Groundwater in the Southern Member States of the European Union:

an assessment of current knowledge and future prospects

Country report for Portugal

Contents

PORTUGUESE GROUNDWATER REPORT – EASAC WG ON THE ROLE OF GROUNDWATER IN THE WATER RESOURCES POLICY OF SOUTHERN EU MEMBER STATES

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1. INTRODUCTION

From an hydrogeological point of view, Portugal is a favoured country. There is a large diversity of porous, karstic and fissured aquifers, where groundwater is stored in great quantities, interacting with surface water systems like rivers, estuaries and sea in a variety of climatic conditions, from the wet North to the dry South. There are also important hydro-mineral and thermal resources, with a relevant national economic value. About 20% of the geographical extension of Portugal is occupied by 62 aquifer systems, of which 60 % are porous.

Significant renewable groundwater resources are available in some aquifers of Portugal, mainly in the huge Tagus-Sado aquifer system, the major groundwater unit of the Iberian Peninsula. In some aquifers under-exploitation may occurs, while in other areas, especially in the Algarve region situations of groundwater over-pumping can occur, in some cases generating water quality problems.

Groundwater plays an important role in public, industrial and agricultural sectors, this last one being the greatest consumer of groundwater.

Groundwater resources are facing increasing pressures from those sectors. Climate change contributes to an increase of water scarcity in Portugal specially in arid and semi-arid cases, as is the case of some regions of south of Portugal, in Alentejo and Algarve (Cunha et al., 2006)

Groundwater quality problems are due to the overload of aquifers with pollutants derived from agriculture, from domestic and industrial landfills, or from the intrusion of saline water.

These anthropogenic changes pose a significant, but largely unknown threat to the health of groundwater dependent ecosystems, which rely either totaly or partially on groundwater to maintain their species, composition and natural ecological processes.

The implementation of the European Water Framework Directive and its daughter Directive on the Protection of Groundwater against Pollution, the so-called European Union Groundwater Directive represents a tremendous challenge for the next years.

The initial main criteria considered in the Directives were to define the groundwater status from the point of view of quality (chemical) and quantity. Recently the ecological perspective was introduced recognizing the importance of the ecological functions of groundwater.

2. SCOPE

The aim of this report is to give an overview of the current groundwater quality and quantity resources of Portugal. The information for preparing this overview comes only from the available literature. The following information and topics are included in this report:

- Groundwater resources
- Groundwater uses
- Economic value of groundwater
- Pressures on groundwater
- Major negative influences of groundwater extraction
- Institutions for groundwater governance

3. GROUNDWATER RESOURCES

3.1 Aquifer Systems

In Portugal groundwater is unequally distributed in the territory due to differences in climatic and geological conditions. From an hydrogeological point of view there are porous, karstic and fractured aquifers, which govern the conditions of storage and transmission of water. Groundwater is linked to surface water in many different forms. According to the geological characteristics Portugal is divided into four main hydrogeological unities: (Figure 3.1).

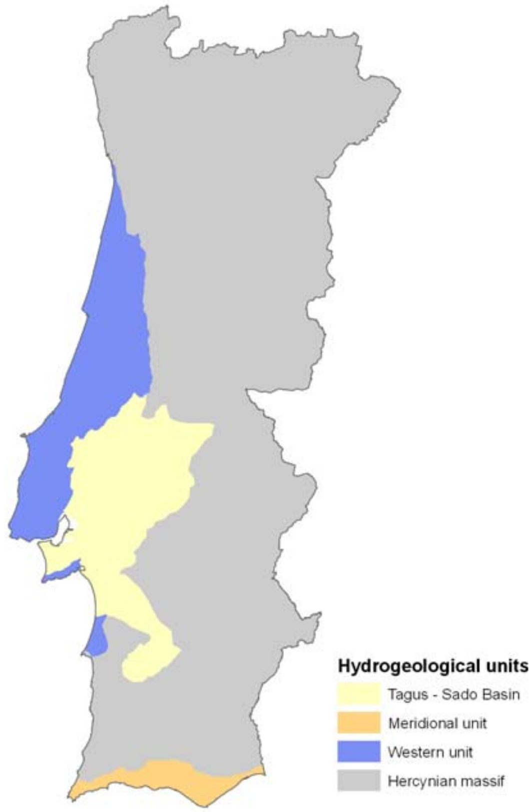

Figure 3.1 - Main hydrogeological unities (INAG, 2001)

Within these unities there are 62 aquifer systems (figure 3.2), out of which 22 are porous, 21 karstic and 19 are a mixture of porous and fissured unities. In what concerns the geographical extension the porous ones cover 60 % of a total area of the aquifers (18,000 km^2).

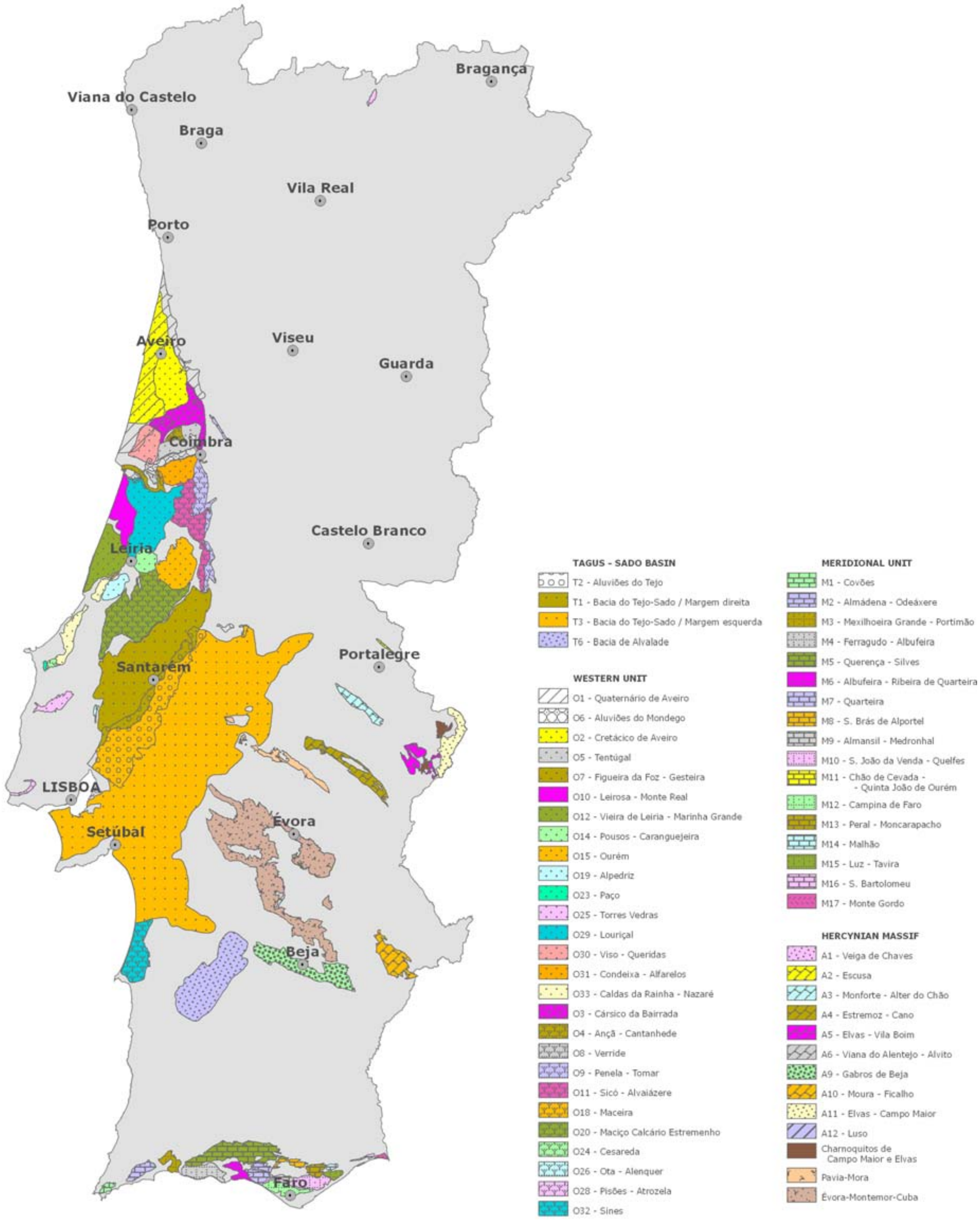

Figure 3.2 – Aquifer systems of Portugal (INAG, 2001)

The unit Hercynean massif is mainly composed by igneous and metamorphic rocks. Due to their low permeability and specific yield values no aquifers have been identified in this large region. The exceptions are some carbonate aquifers in the Alentejo area.

In the Western unit there are 30 aquifer systems, of sedimentary and karstic types, which may be confined or unconfined and may locally be artesian. A few aquifers are multi-layer systems, where leakage mechanisms can occur, and provide groundwater interchange between aquifers.

The aquifer systems in the Meridional unit are carbonated ones with some karstification development.

The Tagus-Sado unit includes the most important aquifer system of the Iberian Peninsula, the Tagus-Sado aquifer system, which covers a large sedimentary basin of about 8000 km^2. This is a multi-layer system, the deepest aquifer being the most productive one. In some areas the system displays a flowing artesian behaviour. This aquifer system is a unique source of water supply for drinking, agricultural and industrial supply. There are also some small alluvial aquifers which have strong links with watercourses with frequent water exchanges.

Figure 3.3 shows that the systems of porous characteristics are the most productive ones with a median value of 13,3 l/seg, following the porous-karstic systems with 7,1 l/s and the karstic ones with a median value of 6,7 l/s.

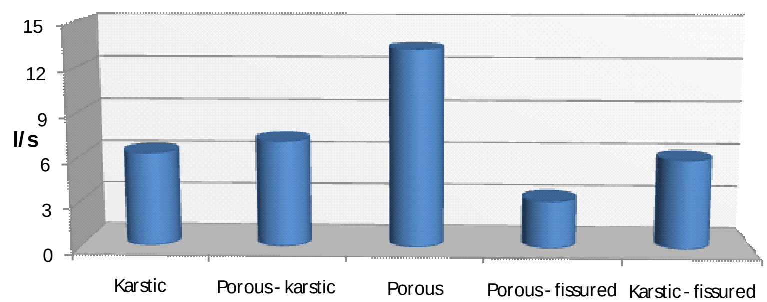

Figure 3.3 – Productivity median values (in l/s) classed according to lithological types

3.2 Monitoring network

Groundwater monitoring has been used to measure water quantity and quality systematically since 1979 covering the areas where aquifer systems exist.

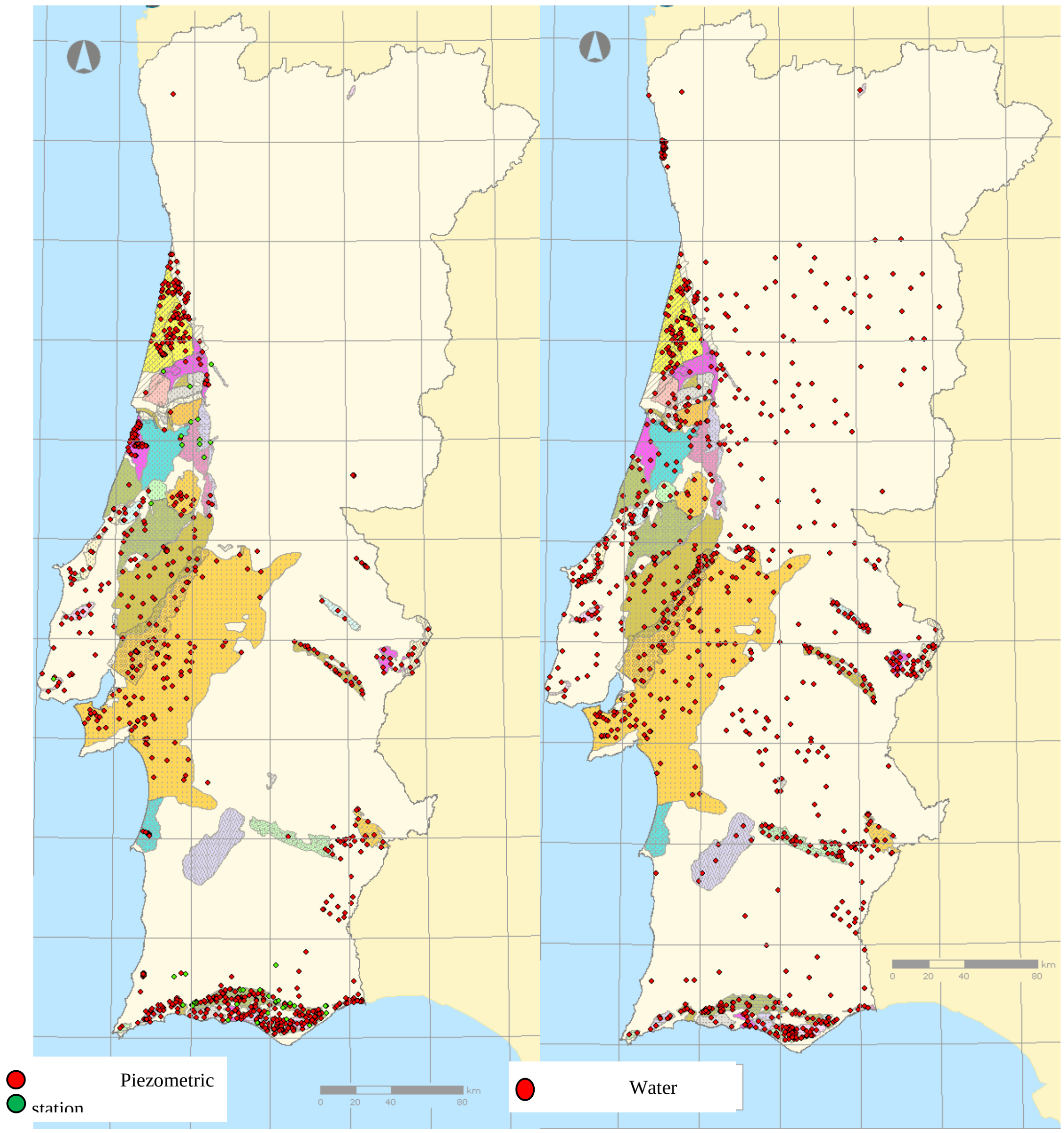

Figure 3.4 – Groundwater monitoring networks (source: Water Institute of Portugal)

Groundwater quantity monitoring network consists of 884 stations (805 for piezometric observations and 79 for spring discharge measurements) (fig. 3.4). Piezometric data are collected in a monthly basis and spring discharge is measured in an irregular basis. Some piezometric time series are long enough to allow a trend evaluation.

Groundwater quality monitoring network in the country consists of 1017 stations. The measured parameters are: the main ions, NO_3, conductivity and pH. The data are collected monthly.

Groundwater bodies

The law 58/2005, that transposes the EU Framework Directive to the Portuguese legislation (see section 8), establish eight hydrographical regions in Portugal for planning purposes (fig. 3.5) : Minho and Lima (RH1); Cávado, Ave and Leça (RH2); Douro (RH3); Vouga, Mondego, Lis and Ribeiras do Oeste (RH4); Tejo (RH5); Sado e Mira (RH6); Guadiana (RH7); Ribeiras do Algarve (RH8).

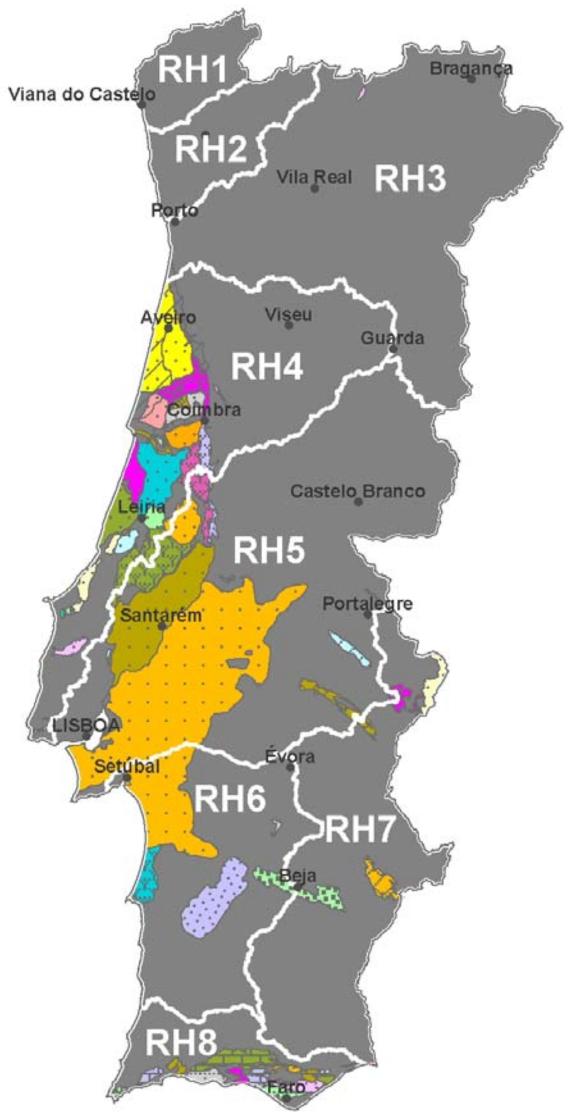

Figure 3.5 – Location of the eight hydrographical regions

The main consequence of this division as regards water planning derives from the fact that some important aquifers are shared by more than one hydrographical region. The most difficult case is the Tagus-Sado aquifer system shared by hydrographical regions: RH5 and RH6.

However the problems can be partially solved by the elaboration of specific management plans in some important aquifers, as it is stipulated by law. Also according to law Portugal is forced to elaborate water management plans for all hydrographical regions, and a characterization of the groundwater bodies at risk. This task includes an identification and characterization of the anthropogenic pressures (topic and diffuse pollution sources), main users and monitoring networks.

The National Water Authority (INAG, 2005) has carried out the identification of 91 groundwater bodies: 62 aquifer systems plus 29 undifferentiated hydrogeological formations (fig. 3.6).

The Water Framework Directive requires a significant effort to evaluate pressures and impacts on groundwater bodies and to identify and adopt measures to obtain a good ecological water status by 2015. In order to comply with these requirements the following bodies have been identified:

1) Groundwater bodies *at risk*, which will presumably not attain good status by 2015 and need further characterization.
2) Groundwater bodies *under evaluation*, for which not enough information is available to make a clear diagnosis as regard the achievement of a good status.
3) Groundwater bodies at *no risk*, i.e. is which according to the available data will attain a good status.

This initial characterization identifies two types of pressures: (i) chemical risk as a result of point and non-point or diffuse pollution, and seawater intrusion; and (ii) quantitative risk as a result of unsustainable extraction volumes. The following main criteria have been used to characterize the groundwater bodies at risk (INAG, 2005):

a) Groundwater bodies with more than 40% of its area subject to intense fertilization.

b) Groundwater well abstractions volumes higher than 90% of the effective aquifer recharge.

c) Waste disposal sites without protection.

The evaluation of impacts has considered separately the chemical and quantitative aspects. In what concerns ~~to~~ the chemical aspects, the main contaminant was NO_3 with a 50 mg/l threshold value. Table 3.1 presents the results of applying the methodology described above.

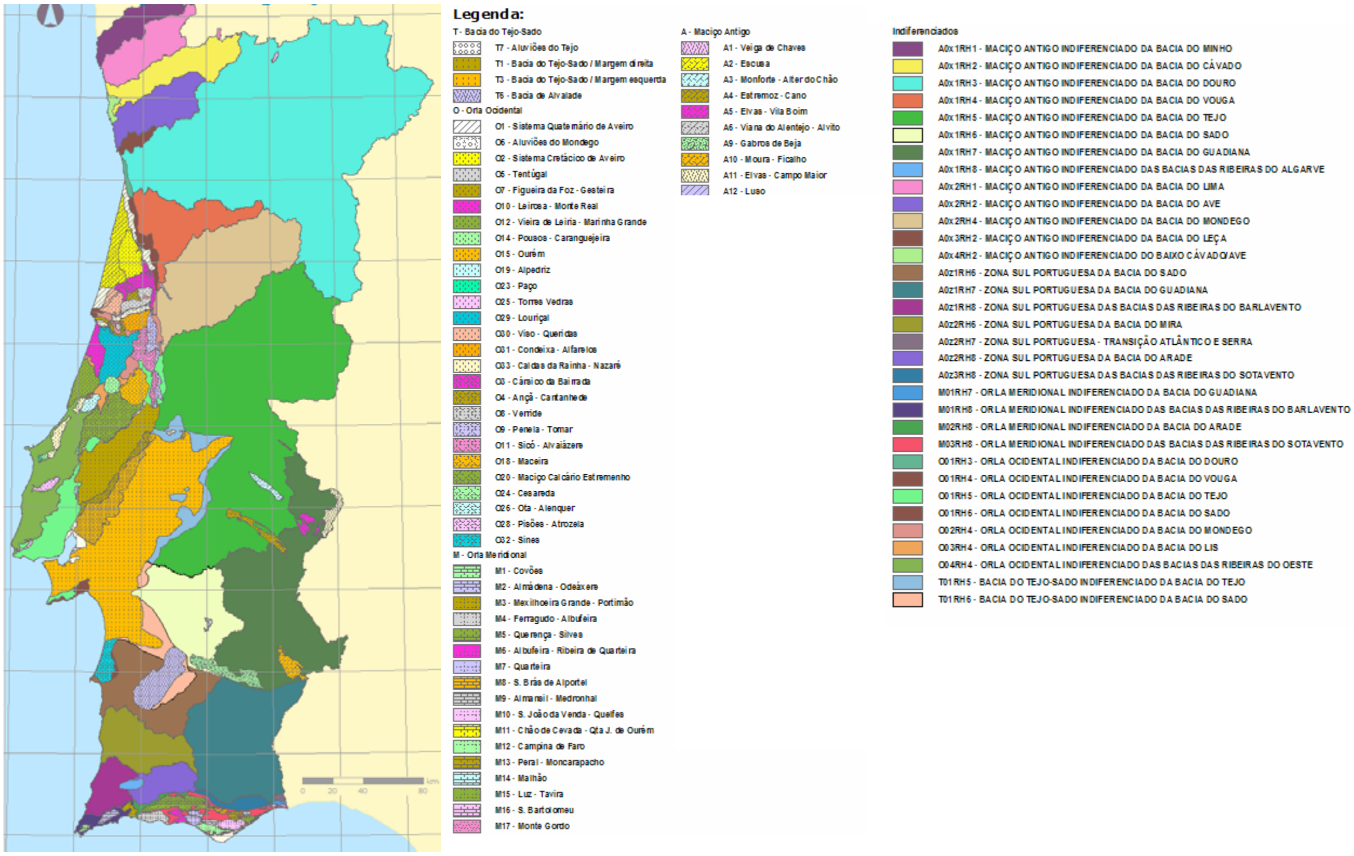

Fig. 3.6 – Groundwater bodies (source: Water Institute of Portugal)

Table 3.1 – Number of groundwater bodies at risk, under evaluation and with no risk

Hydrographical region	At risk	Under evaluation	No risk
RH 1	0	0	2
RH 2	1	0	3
RH 3	0	0	3
RH 4	1	7	12
RH 5	1	5	16
RH 6	0	2	6
RH 7	1	3	5
RH8	2	5	16

Only 6 groundwater bodies have been classified at risk due to diffuse pollution from agricultural practices. For the remaining, 22 groundwater bodies (24% of the total) don't have enough available information so they have been classified *under evaluation* and 63 groundwater bodies (69% of the total) have been classified at no risk.

Unfortunately INAG (2005) does not specify the localization of the various groundwater bodies, accounted in table 3.1.

4. GROUNDWATER USES

Data gathered in the scope of the Portuguese National Water Plan (INAG, 2001) indicate (see Table 4.1) that the agricultural sector annually consumes about 4.2 km^3 of groundwater, the public sector 0.35 km^3 and industry 0.18 km^3, respectively 88.7 %, 7.4 % and 3.8 %.

Table 4.1. Sector-based annual water consumption on the Portuguese mainland (based on INAG, 2001).

	Total		**Groundwater**		**Surface water**	
	(hm^3/year)	%	(hm^3/year)	%	(hm^3/year)	%
Agriculture (irrigation)	6551	74.8	4210	88.7	2341	58.4
Energy production	1237	14.1	0	0.0	1237	30.9
Public water supply	561	6.4	349	7.4	212	5.3
Industry	385	4.4	179	3.8	206	5.1
Tourism	20	0.2	9	0.2	11	0.3
Total	**8754**	**100**	**4747**	**100**	**4007**	**100**

4.1 Public water supply

According to the Portuguese National Water Plan (INAG, 2001) around 85 % of the resident population of Portugal has a drinking water supply, which corresponds to a consumption of around 560 hm^3/year, with per capita values between 130 l/hab.day and 530 l/hab.day. About 45 % of the total drinking water is groundwater. Figure 4.1 shows the distribution of public water supply by surface and groundwater origins. In the different districts of Portugal, Setúbal, Leiria, Santarém, Coimbra and Aveiro are those where groundwater is mainly used for drinking water purposes.

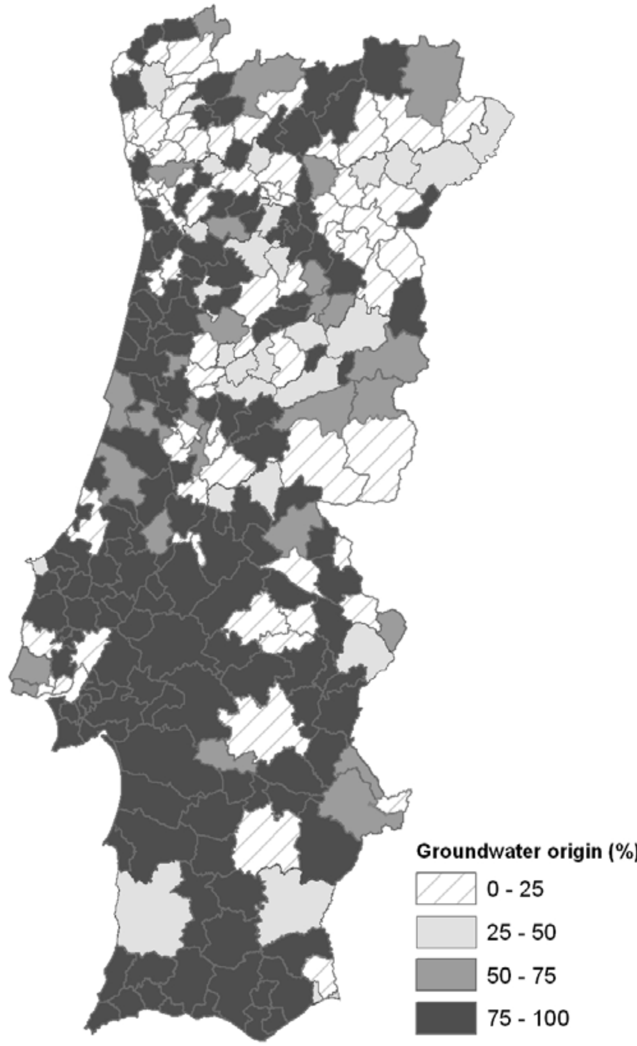

Figure 4.1 – Proportion of groundwater and surface water uses for drinking water supply by municipal regions (APDA, 2006)

4.2 Industry

Also according to INAG (2001), the estimated annual consumption volume used by the industrial activities is 385 hm^3. The largest consumptions are located in Tejo, Sado and Douro basins (see fig. 4.2). About 50% of the industrial consumption is ensured by groundwater.

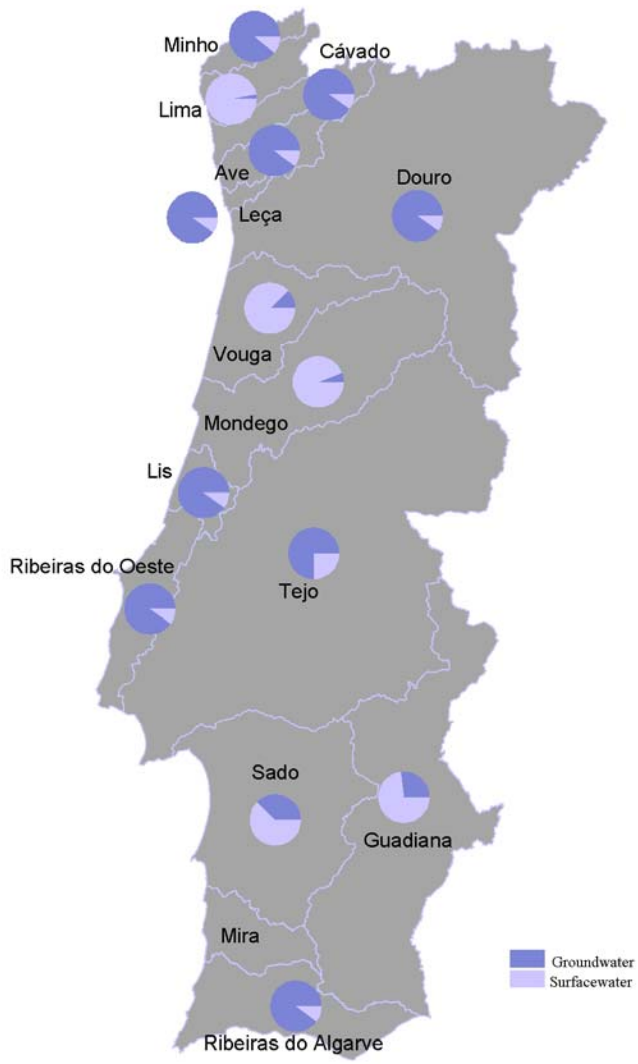

Figure 4.2 – Groundwater and surface water uses in industry. Distribution by river basins (source: Water Institute of Portugal)

4.3 Agriculture

Water withdrawn for agricultural use is estimated in 6550 hm^3/year, corresponding to 75 % of the water consumption in the country. The river basins of Tejo, Sado and Douro are the ones with the largest consumptions (see fig. 4.3). Groundwater contributes to 65% of the agricultural water consumption.

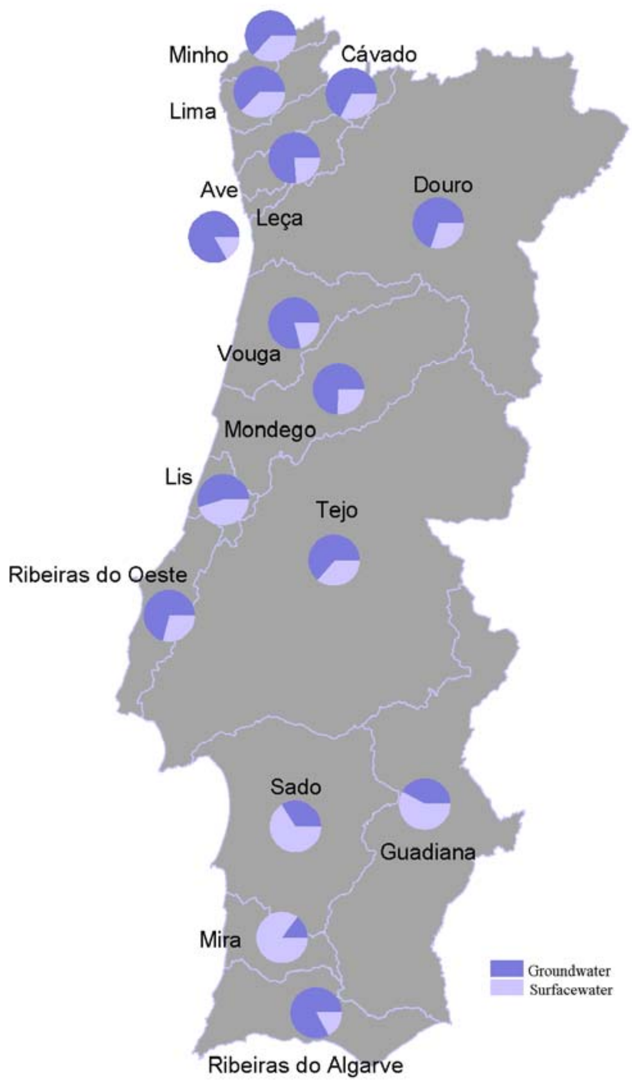

Figure 4.3 – Groundwater and surface water uses in agriculture. Distribution by river basins (source: Water Institute of Portugal)

5. ECONOMIC VALUE OF GROUNDWATER

When dealing with the economic value of groundwater three associated concepts may be of interest: (i) the *value* of groundwater itself, which is determined by the various direct and indirect benefits which groundwater provides its users, including the social, cultural and environmental benefits; (ii) the *cost* of groundwater, related to the expenses of providing groundwater to the users; and (iii) the *price* of groundwater which corresponds to the amount to be paid by the water users.

Also the economic value of groundwater should be associated to its various sectorial uses: urban water supply, rural domestic water supply, irrigation, industry, bottled water and spas, and ecosystems conservation.

In Portugal the relative consumption of groundwater has progressively increased in the last decades with rates of increase higher in the southern part on the country than in the north. However it should be noted that this variation is not the same for all water uses. For instance the relative consumption of groundwater for urban uses as been decreasing in comparison to the consumption of surface water use, and this has been achieved with a reduction of water costs due to a concentration of municipal water supply systems, in regional bulk systems.

As regards the use of groundwater for irrigation the situation is different. Irrigation is the main water consumer in the country, accounting for around 80% of the total water consumption in Portugal. As there is a strong decrease in precipitation and a strong increase in evapotranspiration from North to South, groundwater use for irrigation in the southern part of the country is much higher than in the north. This being said the intensity of groundwater use is not the same in all irrigated areas. In fact, in areas with large or median irrigation projects built and owned by the State the use of surface water tends to predominate, while groundwater tends to be increasingly used in the areas owned by private farmers.

In general terms it can be said that the cost of groundwater for the farmer is lower than the cost of surface water, as the costs of storage and transport of groundwater are normally lower. In the case of drinking water the costs of treatment tends also to be lower.

In Portugal the property of groundwater belongs to those owning the land, but even so they need a permit to withdraw water and they have to pay a charge for withdrawing water. The rational for determining these charges is currently under revision and will be established by the Decree Law 97/2008, dealing with the economic and financial regime of water resources use.

Low water prices and the existence of policies favouring subsidized water for irrigation have been pointed out as a source of inefficient water use in agriculture and of excessive water consumption. But this situation has slowly started to change. On one hand, the reform of the EU Common Agricultural Policy has been reducing the subsidies to agriculture and, on the other hand, the Water Framework Directive has established the principle of full-cost recovery when fixing the water prices.

The information on the economic value of water use in Portugal is very limited, the situation being even more critical in the case of groundwater, as the prevailing private ownership of groundwater linked to the property of the land is the cause of a reduction of State intervention in these resources. Often there is a tendency not to make separate economic analysis for surface and groundwater.

The implementation of the EU Water Framework Directive, which has been transposed for the Portuguese legal system in the New Water Law of 2005, will force a change of this situation, in particular by requiring the full cost recovery of the cost of water by 2010.

In the future, when estimating the costs of groundwater it should be attempted to make a separate calculation of the direct water service costs (costs of well drilling, of the replacement of the water abstraction infrastructures and of the energy costs for pumping) and the environmental and resource costs. Environmental and resource costs will, certainly, be more difficult to quantify than direct costs.

According to the National Water Plan (INAG 2001–p.45/58 (4-II)) the national consumption of surface and groundwater in Portugal, for its various uses, is as follows:

Table 5.1 – Consumption values of surface and groundwater in Portugal

	Surface Water		**Groundwater**	
	km3/yr.	%	km3/yr.	%
Irrigation	2.34	36	4.21	64
Urban	0.21	37	0.35	63
Industry	0.21	54	0.18	46
Tourism	0.01	50	0.01	50
Total	**2.77**	**37**	**4.75**	**63**

As can be seen in Table 5.1, according to this data, the overall water consumption of groundwater corresponds to 63% of the total water consumption and the sector with an highest water use is irrigation, using more that 80% of the total water consumed.

Comprehensive data on the cost and value of groundwater for its different uses are not available in Portugal, and even the data only for urban water supply are scarce at a municipal level. The values of water tariffs for urban water supply provided by APDA (2006), for the year of 2004, indicate an average price of 0,76 €/m3 (for an individual users with a consumption of 120 m^3/yr) and of 0,83 €/m^3 (for a consumption of 200 m3/yr), what shows the progressive character of the tariffs, penalizing the consumers with higher consumptions. APDA (2006) provides also the individual water prices for the various municipalities, which show a very wide dispersion of the prices practiced.

In what concerns the sector of bottled waters, and according to the Portuguese Industrial Association for Natural Mineral and Spring Waters there are 18 natural mineral waters (representing about 67 % of the bottled waters market) and 13 spring waters. The former belong to the public domain, whose exploitation is subject to a concession and the later are under private property and are subject only to a specific licensing of the State authorities.

The global economic value of bottled waters was, in 2006, about 250 millions euros. During the last 10 years the mineral water consumption has grown 57%, with a significant increase of consumption per capita from 61,6 l/year in 1997 to 92,3 l/year in 2006. The total consumption is estimated in 965.5 millions of liters in 2006

6 PRESSURES ON GROUNDWATER RESOURCES

6.1 Aquifer recharge

Recharge is a critical component of the water cycle when assessing sustainable groundwater resources.

Figure 6.1 shows multiple box-plots with aquifer recharge values as a percentage of the mean area precipitation.

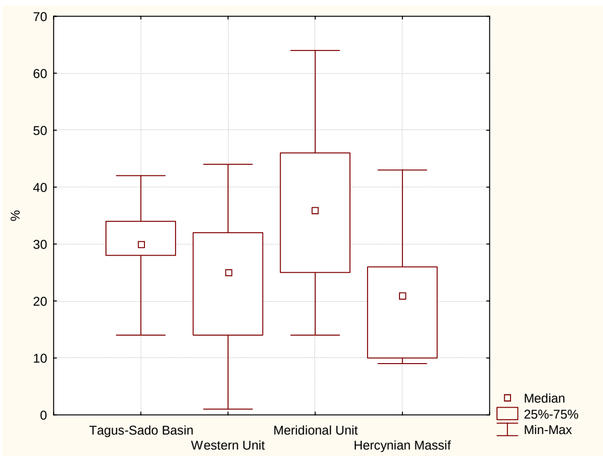

Figure 6.1 – Multiple box-plots of recharge values estimated for the main hydrogeological unities

According to the lithological types aquifer recharge values can vary from a minimum of 5% of the total mean area precipitation (e.g. schists in the Hercynian massif) to values higher than 50% in the case of karstic hydrogeological formations located in the Meridional Unit (fig. 6.2).

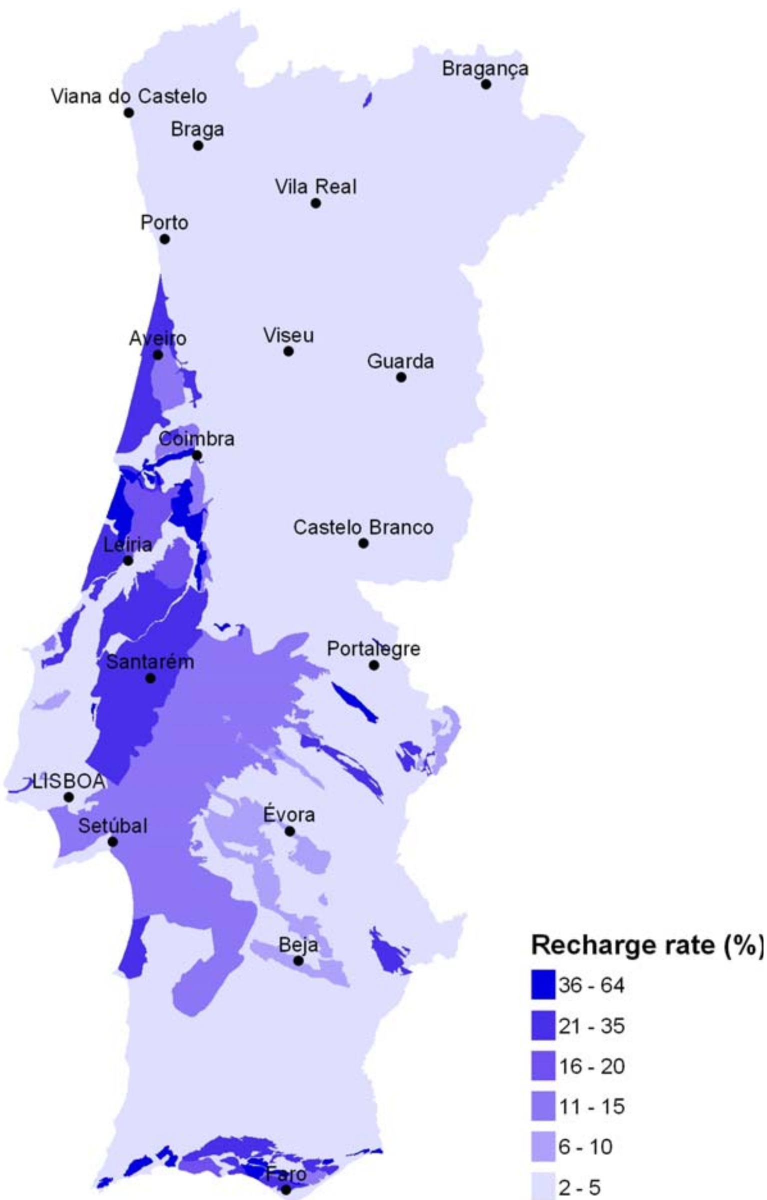

Figure 6.2 – Distribution of mean area aquifer recharge values (Ribeiro, 2002)

6.2 Renewable groundwater resources

Renewable groundwater resources are defined as the average recharge of aquifers generated from precipitation, corresponding to a natural situation without human influence.

Figure 6.3 shows the renewable groundwater resources map of Portugal. The estimated annual median value is around 0.15 hm^3/km^2.

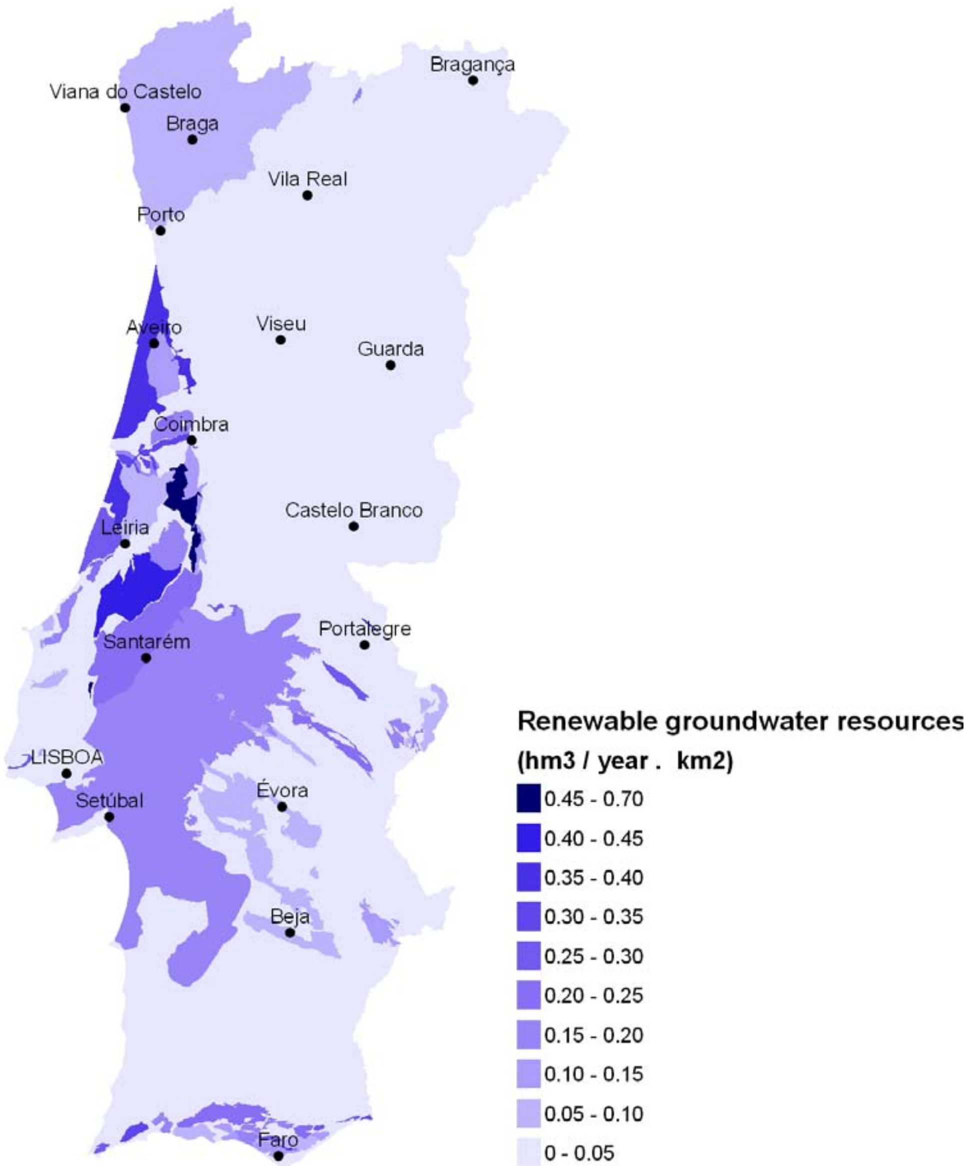

Figure 6.3 – Renewable groundwater resources (Ribeiro, 2002)

6.3 Impact of land use changes

Human activities have imposed large-scale changes on terrestrial ecosystems in the last century, primarily related to the agricultural activities. For example, agricultural land use was associated to high concentrations of nitrate (NO_3^-), the main ion in inorganic agricultural pollution.

Nitrate pollution of groundwater has already reached worrying levels in several regions of Portugal, especially in the shallow aquifers. According to INAG (2001), many aquifer systems in the Algarve province, in the south of Portugal, present nitrate levels above 25 mg NO_3^-/l and several above 50 mg/l (INAG, 2001).

By using an expedite methodology it has been possible to identify the areas of the main aquifer systems of Portugal which are more vulnerable to an agricultural land use (Ribeiro, 2002). Figures 6.4, 6.5 and 6.6 show those areas in the three main hydrogeological unities where there is a risk of groundwater contamination by agricultural use.

In the Meridional unit a majority of the aquifers are vulnerable to contamination, but in the Western unit only the Aveiro shallow aquifer and the Mondego alluvial aquifer are susceptible to nitrate contamination. In the Tagus-Sado aquifer unity only the alluvial aquifer is considered as a vulnerable zone.

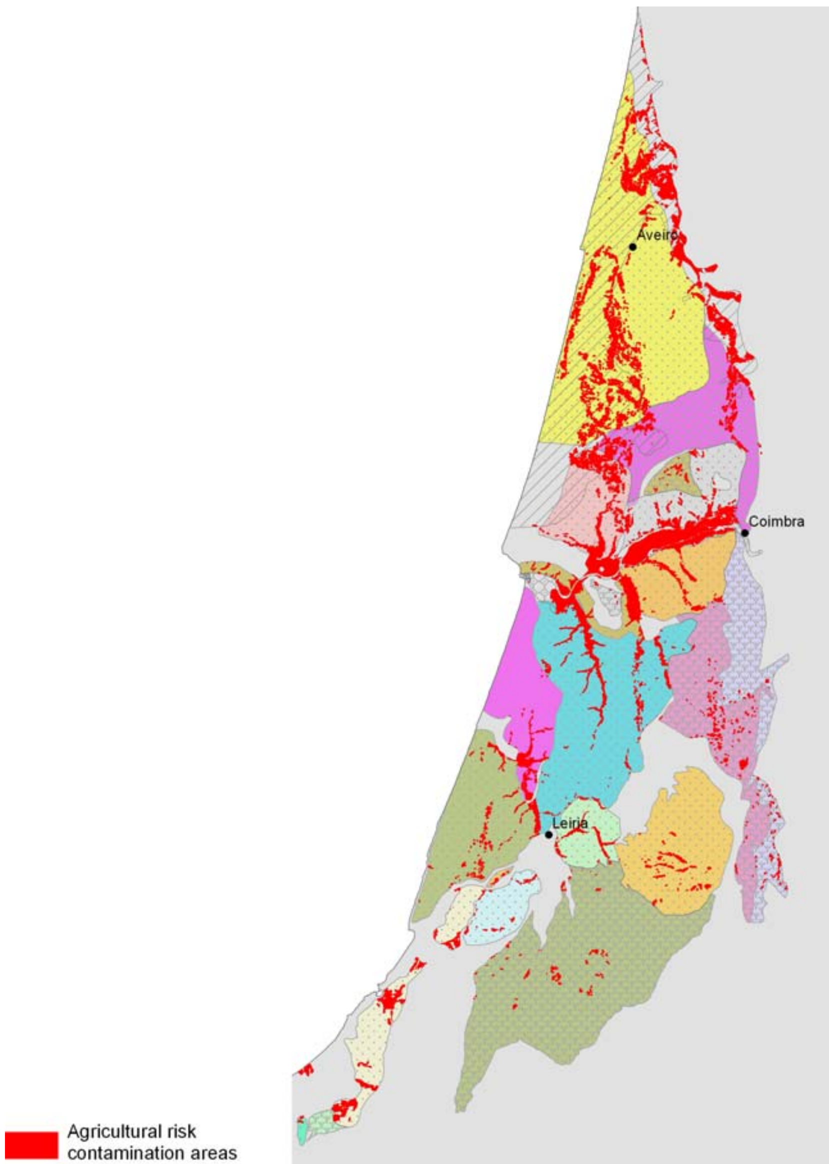

Figure 6.4 – Location of agricultural risk contamination areas in the Western unit.

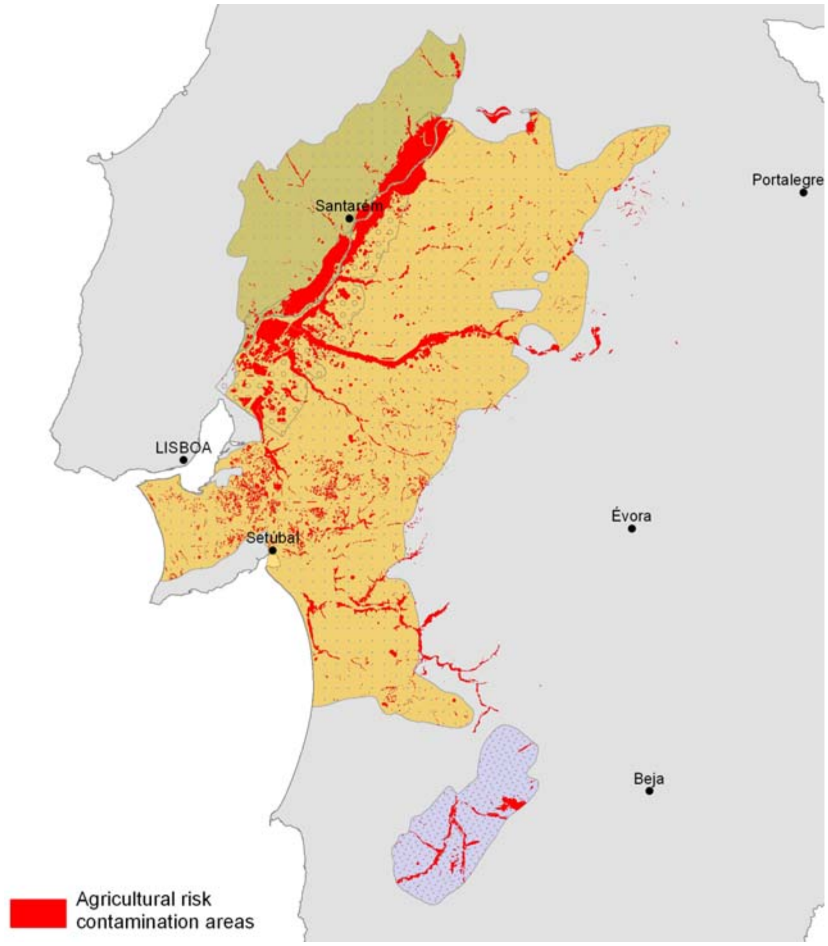

Figure 6.5 – Location of agricultural risk contamination areas in Tagus -Sado aquifer system.

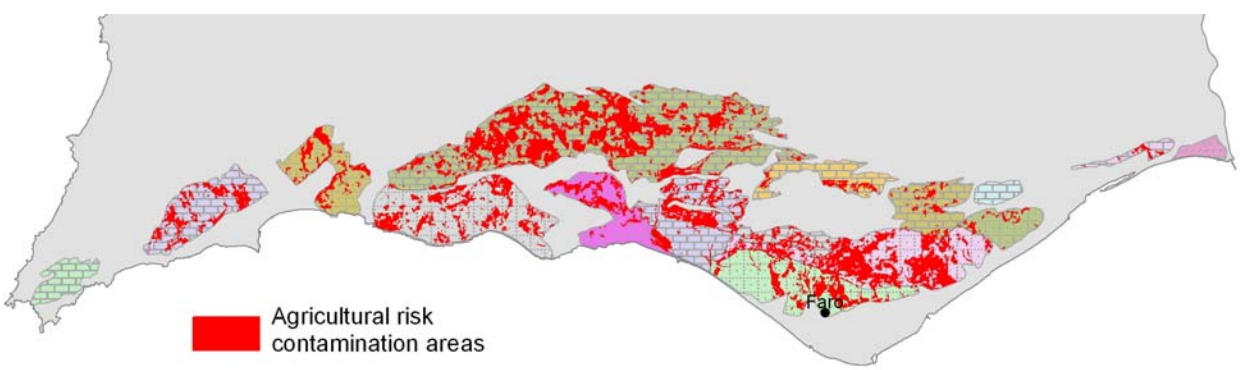

Figure 6.6 – Location of agricultural risk contamination areas in the Meridional unit.

7. MAJOR NEGATIVE INFLUENCES OF GROUNDWATER EXTRACTION

Groundwater is a highly valuable resource both to humans and the environment, and therefore it is essential to understand the environmental implications of groundwater exploitation. Examples of some negative influences of groundwater extraction related to over-exploitation, under-exploitation and saltwater scenarios are provided below.

7.1 Over-exploitation

Groundwater over-exploitation is a withdrawal from a groundwater reservoir in excess of the average rate of replenishment.

The obvious consequences of groundwater over-exploitation are aquifer depletion and water quality degradation.

An aquifer over-exploitation situation can be detected by the analysis of piezometric time series.

By using Mann-Kendall seasonal statistical test we are able to identify the most significant piezometric trends in some important aquifer systems of Portugal.

Significant downward trends have been detected in eight coastal aquifer systems of Algarve (Almadena–Odeáxere, Mexilhoeira Grande–Portimão, Ferragudo-Albufeira, Albufeira-Ribeira da Quarteira, Quarteira, Campina de Faro, São Bartolomeu and Monte Gordo - see fig. 7.1) due to intensive groundwater pumping specially in summer periods. Due to their location these aquifers present an effective risk of contamination by seawater intrusion.

However in the Querença-Silves aquifer, the most important aquifer system of this region, both upward and downward trends, as well as no trends, have been detected in different sectors which is in line with a characteristic karstic hydraulic behaviour.

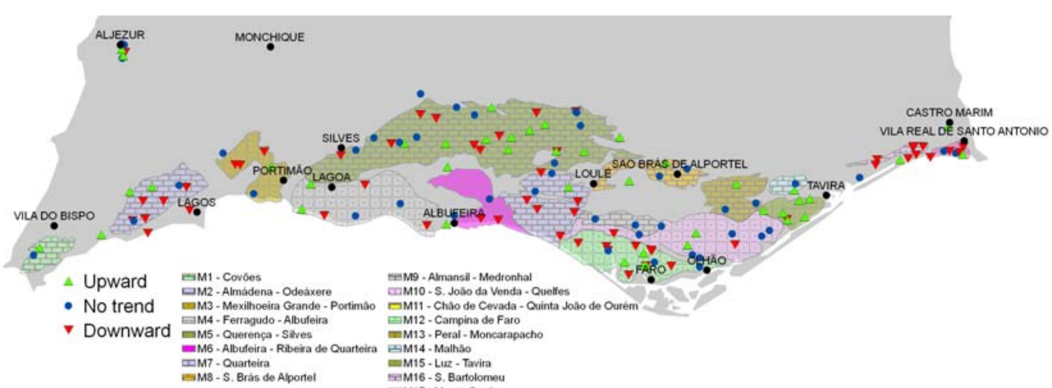

Figure 7.1 – Piezometic trends in aquifers systems in the Meridional unit

In what concerns the Western unit, a large majority of downward trends has been detected in the cretaceous aquifer of Aveiro (fig. 7.2), with piezometric drawdowns between 0.5 cm/month to 7.2 cm/month. A similar over-exploitation situation has been detected in some areas of the Liásico Norte of Mondego aquifer. In opposition, the Leirosa-Monte Real aquifer system shows a great percentage of upward trends.

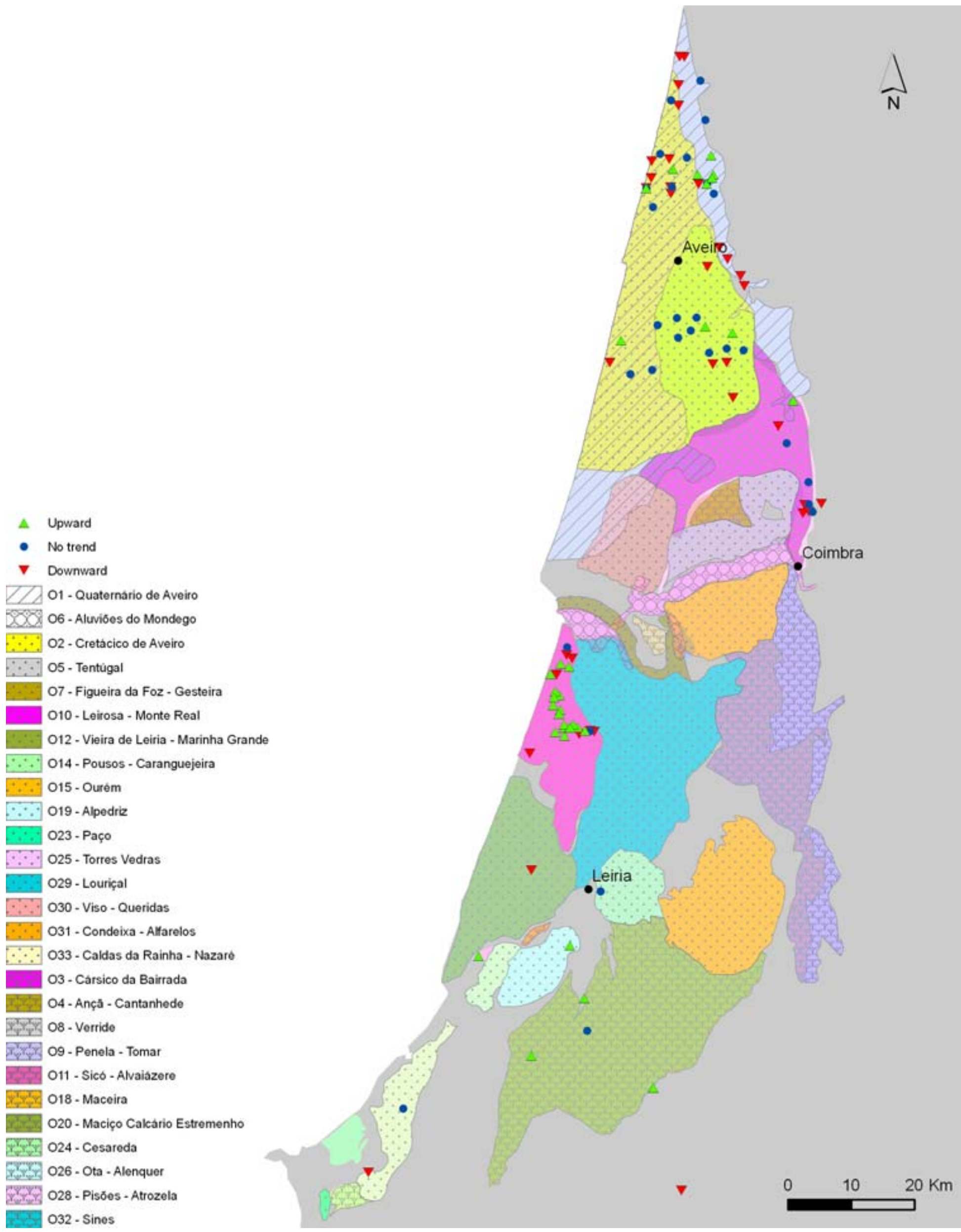

Figure 7.2 - Piezometic trends in aquifers systems in the Western unit

Another consequence of groundwater over-exploitation is the impact on the ecological integrity of streams and wetlands, resulting in significant losses of habitat and biodiversity.

A case study carried out in Alentejo, a semi-arid region of Portugal (Alves *et al.*, 2002), confirms the probable impact of groundwater resources withdrawn in some river ecosystems. Based on surface and groundwater levels data observed in Enxoé stream area, located in Guadiana basin, a strong correlation between the water table and Enxoé streamflow is identified (fig. 7.3).

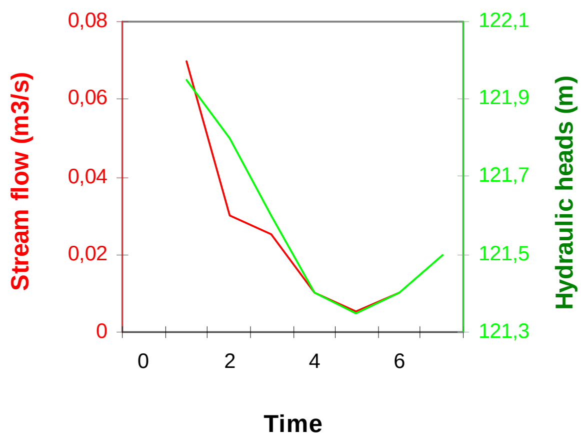

Figure 7.3 - Relation between streamflow observed in Enxoé and measured water table observed in a well near the stream.

7.3 Under-exploitation

In the absence of groundwater extractions, a further rise of the water table may have a negative impact on some ecosystems especially in agroecosystems.

In fact the drainage of water from the crops root zone may become increasingly difficult or even impossible, with potential damage to these particular ecosystems.

This is the case of the agroecosystem located in the Luz-Tavira aquifer, an area of intensive citrus culture situated in the Meridional unit. As an almost immediate consequence of the shift in irrigation supply from local groundwater wells to surface water from reservoirs (fig. 7.4) a sharp rise of the water table occurs (fig. 7.5) followed by the almost complete attenuation of inter-seasonal oscillations (Stigter *et al.*, 2006).

As a consequence, groundwater discharge is greatly increased, due to the deactivation of a large number of wells and to additional recharge from excess irrigation with surface water. During a field campaign held in the summer of 2004, the total discharge of four springs was measured to be 23 l/s, approximately four times the median aquifer yield.

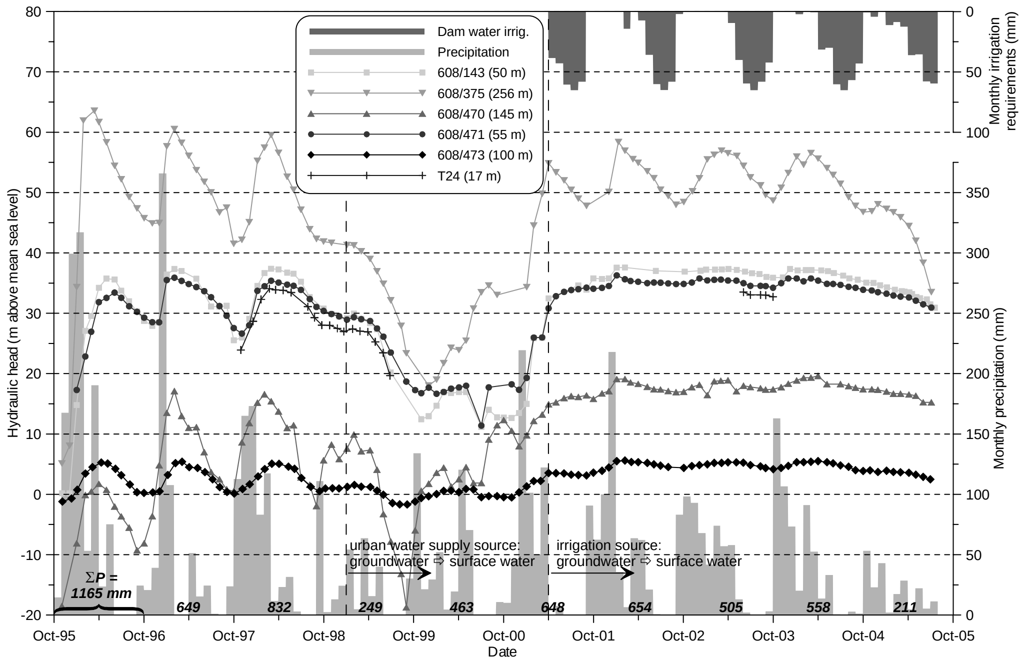

Figure 7.4 - Plot of piezometric time series (1995-2005) in Luz-Tavira aquifer with indication of the time where the replacement of groundwater by surfacewater occurs.

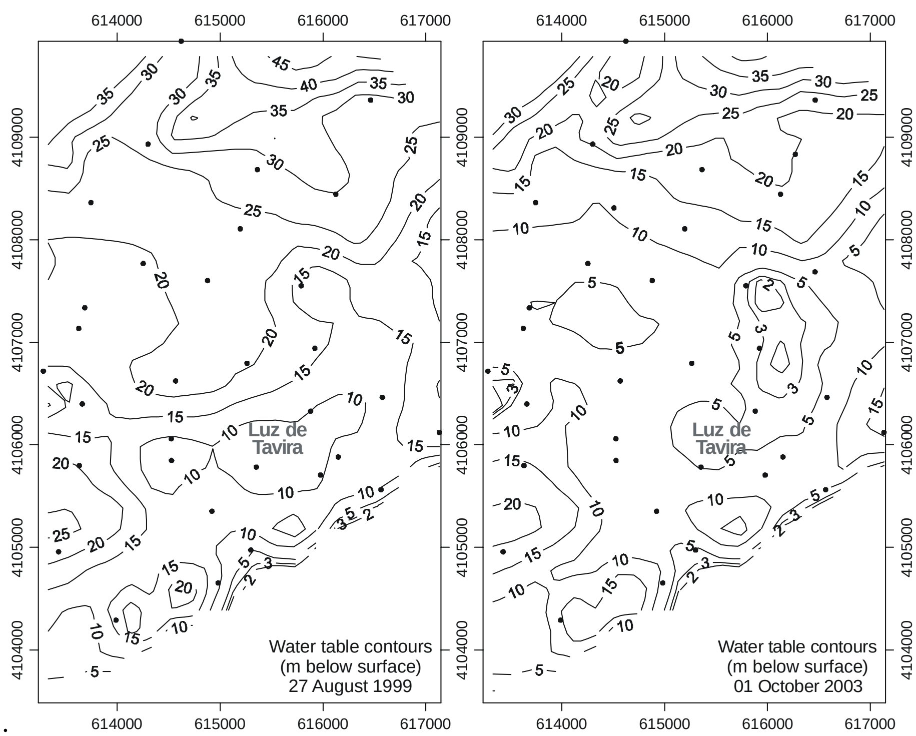

Figure 7.5 – Water table contour maps observed before and after the change of the water origins for irrigation in Luz-Tavira citrus trees

7.4 Saltwater intrusion

In the Meridional unit, some aquifer systems are threatened by seawater intrusion due to groundwater over-exploitation. Some cases have been detected specially during dry periods in the coastal aquifer of Mexilhoeira Grande-Portimão, where chloride concentrations can reach values higher than 500 mg/l Cl^-. This is also the case in inner aquifers such as the Querença-Silves aquifer during extensive drought periods. In this case saltwater intrusion is carried out as a consequence of upstream tide propagation in the Arade river to which this aquifer is hydraulically linked (Monteiro *et al.*, 2006).

Saltwater intrusion can be also induced by leakage mechanisms between aquifer and estuaries across an aquitard formation. This phenomenon has been detected in some local areas of the Tagus-Sado confined aquifer system in the vicinities of the Sado and Tagus estuaries, due to intensive groundwater exploitation (UNESCO, 1980).

Other cases of saltwater contamination have occurred also in some areas of Algarve where groundwater exploitation is important, due to the leaching of the salt minerals existing in the evaporite diapiric formations (fig. 7.6). In these areas the chloride content in groundwater has reached values of around 6800 mg/l !! (Ribeiro, 1999).

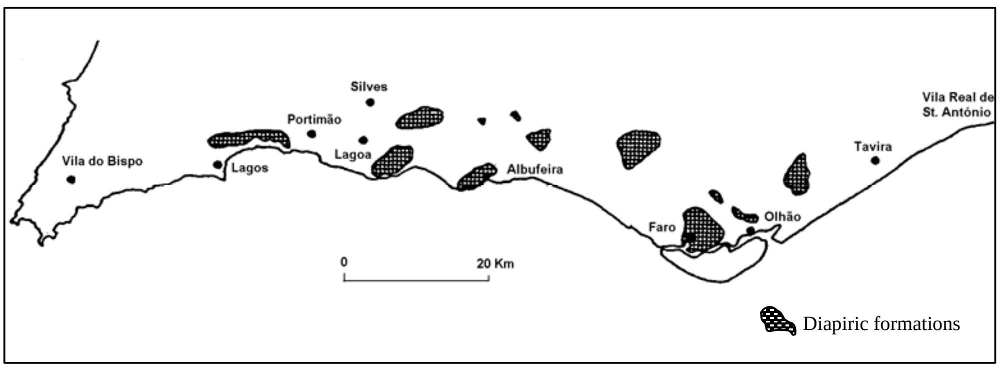

Figure 7.6 – Location of diapiric formations in Algarve

8. INSTITUTIONS FOR GROUNDWATER GOVERNANCE

In 2005 a new Water Law (Law 58/2005) was approved by the Portuguese Parliament, which is a framework law for all the Portuguese water resources, including groundwater. This law not only transposes the EU Framework Directive to the Portuguese legislation but also considers and updates the historical issues and principles of the Portuguese water legislation. The law creates five Hydrographical Region Administrations (ARHs): North (including the areas of RH1, RH2 and RH3), Centre (RH4), Tejo (RH5), Alentejo (RH6 and RH7) and Algarve (RH8). Two additional AHRs are also created in the Madeira and Azores islands.

Another legal instrument (Decree-Law 382/99) establishes the criteria for the delimitation of protection areas for public water supply wells used for human consumption. This law is compulsive for wells with an average pumping capacity of 100 m^3/day or for wells that are used to supply drinking water to a population of more than 500 habitants.

The European Water Nitrate Directive 91/676, concerning the protection of waters against pollution caused by nitrates from agricultural sources was transposed to the Portuguese national legislation by the Decree-Laws 235/97 and 68/99. According to these legal instruments eight vulnerable zones have been designated so far and related intervention plans have been implemented in these areas.

In what concerns mineral waters the Decree-Law 90/90, establishes criteria for licensing this type of geological resources, including hydrogeological studies and chemical analysis.

The main institutions with competence in groundwater issues in Portugal are the Water Institute (Instituto da Água - INAG), the National Institute of Engineering, Technology and Innovation (Instituto Nacional de Engenharia, Tecnologia e Inovação - INETI), and the General–Direction of Geology and Energy (Direcção-Geral de Geologia e Energia - DGGE).

INAG is the national water authority. It is an organism of the Minister of the Environment, Land use Planning and Regional Development, whose mission is planning and management of water resources. This includes: to fulfil the water necessary for a sustainable development; to protect the water resources; and to predict and minimize water-related disasters, such as floods and droughts.

INETI is a Research and Development organization of the Minister of Economy and Innovation whose objectives are to promote public policies in areas such as energy, environment, sustainability, normalization and certification. Within this organism there is an Hydrogeological Department of the Geological and Mining Institute with competences in the definition, mapping and characterization of hydrogeological formations and in the evaluation of groundwater and hydrothermal resources, DGGE is an department of the Minister of Economy and Innovation with responsibilities in the conception, promotion and evaluation of policies in the field of energy and geological resources. In particular it has intervention in licensing of prospecting, investigation and exploration of hydromineral and geothermic resources.

The main Portuguese NGOs with intervention in groundwater issues are the Portuguese Water Resources Association (Associação Portuguesa dos Recursos Hídricos – APRH), The Portuguese Group of the International Association of Hydrologists (Grupo Português da Associação Internacional de Hidrogeólogos - AIH-GP) and the Portuguese Association of Water Distribution and Drainage (Associação Portuguesa de Distribuição e Drenagem de Água - APDA)

The mission of APRH is to promote the progress of knowledge related to the national water resources especially in the domains of management, planning, development, administration, science, technology and research. In this association there is a Groundwater Commission, which deals specifically with groundwater issues.

AIH-GP is a scientific and educational organization whose aims are to promote research into and understanding of the proper management and protection of groundwater for the common good throughout the world.

APDA represents the interests of the main entities responsible for the water supply and residual water systems and its objective is to promote the research of themes related to water quantity and quality.

A few NGOs dealing with environmental issues in a general way are also interested in groundwater issues. Three of them deserve special mention: the League for Nature Protection (Liga para a Protecção da Natureza – LPN); QUERCUS – National Association for Nature Conservation (QUERCUS – Associação Nacional de Conservação da Natureza); and the Study Group of Land Use Planning and Environment (Grupo de Estudos de Ordenamento do Território e Ambiente – GEOTA).

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