s. However, dams and reservoirs have helped to compensate for water deficiencies in dry areas, and the Government plans to pursue the development of all possible hydropower options in the future.

Almost half of the electricity consumed in Sri Lanka is used for domestic purposes. At the beginning of the year 2002, only 65 percent of the population had access to electricity from the national grid, although this ratio is scheduled to be increased to 77 percent by the end of 2006.

### Water and industry

The pollution of surface and groundwater resources by industries is a grave concern. For example, Kelani River, which is the main source of drinking water for over 2 million inhabitants in the capital city Colombo, is polluted by industries. Groundwater pollution has also been detected in well-water in mixed residential and industrial areas. The Central Environmental Authority and local government authorities are given the responsibility for controlling industry-related water pollution.

### Management responses

Demand management in the irrigation sector involves the adoption of a cultivation calendar and an irrigation schedule to optimize water use. Both irrigation officials and farmers take part in this joint effort. The utilization of different kinds of seeds (like the introduction of short-term rice paddy varieties) is another method for maximizing productivity. Community participation in irrigated agriculture is now common in Sri Lanka, although this was accepted as government policy only after the mid-1980s. Since then, farmer institutions have been included in the formal institutional structure. In the water supply sector, public participation in rural water supply schemes is substantial, and communities contribute by sharing costs and management roles.

Demand management in other sectors is mainly affected through the tariff structure. For example, per unit of industrial water use is priced up to six times higher than domestic water use charges. In allocating water among different sectors, water for drinking, sanitation, irrigation, ecology, environment and hydropower generation has priority over industrial and commercial water requirements.

### Risk management

Floods, droughts and landslides are the most common and destructive types of natural disasters in Sri Lanka, with twenty-three droughts reported to the Department of Social Services between 1947 and 1992.

More recent droughts occurred in 1995-1996, 2001, 2002 and 2003. The disruption of livelihoods and productivity losses that occurred as a result of these droughts severely disrupted the Sri Lankan economy. During the 2001 drought, for example, the country faced power cuts for up to eight hours per day. In 2004, an estimated 52,000 ha of crops were damaged in seven districts, and the government had to appeal for assistance to provide food rations for over 1 million people during a six-month period (Ministry of Social Welfare, 2004).

Several basins in Sri Lanka are flood-prone. The most recent flood, which took place in May 2003, was one of the worst since 1947. It affected 139,000 families, completely destroyed 9,500 houses and claimed the lives of 250 people. The cost of the damage was estimated at US \$76.8 million.

For drought and flood mitigation, a number of structural and non-structural measures have been taken. Reservoirs built for irrigation purposes also serve as flood protection and drought mitigation. Flood warning systems are unfortunately missing in a great number of basins. Furthermore, flood-forecasting models fail to simulate real-life situations, due to the poor mathematical algorithms employed. Efforts to minimize the possible damages of water-related disasters include raising public awareness and arranging insurance schemes for those who are frequently subjected to floods and other natural disasters. However, inadequate resources for data collection and dissemination and the inadequacy of early warning systems remain major constraints for effective disaster

**BOX 14.10: THE SOCIAL, ECONOMIC AND ENVIRONMENTAL COSTS OF THE TSUNAMI IN SRI LANKA**

The 26 December 2004 tsunami was the biggest natural disaster to strike Sri Lanka. It resulted in 38,900 deaths and displaced about 443,000 people on the eastern and southern coasts.

The damage to homes, infrastructure, ecosystems and agricultural lands was enormous. The cost of the damage to assets is estimated at US \$1 billion, while the cost of full recovery is about twice that.

Coastal populations earning their livelihoods from fishing and tourism have been deeply affected. Infrastructure, such as roads, bridges,

railways, harbours, schools and telecommunications networks was highly damaged as well as fishing vessels, water supplies and many dwellings, including hotels..

However, cost estimates alone do not fully reveal the human loss and suffering that occurred as a result of the tsunami. It is estimated that more than 900 children were orphaned or separated from parents, and many parents lost all of their children. Clearly, women and children were the most affected groups during the disaster as well as in the aftermath, and ensuring their security

remains a continuing challenge and a grave responsibility even today.

Ongoing research has revealed that environmental damage to coastal ecosystems, such as coral reefs and mangroves, reduced the capacity of the natural barriers to mitigate the tsunami force and thus intensified the destruction. Therefore, the Government and non-governmental organizations are planning to restore these natural barriers where possible and preserve the ecosystems with the participation of the community (for a discussion of early warning systems, see **Chapters 1 and 10**).

management (see **Chapters 1 and 10**). **Box 14.10** gives an overview of the dramatic damages caused by the 2004 tsunami.

### Ensuring the knowledge base

Sri Lankan universities do not offer undergraduate courses specifically on water resources, but the curricula of civil engineering, agricultural science and some other science programmes contain water-related courses. However, the scopes of these courses vary depending on the nature of the degree. Because water-related courses are taught as optional subjects, in-depth water topics usually do not exceed 15 to 20 percent of the total course content.

Currently, universities and a few government agencies carry out scientific research on water resources and related topics. On the other hand, several government agencies carry out research relevant to their primary responsibilities, which include pollution control, irrigation, agriculture and sanitation.

### Conclusion

About half of the Sri Lankan population struggles to survive on an income of less than US \$2 per day. Hundreds of thousands of children suffer from malnutrition. However, the use of high-yielding crops, more fertilizers, better pest management practices and improved irrigation infrastructure have contributed to an increase in food production. As a result, Sri Lanka is on track to achieving the hunger-related MDGs. Industrialization and poor agricultural practices are threatening the quality of surface and groundwater. Although water-related legislation exists, the fragmentation of institutions, unclear responsibility, a lack of accountability and inadequate resources prevent the satisfactory implementation of provisions for controlling water pollution. Water-related disasters also present a great concern, as their financial and social damages put a heavy burden on the island's already fragile economy. Early warning systems are lacking in many basins, and forecasting models fall short of making accurate predictions.

The great challenge lying ahead is to improve the quality of life for inhabitants without jeopardizing ecosystems. The establishment of river basins organizations for the better management of valuable resources will help to alleviate poverty and environmental degradation.