



# Ethical and Moral Issues Relative to Groundwater

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## Abstract

Groundwater is the major freshwater continental resource and reserve. Its quantity and quality are characterized by the delayed and damped response to external action and the large storage with slow renovation rate. This is not known to everybody and is difficult to be experienced personally, as groundwater cannot be directly observed. Therefore, specific knowledge is needed to address correctly the ethical and moral issues related to aquifer use and management. Poor consideration cause deviated policies, social disturbance, inefficiencies and negative impact on the environment and the services it provides. The subject of ethics is humans, but not Nature and the environment as such. This is something that some powerful organizations and minorities try to reverse, by subverting the principles of ethics and trying to erase the God-related fundamentals of moral. Groundwater ethics deal with present circumstances, as well as with the future, represented by scenarios that, to be ethically acceptable, should be non-biased, scientifically feasible and free of pre-set orientations aimed at other objectives. Ethics play an important role in water policy making, especially for groundwater. Science and technology cannot produce unique solutions to existing human and environmental problems if conditions are not previously set by a well-informed society and administrative, legal, social and economic agreements bound the objectives. This involves deep ethical and moral implications. Science and technology contribute the means to convert objectives into assessments that help in decision making at a higher level.

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## 1 Introductory Background

Ethics and moral are close concepts, which are often considered synonymous, although they differ conceptually. Hereinafter, ethical behaviour refers to conformity with norms widely accepted by a given society to improve human well-being and to get a peaceful living and mutual respect. What is considered good and honest may vary from one group to another and change with time, according to local habits, fashion, and socio-economics. However, interest groups with other goals may condition them and set what is politically correct. Moral refers to conformity with that are partly non-dependent on humans but derived from religion, by recognizing that man is a transcendent being whose final destination is God. In the Judeo-Christian religion, as is considered hereinafter, norms are embedded in God's commandments, which are written down and imprinted in the right conscience of any human being. The fundamentals of moral are independent of what society may consider correct and of the objectives of pressure groups and doctrines in fashion.

Water ethical and moral principles have to be applied to make water available to humans and their activities to preserve water resources, to maintain a healthy relationship with Nature, the environment and the services it provides, and to consider other components that affect humans too, such as economy, health, energy, land use, employment, quality of life, and spiritual and religious values.

Ethics and moral apply to humans, who have rights and duties, but not to Nature in general and to the environment in particular, as they are not able to decide. The common home concept, associated to United Nations favoured modernism, is a biased concept, as Man is transcendent and

travels to its final destination in God. So, the “common home” is really a “common bus” to follow the path each human has to do.

What has been said before applies to water, as all humans have a right to it, as a vital asset and a provider of goods. Therefore, water quantity and quality have to be preserved, and make it available in space and time, considering that water use implies some degradation. Ethical behaviour means trying to compensate degradation, especially to those that suffer damage without participating in the benefits. Damage is not known beforehand, so precaution is needed, although an excess of precaution may lead to inactivity, with possible worst consequences to society than errors.

Individuals, besides the right to receive the needed water quantity and quality, have the duty to get, contribute, obtain, preserve, and maintain the infrastructures, according to the capacity of each one. Both rights and duties are ethical issues. The right to water is not primary but a secondary one, as water is not everywhere, and in any moment, but has to be made available. Positive action is needed, which have to be compatible with other rights, such as those related to the environment and the services it provides, energy, land use, employment and health.

There is a close relationship between water ethics and social and economic issues. They depend on tradition, although a common behaviour code must be worked out when different cultures coincide in space and time. Ethics is different and more than good management, sound governance, and social benefits and accomplishments. Therefore, ethics is not a guide with rules and recommendations for action, but a set of supporting concepts and principles for human behaviour.

To some extent, ethics is an alternative to the neo-classical and neo-liberal economic vision. This refers not only to the utilitarian aspects, but also to the non-quantifiable ones, such as tradition, personal feelings, and religion (Custodio 2000; Llamas et al. 2005; Delli Priscolli and Llamas 2012).

Water ethics relies on the application of the precaution and subsidiarity principles, with transparent action and information, and considers the relationships with other ambits. Water is a common good, so the access to it and its use must be equitable and fair, adequately regulated, without clandestine abstraction and out of law activities, and has to be made available and secured by the authorities, although this does not exclude the participation of the private sector when it is able to contribute the efficiency and knowledge that the public administration may lack. The discussion about the public and private roles in water supply is sterile as they are complementary.

## 2 Groundwater Characteristics and Ethics

Groundwater is a part of the continental water cycle, the major freshwater volume aside from ice caps. It is more widespread and less variable than surface water runoff. Generally, groundwater renovation time is of many years or decades, the reserves greatly exceed the annual flow and recharge, and its quantity and quality often vary vertically. Surface runoff can be directly observed, although the large variations make natural availability very uncertain. Groundwater geographical distribution and yield are less uncertain, although aquifer properties are more difficult and costly to know and the effect of changes are often highly delayed and dampened. This is generally not known by citizens and even by many water managers and decision makers, and is out of the mind of politicians, who in many cases stay in duty shorter terms than the aquifer response delay. This is not an excuse to obviate ethical behaviour, which should emanate from civil society and based on non-biased data and information.

Small changes in groundwater storage may produce serious impacts in groundwater, which is often essential to humans and the environment. Besides a reserve, groundwater is a renewable water resource, depending on the relationships with the other components of the hydrological cycle. In arid and semiarid areas, reserves become important, not only to regulate yearly variations in recharge and exploitation, but as an asset which can be depleted (mined) to get temporal economic and social benefits. This introduces new ethical and moral considerations. Simplistic considerations that consider groundwater as a common mineral resource cannot be applied.

## 3 Are Groundwater Resources a Univocally Defined Concept?

A frequent question in water planning, especially in arid and semiarid areas with high water demand, is how much water resources could be safely taken from natural systems to supply demand. The European Water Framework Directive does not pose the question. This should be addressed in the Country Members water legislation and water planning norms. Water allocation by applying simple rules and looking for the fair access to water is a way to try to bypass ethical and moral responsibilities, assuming that ethics were already considered when the rules were set at a higher level. To ethically address the often slow response of groundwater to external action, specific knowledge at the different decision-making levels is needed.

Groundwater plays a role in any circumstance in the hydrological cycle. This has to be evaluated through complete water balances along time in a given area, basin or aquifer. Long-term average water balances only give the order of magnitude of the terms but not on their relevance, except for large aquifer systems. In a correctly done groundwater balance, besides recharge, abstraction and recycling, storage variation, use in natural processes, maintenance of ecological services and preservation of quality, local climate and landscape have to be included. This is different to the common practice of calculating beforehand how much water is needed for natural and human processes and assuming that what exceed the sum are the available additional water resources. When water is for crop irrigation, water needs depend on the year. This has to be considered in resources allocation.

Any human direct and indirect modification of one or several of the water balance terms modifies the others. For groundwater, these modifications are slow and balanced by storage changes. The right question is not how much water resources are available but how much the system will change as the result of externally introduced changes. There is not an available water resources quantity of a given quality but a decision from the top on how much can be disturbed the system to yield social net benefits, without unacceptable results. Thus, there is no unique solution, but a set. Deciding on what is advisable, desirable, or undesirable is the responsibility of water authorities, water users, the civil society and politicians, but not of hydrologists and hydrogeologists, whose role is to provide the analysis and synthesized information for decision makers. This analysis has to be supported by adequate knowledge, good data and consideration of unavoidable uncertainty. The commonly used concepts of hydrological disequilibrium and overexploitation are colloquial, but meaningless.

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#### 4 Aquifers as Natural Infrastructures

Aquifers store and distribute groundwater. Therefore, they can be used as water management structures, in the same way that they function naturally. This use modifies their natural behaviour and affects the terms of the water balance. However, this helps in adapting the water cycle to human needs without recurring to costly engineered infrastructures and often with less environmental changes and less energy consumption. Something similar applies to soil and ground use to modify and treat water quality, and of river stretches beds as channels to transport water. To decide on the acceptance of these possibilities, the complete water balance has to be analysed, not only a few terms of it. Direct effects as well as externalities have to be considered, but further to

quantifiable tangible values, there are the non-measurable, intangible values, which may be significant to locals and visitors. Thus, the use of aquifers and the ground as natural infrastructures, which is often socially and environmentally favourable, is not a mere engineering activity and involves ethical considerations to take into account negative externalities.

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#### 5 Which Are the Subjects, the Humans or the Environment and Nature?

Utilitarianism, consumerism, and the search of increased benefits may lead to serious environmental damage. It includes an excessive use of non-renewable raw material resources, among which there are groundwater reserves and freshwater in coastal aquifers. To control this consumption and the associated energy demand, speculation and health problems, increasingly complex and sophisticated techniques and tools are needed to make the world more manageable and habitable. As this may go against what is often considered as sustainability, there are ethical and moral considerations involved. Human sensitivity has evolved at a slower rate than tools, after decades in which economic optimization of growing and productivity was the goals. The quality of human living is the result of a combination of knowledge, faith, will, and love.

Scientific and technological progress has reshaped the world's economy to be globally connected and increasingly urban. This is a paradigm that humans have still to assimilate. Nature and the environment are essential to human beings, although this is often out of focus and transformed into a new religion in which "Mother Earth" substitutes God and opens the door to old myths and superstition. This man's centred vision has profound consequences in ethics and makes useless moral considerations.

The environment is not static. It evolves due to natural causes, although slowly and difficult to be observed during a human life. Going against these changes is difficult and costly, if not useless. This may require efforts that cut down the capacity to deal with other important human problems. Humans need Nature, but Nature does not need humans. Nature is not a god to be served in exchange of goods, but the provider of means to accomplish Man's role in the Earth. From the Judeo-Christian point of view, there are non-tradable principles. So, water and water resources cannot be ethically used to get political benefits, for coercion and as a mean to introduce ideologies.

The environment is a serious affair, but it is non-static and in the service humans. Adaptation seems a correct position in the long term, even if this implies migration and a different future world, provided, and there is time and will for a soft transition.

## 6 Other Groundwater Related Issues

Groundwater net recharge depends on climate, although there are other factors to be considered as well, such as river infiltration, changes in land use and soil, kind of vegetation and state of exploitation. Climate is variable due to natural processes, and it will continue to vary due to phenomena that are out of the human control. Therefore, ethics does not apply to them. However, there are factors affected by human activity, involving ethical and moral considerations. There are complex relationships with negative externalities derived from decisions, which are often disregarded or unknown beforehand. Water transfer to an area with scarce local water resources, to solve supply problems, may create mid- and long-term changes in local groundwater recharge, which result in salinization, high water tables and wetland deterioration.

Except in the rare situations in which groundwater is obtained by means of drainage galleries (tunnels) or natural outflows, it has to be pumped from the ground from wells and boreholes. Therefore, groundwater abstraction consumes energy. In areas with high water demand and deep groundwater levels, energy consumption may be a significant fraction of total energy, as in some of the intensely irrigated agricultural areas in arid environments. Therefore, there is a water-energy nexus, which has social implications and needs setting policies based on ethical principles, especially when energy supply is limited, other users cannot access it, and cost is subsidized.

Many people and scientists admit that climate is changing by human influence, related to an increased greenhouse effect due to fossil fuel combustion and related waste gases and particles. However, other generally well-informed scientists and aware of the Earth climatic history evaluate that this influence is small and less than the uncertainty of current climate knowledge and capacity of long-term prediction. This involves deep ethical and moral implications.

How climate change will affect groundwater can be evaluated with existing models, which are quite well advanced and good, but not all relevant processes are correctly incorporated; there is no long-term calibration, and downscaling is still a difficult and uncertain process. The main problem is how to obtain reliable data series for the coming with climate models. This is often done by setting scenarios, but to obtain and evaluate changes and their probability, these scenarios should be non-biased. Translating results into reports understandable by citizens, managers, mass media and politicians has to follow ethical and moral principles to avoid bias and manipulation.

The commonly large groundwater storage in aquifers relative to recharge allows the regulation of fluctuations, both natural and as the result of human action. This is a main asset in favour of groundwater and its integration in water resources systems that include the environment and its ecological services. At least, a part of storage should be preserved for this function, both under current and probable future circumstances, taking into account uncertainty.

When considering groundwater storage depletion (mining) as a solution to water supply problems, results have to be fair with current and future generations. The increasing cost of water, water quality impairment, possible land subsidence, impact on wetlands, discharge of water and solutes into the sea in the case of coastal aquifers, and capacity of regulating the water cycle fluctuations are significant ethical issues, which need data and transparency.

Virtual water may be important in many areas. Import of produced and manufactured goods implies that water and energy were used abroad and not in the area. Export to other areas means water and energy spent in the area, besides keeping the waste associated to this production and that derived from making available the water and energy consumed. This has profound ethical and moral implications. The future generations will inherit land changes, groundwater storage depletion, wetland disappearance, and a possible large passive as wastes that may affect groundwater in the mid and long term. More general scope ethical and moral considerations refer to the fair payment of virtual water-rich imported products, to guarantee that these goods are not obtained from impoverished areas, with destruction of non-recoverable land, environment, structures, and especially groundwater resources and reserves. It is surprising that virtual water is not considered in many agendas dealing with water and groundwater resources.

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