

WATER RESOURCES AND SUSTAINABLE DEVELOPMENT IN MOUNTAINOUS AREAS. THE CASE OF THE ALPS.

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Abstract

Water resources management in mountainous areas is one of the most crucial issues of sustainable development in a large part of the world. It also is one of the most multi-factorial problems man has to solve in the new century. Water resources management must be thought in a long-term prospect. It is essential that it integrate many social, economic and scientific inputs, because it interacts with several issues concerning the future of man on Earth and the future of Earth itself. One of the most interesting points is the close interaction between water and the other main component of sustainable development: energy.

In the present discussion, we focus on the specific field of mountainous regions in industrialised countries. We choose the Alps as a case study in which many thoughts are given and experimental studies performed with a view to a new equilibrium in the future. Groundwater management must be closely integrated in the global hydrological balance in high altitude catchments. On this way to a new equilibrium, we must face challenges which it becomes increasingly urgent to solve. The present talk mentions, illustrates and discusses some of them by various examples.

1. Priorities in the use of water

Political priority ranking between drinking water, hydroelectricity and base flow in riverbeds, especially during the winter season, must be re-examined. Some years ago, in the Alps, a drastic rise of minimal discharge in the rivers for reasons of environmental protection led, and still leads, to the closing of small electric plants intended for local power production. If the sustainable development does not bring about a global diminution of energy consumption, this measure will lead to an increase of non-renewable energy consumption. This shows that water management cannot be done out of context. The coupled use of some important springs both for drinking water and mini-electrical plants must be more developed.

2. Highland - lowland water distribution

The key of an integrated management at the scale of the catchment is in the mountainous areas themselves. Political long-term commitments must be negotiated between the different countries concerned under the high supervision of international committees; these will have to lay down some general rules concerning the right for water.

3. Quantitative and qualitative protection

Tourist development in mountainous areas is often in contradiction with water protection. To reduce this impact, innovative solutions must be studied and tested in the field. For example:

- Consumption decrease through education, improved distribution techniques and a dissuasive pricing policy.
- Qualitative protection of ground and surface water through large protection zones that are taken into account by the land planning policy.
- Waste water treatment: improvements are needed for remote treatment systems, especially for high-altitude hotels and huts.
- Management of aquifers in order to avoid long-term overexploitation, enhancement of artificial and riverbank recharge.
- Infiltration of urban surface water: this new policy, which aims at the restoration of the local water cycle, must pay great attention to the slope stability and landslide hazards.
- Impact of underground structures on the groundwater flow systems: the traditional groundwater drainage system set up for tunnelling operations must be replaced by a more respectful construction that restores natural reservoirs.
- Artificial snow production for skiing purposes results in a local change of the water balance, which should be quantitatively positive for groundwater recharge; however, the use of chemical additives must be avoided in order to protect the water quality.

4. Climatic changes

The rise in temperature will have a large impact on mountainous areas in general and on water resources in particular. Especially the water that is stored in temporary frozen soils and in permafrost, as well as in glaciers, will modify considerably the regimen of waters. It is difficult to forecast in detail what will happen, but we can still consider that the low water conditions will occur drastically earlier in the season and be more accentuated. The process of natural recharge will be also modified, as well as the slope stability.

The solutions that we must develop need scientific innovation, but also a very restrictive regulation on an international scale. The law specialists should base their work on interdisciplinary scientific commissions. To meet this challenge, politicians, sociologists, economists, lawyers, land planners and scientists have to find a common language. If we succeed in this task, it will be the beginning of sustainable development.