Custodio, E. (2000). Some relevant ethical issues in relation to freshwater resources and groundwater. *Boletín Geológico y Minero.* Vol. 111-6, 121-130.
ISSN 0366-0176

Some relevant ethical issues in relation to freshwater resources and groundwater

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ABSTRACT

Freshwater resources are limited and the demand for water is steadily growing. In some areas a large proportion of available water resources are already committed. This justifies the concern manifested by some social groups and many individuals. There are two opposing areas of action which attempt to solve what is often seen as a major problem. One consists of promoting action to make more freshwater available, which means interfering more with the environment, affecting human communities and depleting groundwater reserves. The other consists of correcting the current and often highly inefficient use of freshwater in order to reduce demand, and at the same time protecting groundwater reserves and preventing further degradation by contamination. These are issues which should be seriously considered before imposing any further strain upon the environment and wasting badly-needed economic and human resources. Available, usable freshwater resources must be assessed, while taking into account the uncertainty associated with natural processes, and seeking long-term sustainability within a changing setting. In this respect groundwater is still a poorly managed and, to some extent, misunderstood essential freshwater resource. The sustainability of long-term groundwater use is compatible with limited depletion of aquifer reserves only in the short term. Solving current and future problems involves not only science and technology, but also economics, public understanding and political will. All of these issues must be guided by ethical considerations.

Key words: Groundwater, Freshwater resources, Ethical issues.

Algunas cuestiones éticas importantes en relación con los recursos de agua dulce y el agua subterránea

RESUMEN

Los recursos de agua dulce son limitados y la demanda de agua crece continuamente. En algunas áreas una gran proporción de los recursos de agua disponibles ya están comprometidos. Esto justifica la preocupación que manifiestan ciertos grupos sociales y muchas personas. Existen dos modos extremos de actuación para tratar de resolver lo que a menudo se ve como un grave problema. Uno de ellos consiste en promover la puesta a disposición de más recursos de agua dulce, lo que conlleva más interferencia con el medio ambiente, con afección a comunidades humanas y con consumo de reservas de agua. El otro consiste en corregir el actual uso del agua dulce, que es frecuentemente muy ineficiente, para reducir la demanda, y al mismo tiempo proteger los recursos de agua subterránea, previniendo que continúe su degradación por contaminación. Estas son cuestiones que se deben considerar seriamente antes de imponer más tensiones al ambiente, gastar recursos económicos necesarios para otros fines y malusar recursos humanos. Es necesario evaluar los recursos de agua dulce que están disponibles y que se pueden usar, al tiempo que se considera la incertidumbre de los procesos naturales, buscando la sustentabilidad a largo plazo en un contexto que va cambiando. Bajo este punto de vista el agua subterránea es todavía un recurso de agua dulce esencial, pero que está mal gestionado y hasta cierto punto mal comprendido. La sustentabilidad a largo plazo del uso del agua subterránea es compatible con un consumo limitado de reservas del acuífero, pero sólo a corto plazo. La resolución de los problemas actuales y futuros supone no sólo ciencia y tecnología, sino también economía, entendimiento público y voluntad política. Todas estas cuestiones deben ser guiadas por consideraciones éticas.

Palabras clave: Agua subterránea, Recursos de agua dulce, Cuestiones éticas.

SUSTAINABILITY OF NATURAL AND FRESHWATER RESOURCES

There is a widespread awareness of the world-wide scarcity of freshwater resources (Shiklomanov, 1997; Brundtland *et al.,* 1987; Biswas, 1992; Gleick, 1993; 1998). It is believed that this scarcity will increase in the future to the point that it will limit human habitability in some areas of the Earth, and create social stress leading to war and conflict. But all this depends on the way in which the figures are presented, how the demands are calculated and forecasted, and how local problems are upscaled to global ones. Neo-Malthusian and black and white (good and bad) fundamentalist thinking is a real danger behind many theories, which are mostly supported by a poor, often incorrect, understanding of the water cycle and of Nature. Often, there is also blind support of what at first sight seem obvious solutions, but which may be expensive, cumbersome, and unbacked by detailed studies using the best available data. Another frequent mistake is to convert a purely local situation into a large scale, broad-based problem. Human beings, with our capacity to solve problems and to produce new scientific advances and appropriate technologies, have clearly improved man's quality of life and redressed many of the problems related to mankind and Nature (Tierney, 1990). Part of the problem is poor use of resources and insufficient solidarity (John-Paul II, 1991). Some situations, the development of which has been presented as leading to final disaster, have been effectively overcome. Working and appraising the situation at a global scale allows solutions to be defined and found alternatives that may not be clear from a local perspective. Good global solutions may sometimes appear to contradict common sense, when the point of view is too narrow, and different points of view and opportunities are completely missed.

But this optimistic viewpoint has to be set against the current, unprecedented global influence of many human activities. The Earth has limited space, resources and capacity to absorb waste. This makes the new challenges more difficult to deal with and the danger of exceeding global limits more dangerous. But key conditions are also changing, and what at the present time seems obvious may be quite different in the future. Concern is beneficial, if this does not obscure vision, and being prepared for action is wise, but introducing drastic measures to redress rapidly unstable situations may be much more detrimental and inhumane than healthy. Prudent evolution and flexible action is what history and mathematics show is the attitude to be recommended (Plate, 1993), especially when future scenarios are uncertain (Azqueta and Ferreiro, 1994). Even continuous population growth is doubtful (Pearce, 1999).

"Doomwatching" mostly relies on measuring quality of life by imitating the current demand and way of life of industrialised countries, which means developing new resources, looking for new space to dispose of waste, invading unspoilt areas to use them as short-term leisure space for a few, and producing degradation-resistant products which are scarcely compatible with Nature. But there is significant space for human creativity to be able to curb growing demand and, at the same time, preserve, maintain and increase quality of life, spreading this to the whole of mankind. This implies a new, generous definition of sustainability, in a wide context, not restricted to local situations, in which some "degradation" may be an acceptable but time-limited option for obtaining global goals which would contribute net benefits to mankind. Sustainability has to be matched with improvement and the advance of science and technology, as well as the development of ethics, socio-political objectives and human behaviour (Plate, 1993). Future major issues have still to be identified, and their characteristics may be quite different from present ones.

It is clear that the Earth is evolving and Man is part of it, and moves forward with this evolution. It is not possible to freeze time: mankind must advance alongside, making the best use of existing resources, at a speed that is adapted as far as possible to the rate of renewal. Any human activity seeking socio-economic benefits may involve some detrimental effects. A continuous trade-off is needed between the unrenounceable goal of improving quality of life, by developing natural resources, and causing some environmental damage. This damage has to be bearable and compensateable in broad terms, although economic evaluation is not an easy task (Foster and

Foster, 1989; Llamas *et al.,* 1992; Galloway, 1997). Evolution, both natural or man-made, means an inevitable increase in the system's entropy (Georgescu-Roegen, 1971). However, if we consider the time scale of the life-span of mankind, our system is not a closed one. Exchange of energy with the exterior – the Sun and space - is the way to sustainability in a more universal context.

Sustainability has short-term stages, whose asymptotically attainable final stages also change as mankind evolves. This means that "unsustainable" use of resources are needed for some time and under changing circumstances, but part of the net benefits derived should be spent on new developments for conservation, preservation and restoration. Also, development which is focussed towards increasing the supply of new goods and driven by unreasonable and poorly controlled demand should be substituted by a clear policy of saving and reuse, whenever possible.

HYDROLOGY AND WATER RESOURCES

Water plays a key role in Nature and at the same time it is essential to human life and man's economic activities, such as producing food, improving health conditions, generating energy, acting as a means for communication or transport, and diluting and transforming waste products. In practical terms all usable water on the Earth is included within the water cycle, which is a complex system interacting with the physical, chemical and biological environment. This water cycle, from the point of view of fresh water resources, has five main components: water in the atmosphere, water on the surface of the Earth (rivers, lakes and soil humidity), water in soil pores and fissures, sea water and solid water (ice and snow). All of these are closely interrelated at local, regional and global scale, and explain many of the specificities of the Earth's evolution and the possibility of life. They play a key role in climate and its changes. All of this is the subject of Hydrology, an important branch of the Earth Sciences. But hydrological principles are often poorly known by the public, policy-makers and even scientists. Hydrology is often negatively influenced by a series of misconceptions and biased understanding (Custodio and Llamas, 1997). Often decision-makers on water resources take or have to take poorly-founded and hydrologically unsound decisions. Decision-making tends to favour easy recognisable aspects which are often poorly examined and even wrongly interpreted, and which do not consider the water cycle as a whole and its relationships with the environment. Each part of the cycle behaves in a significantly different way with regard to conditions such as renewability, time scale of fluctuations or changes, links with the environment, the delayed effect of impacts, associated water storage, quality of water, vulnerability, and the risk of contamination.

Most wrong decisions are the result of only looking at one part of the cycle - generally surface water - and neglecting or oversimplifying the links with the environment. A major loser is groundwater, which is often ignored and neglected, unnecessarily wasted and contaminated, and deprived of its important environmental role without any beneficial use. All this unethical behaviour may degrade into an uncorrect and irresponsible attitude when there is conscious ignorance. This may happen in order to promote certain projects without looking for true alternatives, disregarding sound socio-economical analysis, at least in regional terms, and without taking into account the short- and long-term consequences in a regional and even global context.

Some authors forecast that water in dry areas will be a cause for wars in the near future. This is a real danger, but so many things are at stake that mitigate the risk. There are examples which show that solutions and agreements precede political arrangements. Water, then, could be a future element of cohesion rather than of war or serious conflict (Llamas, 1999b).

UNCERTAINLY AND WATER RESOURCES

Hydrology is the discipline of Science that deals with the evaluation of the role of water in Nature and how this water can be transformed into a resource to supply human needs. It is both a science and a technology. Water resources are defined by their quantity and quality with respect to the intended use, taking into account when and where water is needed. All these are terms that can be modified by Man using scientific principles and applying technical means, but they are characterised by the uncertainty inherent in all natural processes and situations. Natural uncertainty is due to the stochastic component of rainfall and other natural processes, and to the imprecise knowledge and simplification of the physical support – land, river, soil and aquifer systems - and the physico-chemical behaviour of solutes, colloids and micro-organisms, and their interaction with environmental gases, solids and biota. This uncertainty contains very different characteristics in the different parts of the water cycle.

The greater the associated volume (or reserves) of water of a part of the water cycle, the less uncertain is stochastic behaviour. In this sense, groundwater is usually more reliable than surface water due to the very long turnover time. Similar or, perhaps, smaller investment in studies is needed in the case of groundwater, in order to obtain a comparable physical and chemical understanding, and this can be made available with less investment in structures. This does not mean that one is superior to the other; rather it shows that they are different, often complementary, amenable to joint use, and both necessary assets in different contexts. The common attitude of disregarding groundwater as a reliable water resource may be due to ignorance and arrogance, which may imply a high associated economic, social and environmental cost. Besides, it may also be the result of corruption when obscure goals are sought. These include increasing short-term benefits for a few, while charging the associated direct costs and especially the indirect ones to society at large. This means maintaining the privileges of some powerful groups, unduly supporting a particular professional group, and obtaining political benefits associated to large public works which attract the attention of the poorly-informed and the mass media which do not understand and under-evaluate less impressive but more efficient, more rewarding and less expensive undertakings.

But the basic viewpoints of Hydrology are not the only ones to be considered, since obtaining water resources and using them have a widespread influence on land use, population behaviour, economics, politics and the environment. Some aspects lend themselves to quantitative analysis but others are not easily quantified, especially the external and intangible side-effects (Constanza, 1991). Here ethics plays an important role in looking for feasible solutions that do not burden present and future generations more than necessary. This is still more important for developing areas, where poor understanding aggravates uncertainty, due to lack of data and insufficient knowledge. Lack of institutions and deeply-rooted myths regarding water make sound ethical decisions more difficult.

FRESHWATER SHORTAGE

Freshwater is scarce in arid and semi-arid lands. Basically, its scarcity tends to be considered one of the main problems for development. But this is not necessarily true, since there are areas with a low volume of renewable freshwater per capita or by surface area with acceptable per capita gross earnings, and also vice versa. Water used for direct human consumption -drinking, cooking, food processing- is a fairly small quantity. Basic needs can be supplemented, when they are really needed, by sources such as brackish and salty water desalination, transport from distant areas, and use of groundwater reserves, even if the unit cost is high or very high. The total cost is often a small proportion of living expenses. If needed, it is something that can be supported by socially oriented subsidies which are ethically sound, do not burden the economy excessively, and appear to be politically acceptable as a general policy. But what is acceptable for relatively rich cities and human settlements may not be bearable for rural communities and poor, developing areas. As often happens, there are no universal solutions but rather solutions which are tailored to local circumstances.

Problems of freshwater availability in many regions, even in rich ones, begin to appear when all domestic and urban water is required to be of potable quality. This is the common policy in most developed and developing areas, disregarding freshwater availability. Really, most of the water demand is mostly for other uses than direct human consumption. The situation worsens in water-scarce areas when this water is used for tending green areas and recreation uses, such as swimming pools. The cost to the consumer and to the environment may become too high. This may also create serious problems for water utilities. They have to invest to expand the water source areas and often have to fight bitter conflicts with neighbours and rural areas, and are forced to progressively abandon contaminated areas. Early decommissioning or abandonment of investments made in these areas increases water costs, coupled with the need to introduce increasingly expensive water treatment to obtain and guarantee potability. Also, geotechnical and water-logging problems related with the groundwater table in and around urban areas are not rare (Chilton, 1997).

What is a bearable problem for water-rich areas - although it may be a growing concern even for them - may become a dramatic burden for arid and semi-arid areas. A double domestic and urban water supply system is a possible solution to be experimented with and developed (Pettersen, 1994). The condition is that this low quality water, which should not be used for direct consumption, should not present any serious health risk if accidentally drunk. Regulations have to be developed and enforced. It seems necessary to ban acute toxic components but to relax current limits on salinity, nitrate and some components, such as some natural heavy metals, fluoride and total organic substances. Drinkable water needs a completely separate distribution system, which in small towns and rural areas can be as simple as the use of distributed drum water or water made available at public fountains. This implies dramatic changes in current habits, in architecture and in urban planning, and a serious commitment to prevent wasting effort and money in producing costly potable water – often in an unsustainable form and with important environmental and social damage - to be wasted in uses which do not require such high quality.

Similar considerations apply for industrial and commercial freshwater demand. Using high quality water – sometimes non-easily renewable, and even fossil groundwater (palaeowater) - just for basic industrial processes and cooling, with no or little recycling is, today, grave ethical misconduct. It is not rare to find this situation, while domestic supply has to rely on poor quality water and even suffer shortages. In this field there is much to be implemented in recycling and the use of low quality water resources, such as moderately contaminated surface or groundwater, and water reuse, even if this adds to treatment costs. These costs are the price of protecting the use of drinking water and making it sustainable, and must be shared by all stakeholders.

The worst problems of water demand in arid and semi-arid areas - even in relatively humid areas - are created by irrigated agricultural land where large surfaces are involved. In some cases this agriculture is so intensive that it is close to a food-processing industrial activity. However, in many other cases it is the result of continuing with local traditions, employing untrained population, pursuing state policies of self-sufficiency in food production at any cost, maintaining isolation on the grounds of fundamentalist political ideas and irrational fears and aversion, or trying to prevent highly unlikely future trade conflicts. These conflicts are wrongly based on a historical background of conditions which will not return in the future, at least in the same form. Often this refers to agriculture, and especially irrigated agriculture - including cattle and livestock rearing - which is heavily subsidised and protected, especially when the source is surface water. Subsidies are for infrastructures, agrochemicals, agroenergy and the means of production. This distorts the economy, sometimes in a profound way (Mayers and Kent, 1998). For these groups the use of water may become a secondary issue, when really they are producing much of the water scarcity, contamination and social stress, and destroying the environment and strategically important groundwater resources by slowly wasting renewable reserves of freshwater which may be badly needed for other purposes.

WATER NEEDS AND EMPLOYMENT

The long-term unsustainability of much irrigated agriculture in arid and semi-arid lands is the result of excessive irrigated areas, low efficiency of water use, distortion due to subsidies, inadequate plant and animal products, poor environmental concern, short-term goals, political manoeuvring, inadequate hydrological knowledge, lack of efficient water management institutions, poor information of farmers, and the difficulty of finding other jobs for the relatively untrained.

Increasing water problems are often solved by new and expensive water works and by extending the catchment area by developing - sometimes abusively - distant aquifers or by often conflict-provoking water transfer between river basins. All this needs public investment which is becoming progressively greater and greater. This is a new kind of subsidy, generally paid by the whole population, which is economically unsound in many cases. Often these projects are not supported by socio-economic studies of true alternatives. What sometimes is called a study of alternatives is often reduced to variations around a basic project, decided on the basis of hydraulics and with some political orientation, or just to solve project implementation difficulties of a purely engineering nature. In many cases, but not always, a market approach helps to solve conflicting situations and allocate water resources (Howitt, 1993; Delli Priscolli, 1998). Groundwater, alone or combined with other freshwater resources, often plays a key role in providing feasible solutions (Sahuquillo, 1991; Llamas, 1999a).

In most cases a better use of the already scarce economic resources may be to train people for other jobs, improving agriculture (more valuable products with less water and more employment per hectare), creating infrastructures to foster development (communications, roads and railways, factories), reducing water demand by technological improvement, optimising existing local water resources (combined use, reuse, supplementary desalination), protecting the environment, developing trade and tourism, and so on. To implement all this, a top level Institution is needed, superseding the sectoral point of view of specialised organisations. Food can be imported cheaply and more efficiently than water. This also helps the development of other areas of the world with more water resources, manpower and favourable conditions for food production, but that need manufactured goods or other resources, such as oil or minerals. This is also needed to ease the current high pressure of emigration, and the human suffering, hidden slavery and criminal activities which result from this.

Often it is argued that if agriculture is abandoned there is desertification. This is true in many areas, where a rural population is necessary. But these populations should be given the opportunity to have a quality of life that makes the countryside attractive, comfortable and socially rewarding. This is not necessarily linked to intensive agriculture or animal husbandry but to landscape, heritage and Nature preservation. This role should be economically compensatable by the tax payer by improving local services, promoting tourism, providing educational facilities and paying for conservation and restoration projects, instead of direct subsidies which are prone to mismanagement and corruption, and contemptuous towards those who like and are proud of their condition, role and place of residence.

WATER CONTAMINATION

Probably the greatest threat to the sustainability of surface and groundwater freshwater resources is contamination. Although some pollutants are natural (salt water, sea water intrusion, displacement of groundwater bodies with dissolved substances which represent a health risk, such as arsenic, fluoride, boron, some heavy metals, radon and radium), most of the damage and risk comes from man-made hazardous substances and saline components introduced by man. Many of these do not exist in Nature. They vary from agrochemicals (mainly nitrogen and phosphorous compounds, and pesticides, their breakdown products, and their solvents) to household products (phosphorous and boron compounds, surfactants), and include a large list of industrial and energy products (salts, organic solvents, petroleum products and derivatives, phenols,...) and even pharmachemicals which in very small concentrations may affect humans and animals, especially if water containing them is part of the daily intake.

Also, surface water and shallow groundwater is often contaminated by micro-organisms, bacteria and viruses. Deep groundwater is normally free of these, but water taken from these sources may not be, due to poorly constructed and maintained groundwater wells, or poorly protected springs.

Pollutants move sluggishly in the ground, especially if they are adsorbed on the surface of solids. Retention favours the breakdown of reactive, unstable or radioactive substances. So, groundwater and surface water fed by groundwater may seem protected, but the onset of contamination is only a matter of time for non-degradable substances.

Control and correction of sources of contamination is a primary goal and a key ethical objective, both in developed and developing countries in both arid and wet areas. There are specific situations to be taken into account, depending on local circumstances. Action means not only treating water and waste products before releasing them into the environment, and isolating or destroying waste, but also controlling the use of substances that pose the risk of contamination to the sustainability of freshwater resources and the continuing existence of good quality groundwater reserves. This is not a problem limited to developed countries and a consequence of their development. It is also a problem for developing countries too. They use the same newly invented products, sometimes in larger quantities and in a less careful and controlled form. The damage to water resources in such developing countries may seriously hamper the environment and possibilities for development, since the income they may generate will be spent soon or later on protecting the population and its activities (including tourism), to compensate for the losses on rejected, exported goods, especially food, and to cover future unavoidable costs to restore or substitute damaged water resources and land.

Polluting chemicals should be substituted by less hazardous products; users have to be trained; effective control and licensing on distribution and use is needed; and the risk has to be make known to all users and those exposed. Protected areas will probably be needed to secure drinkable freshwater resources for towns and especially for large urban areas. These protected areas - which may coincide with natural parks - must include large springs and the headwater of unspoilt rivers, as well as major aquifers containing high quality water reserves, especially deeply confined aquifers and palaeowaters in coastal areas (Custodio *et al.,* 2000). This water should be reserved for drinking purposes.

AQUIFER PROTECTION AND GROUNDWATER USERS' ASSOCIATIONS

The protection of aquifers as a highly valuable resource and reserve of freshwater, and at the same time the preservation of a part of their environmental role (Custodio, 2000a) is a complex issue, but a feasible one. The major difficulties are the lack of experience of sound management, and the need for new methods to deal with their extensive characteristics. Aquifers are or can be scientifically and technically well understood. But they have often been erroneously considered from the managerial point of view as an extension of surface water. This is a major error, aggravated by the fact that even some of the surface water techniques also fail when the system becomes complex.

A large number of players with interests in wells, springs, river base flow, gallery forests, wetlands, drainage and so on affect aquifers and aquifer systems. These players are generally small, non-related water owners and users – stakeholders - who are unaware that they receive benefits from the aquifer system, which is an infrastructure provided by Nature.

There is also the common pool resource problem (Young, 1992; Aguilera, 1991;1996; Azqueta and Ferreiro, 1994). This means that when reserves are used there is no incentive to save water or protect it, since doing this will only increase the benefit of others. Without regulation the final situation is reserve depletion or quality degradation. Long-term development is reduced to recharge but at a high cost due to accumulated water head drawdown. But this is not new, since uncontrolled development of surface water has similar problems, with the exception of the time delay in the case of groundwater reserves.

All this can be redressed by regulations, which include an effective water institution with adequate legal instruments, working together with the aquifer system's water stakeholders, who should be organised into an association or a similar structure. This association should have a technical office for management and monitoring. There is already a small number of real experiences (Aragonés *et al.,* 1996; Galofré, 1991), but more of them are needed before good understanding and practice is gained, especially when there are many stakeholders, farmers and rural water users.

Groundwater users' associations must be truly representative of all interests and effectively participate in water management, under the guidance of the water institution which is responsible for water management and water law enforcement. In order to do its job, the association has to have the power to correct and punish offences, and should collect and receive funds from its members and from the water authorities. The institution should be responsible for incentives to foster policies agreed upon (Schaible *et al.* 1999).

There are several key factors in aquifer protection. From a technical point of view, abstraction works have to be correctly designed, constructed, operated, maintained and abandoned. Adequate abstraction, recharge, discharge, groundwater use, groundwater head and quality monitoring systems must be constructed and operated, and the data added to data bases. It is essential that monitoring considers the three-dimensional nature of groundwater.

From the point of view of land use, recharge areas have to be preserved and even improved and extended. Sources of pollution must be controlled. All this means some power to enforce plans for land-use. These plans for land-use should be based on a large consensus of all parties involved. All this is part of groundwater management, which is not an easy task, but it is a feasible and rewarding one, provided adequate training exists and "hydromyths" and deeply entrenched barriers are abated. Not only people are needed but also institutions, and there is a shortage of these in many countries, especially in developing countries (Lloyd, 1994).

An aquifer system is a natural infrastructure provided free of charge by Nature. But obtaining and developing water resources need investment, maintenance and operation. This has a cost, which should be paid directly by the water abstractor. But to compensate for indirect costs, especially those related with the environment, monitoring, studies and implementing decisions, funds must be collected. Funds are also needed to reverse adverse situations such as recharge reduction, contamination issues, forced changes in the quantity of abstraction and its pattern, to control the displacement of poor quality groundwater, and to implement treatment facilities.

The source of funds is variable, from those responsible for the damage to the whole community, or possible new abstractors, or from general taxes provided by the water boards. This last source should be restricted to special situations such as improvements of a general nature, or combating serious contamination from unknown sources.

Destroying aquifers by contamination, including diffuse contamination from agriculture; by deteriorating recharge areas; by permitting contaminated or low quality water to penetrate good quality aquifers through poorly constructed wells; by incorrectly disposing of liquid or solid waste, or through many other activities, is ethically inadmissible. This entails the cost of destroying existing infrastructures which are often very costly to substitute if, indeed, this is possible at all.

Short-term use of reserves is admissible and sound within a scenario of future new developments paid from the net profits obtained (Collin and Margat, 1993; Custodio, 1993; Foster, 1992; Margat, 1993). This has special aspects in arid lands (Lloyd, 1997; 1998; Margat, 1990), where mining groundwater resources is a possibility (Llamas, 1999). But this should not be admitted if only short-term benefits are sought, simply leaving restoration, substitution and bearing the negative consequences to future generations, at their own expenses and without passing on to them the appropriate means of coping with these expenses (Howe, 1987). Aquifer-intensive development - often called overexploitation - is both a misfortune and a blessing, depending on the way and circumstances in which it is carried out (Llamas, 1992; Custodio, 2000b).

A common point of view is that natural poor quality groundwater, generally brackish and salty water, is not useful at all, and that aquifers containing them have no economic value and can be used to store waste water. With the cost reduction of desalination, this becomes inadmissible in water scarce areas. This poor quality groundwater is often free of hazardous man-made pollutants, and thus a possible source of potable water.

In any case, good water quality aquifers, especially those containing old water, which is free from man-made pollutants, should be reserved for drinking purposes and not wasted in uses that do not require high quality standards. This has to be combined with optimum use of water resources and the preservation of at least a part of the environmental role of groundwater. Deep-seated, confined aquifers are good candidates for special protection. Preparing and implementing protection plans is an ethical must.

FINAL NOTE

The ideas and assertions contained in this paper are the author's own ones and are not necessarily shared by the organisation to which the author is linked.

A first version of this paper was included in the Series A (Uso Intensivo de Aguas Subterráneas) no.5 (2000), Water and Ethics, in the Papeles del Proyecto de Aguas Subterráneas, Fundación Marcelino Botín, Madrid: 34-43, and was read at the First Joint World Congress on Groundwater, Fortaleza 2000, organised by ABAS, ALHSUD, and IAH, which preceded the World Geological Congress in Rio de Janeiro, August 2000.

This paper comes within the European Framework Programme PALAEAUX (ENV4-CT95-0156) and BASELINE (EVK1-CT-1999-0006) and several CICYT projects (MADRE, HID-97-0321, and BROMUROS, HID- 99-205).

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Original recibido: Septiembre 2000.
Original aceptado: Diciembre 2000.