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Groundwater legislation in Turkey: problems of conception and application

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The uneven distribution of water resources, a growing population, urbanization and global climate change require new approaches for groundwater management in Turkey. "Safe yield" should yield to broader concepts such as "sustainability". Groundwater management needs to consider future needs of the people and all ecosystems in accordance with basin development models. Groundwater law needs to be expanded beyond quantity to address quality concerns. A new institutional framework should be established and groundwater regulation should reflect new approaches and ideas, in particular to address problems of application.

Keywords: groundwater law; concepts; application; licence; sustainability; Turkey

Introduction

Groundwater is a major resource in Turkey. In 2007, 55% of groundwater was allocated to irrigation and the reminder to drinking water and industry. Groundwater is particularly used in areas where the usage of surface water is not possible or convenient. Because of fast social and economic developments in the country there is a growing need for groundwater resources. Groundwater investigations have been carried out since 1956, under the responsibility of the General Directorate of State Hydraulic Works (DSI; the Turkish acronym). The DSI is the main authority responsible for surface and groundwater resources in Turkey.

The growing demand for and usage of groundwater urges the development of an adequate legislative framework and management structure, focused on the sustainable use of groundwater (Yazicigil and Ekmekci 2003, Sakiyan and Yazicigil 2004, Vliegenthart *et al.* 2007). Groundwater resources in Turkey are managed by the DSI on behalf of the state according to Law of Groundwater, No. 167. The law contains the exploration, allocation, utilization, protection and registration of groundwater resources. Within the framework of the Groundwater Law, whenever and wherever any person intends to construct a water structure in order to provide groundwater (such as drilling a well, excavating galleries or tunnels, etc.), they should obtain licences for exploration and use from the DSI. In addition, in accordance with the aims indicated in the Law on Groundwater, the Regulation on Groundwater and Technical By-law on Groundwater were prepared in order to apply the law efficiently. The technical bylaw covers technical details.

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There are some serious problems in groundwater management in Turkey in both conception and application. Some of these problems are summarized by Yazicigil and Ekmekci (2003). The present paper, however, provides an overview of groundwater management and discusses the problems in greater detail.

Water potential and principal stresses on groundwater resources in Turkey

Turkey has a semi-arid climate except for a small area near the Black Sea and some mountain belts. Average annual precipitation is only 642.6 mm, but this figure conceals wide variation from region to region (Food and Agriculture Organization of the United Nations (FAO) 2001), ranging from 250 mm in the central area to over 3000 mm in the north-east Black Sea region. About 70 % of precipitation falls in the winter and spring periods.

It is estimated that the average annual renewable fresh surface water potential of Turkey is about 234 billion m^3 (World Water Council 2003). The total safe yield of groundwater resources is estimated by the DSI as 12 billion m^3. The usable total water potential that is technically and economically feasible is estimated at 110 billion m^3. At present the average per capita water availability in Turkey of about 1550 m^3 per year is considerably less than the world's average of nearly 7000 m^3. Of course these are global statistical figures and almost everyone agrees that the world's available freshwater supply is not distributed evenly around the globe, throughout the seasons, or from year to year. The population of Turkey is expected to reach 80 million in 2025 and 110 million in 2050. Thus, the per capita water availability will be 1300 and 945 m^3, respectively (DPT 2001).

Sand–gravel deposits and carbonate formations compose the most productive aquifers in Turkey (Figure 1). Carbonate formations (majority karstified) cover nearly one-third of the country. Large limestone aquifers, which are over 1000 m thick and have an important groundwater potential for local and regional demand, are mainly located in the Taurus Belt and other regions of Turkey. The existence of large limestone areas and alluvial deposits particularly located in fault-controlled plains and valleys provide Turkey with a great groundwater potential.

The DSI began monitoring groundwater levels, groundwater quality and discharge of the large springs all over the country in the 1960s when the law entered into force. In general, three kinds of water level monitoring exist: with automatic limnigraphs, manually each month and manually twice a year. As of 2009, the measurement of groundwater level is made at 2500 groundwater monitoring wells. Discharge measurement is made at 1300 large springs, and quality assessment on groundwater is made at about 500 wells. The measured large springs constitute 75% of the total spring discharge of the country. Additionally, there are 1150 quality sampling points of surface waters in the country as of 2008. Sampling from the streams is realized monthly or seasonally. Each regional directorate of the DSI performs its own monitoring and sends the achieved data to the General Directorate. Groundwater levels, quality changes, and allocations are recorded and assessed by the DSI in all groundwater basins. If the total allocation reaches the safe yield of the aquifer or groundwater basin and if a significant decline of groundwater level has occurred, the abstraction is limited and the drilling of new groundwater wells is forbidden by the DSI.

Stresses on water resources in Turkey are similar to other regions of the world. The major anthropogenic stresses on the aquifers in Turkey are overexploitation, pollution, urbanization, and removal by sand–gravel pits and stone quarries. Pollution increases with the increase of the population, the use of agricultural chemicals and fertilizers, and with urbanization and industrialization. Also, urbanization and industrialization particularly on

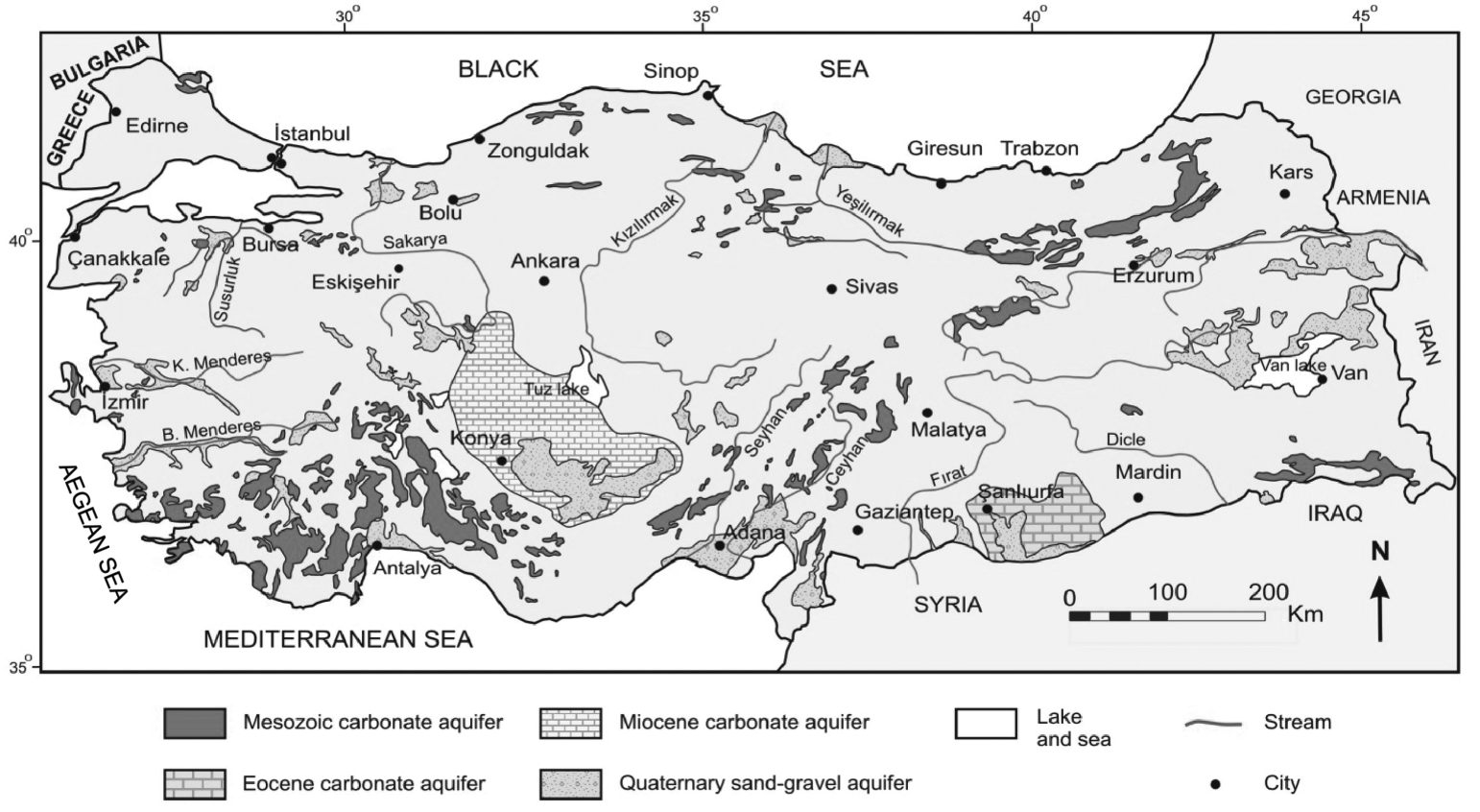


Figure 1. Large groundwater aquifers in Turkey.
Source: modified from http://www.mta.gov.tr/.

the aquifers in the plains cover the aquifer surface and prevent groundwater recharge. Urbanization also increases pollution. The other threat is excavation of the aquifers by quarries and pits. Alluvial aquifers in the plains and valleys have been destroyed by sand–gravel pits and limestone aquifers have been removed by stone quarries, despite official limitations and statements of protections, as well as regulatory sanctions against anthropogenic threats to the aquifers. However, there are serious problems because of some unclear statements and gaps in the regulations, and failings in the applications (Apaydin 2009, p. 147).

History of regulations on water resources in Turkey

The current constitution states that water resources are the natural wealth of the country, being within the power of the state. The Turkish Civil Law of 1926 distinguishes water resources as either "public water" or "private waters". According to this law streams, lakes and groundwater resources belong to public waters but springs are accepted as private waters. Consequently, the owner of the land where a spring is located is also the owner of that spring. The new Turkish Civil Law (updated in 2001) allows springs to be considered public water as well as private water. The law establishing the DSI (Law No. 6200) gave it authority over all water resources in Turkey. According to this law, the DSI was empowered to plan, design, construct and operate dams and hydroelectric power plants. Moreover, the DSI performs some functions such as irrigation and providing domestic and industrial water supplies for large cities. The first regulation on groundwater resources in Turkey is the Law of Groundwater. This law was put into effect in 1960 (No. 167), and according to the first article of this law all groundwaters belong to the state.

Turkey did not discuss the environment in detail until the 1980s. The Undersecretariat of Environment was founded to be responsible for the coordination of all national and international activities concerning the environment in 1978. However, this issue was not considered a priority for the state for a long time. The Environmental Law of 1983 has many environmental measures. The main aim of the law is to prevent and eliminate environmental pollution, and also to allow the management of natural water resources and the land. Since the Environment Law came into effect, several regulations have been issued related to environment, notably the Regulation of Water Pollution Control (1988, revised 2004), Regulation of Control of Solid Waste (1991), Regulation on Assessment of Environmental Impact (1992), Regulation on Control of Medical Waste (1993), Control of Toxic Chemical Substances and Products Regulation (1993), and Control of Hazardous Wastes Regulation (1993). The Ministry of Environment was founded in August 1991. The most important regulation for water resources aside from the Groundwater Law is the Regulation of Water Pollution Control. It contains the prohibitions and limitations to prevent the pollution of waters. It also has some prohibitions on the excavation of aquifers by sand–gravel pits and quarries.

At present there are almost 50 regulations related to water resources and management. In general terms, Turkish regulation of water resources and environmental protection issues has been developed in four key areas: constitutional mandates, regulatory law, natural resource utilization regulations, and public health law (Baris and Karadag 2007). Most are related directly or indirectly to groundwater resources (Table 1).

The "ownership" and "right to use" of groundwater in Turkey

In Turkish law there are two main points related to waters: "ownership" and "right to use". Groundwater resources in Turkey are managed by the DSI on behalf of the state according to the Law of Groundwater, No. 167, and according to the first item of this

Table 1. History of the main regulations and related authorities on water in Turkey.

Year	Regulation	Related authority	Explanation
1926	The Civil Law	Independent courts	Provides that streams, lakes and groundwater are public waters, while springs are private
1945	The Law of Bank of Provinces	The Bank of Provinces	Domestic water supply for municipalities except for large cities
1954	The Law of Establishment of DSI	State Hydraulic Works (DSI)	Monitoring and licensing surface and groundwater for dams, groundwater facilities and hydropower plants
1960	The Law of Groundwater	DSI	Groundwater resources belong to the state; abstractions require licence from the DSI
1961	The By-Law of Groundwater	DSI	Explains important issues related to the law
1972	The Technical By-law of Groundwater	DSI	Technical details on groundwater
1982	The Constitution of 1980	Republic of Turkey	All natural resources belong to the state
1982	The Environmental Law	Undersecretary of Environment	Allow the management of natural resources and the land
1991–1993	various regulations[1]	Ministry of Environment	Provide measures against pollution
2001	The Civil Law (updated)	Independent courts	The owner of the land where a spring discharges has private rights over the spring
2004	Regulation of Water Pollution Control (updated)	Ministry of Environment	Principles of control of pollution into surface and grounwater
2005	Regulation of water for human consumption	Governorships and Ministry of Environment	Governs the sale of spring and groundwater for human consumption
2007	Regulation of mining, operation and control of sand, gravel and similar materials	Ministry of Environment	Governs mining of sand, material and similar materials
2007	The Law of Geothermal Resources and Natural Mineral Waters	Ministry of Energy and Natural Resources, and Governorships	These waters belong to the state; use requires a license from governorship

Note: [1] Regulations of "Control of Solid Waste", "Environmental Impact Assessment", "on Control of Medical Waste", "Control of Toxic Chemical Substances and Products" and "Control of Hazardous Wastes"

law all groundwaters belong to the state. Each person intending to obtain groundwater through means such as digging a well or extracting galleries or tunnels should obtain a licence from the DSI. The Law of Groundwater does not include spring waters, thermal and mineral waters. Turkish Civil Law (updated in 2001) covers spring waters generally. According to this law all surface waters and groundwaters are public waters and so belong to the state. Private spring waters discharge on private property. According to the decisions of the Turkish Supreme Court, public spring waters belong to the public, and in order to have a personal right to use it one must be a user for a long time (an ancient right) or one can have beneficial use of the discharge with respect to the discharge amount and needs. If any disagreement happens among users of the public spring water, the local governorship or a court allocates shares according to factors such as the discharge of the spring, one's needs, ancient rights, local customs. Thermal and mineral waters belong to the state but are not covered by the Groundwater law. Tle Law of Geothermal Resources and Natural Mineral Waters requires users to obtain a license (Table 2).

Principles of the Turkish Groundwater Law

General features

The Groundwater Law does not include items for protection against pollution. It has some protective statements only with respect to the amount and right of users. The Regulation on Groundwater (22 articles) and the Technical By-law on Groundwater (18 items) were prepared in order to apply the law efficiently.

Within the framework of the Groundwater Law, whenever and wherever any person intends to construct a water structure in order to obtain groundwater, they should obtain licences from the DSI (Vliegenthart *et al.* 2007). These licences are for exploration, for use, for reclamation and alteration. A licence for exploration provides permission to drill the borehole. Wells shallower than 10 m and drilled or excavated by hand are not covered by the licence. This licence is valid for one year and if the owner of the licence requests, the validity period can be extended for one year. The owner has to drill a borehole in this period and apply for a "licence for use". If the request is suitable from a legal and technical perspective, a "licence for use" is given by the DSI. A "licence for reclamation and alteration" is given to the owner of a "licence for use" for reclamation and alteration in the borehole. An amount of water is assigned to the owner of the "licence for use" for

Table 2. Main water categories and related regulation (current) in Turkey.

Water type	Regulation	Ownership	Right to use
Surface waters	The Law of Establishment of DSI	State	The DSI construct hydraulic constructions on the streams. It also allocates the surface waters from streams
Spring waters	The Civil Law	Public or private[a]	The owner of the discharging land is allowed to use private springs
Ground waters	The Law of Groundwater	State	Each person has to obtain licences from the DSI to abstract groundwater
Thermal and mineral waters	The Law of Geothermal Resources and Mineral Waters	State	Each person has to obtain licences from governorship to abstract groundwater

their needs. All licences are stored in an archive. All groundwater works/constructions such as boreholes, galleries, drainage trenches, etc. have to be performed by an authorized and responsible engineer.

Key concepts

Beneficial need and allocation

"Beneficial need" is the need for drinking, cleaning, municipal services, animal watering, irrigation, mining and industry, sports, etc. The amount of beneficial need for an owner of an exploration licence is determined by the DSI by consultation with other related authorizations if needed. The DSI allocates a certain amount of groundwater to be used by the owner of the "licence for use". The allocated water cannot exceed the amount of beneficial need. All allocations are saved in an archive by the DSI.

Authorized and responsible engineer

According to the Groundwater Law, hydrogeological investigation, project preparation, supervising drilling of the borehole and other works, and related reports are realized by an "authorized engineer". In order to obtain any licence for groundwater exploration and use, an authorized engineer has to be hired. The authorized engineer is responsible to the DSI as well as to the customer for all works.

Licensed drillers

The construction of groundwater facilities has to be done by an expert on drilling, gallery and tunnel construction. The expert is named a "licensed driller" in the application. In order to be a licensed driller one must pass the tests given by the DSI every year and obtain a licence. Licensed drillers have to work in accordance with the groundwater regulation.

The right of neighbourliness

A person with insufficient groundwater available at reasonable cost in his own land may use a well located in adjacent land provided that his neighbour has water in excess of his beneficial needs and that the user pays all extra construction and operating costs at the going rate.

Safe yield of the aquifer

The amount of allocated water cannot exceed the safe yield, defined by law as "the amount of water that can be abstracted continuously from the aquifer without degradation".

Groundwater exploitation field

According to the law, the DSI performs the hydrogeological investigations in a basin or field that contains significant groundwater potential, and the offers to the related ministry a declaration on the groundwater exploitation field in the Official Gazette. Hydrogeological features such as boundaries of the aquifer fields, well yields, the maximum depth of wells, groundwater quality, groundwater safe yields, protection fields, etc. are declared in the statement.

Authorization and responsibility of the state, the engineer and the people

According to the Groundwater Law, the DSI is the owner of the groundwater resources in Turkey and has all rights of possession and intervention. The DSI has all authorization on controlling the reports, projects and constructions made by responsible engineers and experts. It assigns authorized personnel to control all the works on groundwater resources. It can intervene and make the required corrections if a report or project is not suitable for the regulation and technical rules or if any application is not suitable for the approved project. The main purpose of the control by the DSI is to protect both the rights of users, the responsible engineer and the licensed driller, and to save and manage the groundwater resources.

One of the most important responsibilities of the DSI is to investigate groundwaters in all basins in the country and to prepare the hydrogeological reports, and finally to determine "groundwater exploitation fields". The other important responsibility of the DSI is to monitor groundwater levels, quality changes, allocations and abstractions. The DSI has the authority to determine the amount of groundwater to be abstracted. Moreover, it can decrease or increase the allocated water on the licence for use or the licence for reclamation and alteration.

Responsible engineers and drillers cannot drill any borehole without a licence. If a borehole is drilled without a licence, the engineer and the driller as well as the owner of the well are responsible. Warning, sanction or punishment are applied to all responsible persons. Responsible engineers have to prepare the hydrogeological reports, well projects, make the required tests in the wells suitable for the standards in groundwater regulation, and give all real data to the DSI. They are also responsible for the suitability of the application to the approved project.

Responsible engineers are compelled to work with a licensed driller. According to the law, pouring the surface waters into the wells, mixing bad-quality waters and fresh water in the aquifer, being wasteful of groundwaters, making swamps around wells and irrigation lands, and salinizing irrigation lands are prohibited. Although the measures and rules are displayed on the approved projects and reports, any application that does not fit the measures or rules is the responsibility of the engineer. The owner of the licensed drilling process is responsible for the measures mentioned above during the abstraction of groundwater. If the DSI demands additional data or explanations about hydrogeological investigation, well construction, pumping or laboratory tests, abstraction rate and times, etc. may be supplied by the responsible engineer and the owner of the licence. The DSI has the right to control all groundwater works made by engineers, driller and users.

Statements on penalty matters

There are three kinds of penalty in the Groundwater Law: warning, cancelling of the licences and a fine. The fine is applied: (1) for situations such as drilling a borehole without a licence, (2) for intentionally giving misinformation to the DSI, (3) for the unsuitability of the application to the approved project, (4) for the abstraction of excessive groundwater than the allocated amount, and (5) for allowing the uncontrolled flow of groundwater from artesian wells, etc.

In the condition explained in the first item, a fine is applied to the responsible engineer, well driller and owner of the borehole. After the fine is applied, a licence is given for the borehole only if there are no other problems. Otherwise the borehole is cancelled by the DSI. If any misinformation is given to the DSI (the second item), a warning and fine are applied to the responsible engineer. If there is any mistake in the application (the third

item), both a warning and a fine are applied to the responsible engineer and driller. If the abstraction is in excess of the allocated amount (the fourth item), a warning is applied to the owner of the licensed borehole at first, then a fine is applied if the same condition continues. If the situation does not change even though the warning and fine have been applied, the well may finally be cancelled. If water is allowed to flow uncontrollably from artesian boreholes (the fifth item), both a warning and a fine are given to the responsible engineer and the driller.

If a driller does not comply with the regulation, a warning is first applied; if the fault is repeated, his drilling licence is suspended for six months. If any fault is made again, the licence of the driller is cancelled by the DSI.

Main problems in the conception and application of groundwater management

Lack of planning in accordance with the "sustainability" concept

The Law of Groundwater, the Groundwater Regulation and the Technical By-law on Groundwater of the DSI were put into effect in 1960, 1961 and 1972, respectively. Almost no revision or improvement has been made in groundwater legislation since those dates. However, some major advances have been experienced in Turkey as in the world over the past 40–50 years. One of the most important advances is the transformation in some concepts and approaches related to water resources management.

With respect to groundwater resources and as summarized by Henriksen (2008), Lee (1915) first defined safe yield as the quantity of water that could be pumped "regularly" and permanently without dangerous depletion of the storage reserve. Meinzer (1923) later defined safe yield as "the rate at which water can be withdrawn from an aquifer for human use without depleting the supply to such an extent that withdrawal at this rate is no longer economically feasible". Over time the concept expanded to include the degradation of water quality (Conkling 1946), the contravention of existing water rights (Banks 1953) and other factors. Todd (1959) defined the safe yield of a ground water basin as "the amount of water which can be withdrawn from it annually without producing an undesired result". The fundamental idea behind safe yield – quantifying the desirable development of a groundwater basin – remains today; however, in the second half of the 20th century the concept expanded to include economic, legal and water quality considerations (Alley and Leake 2004). In the Turkish Groundwater law safe yield is described as "the amount of water that can be abstracted continuously from the aquifer without any hazard". The term "hazard" may refer to both quantity and quality, but if the law is examined one can see that the concept of safe yield considers only quantity and ignores quality. For this reason the concept of "safe yeild" must yield to "sustainability" in the Groundwater Law. Groundwater sustainability is commonly defined in a broad context, and somewhat ambiguously, as the development and use of groundwater resources in a manner that can be maintained for an indefinite time without causing unacceptable environmental, economic or social consequences (Alley and Leake 2004).

In addition to the necessity of sustainability for groundwater resources, there is another important factor for Turkey. As known, the country is a candidate to join the European Union and water is a cornerstone of European Union environmental policy. Directive 2000/60/EU marks the beginning of a new era in European Union environmental policy as it sets the legal background for the long-term, sustainable management of water resources on a basin level (integrated river basin management). The directive aims at the establishment of a common European policy for the protection of internal, surface, transient, coastal and groundwater in combination with protection of the environment (Baltasa

et al. 2010). The new Groundwater Directive (2006/118/EC) establishes a regime that sets underground water quality standards and introduces measures to prevent or limit inputs of pollutants into groundwater. It establishes quality criteria that take account of local characteristics and allow further improvements to be made based on monitoring data and new scientific knowledge. The directive thus represents a proportionate and scientifically sound response to the requirements of the Water Framework Directive (WFD) as it relates to assessments on the chemical status of groundwater and the identification and reversal of significant and sustained upward trends in pollutant concentrations. Member States will have to establish the standards at the most appropriate level and take into account local or regional conditions (European Union 2006).

Groundwater legislation in Turkey is based on meeting present demands. It lacks the concept of planning for the future. In other words, the legislation does not consider the future needs of the people and all ecosystems in accordance with basin development models. Water demands are randomly met by the DSI and if the total allocation reaches the safe yield of the aquifer basin, the abstraction is limited and the drilling of new wells is forbidden by the DSI. That is to say, the aphorism "first come, first served" is valid in the application. If any need occurs after the allocation has been limited, the amount of water needed is transferred from an adjacent basin. This is an expensive and difficult application and creates some problems in sharing waters between inhabitants and users.

Spring waters are not in the Groundwater Law

The other important problem is that the springs and groundwaters are separately considered in the legislation. The Groundwater Law does not deal with springs, although all springs are the discharges of groundwater bodies. Furthermore, there is an uncertainty on the distinction between private and general or public waters in the regulation. This is a fundamental problem and all groundwaters should be combined in the same regulation and the ambiguity cleared up.

Uncertainty between "beneficial need" and "marketing"

Until 2001 no statement on marketing groundwater existed in the Groundwater Law. The law considered only the concept of "beneficial need". The sale of groundwaters from wells was forbidden. In 2003, a phrase was added to the fourth article of the law, allowing the sale of groundwater. Thus, the allocation of groundwater turned into two concepts as sale and beneficial need. Today, the sale of groundwater is allowed, but having the licence for use is essential before having a licence for sale. The governorships rent the groundwaters for sale after the DSI has given the licence for use to the salesman according to the regulation. Consequently, the last decision is given by the DSI both for beneficial needs and the sale of groundwater according to the regulation. However, some problems exist in the application between the DSI and the governorships over the licence for sale. The most important of these is giving a licence for sale to a governorship without getting a licence for use for the sale. The result is chaos in groundwater management.

Inability to control withdrawal

According to the law, the DSI allocates a certain amount of groundwater to the owner of the licence for use and the allocated water is not allowed to exceed the amount of beneficial needs. However, to control whether or not the user exploits excess water is not at all easy. Although the DSI technical bylaw allows the installing of meters on thousands of pumps,

monitoring them is very difficult in the existing conditions. In consequence, diversion of groundwater to unauthorized purposes or unpermitted use are problems.

Law does not adequately consider quality

Almost no statements on the protection of groundwater quality exist in the Groundwater Law. The law considers only amount and ignores quality. This fact is a considerable deficiency and does not agree with the modern approach to water management. Prohibitions and limitations on the issue of groundwater pollution exist in the Regulation of Water Pollution Control. This regulation contains the principles on controlling surface and groundwaters against pollution. The authority on this regulation is the Ministry of Environment. Urbanization and industrialization affect the recharge of the aquifers in Turkey by covering aquifer surfaces. This is particularly problematic on the large plains which have abundant groundwater potential beneath them. However, there is no statement on groundwater recharge in the regulations.

Problems between the authorities

According to the existing regulations, the DSI seems to be the only authority on water management, whereas there are other authorities on water supply and allocation (Table 3). The major other authorities are the Bank of Provinces, governorships and municipalities. The first supplies drinking water to the municipalities, the second supplies drinking water to the villages. Some municipalities supply their own water needs. The Bank of Provinces and all municipalities are compelled to obtain groundwater licences from the DSI for the supply of groundwater. However, there are some problems between the DSI and the municipalities

Table 3. Present water-related authorities and functions in Turkey.

Authority	Water-related function	Activities
State Hydraulic Works (DS)	Management of the waters except for private spring waters, thermal and mineral waters, flood control, and water supply for drinking for large cities, for irrigation and industry	Monitoring and licensing surface and groundwaters for allocation and planning, design, construction and operation of dams, groundwater facilities, and hydroelectric power plants. Moreover, the DSI performs the function of irrigation, domestic and industrial water supplies for large cities
The Bank of Provinces	Domestic water supply for municipalities except for large cities	Construction of drilling wells, pumps, pipelines and municipalities (except for large cities)
Governorships	Drinking water supply for rural settlements (villages) and licensing thermal-mineral waters for sale	Drilling wells, constructing pumping plants, pipelines
Ministry of Environment and Forestry	Water pollution control	Devises regulations on rules and principles. Provincial directorates of environment in all provinces apply to them

on licensing and the authorization on groundwaters. Besides, the governorships are not obligated to obtain a licence. Although they are bound to give all data about groundwater wells to the DSI, they do not satisfy this requirement. The problems on sharing the authorization and responsibilities between the DSI and other water-related authorities have been continuing. Consequently, because all data on groundwater use cannot be collected in the data bank of the DSI, the monitoring, assessment and management of groundwater cannot be performed as desired.

Lightness of penalties

Another problem in the regulation is the insufficiency and lightness of the existing penalties. The heaviest penalty applied to the licensed driller is cancelling the licence. This is a heavy penalty for a licensed driller; however, unlicensed drillers can only be fined, so they continue to work. Despite the serious controls, unlicensed drillers continue to work. If a licensed driller is caught, a fine is applied and a warning given; however, he may continue to work in another region. The regulation does allow confiscation of the drilling machine and the proscription of the activities.

Conclusions and discussion

Turkey has a groundwater law and has had notable experience of groundwater management for 50 years.

The major anthropogenic effects on the groundwater aquifers in Turkey are overexploitation, pollution, urbanization, and removal by excavations of pits and quarries. The Law of Groundwater, No. 167, bears the limitations and conditions on the abstraction and use of groundwater. Statements on pollution and removal by excavations exist in other regulations. However, Turkish regulation contains no statement regarding the adverse impact on groundwater recharge of impermeable overlying surfaces due to urbanization and industrialization. Nor have hydrogeological surveys been carried out everywhere in the country; and existing investigations should be revised in the light of the new conditions. Consequently, there are serious problems in groundwater use and management both in conception and application. Dominant concepts in regulations must be radically transformed, such as from safe yield to sustainability, from supply management to demand management and planning, and from pragmatic approach to rational approach. Further, the uneven distribution of water resources, a growing population and urbanization in Turkey and also global climate change require new ideas and new approaches for water management.

Everyone clearly agreed in the second half of the 20th century that all ideas, approaches and regulations related to water resources management should consider “sustainability”. The sustainability of water resources entails monitoring, saving, protection and planning. Modern regulations and effective application are complementary elements. Primarily, water is dynamic in nature and the needs of users are not stable but changeable and growing. Hence, sustainability is a dynamic concept and sustainable water resources management is a concept that emphasizes the need to consider the long-term future as well as the present. Sustainability is related to various measures of risk and uncertainty about a future that cannot be known, but which can surely be influenced. Projections about the future will need to be revised periodically (Loucks 2000). Hence, a new institutional framework should be constructed and the present groundwater regulation should be revised in light of new approaches and ideas.

The most important application problem is the absence of any good groundwater planning that meets present and future needs in a basin or region. In fact, to make good water planning is not possible without integrated basin plans including all dynamic elements such as population, urbanization, agriculture, land use and land cover. Even if DSI performs the hydrological–hydrogeological investigations, monitoring, saving, protection and the related authorities (DSI, the Bank of Provinces and governorships) meet the present water needs; it is not enough for sustainable groundwater management at all. In short, the existing groundwater management in Turkey is meeting only the present needs of the people; it does not consider future needs of the people and all ecosystems in accordance with basin development models. Although there are some recent studies conducted on sustainable groundwater management in Turkey (Sakiyan and Yazicigil 2004) these studies were not followed by DSI due to a lack of trained personnel on basin-wide model development.

The other application problem is on the issue of combating illegal drillers. Although there are some prohibitive statements in the Groundwater Law and five-year effort, illegal drillers could not be completely eliminated. Today many unlicensed boreholes are drilled all around of the country, even if DSI and the governorships combat illegal drilling. This illegal and uncontrolled use causes the overexploitation of groundwater. The main reasons for this unfavourable situation are economic, social, institutional, educational and legal conditions. Primarily, training and education is the requirement for sustainable water management for managers as well as for the people. Another important factor in sustainable water resources management is that local people must be not only capable, but also willing to assume the responsibility for their water resources systems (Loucks 2000). On the other hand, allowing related people to participate in decisions on water resources management and implementing effective control by the responsible authorizations will overcome all the problems.

More importantly, Turkey is a candidate to the European Union. European Union Directive 2000/60/EU marks the beginning of a new era in European Union environmental policy and it sets the legal background for the long-term, sustainable management of water resources at a basin level (integrated river basin management). Consequently, the water management policies and practices of Turkey have to be appropriate to modern approaches and European Union directives.

References

Alley, W.M. and Leake, S.A., 2004. The journey from safe yield to sustainability. *Ground Water*, 42 (1), 12–16.

Apaydin, A., 2009. Man made threats on aquifers and some problems caused by regulations and applications in Turkey. *In*: Proceedings of 62nd Geological Congress of Turkey, Ankara, Turkey.

Baltasa, E.A., Dervosb, N.A. and Mimikouc, M.A., 2010. Hydrological response and examination of the water resources in an experimental watershed in Greece. *Water International*, 35 (3), 324–335.

Banks, H., 1953. Utilization of underground storage reservoirs. *Transactions of the American Society of Civil Engineers*, 118, 220–234.

Baris, M.E. and Karadag, A.A., 2007. Water resources management issues in Turkey and recommendations. *Journal of Applied Sciences*, 7 (24), 3900–3908.

Conkling, H., 1946. Utilization of ground-water storage in stream system development. *Transactions of the American Society of Civil Engineers*, 3, 275–305.

DPT, 2001. *Water basins and their utilization and management, 8th Five Year Development Plan (2001–2005)*. Ankara: Prime Minister's Press.

European Union, 2006. *Rural development in the European Union, statistical and economic information report*. Available from: http://ec.europa.eu/research/fp6/index_en.cfm.

Food and Agriculture Organization of the United Nations (FAO), 2001. *Gateway to land and water information Turkey*. Rome: FAO.

Henriksen, H.J., 2008. Assessment of exploitable groundwater resources of Denmark by use of ensemble resource indicators and a numerical groundwater–surface model. *Journal of Hydrology*, 348, 224–240.

Lee, C.H., 1915. The determination of safe yield of underground reservoirs of the closed basin type. *Transactions of the American Society of Civil Engineers*, 78, 148–251.

Loucks, P., 2000. Sustainable water resources management. *Water International*, 25 (1), 3–10.

Meinzer, O.E., 1923. *Outline of groundwater hydrology with definitions*. Water-Supply Paper No. 494. US Geological Survey.

Sakiyan, J. and Yazicigi, H., 2004. Sustainable development and management of an aquifer system in Western Turkey. *Hydrogeology Journal*, 12 (1), 66–80.

Todd, D.K., 1959. *Ground water hydrology*. New York, NY: Wiley.

Vliegenthart, F.J.L., *et al*. 2007. *A new approach for groundwater management in Turkey*. Groundwater management plan according to EU Groundwater Directive (80/68/EEC) and Water Framework Directive (2000/60/EC) Antalya: International Congress on River Basin Management.

World Water Council, 2003. *Country report*. Prepared for the 3rd World Water Forum, March. International Congress on River Basin Management. Available from: http://www.worldwatercouncil.org/index.php?id=944

Yazicigil, H. and Ekmekci, M., 2003. Perspectives on Turkish groundwater resources. *Groundwater*, 41 (3), 290–291.

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