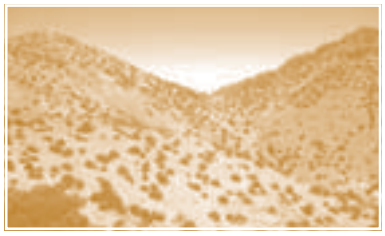
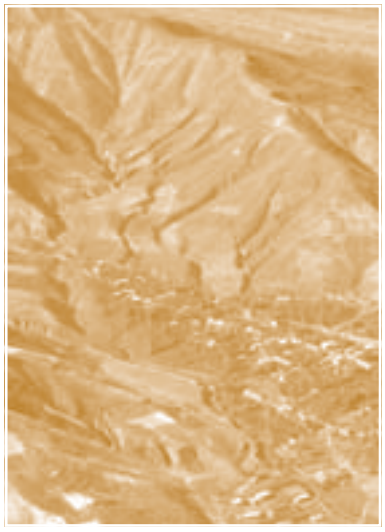
RISKS AND THREATS TO WATERSHEDS

Watershed ecosystems are relatively stable and solid. Throughout history, there are very few instances of watershed collapse due to human activities. However, starting in the twentieth century, unsustainable development has often threatened the ecology of watersheds in many parts of the world.

In many cases, local population growth (resulting from better health status and education) has played a primary role in this process. To support the lives of ever-increasing numbers of people, upland forests have been cleared and turned into agricultural or grazing land. Large-scale timbering and fuelwood collection have contributed to watershed degradation. Loss of forest cover has increased upstream erosion and downstream sedimentation. Because of these changes, many watersheds are losing their capacity to regulate runoff. Subsequently, upland soil has become more arid, and nearby lowland areas more exposed to seasonal flooding. Landslide threats have also increased.

Combined with the adoption of inappropriate technologies, uncontrolled population growth has sometimes made upland livelihoods unsustainable and insecure. The majority of upland inhabitants migrate to towns or the lowlands. In the regions that first experienced this process (e.g. the Mediterranean), this has eventually led to depopulation of many highly degraded watersheds. Such depopulation has not proved beneficial for watershed ecology. Without land husbandry, erosion increases, stream regulation decreases and forest fires become more frequent. Sustainable human activities are essential to the ecological balance of watersheds.





Top: Overgrazed and devegetated uplands in the High Atlas mountains, Morocco
Centre: Mechanized timbering on steep slopes, Bhutan
Bottom: A degraded watershed in Tajikistan

Opposite page: Gully erosion on arable land caused by upstream overgrazing in Southern Lesotho

Top: Expansion of residential areas on the slopes of the Quito Valley, Ecuador
Bottom: Urbanized watershed in the Syrian Arab Republic

Opposite page: The impact of a flash-flood on infrastructure in Paznau Valley, Austria

Ill-designed hydraulic engineering is another leading cause of watershed degradation. Many dams and reservoirs have been built on the basis of inaccurate estimates of water reserves and runoff, and with insufficient attention to the roles that forest and other vegetation cover play in controlling the speed and composition of these flows. Residential areas, roads or tourist resorts built on steep slopes contribute to the increase and acceleration of runoff. Natural and artificial basins have often proved incapable of retaining this flow. Many of them have been filled by sediment, and some have overflowed, causing downstream disasters.

Reforestation and the eviction of local people from critical areas such as forests, steep slopes or wetlands have been the most common measures to prevent watershed risks and threats. Conventional conservation policies have not always been successful, however. Reforestation with rapid-growing, exotic species has altered watershed

THE VAJONT TRAGEDY

In the 1950s, Italy was still recovering from the Second World War. Urbanization and industrialization were the engines of an accelerated development process. Demand for electricity was increasing, and major public investments were made to build dams and turbines in the Alps and Apennines. The environmental and social costs of these works were underestimated or simply disregarded.

To power the industrial development pole of Porto Marghera (Venice), a major hydroelectric plant was built in the Vajont valley, an impressive canyon in the eastern Alps. Local people who suffered expropriations and resettlements were sceptical about the technical viability of the work: they knew that the surrounding mountains were unstable and prone to landslides, particularly Mount Toc (which means the "fragmenting mountain" in the local language).

On 9 October 1963, a landslide of 260 000 m^3 broke off from Mount Toc and fell into the dam reservoir. The gigantic wave caused by the landslide by-passed the dam and flooded the downstream valley. Two thousand people died, and half of the inhabitants in the valley lost houses and fields. The watershed management works – terraces, irrigation and drainage channels, and tree plantations – that local farmers had made over the centuries were destroyed in a few minutes.

The Vajont tragedy had a major impact on Italian public opinion and politics. The country understood that any work affecting the geological and hydrological balance of watersheds requires strict and sound security regulations. Many people also realized that economic growth cannot take place at the expense of the environment.

Source: www.vajont.net

ecology, with unknown long-term consequences that are still not fully understood. Local biodiversity has been partially lost. Evictions of watershed inhabitants from forests, meadows and riverbanks have worsened people's livelihoods, enhanced social conflict and taken critical environments out of community control. In general, State-enforced, "top-down" conservation measures have not proved to be very useful in the management of watersheds.

Global climate change is also contributing to watershed degradation. Because of global warming, glaciers and perennial snow melt more quickly, reducing this important freshwater reserve and altering down-slope flows. Changes in vegetation that are connected with changes in temperature and water availability can be observed. Areas that were once fertile have become barren and unproductive.

KILIMANJARO'S "PERENNIAL" SNOWS

Ernest Hemingway's story "The snows of Kilimanjaro" made this African mountain famous for being perpetually shrouded in snow, despite its location in the equatorial belt. The glaciers on Mount Kilimanjaro have persisted for at least 10 000 years. But as a result of the combined effect of global climate change and modification of local practices (including changes of land use), they lost 80% of their area during the twentieth century. In 2000, images from Landsat (see below) presented an alarming picture.

They showed that much of the snow and glacier at the Kilimanjaro summit had disappeared in just ten years. If the current trends are not inflected, the loss of more than half a metre in thickness each year will likely lead to the complete disappearance of the Kilimanjaro ice fields in less than 15 years, with significant consequences on downstream hydrological flows.

Source: Based on UNESCO World Heritage Centre. 2007. *Case studies on climate change and world heritage.* Paris, UNESCO.