SERVICES PROVIDED BY WATERSHEDS

Watersheds offer multiple services to human societies. The world's supply of freshwater for domestic, agriculture and industry uses depends very much on flows that are created and regulated by watersheds. Agriculture and food security largely depend on surface water and sediments, collected and transported by the slopes of watersheds. Watershed forests are an important source of timber and fuelwood. Symbolic or recreational value is often attached to the natural and cultural landscape of watersheds. And last but not least, many rural people directly depend on watershed natural resources for their lives and livelihoods.

Watersheds capture most of the 110 000 km³ of rain that falls to earth every year. Thanks to their basin shape, watersheds also store most of the renewable freshwater reserves in the form of underground water and soil moisture. Watersheds do not simply collect water, however. Rain is initially absorbed by watershed soil. Part of the precipitation flows rapidly downstream as runoff; the other part is evaporated or retained by the vegetation and filtered into the water table (which feeds springs and wells), or — at high altitude — transformed to snow and ice (which slowly melt during the hot season). Watersheds regulate water flows, preventing floods and droughts in the nearby downstream areas.

Watershed processes also enhance water's chemical properties. By flowing over rocky soil or being stored in underground reservoirs, rainwater is enriched with the mineral salts that are essential for all living beings. Surface runoff brings downstream mineral and organic sediment, which fertilizes the lowlands. The physical and chemical

Top: Villagers digging an irrigation channel in Kabul district, Afghanistan
Bottom: Woman washing clothes at a fountain in a Nepalese village

Opposite page: Waterfalls in the Meghalaya Hills, India, one of the wettest places on earth, discharging into the floodplains of Bangladesh

FRESHWATER FIGURES

> Freshwater available on earth has a global volume of about 35 million cubic kilometres. 99.6% of this water is stored in glaciers or underground. The remaining 0.4% corresponds to atmosphere water, surface water, and soil moisture. (*)

> In humid areas, the proportion of water generated in the mountains can comprise as much as 60% of the total freshwater available in the watershed, while in arid and semi-arid areas, the proportion is much higher – up to 95%. (**)

> Of all the freshwater used by humankind, 70% is used for agriculture and 20% for industry. Domestic uses account for only 10% of the total. (*)

> Hydropower supplies 2.2% of the world's energy and 19% of the world's electricity needs. (*)

> At present 45 countries, where over 750 million people live, face a situation of water stress, which means that the renewable water resources per person are less than 1 700 m^3/ year. In 2025, this will concern 54 countries and more than 2.8 billion people. (*)

(*) *Source*: FAO. 2007. Aquastat online data base, Rome. www.fao.org/ ag/aquastat

(**) *Source*: Mountain Agenda 1998. *Mountains of the world. Watertowers for the 21st century.* Bern, Switzerland. University of Bern.

action of slope vegetation ensures optimal absorption, filtration and release of runoff. In addition, forest trees and underwood protect the soil against the impact of rainfall and deliver additional fertile organic sediment.

Watershed slopes control the strength and speed of runoff flow. Since 3 000 BC, human societies have learned to control watershed streams to feed irrigation schemes. For hundreds of years, these streams have also powered mills, timbering machinery and mining equipment. Twentieth-century hydraulics has succeeded in converting watershed force into hydroelectric power, which has become an important source of clean energy.

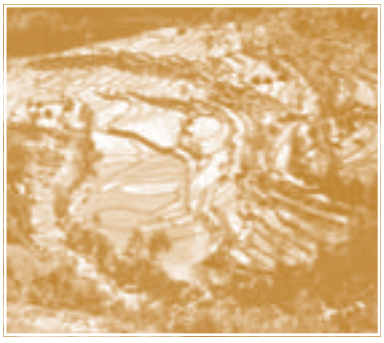
A regulated water flow is certainly the most outstanding service that watersheds provide to societies, but it is not the only one. The water-rich soil of watershed slopes often encourages the growth of shrubs and trees. This vegetation cover slows runoff erosion – i.e. the removal of soil as it is washed out by water. In particular, the deep and tangled roots of forest trees contribute to the cohesion of land surface layers. Tree trunks are an effective barrier against landslides and avalanches.

WATERSHED ENVIRONMENTAL SERVICES AND THEIR USERS

Service	Users
Improvement or stabilization of annual water flow	Drinking-water suppliers Hydroelectric facilities Irrigation
Improvement or stabilization of dry season flows	Drinking-water suppliers Hydroelectric facilities Irrigation
Low concentrations of suspended sediments	Drinking-water suppliers Hydroelectric facilities
Low concentrations of sediment bed load	Hydroelectric facilities Irrigation
Low concentrations of fertilizer and pesticide residues Improvement of microbial quality	Drinking-water suppliers

The role of watershed natural resources in upland farming, ranching and timbering should not be forgotten. Through a complex adaptation process, upland cultures have developed sophisticated livelihood practices that allow local people to make a sustainable living in the special (and sometimes harsh) environment of watersheds. Watersheds also contribute to the welfare of society at large by supplying upland crops and foods, wood products, minerals and a source of bio- and cultural diversity. The socio-economic importance of watersheds is twofold: for local inhabitants and for lowland users of watershed produce.

Subsequently, watersheds have also attracted industrial-scale business. Mining has been a major industry in the uplands for a long time. Hydropower plants and dams have been built in many watersheds over the last 50 years. The tourism industry has also mushroomed, taking advantage of watersheds' natural and cultural landscapes. Public funds have been invested in building roads and infrastructure, and the real estate market has developed in many upland areas.



Top: Forest belt protecting a settlement and fields from avalanches in Val Müstair, Switzerland
Centre: Downstream irrigated terraces in the Hilkot watershed, Pakistan
Bottom: A hydropower plant in the Eastern Andes, Ecuador

Opposite page: Springtime torrent carrying sediments downstream in the Ourika Valley, Morocco