

Water sustainability

Introduction

For the World Health Organization no less than 50 litres of water per day are necessary for each individual, so that we can speak of acceptable conditions of life. The mean estimates indicate a consumption of 350 litres of water for a Canadian family, 165 for a European family and 20 litres for an African family. If significant changes are not introduced, in 2025 approximately 2/3 of the Earth's population shall live in conditions of water poverty. The United Nations have assessed 40 litres as the minimum requirement of water as the objective of the mobilization of the World Water Day that takes place on the 22nd March every year.

Water

Water as a resource

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The consumption of fresh water

The various climate and hydro-geological conditions make water availability very different from one region to another. It is possible to talk about water shortage when the annual per capita water availability is below 500 cubic meters, and below 1000 cubic meters for those countries with a weak socio-economic organization. During the last century the global consumption of fresh water increased by 10 times, and around 68% of the water is now used in the agricultural sector. This percentage is decreasing as the consumption of water for industrial (24%) and household (8%) reasons is increasing. In less developed regions the percentage of water used for agriculture is higher, differently from more developed regions, where the percentage of water used for industrial and household reasons is higher. The average per capital annual consumption changes from the more developed regions (1200 cubic meters) to Sahel African regions (120 cubic meters). This situation is explained by saying that a wealthier life requires a higher consumption of water, although the opposite is not always true: in fact, in less developed regions agriculture absorbs most of available water, but due to the inefficient irrigation systems around 60% of it is lost. And always due to an unsuitable distribution, 36% of industrial and urban water is lost. Other problems that have to be added to the already-mentioned ones are: drought, climate change, deforestation and pollution of aquifers.

Drought and desertification

Due to the extent of damages and the number of people involved, drought is the number one natural catastrophe. A dry period is marked by less frequent precipitations compared to the annual average of the area. Drought is considered as serious when the average farming production decreases by 10% and catastrophic when it decreases by over 30%. Dry periods have become more frequent and more intense over the last few decades, involving almost all of the emerged areas.

This tendency to drought has not only affected the dry or half-dry areas of Africa and Asia, that have been the most seriously affected by the different dry spells of the last 30 years, but also the mild and northern countries. More or less one half of the surface of the emerged lands can be defined as dry or half-dry. Both ecosystems are

extremely fragile and vulnerable. If exposed to drought for long periods, they can be affected by desertification, i.e. they can turn into deserts. At present, approximately 70% of the Earth's dry areas – equal to 3,600 million hectares – is degraded. In Africa alone, 45% of the population – equal to approximately 325 million people – live in dry areas. It is therefore absolutely important to protect these regions.

Causes

The history of the biosphere has been marked, during the different geological ages, by natural climatic fluctuations that have altered the width of deserts. Exceptionally dry periods have become more frequent and more intense over the last few decades: from 5 a year in the Seventies to 12 a year in the Eighties. There are many complex causes for such increase: it must however be borne in mind that man's pressure, through a bad or improper use of the land, can heavily alter the characteristics of the soil, of the vegetal covering and the low atmosphere, thus irretrievably affecting the delicate balance of the hydrological system.

The effects

Desertification reduces the ability of an ecosystem to survive when the climate changes, with dramatic consequences, such as:

- loss of productivity of the soil;
- degradation of the vegetal covering, through to its total disappearance;
- dispersion of solid particles in the atmosphere – sand storms, air pollution – with a negative impact on man's health and productive activities;
- reduction of farming and breeding production: malnutrition and hunger; migrations of people and wars

Ice and glaciers

Glaciers as a water supply

Glaciers in the temperate regions supply a very important source of water to the local rural communities' economy. Glacier waters are used more systematically to irrigate fields, while for drinking purposes, their use is often limited by the great amount of solid particles transported by the waters, that often have a greyish colour and a particular milky aspect. In the high valleys of the Karakorum, that are veritable high-altitude deserts, where yearly precipitations are about 200 to 80 mm, agriculture depends exclusively on glacial melt waters. To be able to exploit them, canal systems are built, at times several kilometres long. These are often built on unstable glacial deposits and need constant maintenance and continual modifications to adapt them to front variations of the glacier. In the past, even in the Alps, in the Aosta Valley or in the Rhone Valley, there was a network of irrigation canals, locally called "bisse" or "ru", that exploiting melt waters. In polar regions, instead, populations living far in the North, such as the Inuits, have been exploiting icebergs as a source of drinking water for a long time. Having been formed from glacier ice, which originated from the transformation of snow, icebergs are made up mainly of fresh water. Even today new projects are continually proposed to exploit these precious resources. A proposal was to tow an iceberg close to the coast of a country with water shortage; however, for the moment, the cost of these operations is much greater than its benefits.

Glaciers as a source of energy

La produzione di energia idroelettrica rappresenta una voce importante per le regioni montuose di molti Paesi, tra cui anche l'Italia. Le acque di fusione glaciali garantiscono un apporto di grandi quantità di acqua anche durante la stagione estiva, e moltissimi serbatoi e impianti idroelettrici sono alimentati direttamente dai torrenti glaciali. Sulle Alpi italiane, moltissimi esempi si osservano nelle regioni montuose del Nord, come Piemonte, Valle d'Aosta, Trentino-Alto Adige, Lombardia. In alcuni ghiacciai, le acque vengono captate direttamente all'interno del ghiacciaio. Tra i più famosi, possiamo ricordare l'Engabreen, in Norvegia, dove si trova, installato nei tunnel di captazione, un importante laboratorio glaciale, che permette di fare osservazioni sull'interno del ghiacciaio. Anche sul Ghiacciaio dell'Argentière, che scende

dal versante francese del M. Bianco, negli anni Sessanta furono scavati dei tunnel nel ghiaccio per imbrigliare le acque di fusione, ma, a causa di impreviste variazioni di direzione dei torrenti sottoglaciali, il progetto non ha avuto il successo sperato, e le gallerie sono ora state chiuse e trasformate in laboratorio sotterraneo per lo studio dell'erosione basale.

Glaciorisk

This is a research project promoted by the EC, with the participation of France, Italy, Austria, Switzerland, Norway, Iceland, which will last three years and which involves research institutes in the glaciology sector (for Italy CNR and Società Meteorologica Italiana). The aim of the project is to identify the dangers and risks connected with glaciers, identifying the most dangerous glaciers in the Alpine range. The major risks connected with glaciers are, besides the mentioned surge and jökulhlaup,, also the collapse of seracs or extensive parts of ice and avalanches consisting of ice deposits, that in the case of LIA lateral moraines, can even be dozens of metres high.

The response to climatic variations

Many alpine glaciers have been 'monitored' for over a century, and for many of these we have measurements of the front position for many consecutive years. When it is possible to associate front variations to climatic data such as, for example, rainfall and temperature, then interesting observations can be made on how each single glacier responds to variations in these two important parameters. First and foremost, each glacier responds in a different and independent way, depending on factors such as its size, so that the same climatic event can determine the rapid forward thrust of one glacier and a standstill or limited forward movement in a neighbouring one. In addition to this, all glaciers do not respond at once, but react with a certain inertia, normally a couple of years. A positive balance is usually due to cool summers with snowfall that greatly reduce summer ablation, while winters with little snow, albeit cold, and very hot summers bring about negative balances. However, the hot season events are those that bring about the more significant variations, so that it is not so important how much snow fell in winter but how much of it was preserved in summer. In a glacier's balance, therefore, a sweltering summer like that of 2003 or 2004 will play a more significant role than a particularly snowy winter, like that of 2000-2001.

The Vostok lake

The Vostok Lake is the biggest of the glacial lakes identified within the Antarctic ice-sheet. On the basis of radar surveys, carried out as far back as 1970, its presence was hypothesized, but its existence was confirmed in 1996 on the basis of data obtained from satellite radar altimeter measurements. The lake is enormous : it is 240 km long, 50 km wide, 600 m deep and has a surface area of 12,000 km², it is as big as the Campania region. Its surface is situated at a depth slightly over 3,700 m. It is found just under one of the most important drilling points carried out in Antarctica, by a French and Soviet project; it is here that the longest core ever extracted was obtained allowing the study of 420,000-year-old ice. The drilling has reached a depth of 3,623 m, 120 m away from the lake's surface, and there are no technical obstacles to its continuation. However, scientists hypothesize that the lake, whose age is estimated around 1.5 million years, could contain particular forms of life that evolved in extreme conditions and in complete isolation, without light, at a temperature of 1-2°C below zero and at a pressure of 350 atm. The opening of a connection with the surface, together with pollution produced by drilling oils, could pollute and damage this incredible ecosystem irreversibly. The scientific world has, therefore, decided to stop drilling until a method is found to carry out the researches without the risk of pollution or damage to the lake's ecosystem : it would be senseless and ethically incorrect to destroy a delicate system just to get to know it better and to study it!