Innovative and Sustainable Groundwater Management in the Mediterranean

D4.1: The Social-Economic System Characterization, Stakeholder Mapping and Water Governance for Selected Case Studies

VERSION 3.0

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Authors	Ali Kerem Saysel Irem Daloğlu Çetinkaya İzel Uygur Nadim Copty			
Co-Authors	J. Jaime Gómez-Hernández Hanene Akrout			
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Glossary

AFAD	Disaster and Emergence Management Presidency
BÜGEM	General Directorate of Plant Production
CSO	Civil Society Organization
DKM	Nature Conservation Centre
DSI	State Hydraulic Works
HYMK	Central Basin Management Board
IBA	Important Bird Area
IPCC	Intergovernmental Panel on Climate Change
JMO	Chamber of Geological Engineers
KCB	Konya Closed Basin
KOCD	Konya Leader Farmer Association
KONPADER	Association for Producers of Beet and Agricultural Products in Konya
KOP	Konya Plains Project
KOP BKİ	Konya Plains Project Regional Development Administration
KÖSİP	Small-Scale Irrigation Activities Program
MAF	Ministry of Agriculture and Forestry
OSB	Organized Industrial Zone
SYGM	General Directorate of Water Management
TBB	Union of Municipalities
TEMA	Turkish Foundation for Combating Erosion, Reforestation, and the Protection of Natural Habitats
TEYAP	Agricultural Education and Publication in KPP Region
TRGM	General Directorate of Agricultural Reform
TÜBİTAK	Scientific and Technological Research Council of Turkey
YASKEP	Groundwater Protection Action Plan
WWF	World Wildlife Fund

Executive Summary

The overall objective of the InTheMED project is to implement innovative and sustainable management tools and remediation strategies for MED aquifers (inland and coastal) in order to mitigate anthropogenic and climate-change threats by creating new long-lasting spaces of social learning among different interdependent stakeholders, NGOs, and scientific researchers in five field case studies, located at the two shores of the MED basin, namely in Spain, Greece, Portugal, Tunisia, and Turkey.

InTheMED will develop an inclusive process that will establish an ensemble of innovative assessment and management tools and methodologies including a high-resolution monitoring approach, smart modelling, a socio-economic assessment, web-based decision support systems (DSS) and new configurations for governance to establish efficient and sustainable integrated groundwater management in the MED considering both the quantitative and qualitative aspects.

The objective of this document is to assess and understand the present groundwater governance in selected MED case studies. To fulfill this objective, this document contains system characterization of the case studies, stakeholder mapping and governance analysis. The case studies include the Konya Closed Basin in Turkey, Requena-Utiel, Spain and Grombalia, Tunisia.

1. Introduction

This document is the deliverable number D4.1 of the "Innovative and Sustainable Groundwater Management in the Mediterranean" Grant Agreement Number 1923 project.

The deliverable provides assessment of governance schemes in three selected case studies: Konya Closed Basin of Turkey, Requena-Utiel of Spain, and Grombalia of Tunisia. The analyses are based on surveys regarding system characterization, prepared by Boğaziçi University and filled by participating partners; and the interviews held by related research teams with diverse stakeholders in each case study.

For each case study, first a social-economic system characterization and the groundwater issues are presented. The stakeholders in groundwater governance are identified and mapped. Groundwater governance in each case study is separately explored and assessed.

This deliverable summarizes the initial stage of the research to be completed within WP4 of the project. The content of this document paves the way for participatory the participatory systems mapping and conceptual modelling in the next stage of the research.

2. Case Studies

The main characteristics of the three case studies are summarized in Table 1. The case studies show diverse differences in size, population, and location (inland/coastal) of the groundwater basins. The basin sizes range from 363 to 62,000 km^2 and the population from 30,000 to 3,000,000 people. The climatic properties are also different with mean annual precipitation ranging from 356.5 to 440 mm and mean annual temperature from 12 to 22 $^{\circ}$ C (Table 1).

Table 1. Characteristics of case studies

Characteristics	Konya, Turkey	Requena-Utiel, Spain	Grombalia, Tunisia
Size (km^2)	62000	1360	363
Population	~3,000,000	30,000	201,836
Location	Inland	Inland	Coastal
Mean P &T ($mm\ y^{-1}/^{o}C$)	387/12	440/13	356,5/22
Principal Groundwater Users	Agriculture, urban	Agriculture, urban	Agriculture, industry, tourism
Overexploited	Yes	Yes	Yes
Groundwater Pollution	Nitrate, salinity	No	Nitrate, salinity

The participating partners filled out surveys prepared by Boğaziçi University for system characterization and conducted interviews at the field with relevant stakeholders for stakeholder mapping and governance analysis. The data collected for the 3 case studies are presented in the following sections.

2.1. Konya Closed Basin, Turkey Case Study

2.1.1. System Characterization

Konya Closed Basin (KCB) is located in Central Anatolia, Turkey with a size of over 62,000 km^2 (Figure 1). KCB is one of the 25 watersheds in Turkey. The basin has significant agricultural potential; historically it has been the wheat production hub of the country. Therefore, the local residents have a long history of being farmers and the industrial production is built upon agricultural production as well. In recent years, industrial and agricultural production has been increasing, leading to an increase of the share of the region in the national economy and trade. On the other hand, the basin is also an ecological hotspot; the area hosts many endangered plant and mammal species and is a breeding ground for various endangered bird species (WWF, 2014).

Figure 1. Location map of Konya Closed Basin, Turkey (Devlet Su İşleri, 2015)

Agriculture is by far the most prominent sector in terms of water and land use in the basin. Around 78% of the total water use (both surface and groundwater) is appropriated for agricultural use. !n 2018 the Ministry of Agriculture and Forestry estimates that has high as 90% of water resources (both surface water and groundwater) are used for irrigation purposes (T.C. Tarım ve Orman Bakanlığı Su Yönetimi Genel Müdürlüğü, 2018). Agriculture is followed by drinking/utility water use, which constitutes around 8% of the total water use. Industrial production has the third highest water demand. The main sectors in the basin for industrial

production include fabricated metal products, food products, furniture, rubber and plastic products, garments, motor vehicles, wood products, non-metallic mineral products and leather and related products.

In addition to the direct benefits of the groundwater to the ecosystem of the KCB, the groundwater resources also have a significant role in the preservation of the biological hotspots present in the basin such as the 15 important bird areas (IBA) and 8 important plant areas, as well as providing mating areas for 8 of 13 of endangered bird species in Europe. The groundwater resources also provide a recreational and touristic value to the region (i.e., Meke Lake, hot springs, and caves).

2.1.1.1. Main Issues of the Basin

In recent years, Konya Closed Basin has been brought to both local and national agenda, with its water scarcity and groundwater stress. Being surrounded by mountains, the streams in the basin do not discharge to open waters, making it a "closed" basin. The area has semi-arid climate conditions. Yearly precipitation is 300-350 mm in most parts of the region, which is nearly half of the average yearly precipitation in Turkey (740 mm). For the last 30 years, the basin has experienced significant change in climate. The yearly precipitation has decreased 10-25 mm and is anticipated to further decrease by 20-30%, along with a potential of 7□C increase in average temperatures (WWF, 2014).

Groundwater use in the basin began in the 1960s; given that the basin holds 17% of groundwater sources and only 2% of the surface water sources of the country, groundwater dependency rapidly increased, as the surface water had constantly fallen short of demand (WWF, 2014). According to the WWF study (2014), yearly available surface water and groundwater are given as 1.93 billion m^3 and 2.45 billion m^3 respectively, whereas the average real use is 2.0-2.5 billion m^3 for surface waters and 4.0-4.5 billion m^3 for groundwater, resulting to about yearly 50% budget exceedance.

KCB has the highest groundwater use in Turkey (WWF, 2014) leading to water stress in the basin due to a number of pressing issues:

- Agricultural incentives for producing water demanding crops, such as sugar beet and maize has significantly increased the irrigation water demand.
- Population increase around the basin settlements (Konya Ovası Projesi Bölge Kalkınma İdaresi Başkanlığı, 2020) drives the increase in drinking and utility water demand.
- Renewable energy investments in the region are increasing (Konya Ovası Projesi Bölge Kalkınma İdaresi Başkanlığı, 2020). Industry incentives in the region have followed an undulant path in the past few years; however, overall, there is an increase in the amount of investment after the 2010s compared to 2000s. The foreseen growth in industry reflects on the water demand of the sector. The allocated amount of water is expected to increase in the upcoming years (Konya Ovası Projesi Bölge Kalkınma İdaresi Başkanlığı, 2020).
- Due to climate change, a reduction in surface water runoff is observed and impacts on both surface and groundwater are expected to exacerbate (WWF, 2014).

The General Directorate of State Hydraulic Works (DSI) reports a 28m average decline in groundwater levels from 1980 to 2010s. In an inventory study carried out by DSI 4. District Office in 2007, 94.000 groundwater wells were identified in the basin, of which 66.808 were drilled illegally. The total number of wells are estimated to have exceeded 100.000 by the end of 2012. The Chamber of Geological Engineers (JMO) estimates that the groundwater sources will be available to use only for another 20-30 years given the current state of the aquifers (WWF, 2014). WWF (2014) also argues that the extraction rate is not linear, it rather has an increasing pattern.

The lack of a standard in measurement and monitoring methods for water resources leads to high variation in the observed groundwater levels. Different sources estimate inconsistent depletion rates. It could be argued that the past and seemingly ongoing practices (and maybe a lack of sufficient monitoring and appropriate sanction enforcement so far) has transformed groundwater governance from community control of a public good to a de facto open access situation, which created a false sense of exemption for local users.

In addition to water scarcity in the basin, another challenging issue is the agricultural practices and dominantly applied crop patterns. The basin is dominantly used for agricultural

production; therefore, irrigation is one of the most important aspects to investigate when studying groundwater stress in the basin. Nearly 90% of water (both surface water and groundwater) is used for irrigation purposes (T.C. Tarım ve Orman Bakanlığı Su Yönetimi Genel Müdürlüğü, 2018). Currently available water reserves in the basin can satisfy the demand of existing sectors and purposes of use (drinking and utility water, industry - production, energy, mining etc.-, environmental water demand) excluding agricultural demand, under normal to extreme drought conditions (T.C. Tarım ve Orman Bakanlığı Su Yönetimi Genel Müdürlüğü, 2018). However, the significant role of agriculture in water demand and consequently on water stress is discernable.

Currently, irrigated farming is implemented in 890.000 ha (nearly 33% of the total farming land of the basin). In rest of the agricultural area (1.995.417 ha) dry farming is practiced (WWF, 2014). The state policy premeditates increase in the ratio of irrigated farming. The Minsitry of Agriculture and Forestry is aiming to increase the irrigated land area to 969.000 ha by 2025 (T.C. Tarım ve Orman Bakanlığı Su Yönetimi Genel Müdürlüğü, 2018).

The crop pattern had an important role in shaping the rural development, industry and welfare in the KCB. Since mid-20th century, the government has incentivized production of sugar beets. In the following years fruits, potato, corn and trefoil production has increased in the basin. Maize and sunflower production has been supported via financial schemes in the last few years. All those products have higher water demand, compared to grains like wheat, barley etc. (WWF, 2014). With the change in crop patterns, the water demand consequently increased in the basin.

Another important aspect of irrigated farming is the method of irrigation. Until 2000s, traditional irrigation (flooding or other open channel irrigation) was the dominant irrigation technique in the basin. However, with the change in crop patterns and decrease in surface and groundwater levels, stakeholders in the region realize that transitioning to a more efficient technology (closed channel irrigation methods - either drip (micro) irrigation or sprinkler system) is essential for the sustainability of the water resources and agricultural practice in the basin.

2.1.1.2. Proposed Solutions to Groundwater Depletion

Land Consolidation and Adoption of Modern Irrigation Technologies

There is uniformity among the stakeholders for the adoption of modern irrigation practices and land consolidation practices. Land consolidation is the reallocation of parcels with the aim that landowners obtain larger parcels at one or more locations in exchange of their former and fragmented land plots. The benefits of land consolidation include but are not limited to the following: Aggregation of patchworked land, formation of parcels into appropriate shapes, cost-reduction in agricultural machinery use, increase in arable land, easier and lower-cost of transportation (Ankara Valiliği İl Gıda Tarım ve Hayvancılık Müdürlüğü, 2015). Land consolidation also reduces irrigation investment costs and efficiency of water distribution. Therefore, land consolidation initiatives are supported by the farmers in the basin.

Both farmers and relevant institutions agree that seepage loss in water delivery channels and evaporation in open-channel systems should be reduced, the water delivered to the field should be used efficiently, evapotranspiration needs of different types of crops should be taken into consideration during irrigation and utmost efficiency should be ensured. However, farmers demand faster bureaucracy, and both financial and technical support from relevant authorities (WWF, 2014). The traditional open-channel irrigation has been abandoned since early 2000s. Stakeholders in the basin state that traditional methods of irrigation are still used in small areas only, where farmers use surface water or treated wastewater for irrigation. Farmers use sprinkler irrigation for wheat, barley and sugar beet, and drip irrigation for other crops like corn, sunflower, beans, potatoes etc. The technology transition to either sprinkler or drip irrigation is complete in groundwater-irrigated fields. The state had an important role in this transition; drip and sprinkler irrigation investments have been financially supported since 2000s. Although some stakeholders argue that state was late in providing such incentives, farmers are content with the praxis in general. A third, and more efficient, technology solution option is underground drip irrigation. However, the state currently does not yet provide any financial incentives for underground drip irrigation equipment, and farmers consider it too costly or unaffordable without support. Therefore, underground drip irrigation is not common in the basin.

Change in Agricultural Product Pattern

In the last couple of decades, the irrigated portion of the total cultivated land is increasing. High profitability crops (like corn, sugar beet, fruit trees, trefoil, potato, sunflower) are supported by government incentives and are therefore increasing in production volume. These crops have higher water demand whereas less water consuming crops like wheat and barley are being abandoned by the farmers due to economic reasons. Various stakeholders argue that less water consuming crops, which are more suitable to the environmental and climatic conditions of the basin, should be adopted by farmers, and that required financial schemes must be provided to farmers by policy makers (WWF, 2014).

Since 2017, the Ministry of Agriculture and Forestry has started a Basin-Based Financial Incentives Project to support production of certain crops including but not limited to wheat, barley, maize, sunflower, potato and so on. Within the project, the ministry provides fuel and seed support, deficiency payments, and income support for forage crops. The agricultural products to be supported in each basin is identified based on the climate, soil structure, topography, water scarcity, crop rotation, and recommendations from local offices and NGOs. For Konya, the following crops are supported (in 2021): barley, wheat, maize, canola, beans, sunflower, potato, chickpea. Unlike other crops, drip irrigation is a precondition to benefit from the financial support for maize in some regions in Konya (for example Çumra, Karapınar, Kulu, Cihanbeyli, Altınekin…) due to water scarcity.

Inter-Basin Water Transfer

Limited groundwater resources within the basin directed policy makers to supply management with inter-basin water transfer seen as the only solution among most of the stakeholders. With the Blue Tunnel Project, the goal is to provide drinking water to the city of Konya from the Göksu River, which discharges into the Mediterranean, and irrigation water to the south of the Konya Closed Basin. The first survey works of the project started in 1960, but the construction process started in 2009. Although all stages have not been completed yet, it is understood that the project can supply irrigation water to only 1/40 of the basin, inter-basin transfer alternatives for the north and east of the basin continue to be examined (KOP Bölge Kalkınma İdaresi Başkanlığı, 2013).

The local development agency compiled the possible inter-basin water transfer projects recommended by regional and general directorates of public entities like DSI, ministries, local

chambers of commerce and industry, and some universities. The most prominent and supported project proposals were to transfer water from Kızılırmak River (Figure 2), Euphrates (through Kızılırmak), Çatalan Dam (fed by Seyhan River) (Figure 2), Ermenek River (Figure 3) and Sakarya River. This report also includes the opposition against the inter-basin water transfer projects, and instead propose alternative solutions that focus on demand management principles. (KOP Bölge Kalkınma İdaresi Başkanlığı, 2013).

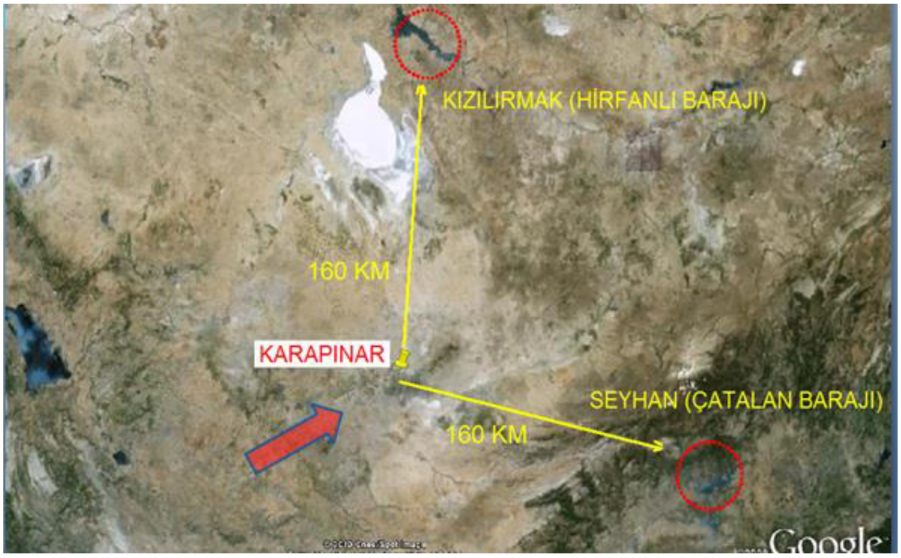

Figure 2. Air distance from Kızılırmak and Seyhan, to Konya – Karapınar Region (KOP Bölge Kalkınma İdaresi Başkanlığı, 2013, p. 43)

Currently, the only active inter-basin transfer to Konya Closed Basin is from Göksu River, via the so called 'Blue Tunnel'. The 17 km tunnel was built as part of the Konya Plains Project of DSI. In fact, it is one part of a more collective plan. In the official reports of Grand National Assembly of Turkey (TBMM), Konya-Çumra Phase Projects (I, II and III) are summarized as the following and shown in Figure 4:

- Phase I includes Beyşehir Lake, Apa, Altınapa, Sille and May Dams, and the irrigation and discharge facilities in Çumra Plain.
- Phase II includes transferring Gembos River flows from Derebaşı Dam to Beyşehir Lake via Gembos Plains with derivation tunnel, reclamation of Beyşehir-Seydişehir-Apa channel, and gravity and pumping irrigation of Beyşehir and Seydişehir surface water obtained from Beyşehir Lake and Suğla Water Storage (TBMM, n.d.-a).

- Phase III consists of Göksu Water Transfer mostly, and involves Bağbaşı, Bozkır, Afşar Dams, Blue Tunnel and Hadimi Tunnel, Hotamış Water Storage and Apa-Hotamış Channel. The overall goal is to transfer 414 million m^3 of water (could be used to irrigate 1/40 of the total agricultural land (WWF, 2014)) yearly from Göksu River. Bağbaşı Dam and the Blue Tunnel first started transferring water in 2015. Hadimi Tunnel, which is currently under construction, is planned to be 18 km long, transferring water from Afşar Dam to Bağbaşı Dam (TBMM, n.d.-b) (KOP'un 2. Tüneli'nde 7/24 Çalışma, 2020).

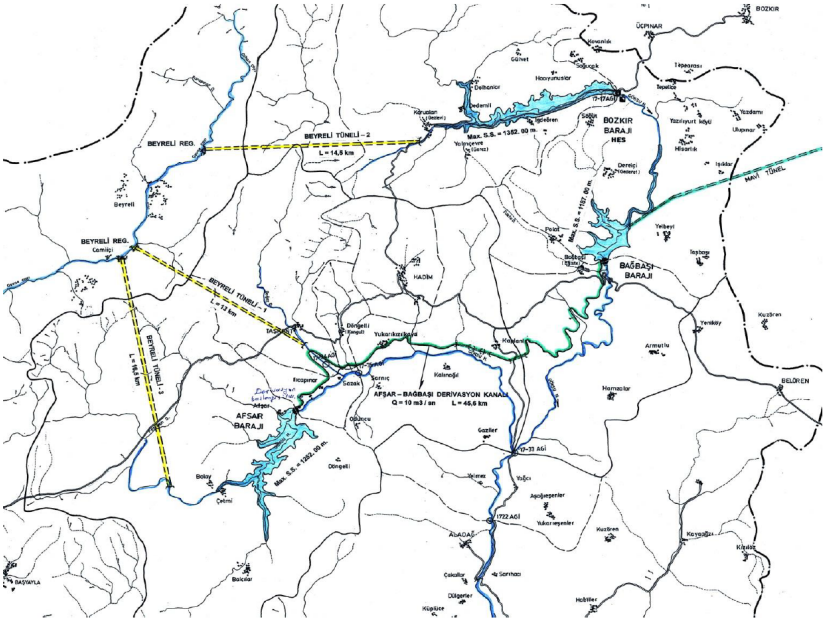

Figure 3. Water transfer project map, from Ermenek River to KOP Region (KOP Bölge Kalkınma İdaresi Başkanlığı, 2013, p. 56)

Figure 4. Map of the Blue Tunnel Project (2017)

The legitimacy of inter-basin water transfers is highly contested. While some stakeholders argue that it is a necessity to meet water demand, others claim that it is unsustainable, both socially and economically, as these infrastructural investments are expensive, insufficient and might lead to more environmental and ecological adversities than expected.

Nonetheless, a new inter-basin transfer project was approved by the Research and Allocation Department of DSI in late 2020 (Konya Hakimiyet Gazetesi, 2020). The contractor company is not mentioned in the news. Also, interestingly, such a big project was not covered by national news channels at all.

2.1.2. Stakeholder Mapping

Within the scope of work package 4 (WP4 - Innovative governance and socio-economic assessment in the MED), it is essential to analyze the actors who have power over the resources and those who have a stake in management of water resources, the hierarchical relationship and information flows among them, and the stand they take regarding the water stress in the basin are crucial. However, abundance of actors and stakeholders due to the nature of the resource, the fragmental legislation and frequent change in organizational structure of the state institutions, complicate the process of mapping all the stakeholders, their respective power and responsibilities and the relationships among them. In this section, only the

prominent actors, and stakeholders are classified (Table 2) and introduced. Their perspectives on the subject are explored and the suggestions/efforts they make for the alleviation of the existing water stress is presented. In Table 3, the approaches of stakeholders to the previously stated proposed solutions are summarized.

Table 2. Classification of stakeholders in Konya Closed Basin, Turkey

	STATE	MARKET	CIVIL
NATIONAL	General Directorate of Water Management (SYGM)	Individual Industrial Actors	WWF
	State Hydraulic Works (DSİ)		The Nature Conservation Centre
	Central Basin Management Board		Water Ambassadors
	Water Management Coordination Committee		TEMA
REGIONAL / BASIN SCALE	Konya Plains Project (KOP) Regional Development Administration (BKİ)		KONPADER
	Basin Management Committee		Union of Irrigation Cooperatives in Konya Region
	Provincial Directorate of Agriculture		
LOCAL / SUB-BASIN SCALE	Irrigation Unions	Organised Industrial Zones	Self-Irrigators
	Provincial Water Management Coordination Committees		Local Media/Newspapers
	Chambers of Agriculture		Irrigation Cooperatives
	District Directorates of Agriculture		

Table 3. Key stakeholders' approach to frequently discussed solution to groundwater depletion in Konya Closed Basin

		Land Consolidation and Adoption of High Technology Irrigation Systems	Adoption of Less Water Demanding Crop Pattern	Inter-Basin Water Transfers
STATE	SYGM			
	DSI			
	KOP BKİ			
	Basin Manamgement Committee			
	Irrigation Unions			
MARKET	Irrigation Cooperatives			
CIVIL	WWF			

	Nature Conservation Centre			
	KONPADER			
	Local Media			

NO EXPLICIT INFORMATION	FOR	IMPARTIAL	AGAINST

2.1.2.1. State Actors

General Directorate of Water Management (SYGM)

SYGM was founded in 2011, within the central organization of the now defunct Ministry of Forestry and Water Affairs. It was then transferred to the central organization of the Ministry of Agriculture and Forestry, in the new government structure - after a significant governmental regime change in 2018.

The main duties of this office include running legislative studies for integrated watershed management, creating and controlling the national water database structure, conducting research on the effects of climate change on national water resources, identifying goals and strategies for protection of both quality and quantity of surface and groundwater sources with relevant institutions and the monitoring of those (Su Yönetimi Genel Müdürlüğü, n.d.). There are 6 main departments within the office (and another office to run the bureaucratic works of the directorate), namely;

- **Basin Management Department:** Prepares, updates, tracks and reports the implementation of basin protection plans, river basin management plans, drinking water basin protection plans, sectoral water allocation plans (T.C. Tarım ve Orman Bakanlığı, n.d.-b).
- **Water Quality Department:** Identifies the water quality related goals, criteria, standards and related policies, strategies and measures required. Classifies groundwater and surface water resources according to the quality criteria and tracks field applications (T.C. Tarım ve Orman Bakanlığı, n.d.-e).
- **Monitoring and Water Information System Department:** Monitors groundwater, surface water and coastlines, prepares basin-based monitoring programs, identifies monitoring stations, methods and periods, parameters to be monitored, provides

coordination between monitoring institutions, establishes and operates National Water Database, builds appropriate models to support policy development and decision making (T.C. Tarım ve Orman Bakanlığı, n.d.-c).

- **Flood and Drought Management Department:** Prepares and tracks basin drought and flood management plans, investigates the impacts of climate change on water resources and potential adaptation measures, keeps flood and drought yearbooks, identifies leakage and evaporation values of water resources, and prepares water budgets (T.C. Tarım ve Orman Bakanlığı, n.d.-f).
- **Research and Assessment Department:** Carries out all R&D activities on quality and reuse of water, on implementations of water management, planning and efficiency, and makes necessary socio-economic analysis and assessment for basin-based management (T.C. Tarım ve Orman Bakanlığı, n.d.-a).
- **Water Law and Policy Department:** Conducts water related policy studies, contributes to developing of water policies of Turkey. Tracks, evaluates and reports water governance procedures and alternatives. Carries out the coordination of EU Environment Chapter (T.C. Tarım ve Orman Bakanlığı, n.d.-d).

SYGM has a regulative and monitoring role at the national scale, which obviously leads to local impacts. However, implementation, enforcement and local management are not the primary responsibilities of this office.

State Hydraulic Works (DSI) & 4th District Office

DSI was founded in 1954, with the purpose of planning, governing, enhancing, and utilizing all water resources in Turkey. Currently, it operates within the central organization of the Ministry of Agriculture and Forestry.

DSI can be considered as the main enforcing institution in water governance and the sole authorized enforcing entity in groundwater governance. Its main duties include drilling wells for groundwater monitoring, research, distribution, protection of groundwater, registry of groundwater use, gathering and evaluation of data, dissemination of irrigated farming and land consolidation.

DSI has 18 departments within its organization, including (but not limited to) the following: Research and Allocation Department, Strategy Development Department, Land Consolidation Department, Technical Research and Quality Control Department, Dams and Hydroelectric Plants Department etc.

Since its foundation in 1954, DSI has always been a prominent actor in water management, however, after the foundation of SYGM, DSI has become an implementing agent rather than a policy making institution (Muluk et al., 2014).

Central Basin Management Board

The board was established in 2019 with a declaration in the official gazette, along with Basin Management Committees and Provincial Water Management Coordination Committees. Chairperson of the board is the Deputy Minister of Agriculture and Forestry. The board members include representatives from other ministries, General Directors of DSI, SYGM, some other offices within the Ministry of Agriculture and Forestry (MAF) and ILBANK, Chairpersons of Turkish Water Institute and Disaster and Emergence Management Presidency (AFAD). The duties of the board include the following:

- Ensuring coordination between different institutions and follow up for preparing and enforcing River Basin Management Plans and Drinking-Utility Water Protection Plans, pursuant to the National Watershed Management Strategy
- Resolving issues presented by Basin Management Committees,
- Presenting National Water Plan, River Basin Management Plans, inter-basin water transfer plans, and unresolved issues of Basin Management Committee to Water Management Coordination

There are some news about the annual meetings of the board, however, the content or the outcome of those meetings are not public information. A limited declaration is released publicly; therefore, the presence and influence of the Central basin Management Board is not clear.

Water Management Coordination Committee

The committee was established with a public mandate in the official gazette (No: 28239) in 2012, by the defunct Prime Ministry. In the mandate, it is stated that the duties of the committee are to provide inter-sector coordination, to increase water-related investments, to develop plans, policies and strategies, to identify protective measures within an integrated basin management approach, and to evaluate enforcement of relevant institutions, with the purpose of ensuring effective and efficient governance of all water resources (*Genelge*, 2012).

The members of the committee include representatives of various ministries (most of which are defunct now, since the mandate was published in 2012, there have been many structural changes in the government), General Directors of DSI, Meteorological Services, Turkish Water Institute and Combating Desertification and Erosion. However, the new structure of the committee is not specified.

Although there is no explicit information on the subject, it could be inferred that since the foundation of Central Basin Management Board, the two committees act as one, given the similarity in their duties and the fact that their identified members are mostly overlapping. The Ministry of Agriculture and Forestry also announced that the Central Basin Management Board and the Water Management Coordination Committee combined their annual meeting in 2019 (*Su Yönetimi Koordinasyon Kurulu 6. Toplantısı ve Havza Yönetimi Merkez Kurulu (HYMK) 3. Toplantısı Gerçekleştirildi*, n.d.).

Konya Plains Project Regional Development Administration (KOP BKİ)

Konya Plains Project is the name of a series of irrigation investment projects by DSI, dating back to 1985. In time, the project expanded to cover more than just irrigation, and in 2011 KOP BKİ was founded to support overall development of the region (*Konya Ovası Projesi (KOP) Bölge Kalkınma İdaresi Başkanlığı*, n.d.).

KOP BKİ operates within the authority of the Ministry of Industry and Technology since 2018. The main purpose of this office is to support the regional economic development and social welfare, via designing action plans parallel to the national 5-year development plans, implementing and following up those plans. KOP BKİ runs a “Small-Scale Irrigation Activities Program” (KÖSİP) to further investigate water scarcity problems, especially in rural mountainside, to increase agricultural income, employment, and social welfare (Konya Ovası

Projesi Bölge Kalkınma İdaresi Başkanlığı, 2018). Another project called "Agricultural Education and Publication in KPP Region" (TEYAP) aims to increase the efficiency of structural investments via education and publication on agriculture and to increase organizational capacities of institutions that strive for this purpose (*KOP Tarımsal Eğitim ve Yayım Projesi (KOP TEYAP)*, n.d.). The office has no regulative power, however, cooperates with DSI especially in projects for land consolidation and modernization of irrigation systems.

Basin Management Committee

Basin Management Committees were founded in 2019, with an official gazette statement (No: 30659). The members of the committee are mostly state officials, with the governor of a city within the basin assigned as the chairperson. The rest of the members include governors of other cities, representatives from municipalities, SYGM, DSI General Directorate, DSI District Office, provincial directorates of various ministries and ILBANK. Universities, NGOs, irrigation unions and cooperatives (chosen by the committee president) participate in the committee with at most 2 representatives (Havza Yönetimi Merkez Kurulu, Havza Yönetim Heyetleri ve İl Su Yönetimi Koordinasyon Kurullarının Teşekkülü, Görevleri, Çalışma Usul ve Esaslarına Dair Tebliğ, 2019).

The duties of the committee are following up, monitoring and reporting of implementation of basin-based plans, evaluating the works of Provincial Water Management Coordination Committees and other relevant institutions, resolving issues related to water governance at the basin scale and reporting to Central Basin Management Board. The committee is also responsible for supplying public information on preparation and updating of basin management plans (Havza Yönetimi Merkez Kurulu, Havza Yönetim Heyetleri ve İl Su Yönetimi Koordinasyon Kurullarının Teşekkülü, Görevleri, Çalışma Usul ve Esaslarına Dair Tebliğ, 2019), however interestingly, there is no online information available regarding the work of KCB Management Committee (as in the case of the Central Basin Management Board).

During field trips conducted by the research team in the Konya plain, the interviewees from public institutions stated that the basin management committee is insignificant and redundant in groundwater governance. The committee is not a decision making or implementing body. While all members of the board already have different roles in various public institutions, not

all institutions are represented in the board. For example, neither development agencies nor well-known NGOs have been invited to the board meetings so far.

Provincial Water Management Coordination Committees

The committees were established with the same declaration as Basin Management Committees and Central Basin Management Board, in 2019. The structure of the committee is very similar to that of the Basin Management Committees, where the governor of the city is the chairperson. Other members include representatives from municipalities, DSI General Directorate, Meteorology Services, provincial directorates of various ministries, Provincial Special Administrations and ILBANK. Universities and irrigation unions (chosen by the committee president) are allowed to participate in the committee with at most 2 representatives.

The duties of the committees are to enforce and track the implementation of basin-based plans on a smaller (city level) scale and identify and implement required measures to minimize the impacts of floods within the city, together with other relevant institutions (Havza Yönetimi Merkez Kurulu, Havza Yönetim Heyetleri ve İl Su Yönetimi Koordinasyon Kurullarının Teşekkülü, Görevleri, Çalışma Usul ve Esaslarına Dair Tebliğ, 2019).

Irrigation Unions

The duties of irrigation unions have officially been identified in the Law of Irrigation Unions (6172) in 2011 as follows: Operation, maintenance, repair, management, and renewal of irrigation facilities within their area of authority, collecting shares and fines, improving facilities that are taken over after the approval of DSI, running educational campaigns on irrigation systems for farmers and contributing to achieve the foreseen production volumes (*Sulama Birlikleri Kanunu*, 2011).

Operation of irrigation facilities used to be DSI's duty, along with planning and building the facilities, until 1993. With the enforcement of the World Bank, operational duties have been transferred to other organizational institutions; irrigation unions being one of them (Soylu and Uysal, 2006). Soylu and Uysal (2006) argue that although it may seem like irrigation has been left to a private and more inclusive organizational structure, irrigation unions are just another public body, lacking democratic engagement. Their argument was validated in 2005, when

irrigation unions were legally identified as local administrative unions (public entities). However, since 2018 DSI has active role in management of the irrigation unions. Currently DSI is responsible for establishment, supervision and management of the irrigation unions.

There are 15 irrigation unions in KCB (Türkiye Belediyeler Birliği (TBB), 2011). However, most of them do not have websites or any other form of publicity. There is almost no reliable information about their contact information, office address, number of members, sphere of activity (size of their operation, irrigation methods they use etc.), except for Çumra, Ova and Karaman Plains Irrigation Unions.

2.1.2.2. Market Actors

Organized Industrial Zones (OSB)

Konya OSB alone has nearly 1.000 members from various industries, most of which are end users of water resources. There is a cooperation platform for state, universities and industry on the website of Konya OSB, however, although it seems like a practical opportunity for cooperative projects for sustainable use of natural resources – like water – there is no available information about the kinds of projects carried out or their outcomes.

In total, there are more than 10 organized industrial zones within the basin region, 9 of them located in the city of Konya.

Individual Industrial/Market Actors

Individual Industrial Actors may be classified into different categories and scales. There are local actors, who are end users, national actors that have facilities in the region, who also are water users, and they also might be involved in cooperation with NGOs or some public entities. ETİ Burçak - WWF partnership (which will be further described in Section 2.1.2.3) would be a good example. Lastly, there might be some international actors, like Coca-Cola (more in Section 2.1.2.3), who are partnering with NGOs in environmental protection campaigns or funding them.

Many industrial companies have water allocation plans arranged with DSI, yet still, most of those use extra water from their own (some of which are unlicensed) wells as well. Also, industrial facilities located close to residential areas use municipal water. Thus, lack of

monitoring and control makes it difficult to calculate industrial water use and demand (Muluk et al., 2014).

Some big players may prefer to take voluntary action in investing to reduce their water use or into waste treatment technologies. For example, in Sectoral Water Distribution Plan for 2019-2024 prepared by SYGM, ETİ Alüminyum (the facility that uses the highest amount of water in the basin) is said to have minimized their industrial water requirement (T.C. Tarım ve Orman Bakanlığı Su Yönetimi Genel Müdürlüğü, 2018). However, according to the 2020 sustainability report of the company itself (Cengiz Holding, 2020), the water use has followed a fluctuant path since 2010. The recent increase is attributed to new process investments. However, clear information is not available in both references.

2.1.2.3. Civil Actors

Union of Irrigation Cooperatives in Konya Region

Irrigation cooperatives have been active in Turkey since 1966. Their duties could be listed as: land development, informative and educational campaigns on irrigation and on-field activities, financial loans to its shareholders for irrigation facilities and operation, technical support by cooperating with other public and private institutions, and environmental protection activities (T.C. Tarım ve Orman Bakanlığı, n.d.-g).

There is no available online information on individual cooperatives in the region. However, they are all united under Union of Irrigation Cooperatives in Konya Region. The union comprises 322 individual cooperatives and operates more than 3.000 groundwater wells (Konya Bölgesi Sulama Kooperatifleri Birliği, n.d.-a).

The current president of this union appears frequently in local media and strongly represents the cooperatives. He claims that if all cooperative irrigation systems in Konya were rehabilitated, the yearly water savings would be equal to the amount of water transferred to KCB from Göksu Plain via the Blue Tunnel. He also states: “Konya doesn’t have a water issue; Konya has water governance issues.” (Konya Bölgesi Sulama Kooperatifleri Birliği, n.d.-b). On the contrary, in an interview of his in 2020, he claims that inter-basin water transfer is a must

for Konya, as well as modernization of irrigation systems (*Cennet Topraklar Konya | Konya Sulama Kooperatifleri Birliği Başkanı - Şaban Güven*, 2020, 03:15-05:21).

Three different irrigation cooperatives were visited in the field trips: İçeriçumra Irrigation Cooperative (Çumra), Mantar Irrigation Cooperative (Altınekin), Alibeyhüyüğü Irrigation Cooperative (Çumra).

Çumra has been a pioneer district in the region in the past, therefore the cooperatives in Çumra district are more corporate and orderly. İçeriçumra Irrigation Cooperative has been founded in 1954 and it is one of the oldest cooperatives in the region. Currently the cooperative has 900 active members and operates 121 groundwater wells. The cooperative management has enforced a noteworthy crop rotation scheme in the last few years to reduce irrigation water requirements of the cooperative fields. The crop rotation scheme dictates that in a specific year, the owners of the field on one side of the main irrigation pipeline cultivate grains while the farmers on the other side are free to grow any green plant. The following year, they switch. Thus, the management reduces the total water use while preventing inequality in income.

Similarly, Alibeyhüyüğü Irrigation Cooperative is located in Çumra district. It has 700 active members and operates 120 licensed wells. The cooperative installed solar power plants with the capacity of 600 kW in 2017. During the summer, they use the solar power to pump groundwater from the wells, and during winter they sell this power to the local electricity distribution company.

Mantar Irrigation Cooperative is a much smaller institution compared to İçeriçumra and Alibeyhüyüğü Cooperatives. There are 45 actively used licensed wells. The cooperative management does not have the financial power to invest in energy infrastructure like Alibeyhüyüğü Irrigation Cooperative, or the institutional power to enforce crop rotation schemes as in İçeriçumra Irrigation Cooperative.

World Wildlife Fund Turkey (WWF Turkey)

WWF Turkey was founded in 1996 under the guidance of The Society for the Protection of Nature (Doğal Hayatı Koruma Derneği) and became the official national representative of WWF in Turkey in 2001. The foundation globally aims to protect all wildlife and their habitats (WWF,

n.d.). WWF Turkey has carried out various field projects, as well as public awareness campaigns regarding water stress, specifically groundwater stress in KCB, as briefly presented below.

Collaborative Projects with ETİ Burçak

ETİ is a Turkish snack brand, in business since 1960s and Burçak biscuit is one of ETİ's most well-known products. The collaborative projects carried out by the two institutions are great examples of NGO and industry cooperation. From 2008 to 2012, the two partners brought several modern irrigation projects into action. It is reported that within the project in 2008, 200 farmers were educated on water use and irrigation and modern irrigation equipment was promoted. The project led to 50% reduction in water use, adding up to approximately 110 years of water use of a family of 4. A 58% saving on energy and 87% saving on labor was achieved, as well as a 30% increase in crop yield (*Eti Burçak ve WWF Türkiye İşbirliği*, n.d.). They also started an online "Climate Adaptation Campaign" (www.iklimeuyumseferberligi.com.tr) for PR purposes, however the relative success of this campaign seems to be pale in comparison to other projects conducted in the area by ETİ Burçak and WWF.

The collaboration of WWF Turkey with ETİ Burçak was not only on field, but also on scientific studies and published reports. The collaboration produced two prominent documents:

a. "Tomorrows of Turkey" (WWF Turkey, 2010) is a scientific study, that was completed in 2010 and aimed to assess the potential outcomes of IPCC's A2 scenario in KCB. The resulting report focuses on water stress in general, groundwater stress and agricultural production/irrigation in detail.

b. The "Report for Water in Konya Today" (WWF, 2014) is one of the main references of this governance assessment study. It summarizes current water-related environmental problems in the basin, with a jargon free understandable writing style, and in my humble opinion, is a must-read document for those interested in the issue, as it captures the essence of the problem much clearer than any other document.

WWF has not been active on the field since their partnership with ETİ Burçak ended. Therefore, the NGO is removed from the initial stakeholder map in the second iteration (Section 2.1.2.4).

Water Ambassadors

Water ambassadors were initiated by DSI as a state-supported series of projects and introduced to the public at Istanbul International Water Forum in 2014. However, water ambassadors were re-founded by some of the interested employees of DSI and some academics as an association to carry out public awareness campaigns for protection of water resources globally (*Su Elçileri*, n.d.). For KCB, the chairperson of the association is a member of the KCB Management Committee. It is peculiar that this information is only available at the 'News' section of the Water Ambassadors website, and there is no other information elsewhere on who else is included in the Basin Management Committee, apart from the state officials, specified in the related legislation.

The association is still, given its origins, closely related to DSI. Although the formality of that bond is not stated in any public documentation, when social media accounts and the activities section of the association website is investigated, it is seen that most of the operation carried out is in collaboration with various state institutions such as DSI regional offices, district directorates of agriculture and forestry, district national education directorates.

Water Ambassadors currently produce an informative animation series for children, to create awareness about water scarcity and efficient water use. The series is shown by TRT Çocuk, a public TV channel, and is also available on Youtube.

The Nature Conservation Centre (DKM)

The foundation was established in 2004 by ecologists and nature conservationists with a focus on: biodiversity, land and water, climate change, systematic conservation planning, and nature education. Although they are not directly focused on groundwater-related issues, the foundation has implemented 4 projects in the KCB area:

Every Drop Matters Cihanbeyli (September 2014- September 2015)

Every Drop Matters was an international program supported by the United Nations Development Program and Coca-Cola, highlighting the importance of each drop of clean water. The segment of the project in Konya, Cihanbeyli was implemented by DKM. Within the project, plant-based irrigation techniques were piloted and implemented, and local communities were encouraged to use more efficient irrigation systems (*Every Drop Matters Cihanbeyli*, n.d.).

Climate Resilient Agriculture Network (2020-2023)

The project is funded by the EU Delegation of Turkey, within the framework of Support for Civil Society Networks and Platforms in Turkey Funding Programme. The objectives are "to enhance informed decision making for climate resilient agriculture through a well-connected network of Civil Society Organizations (CSOs) working in the field of climate change and agriculture, ..., to establish a Climate Resilient Agriculture Network of CSOs, ..., to strengthen the capacity of CSOs network for communicating, outreaching and collaborating for climate resilient agriculture in line with EU environment and climate change and agriculture acquis and policies." The first partner is Konya Leader Farmer Association (KOCD), and Agriculture and Food Ethics Association is listed as a target partner (*Climate Resilient Agriculture Network*, n.d.).

Water Management for Sustainable Farming and Resilient Ecosystems: Knowing More, Using Less (2019-2020)

Partnering with Konya Provincial Directorate of Agriculture and Forestry, DKM implemented a pilot project, financed by Coca-Cola's New World Program, to improve the water use efficiency in agricultural irrigation, to introduce an irrigation program to İvriz Irrigation Union, who has 1825 members and covers a land area of 12000 ha, and to raise awareness among farmers on climate change and water-efficient irrigation methods (*Water Management for Sustainable Farming and Resilient Ecosystems: Knowing More, Using Less*, n.d.).

Agriculture of the Future (December 2013 - December 2016)

The project objectives were to increase the water holding capacity of the soil, efficient use of land and water resources and to increase the capacity to use ecosystem services in agriculture in KCB. The project partners were Coca-Cola Hayata Artı Foundation, General Directorate of Agricultural Reform and the defunct Ministry of Food, Agriculture and Livestock. Key achievements of the project include (but not limited to): crop rotation strategy report, crop calendar adopted to climate change, direct seeded fields (*Agriculture of the Future*, n.d.).

The Turkish Foundation for Combating Erosion, Reforestation, and the Protection of Natural Habitats (TEMA)

TEMA was founded in 1992, by two businesspeople aiming to bring environmental sustainability notion to Turkey, following the 1992 Rio Conference. It is one of the most well-known and trusted NGOs in the country. Although TEMA is mostly known for its reforestation

activities, the association also has water resources-related studies as well. In 2012, they published a draft for a water law, to fulfil the need for a complete legislative framework for water governance. Like Water Ambassadors, they participate in some of the basin management committees, but in which basins is not specified. TEMA was also involved in the Participatory River Basin Management Project funded by the EU (*Su Politikaları*, n.d.).

Although TEMA is not directly involved with groundwater use or protection. TEMA took active role in a project funded by Mitsui & Co. Environment Fund in 2006, cooperating with Çukurova University. The main objective of the project was to build a participatory land use model, with crop patterns, climate, water and socio-economic aspects for the KCB.

Association for Producers of Beet and Agricultural Products in Konya (KONPADER)

KONPADER was founded in 2015 by local farmers. However, there is not much information about the association itself, only some local news and interviews with the chairperson. The association does not have a website, only a Facebook page. From the accessible information and the interview with the chairperson, it could be deduced that although KONPADER does not have much voice at a national scale. However, they seem to have a high lobbying power at local scale.

Konya Leader Farmer Association (KOCD)

KOCD was founded in 2009 by the former governor of Konya. The main purpose of the association is to provide information flow among farmers of Konya. The association aims to bring leader farmers together. Those leader farmers are pioneers, they are keen on adopting new techniques. Under the roof of KOCD, they are both supported (consultancy) and are expected to pass on their experiences to contribute to the development of the region. The association believes that the existence of pioneers is crucial to the success of agricultural extension. They collaborate with Selçuk University, Konya Governor, Konya Commercial Exchange Market and Ministry of Agriculture and Forestry (Konya Önder Çiftçi Derneği, n.d.). The association has nearly 600 members from 11 different districts in Konya.

Self-Irrigators

Some farmers in the KCB are not members of an irrigation union or shareholders of an irrigation cooperative. There is no public information available on independent farmers regarding their

numbers, production size, and their water resources (using licensed or unlicensed wells). Those details are crucial, given the high ratio of unlicensed groundwater wells in the region which might indicate a correlation.

Local Media & Newspapers

There are several local newspapers and a number of TV channels in the KCB region. Groundwater related news on the *Merhaba* and *Hakimiyet* newspapers were scanned as part of this study. Most of the news celebrate the developments in the Blue Tunnel Project and related inter-basin water transfer projects.

The local community of KCB is known to be conservative, with recent elections showing strong support for the current government. Therefore, it is not surprising that the public investments are highlighted in local media. However, it is interesting that non-governmental organizations' projects seem to be overlooked in the media. For example, there are only a few newspaper articles on the report prepared by WWF. It is stated that the Blue Tunnel project is 'evaluated' but does not mention how and why WWF is against the project (Konya Merhaba Gazetesi, 2012).

On the other hand, there are also several news articles on the status of the groundwater resources, and interviews with experts, which could be argued to have a positive influence on the overall awareness level of the local community.

2.1.2.4. Stakeholder Mapping

Stakeholder mapping is central in participatory research projects, guiding researchers on how to approach or what to expect from different stakeholders. Therefore, a stakeholder mapping exercise is quite beneficial in such projects.

The literature is rich with grids or matrices that could be used for the initial mapping of the stakeholders. Murray-Webster and Simon (2006) suggest that a three-dimensional grid, comparing the power, interest and attitude of each stakeholder would "make the technique even better at stimulating thought and informing the project manager in a truly meaningful

way" (pg 1). However, for the project at hand, none of the stakeholders are expected to be 'blockers'. That is why, below, a two-dimensional power/interest matrix is presented.

4 main stakeholder groups can be identified with a power/interest matrix. Namely:

High Power/High Interest Groups: Those are the key stakeholders. Their frequent and intense involvement with the project would be beneficial. They should be engaged with regularly and the relationship with them should be maintained as their inputs could be very valuable. Hence, this group of stakeholders should be *managed closely.*

High Power/Low Interest Groups: The main goal is to move these stakeholders to the right block on the matrix (to the high power/high interest group). Their input can be regarded as consultation. However, there is also a risk that they might use their power to undermine the project if they turn into opposers. So, they should be *kept satisfied*.

Low Power/High Interest Groups: Although they have low power, their interest could be useful for the researchers. They might be consulted on their area of interest, and they can easily be supporters of the project. So, although they might not be involved as key decision-makers of the project, the researchers may make use of their interest through involvement at different stages. They should be *informed* on a regular basis.

Low Power/Low Interest Groups: The stakeholders in this group require the least effort among all four. Due to their low interest and low power, they have low priority, so it is enough to just *monitor* them throughout the project.

It should be noted that, a stakeholder might shift from one group to another during the project. Therefore, stakeholder mapping is an iterative activity and should be reexamined at certain intervals to check if there are any changes. Below are the first two iterations of the stakeholder mapping activity for Konya Closed Basin case study.

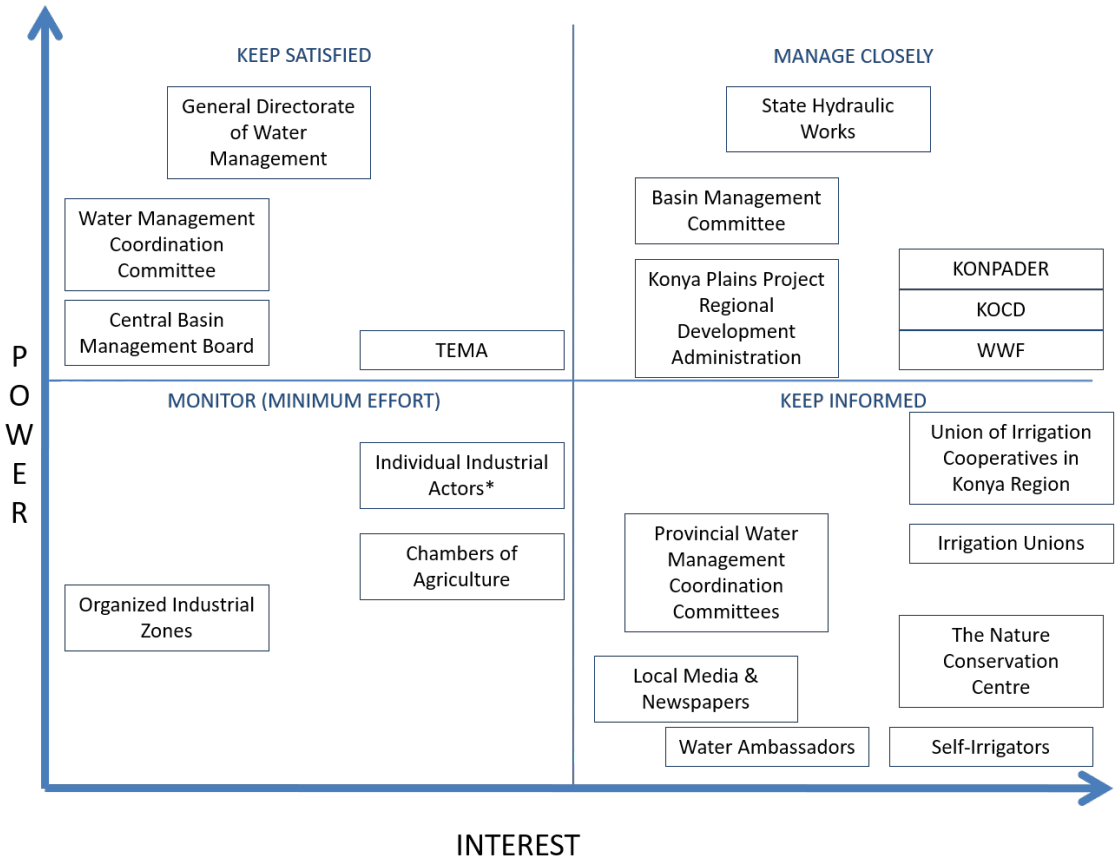

Figure 5. Initial power and interest matrix of the stakeholders in Konya Closed Basin, Turkey

For the course of the KCB water governance analysis study, the initial mapping is completed after a rigorous literature review, prior to field studies. Therefore, the resulting matrix (Figure 5) is a combination of on-paper and desktop knowledge and intuition of the researcher. The second matrix (Figure 6) is prepared after two field trips, and reflects the information revealed in interviews with stakeholders. Some stakeholders are removed from the matrix and some of their positions have been changed, based on the statements of the interviewees.

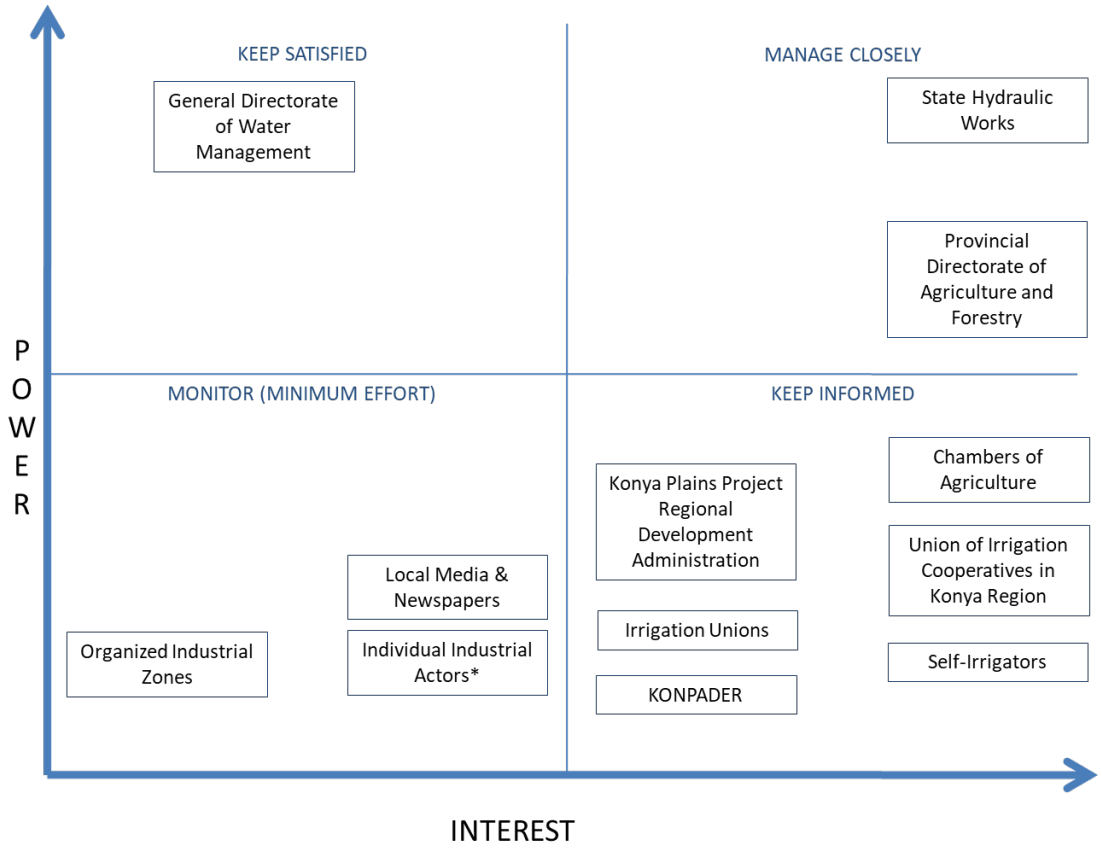

Figure 6. Second iteration of power and interest matrix of the stakeholders in Konya Closed Basin

2.1.3. Governance Analysis

2.1.3.1. Legislation

In this section, the relevant legislation regarding (ground)water governance is briefly introduced. Turkey has a "Water Code", which was adopted in 1926 and has not yet been updated for today's necessities. Considering the change in demand, technology, priorities, purposes of use, and environmental conditions; it is obvious that an overarching and holistic legal framework is required for effective governance of both surface and groundwater resources. The adoption of such a water code has been in the agenda of the government for several years now.

The process is summarized by Ministry of Agriculture and Forestry as follows: In 2011 and 2012, several workshops were organized with attendance from various public entities, universities,

and NGOs. A draft was initiated with contributions of experts from UK, The Netherlands and France. In 2012, the draft was shared with the public and updated according to feedback received. In 2014, the draft was addressed to the Prime Minister and in 2016, it was presented to the ministerial cabinet. Defunct Ministries of Environment and Urbanization, Energy and Natural Resources, and Justice has worked on the draft to overcome the existing disputes, shaping the final version of the draft. In 2018, due to the changes in administrative structuring, the draft was re-addressed to the Ministry of Agriculture and Forestry. Necessary changes aligned with the new structuring have been made and the draft is in the enactment process (T.C. Tarım ve Orman Bakanlığı Su Yönetimi Genel Müdürlüğü, 2019b).

The main goals of the draft water code are sustainability, participation, efficiency, productivity, accountability, scientific approach, accessibility, equal shares in both costs and benefits (T.C. Tarım ve Orman Bakanlığı Su Yönetimi Genel Müdürlüğü, 2018).

The existing legislation is scattered and unable to provide proper coordination among related institutions. Some of the main codes and regulations are presented below. Following that, some legislative conflicts in rights and responsibilities on planning, implementation, monitoring and regulation of water resources management are explored.

Existing Legislation

Law No: 831, The Water Code

The code was adopted in 1926, and mostly regulates the building and operation of infrastructure services for drinking and utility water use. The content of this law is not very applicable or relevant to current status and issues (*Sular Hakkında Kanun*, n.d.).

Law No: 167, The Groundwater Code

The code was adopted in 1960. The important articles of this code could be summarized as the following:

- Groundwater resources are public property and research, use, protection and registration are bounded by the articles of this code.
- DSI is the main state institution that has the right to control and coordinate groundwater operational sites. It provides necessary permits to search for

groundwater and groundwater utilization permits as well as reclamation and modification permits, determines the location, number, depth of wells and amount of water to be used, has the right to drill wells for groundwater studies.

- DSI, along with the relevant ministry (currently Ministry of Agriculture and Forestry) identifies the minimum depth, above which a permit is required for any drilling and digging activities.
- Landowners, if their land is not a part of declared groundwater operational sites, has the right to search for groundwater within their land, and use as much as their 'adequate need', which is determined by DSI. A utilization permit is still required.
- If the demanded amount of groundwater in concurrent applications to DSI is close to the total allowable amount, the final decision on accepting or rejecting the applications is the responsibility of a board with delegates from relevant ministries.
- An additional paragraph added to the code in 2011 stating that all groundwater wells and tunnels must be equipped with measurement systems. Without the measurement system, a utilization permit cannot be provided.
- A provisional clause added to the code in 2011 states that both industrial and agricultural wells with permits that were given prior to the addition of the clause are obligated to set up measurement systems (*Yeraltı Suları Hakkında Kanun*, n.d.).

Regulation for Groundwater

The regulation was adopted in 1961, along with its publication in the official gazette (No: 10875), to define the practical provisions of the Groundwater Code (167). Most articles are structured to clarify and guide stakeholder about the Groundwater Code. Some points are worth mentioning here:

- Even with utilization permits, well depths are determined by DSI.
- The amount of water to be pumped from each well is the sustainable amount and the 'adequate need' determined by DSI. In another article, it is also stated that the portion of groundwater reserved for adequate need can never exceed the safe extraction amount.

- DSI has the right to control the technical legitimacy of the groundwater search, utilization, reclamation, and modification works instantaneously (*Yeraltı Suları Tüzüğü*, n.d.).

Regulation for the Protection of Groundwater Against Pollution and Deterioration

The regulation was published in official gazette with number 28257, on April 7, 2012. The purpose is to identify the methods to protect the current quality of groundwater aquifers that are in 'good' condition (specified in the regulation), to prevent pollution and deterioration of groundwater resources, and to enhance the overall quality of the aquifers. The prominent articles state the following:

- Direct discharge of wastewater, no matter what quality, is strictly prohibited. In some cases, specified in the regulation, direct or indirect discharge of wastewater, even after treatment, is also prohibited.
- DSI is assigned to mapping and monitoring (and setting up a monitoring network) of groundwater resources, holding inventory for groundwater protection areas, and notifying SYGM.
- SYGM is assigned to determining the quality standards and threshold values. Viable threshold values must be set to protect the groundwater resource. SYGM is also responsible for (with DSI being the consultee in the process) publishing groundwater quality reports periodically.
- In resource allocation, protecting the balance between the input (feeding) of the resource and extraction is essential. Requirement of water budgeting and any other factors that might endanger the quality or the quantity of the resource is highlighted.
- A general 'precautions program' is described, identifying measures to be taken and responsible institutions.
- The quality of groundwater is to be monitored by the Ministry of Environment and Urbanization, and the quantity is to be monitored by DSI (*Yeraltı Sularının Kirlenmeye ve Bozulmaya Karşı Korunması Hakkında Yönetmelik*, 2012).

Regulation for the DSI Groundwater Measurement Systems

The regulation was published in official gazette with number 28793, on October 12, 2013. The purpose is to regulate the set-up, use and control of measurement systems for groundwater wells that have utilization permits.

- A proper measurement system, identified by DSI, has to be set up for every groundwater well.
- If/when the measurement system is dismantled, groundwater extraction is strictly prohibited.
- Three types of prominent measurement systems are highlighted: Prepaid water meters, remote-controlled water meters, automated water meter readers.
- DSI is responsible for the inspection of water users (whether the requirements of the regulation are fulfilled or not).
- When surface water is used for irrigation, groundwater wells are cancelled, and measurement systems will not be set up.
- With this regulation, the deadline for installing measurement systems for the wells that had utilization permits prior to the 2011 version of this regulation is postponed (*DSI Yeraltı Suları Ölçüm Sistemleri Yönetmeliği*, 2011).

Law No: 6200, The Code for Services Provided by DSI General Directorate

The code was adopted in 1953, yet several changes to it were made since then. Many of the original articles are now defunct. Most relevant responsibilities, apart from those already mentioned, are below.

- DSI is responsible for land consolidation as enforcing entity.
- DSI may build and operate irrigation facilities, may also transfer operating rights to other public entities (*Devlet Su İşleri Genel Müdürlüğünce Yürütülen Hizmetler Hakkında Kanun*, n.d.).

Regulation for Water Allocation

The regulation was published in official gazette with number 30974, on December 10, 2019. The purpose of it is to identify the rudiments and methods to be used for water allocation by DSI. The main takeaways of this regulation are as follows:

- Protection and improvement of water resources both in quality and in quantity are essential.
- The allocation is done according to the priority of the purpose generating the needs/demands. The priorities are listed as, drinking and utility water, environmental Needs (for sustainability of eco-systems), agricultural irrigation and aquafarming, energy production and industrial demand, commercial, tourism, recreational, mining, transportation etc. needs
- Surface waters should always be given precedence over groundwater for any utilization purpose.
- Water potential should primarily be used within the same basin.
- Allocated water for a certain purpose cannot be overused, utilized for a different purpose, or transferred.
- The rule that "The adequate need reserved for utilization can never exceed the safe extraction amount." is repeated.
- DSI is responsible for the inspection (to check whether the resource is utilized according to the allocation specifications), if allocation is done by DSI itself.
- DSI is responsible for taking due protections to prevent any unauthorized water use.
- The processes regarding the allocation, and cancellation and renewal of allocations are identified (*Su Tahsisleri Hakkında Yönetmelik*, 2019).

Regulation for Planning, Implementing and Follow-Up of Basin Management Plans

The regulation was published in official gazette (No: 28444) on October 17, 2012. Some changes were made by other regulations in 2017 and in 2019. It regulates the preparation of management and protection plans for watersheds in Turkey, as well as the national water plan. The aim is to provide sustainable use of both surface and groundwater resources, protect the quality and quantity of resources in 'good' situations and improve the deteriorated resources, allocate water according to the priority of the needs, with a holistic approach. Essentials of the plan are as follows:

- A participatory approach is adopted, ecosystem protection and 'user/polluter pays' principle are emphasized.

- Utilizing the water potential primarily within the basin and according to defined priorities is highlighted once again.
- Prior to any legislative studies, planning, and field work, potential ecological, social, and economic outcomes should be assessed.
- Importance of consistency among all levels of planning and coordination in enforcement is underpinned.
- During water allocation and inter-basin water transfer planning, minimum ecosystem requirements should be taken into consideration. All precautions for environmental protection should be taken by authorized institutions, for any physical interference and water utilization.
- Prior to water extraction, water budget preparation for both surface waters and groundwater is essential.
- Regular trend analyses, social impact analyses and cost benefit analyses for determined measures should be carried out. A central monitoring system is required to govern those single-handedly. Regularity and continuity of monitoring is essential.
- Authorized institutions are responsible for, supporting reuse of wastewater and use of thrifty, efficient water technologies along with best possible techniques, and adjusting water prices for utility and irrigation water to encourage efficient use (*Havza Yönetim Planlarının Hazırlanması, Uygulanması ve Takibi Yönetmeliği*, n.d.)

Declaration of the Formation, Duties and Rules of Procedure of Central Basin Management Board, Basin Management Committees and Provincial Water Management Coordination Committees

The declaration was published in official gazette (No: 30659) on January 18, 2019. The purpose is to regulate the operational methods and rudiments of Central Basin Management Board, Basin Management Committees and Provincial Water Management Coordination Committees, founded to coordinate the planning, implementation and follow up of basin management plans. The content mainly consists of the identification of members to those committees and their respective responsibilities. Detailed information is provided in the section introducing the relevant actors (*Havza Yönetimi Merkez Kurulu, Havza Yönetim Heyetleri ve İl Su Yönetimi Koordinasyon Kurullarının Teşekkülü, Görevleri, Çalışma Usul ve Esaslarına Dair Tebliğ*, 2019).

Law No: 6172, The Code for Irrigation Unions

The code was adopted in 2011. It regulates the duties and authority of irrigation unions, which are public entities and are responsible for the utilization, operation, maintenance, and development of irrigation systems built by DSI. Detailed information is provided in the section introducing the relevant actors (*Sulama Birlikleri Kanunu*, 2011).

Conflicts in Existing Legislation

When the contents of the various legislative documents are compared to each other, repetition in some authorizations becomes visible. In other words, in some cases, more than one institution is assigned the same responsibility. These conflicts in authority, as emphasized in previous sections, may result in inefficient use of both financial and human resources due to repetitive and redundant implementations. On the other hand, it may also lead to bureaucratical stagnancy, if several institutions pass the responsibility around to each other.

The confusion in responsibility areas and enforcement is not always caused directly by an overlap of authorization, but rather the vagueness in the wording of either the definition of the duty or of the premeditated method or level of coordination between authorized institutions. In fact, the vagueness problem is much more common than the direct overlap problem. Some relevant examples are provided below:

1. Job Description: Tracking and evaluating the enforcement process of the basin management plans
   Authorized Institutions: SYGM's Department of Basin Management and Basin Management Committee

Every department under SYGM is introduced on the website of Ministry of Agriculture and Forestry and their functions and job descriptions are specified. For the Department of Basin Management, job description is clearly stated.

In the *Rescript for the Formation, Duties and Rules of Procedure of Central Basin Management Board, Basin Management Committees and Provincial Water Management Coordination Committees (Article 7, sub-article (1), versicle (d))*, it is stated that the Basin Management Committee is responsible for the above job description (Table 3), pursuant to the *Regulation for Planning, Implementing and Follow-Up of Basin Management Plans.* However, in the

mentioned regulation, the working principle of the Basin Management Committee is not clearly stated. The ministry is authorized to form the committee, and then define its working principles. There is no further information available.

2. Job Description: Defining, Characterizing and Revising Groundwater Bodies
   Authorized Institutions: SYGM's Department of Monitoring and Water Information System and DSI

On the website of the Ministry of Agriculture and Forestry, the Department of Monitoring and Water Information System, defining and revising of ground water bodies are specified as a job description, as well as of surface water bodies.

In *Regulation for the Protection of Groundwater Against Pollution and Deterioration (Article 6, sub-article (1)),* it is clearly stated that DSI is responsible for defining the groundwater bodies and reporting to SYGM (to which specific department is not mentioned).

3. Job Description: Ensuring Groundwater Quality
   Authorized Institutions: DSI, SYGM & Ministry of Environment and Urbanization

In *Regulation for the Protection of Groundwater Against Pollution and Deterioration (Article 6, sub-article (4)),* it is stated that the impacts of pollution on groundwater quality is assessed by DSI and SYGM, and groundwater bodies that are under risk are, conjointly, identified.

In Article 14 in the same regulation, it is stated that DSI is responsible for the inspection of the quantity of groundwater, and the Ministry of Environment and Urbanization is responsible for the inspection of the quality of the groundwater.

2.1.3.2. Existing Management Plans in the Basin

There are several plans, prepared by either state institutions or outsourced to non-state institutions in the last decade, as part of what could be called a transition period in water governance. The plans are developed as outcomes of project-based research studies in most cases. The action steps and goals of the plans are shaped by the results obtained from the research and several analyses carried out.

Below, 6 regional plans on KCB (the published reports) are reviewed and the groundwater related sections are briefly elaborated.

KCB Master Plan

Master Plans for several water basins, with an integrated basin management strategy have been prepared by DSI over the last years. However, the plans are not publicly shared. Only the hydro-geological research report for KCB, which is part of the master plan, has been reviewed.

The report first introduces the overall basin field, geology, and hydrology. Aquifers are analyzed in detail. Inlets and outlets of groundwater resources are determined, a chemical and pollution analysis is made. The report concludes with results and recommendations (SUİŞ Proje, n.d.).

KCB Protection Plan (2010)

The project of preparing the KCB Protection Plan was outsourced to The Scientific and Technological Research Council of Turkey (TÜBİTAK), along with the protection plans of 10 other watersheds by the defunct Ministry of Environment and Forestry. The KCB Protection Plan was completed by TÜBİTAK in late 2010.

The report introduces the overall situation in the basin, then focuses on the status of water resources and environmental infrastructure (urban and industrial wastewater and solid waste), followed by a detailed study of pollution load calculation. Prominent environmental problems in the basin are identified and solutions are offered for short, medium, and long terms.

The emphasis of this report is not on groundwater, but mostly on wastewater discharge, wastewater treatment and surface water and wetlands. The report underlines that the wastewater treatment and discharge systems are at municipal or city-wide scales rather than a basin scale, violating the EU Water Framework Directive. Following that, it provides examples of basin management systems from some European countries and suggests an integrated basin management system for Turkey.

The groundwater-related parts include information regarding the reservoirs in different plains in the basin and their qualities, groundwater potential and the utilization levels. Important suggestions in the plan can be summarized as follows:

- Every groundwater well in the basin should be recorded, continuously monitored and necessary measures should be taken where overexploitation is observed.
- Saline aquifers (due to over extraction) should be rehabilitated. Artificial recharge with rainwater or surface water could be considered in such cases.
- Pilot schemes on leaching fields, permeable pavements in urban areas, artificial ponds should be started both to increase the infiltration level of rainwater and to prevent flooding.
- Groundwater quality should be modelled and various pollution scenarios, involving important point and non-point sources, should be applied to develop different quality management strategies.
- Water distribution infrastructure in agriculture should be enhanced, pressurized irrigation should be prioritized, reuse of treated wastewater should be encouraged, and water allocation plans should be prepared (TÜBİTAK MAM, 2010).

KCB Drought Management Plan (2015)

The project was devised by SYGM in 2015, when it was a general directorate under the defunct Ministry of Forestry and Water Affairs and outsourced to Dolsar Engineering company. It includes very comprehensive information and extensive analyses (hydrological, hydrogeological, topographical, socio-economical) of the basin area, provided in detail with several appendices. The main document with general information on KCB, defines the indices, indicators, and threshold values for drought. It continues with assessing the water potential in the basin, by preparing a water budget and analyzing the expected changes in both surface water and groundwater resources at a sub—basin scale. Then, a sectoral vulnerability assessment is carried out. The aim is to increase the capacity to adapt and mitigate the potential impacts of drought with sector-based measures. Industry, agriculture, drinking/utility, and ecosystem uses are included in the assessment. The following are considered to be increasing the capacity to adapt, which also are relevant to the governance study:

- The locals mostly live off agricultural production, and the past drought experiences have created an overall awareness in the community.

- The irrigation equipment production and distribution are developed in the region, the prices are affordable and accessible for farmers.
- The demand to lower agricultural water use is bottom up, not a top-down imposition. The local people try hard to increase irrigation efficiency.
- Farmers have been facing heavy electric bills due to high groundwater use. As the groundwater table decreases, pumping costs further increase, so they tend to adopt more efficient irrigation systems.
- Regional Development Administration, Provincial Special Administrations and DSI regional offices provide investment opportunities and agricultural loans to farmers in the region, to improve their irrigation systems.

In the following sections, the legislation on drought is explored, national and local coordination among several institutions is assessed, and the capacities of mitigation policies and strategies are analyzed. It is argued that in Turkey, drought management and related decisions have mostly been short-term, covering only the time period of the actual drought, and a long-term strategy that includes measures to be taken to alleviate the impacts of potential future droughts, has not been adopted.

In the light of results obtained from the sectoral vulnerability assessment, 9 primal goals, and relevant action steps were identified as preventive measures. While doing so, some important criteria such as social equality, technical feasibility, institutional capacity, cost-effectiveness, stakeholders' willingness to participate and consistency with environmental legislation were taken into consideration. The goals are as follows:

- Assessment of changes in water potential, impact of periods of drought and potential impacts of climate change
- Project development for allocating water to water poor sub-basins
- Improved coordination among stakeholders in the basin
- Mitigating the impacts of drought on KCB community, economy, and ecosystem
- Decreasing water demand and encouraging measures to protect water resources and water quality
- Increased awareness in local community and educational projects
- Support of national and local governments to develop water and land resources

Following that, a drought management model is proposed, governance measures and responsible institutions are identified. The drought database prepared as part of the project is introduced. The last section explains the enforcement, monitoring and updating of the plan. The KCB Management Committee is the main body in monitoring and evaluating the plan. It is responsible for providing suggestions to SYGM on how to update the plan, based on its evaluations (Dolsar Mühendislik, 2015).

KCB Management Plan (2018)

In the process of alignment with the EU Water Framework Directive, a consortium project has been carried out to convert the basin protection plans into river basin management plans. The project has been completed in 2018 with contributions from the following consultancy firms: Tragsatec, Initec Infrastructures and Su-Yapı. The focus of the project is to assess the relevance of EU Water Framework Directive to existing basin protection plans.

The report first provides general information on the basin's water resources. Following that, the point, non-point, morphological, extraction and other anthropogenic pressures, and their effects on surface and groundwater resources are analyzed. Then, protected areas and monitoring networks for both surface water and groundwater resources are introduced.

According to the report, there are 48 monitoring stations in KCB for 18 identified groundwater bodies. Most of the wells chosen as monitoring points, are drinking water wells (34/48). There are, also some irrigation (7/48) wells, and the rest of the wells are used in industry or for utilization. The monitoring results are evaluated (in accordance with the Groundwater Directive included in the Water Framework Directive) and 18 groundwater bodies are classified as in 'good condition' or 'weak' in terms of quantity and quality (chemical content), separately. As a side note, in the focus area of the InTheMed project, the Çumra-Karapınar region, the number of monitoring wells is 5, and the resultant condition of the groundwater body in that region is 'weak' in both quantity and quality.

The report includes the economic analysis of water use in Turkey and then the preventive measures program. The identified measures regarding groundwater resources include, but are not limited to the following:

- Improvement in monitoring network for both quality and quantity of groundwater

- Recording and holding an inventory for groundwater extraction, as well as monitoring and superintending
- Formation of unions for water users
- Research on the connection of groundwater to aquatic ecosystems in the region
- Creating protection zones for groundwater resources
- In the penultimate section, several plans and programs in both national and local scale are introduced, and their contents are briefly explained.

The report concludes with the actions taken for informing and creating awareness in the community. As part of the project, 3 national and 1 basin-scale awareness raising campaigns have been implemented in 2015-2018. The campaigns included stakeholder consultancy events, a short movie, press releases, presentations, executive summaries, and social media posts. The project video (short movie) was shared with DSI and the national channel, TRT. It was aired in Water Ambassadors TV channel. The consortium, after analyzing all the stakeholder feedback, updated several documents based on the approved feedback (TRAGSATEC et al., 2018).

KCB Sectoral Water Allocation Action Plan (2019 - 2024)

As identified in National Watershed Management Strategy plan, the sectoral water allocation plan has been prepared by SYGM in 2018, for the term 2019-2024. The plan aims to provide sustainable use of water resources at the basin scale and to premeditate water allocation, following hydrological, ecological, and social-economic analyses. The plan is the output of a project, consisting of three main sections: Analysis of the status, analysis of the sectoral water demands, sectoral water allocation plan. The project report includes general information on KCB, surface and groundwater potentials under different climate scenarios, information on the level of water use for various sectors (drinking/utility, environmental, agriculture, industry, energy etc.) and lastly, the water allocation by sectors, under different climate scenarios. The allocation data are given yearly for the period 2019-2024 and then for 2029 and 2040, separately.

The plan specifies water allocation at a sub-basin scale. This makes sense given the large area of the whole basin, the variations in socio-economic parameters among different sub basins and the respective shares of different sectors in different basins.

6 climate scenarios (forecasted, 'normal', mild drought, regular drought, severe drought, extreme drought conditions) are considered for water allocations. One important aspect is that for each year and each climate scenario, the planned agricultural crop pattern is provided. This is important because, as emphasized several times in previous sections, agriculture is the highest water demanding sector, and the type of crops produced is an important determinant in agricultural water demand. Although currently the state policy is to increase the irrigated land and the share of relatively high-water consuming crops, when the crop patterns of the same year in, for example, normal and extreme drought conditions, are compared, the difference is hard to miss. Shares (% area cultivated) of corn, sugar beet, trefoil are very much decreased, and an overall, a decrease in total cultivated area is forecasted.

In the evaluation part of the report, it is argued that all water demands for each climate scenario can be supplied for all sectors other than agriculture. The report is comprehensive in providing drought scenarios and possible water allocation solution; however, it is lacking the crucial information on the shares of surface and ground water in allocation.

In the action plan, DSI is responsible for forecasting yearly water potential, determining inter-basin transfers for the year, allocating water according to the climate scenario (chosen with SYGM), and running feasibility studies for water transfer to irrigated lands in some sub-basins.

General Directorate of Plant Production (BÜGEM – under MAF) is responsible for sharing the crop pattern of the chosen scenario with the producers and running the program to channel them to that pattern. DSI, along with the General Directorate of Agricultural Reform (TRGM – under MAF) is also responsible for carrying out the modernization of irrigation systems.

DSI, along with other unspecified institutions, is responsible for preparing, approving, and enforcing a 'Groundwater Protection Action Plan (YASKEP)'. However, there is no deadline specified in the plan for this task. YASKEP is not available on DSI website or any other reliable source (T.C. Tarım ve Orman Bakanlığı Su Yönetimi Genel Müdürlüğü, 2018).

KOP Action Plan (2014 - 2018)

The KOP region is determined by the borders of the cities included in the program (namely Aksaray, Karaman, Konya, Niğde, Nevşehir, Yozgat, Kırıkkale, Kırşehir), whereas KCB borders are natural borders of the groundwater basin. The difference between those regions is visible

in Figures 7 and 8. It should be emphasized that the KOP region is not KCB, although there is a noticeable overlap. The KOP Action plan was prepared by KOP Regional Development Administration and covers the 2014-2018 period for the entire KOP region which includes the KCB. However, there is no publicly available recent updated versions of the action plan.

Figure 7. KOP Region (KOP Bölge Kalkınma İdaresi Başkanlığı, n.d.)

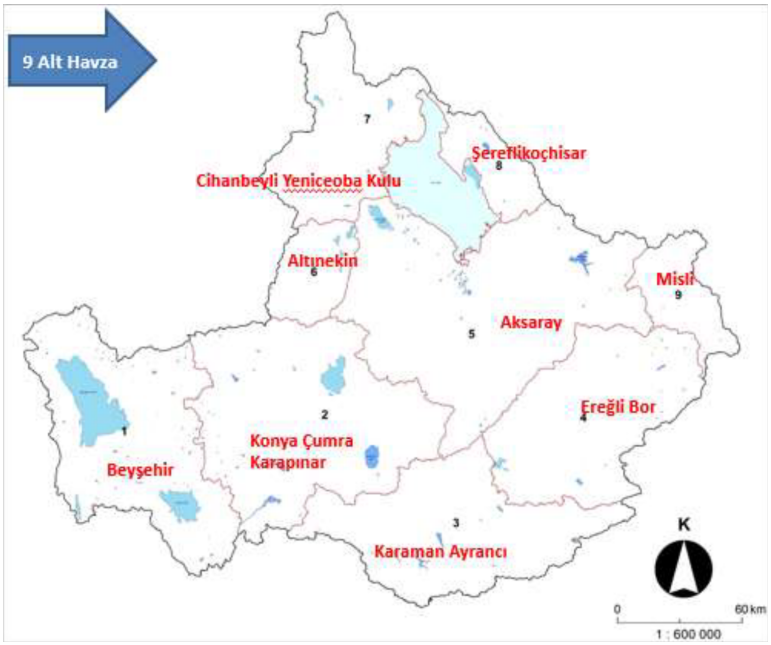

Figure 8. Konya Closed Basin (and sub-basin) borders (T.C. Tarım ve Orman Bakanlığı Su Yönetimi Genel Müdürlüğü, 2018, p. 11)

The document provides general information about the KOP region, includes main goals and policies, and defines 5 main development axes. For the purpose of this report, the highlighted part of the plan will be the sustainable use of land and water resources.

In the action plan, the development axis of 'Sustainable Use of Land and Water Resources' has 3 main categories: Protecting Soil Structure and Increasing Productivity, Sustainable Use of Water Resources and Basin Water Management, Environmental Protection. For all three action steps, responsible institutions and deadlines are identified. Focusing on the second, the action plans are listed as the following:

- Research on inter-basin water transfer – refers to the Basin Master Plans prepared by DSI.
- Completion of 'Major Irrigation Projects' – refers to the construction of dams, water delivery channels and other infrastructure for Blue Tunnel, Hadimi Tunnel and other ongoing projects.
- Infrastructural rehabilitation for existing/in use major irrigation projects – refers to the Ereğli-İvriz irrigation.
- Rehabilitation of irrigation systems – refers to the Small-Scale Irrigation Activities Program
- Financial support for adoption of modern irrigation systems with higher yield – refers to the Support for Rural Development Investments Project that encourages drip and sprinkler irrigation systems
- Research on groundwater potential and the future of this resource in the region
- Roadmap for surface water and groundwater use upon monitoring the utilization of and change in both resources (KOP Bölge Kalkınma İdaresi Başkanlığı, 2014).

2.1.3.3. Analysis

WWF (2014) reports that groundwater levels started decreasing in 1980s and have been decreasing ever since. Farmers on the field state that the decrease in groundwater levels have been the most severe in the recent past – the last 10 years or so. Older farmers tell stories of how they used to hand-dig groundwater wells because groundwater was abundant – available at only a couple of meters depth, and state that they usually had to drain the water from their fields to protect their crops fifty years ago or so. Today, some farmers – especially in Karapınar

region, drill 400 meters into the ground, yet they cannot find any water. The study on groundwater governance in KCB tells a typical tragedy of the commons story. The groundwater depletion in the basin is obvious; yet there is not a single, explicit driver that led to the situation today.

The groundwater use in the basin started in 1960s. The change in the crop pattern was the initial driver of the tragedy. Grains are cultivated during the rainy season of the basin, and their water requirement is lower than green plants. Grains such as wheat and barley were the only crops cultivated in the region until mid-20th century. Therefore, groundwater demand for irrigation was not high back then.

Sugar beet was the first green plant to enter the crop pattern in KCB. It has considerably higher water requirement compared to grains. Since mid-20th century, sugar beet has become one of the main agricultural products of the basin. Production of sugar beet in the basin was supported by the previous governments. In time, food industry developed around sugar beet cultivation. With sugar beet, first came the sugar refineries, and then the fast moving consumer goods (FMCG) corporations in food sector. For example, Konya Şeker (one of the oldest sugar refineries of Turkey - today it is one of the biggest industrial corporations in the country) started production in 1954. Konya Şeker was founded by the initiative of 16 sugar beet cooperatives in Konya region. Sugar beet has been an important element of the economic development of the region. The settling of sugar beet and the related industry in the basin is identified as a lock-in process by various stakeholders, which seems to be irreversible today. The agriculture and the food industry provide important economic benefits to the region. Preventing sugar beet production in the region would not only decrease the income but would also cause other issues like considerably higher rates of unemployment, and strong public opposition.

Since early 2000s, other green plants such as maize, sunflower, potato, fruits, beans etc. have entered the crop pattern. Among those, maize is the most prominent and was adopted fastest by the farmers. Maize is currently the most popular crop among farmers, mainly because of three reasons: First, the revenues are high. However, some interviewees argue that the profit gained from maize and wheat has become nearly equal in the past few years because the cost of electricity (to pump groundwater for irrigation) has increased steeply due to reduced

groundwater table. Second, farmers state that maize is very low maintenance; one only needs to switch on and off the valves for irrigation after sowing, there is no need for field work. Thirdly, corn grains are conveniently marketed with easy to measure industrial standards, individual merchants and through the nation's largest agricultural stock exchange located in Konya city center.

The change in crop pattern increased the water demand for irrigation. Due to scarcity of surface water and precipitation, this demand was mostly met by groundwater resources. To reduce groundwater use, first sprinkler irrigation was adopted by farmers in the early 2000s, followed by drip irrigation a few years later. However, even though the government provides financial support for sprinkler and drip irrigation systems, some of the farmers seem to lack the necessary training regarding the most efficient use of these systems. During the interviews various stakeholders complain about farmers who do not appropriately use sprinkler/drip irrigation systems thus overirrigate their crops. Some even argue that drip irrigation of maize causes more water loss than traditional irrigation methods.

In addition, the infrastructure to pump groundwater, i.e., the number of groundwater wells, fell short of groundwater demand in time. The long bureaucracy to receive a well license seems to have worn out the farmers who seek agility in such processes. They state that if a groundwater well in a field dries out during crop growth season, another well needs to be drilled immediately to keep irrigation going. However, since DSI bureaucratic processes take too long, farmers do not usually wait for the license. Instead, they have unlicensed wells drilled in their fields to protect crops from drying. In 2008, DSI identified 66800 unlicensed wells in the basin, but a similar study has not been conducted since then. Today, the number of unlicensed wells is not certainly known but estimated by the interviewees to be more than 100,000 (twice the number of licensed wells). Additionally, farmers claim that if a groundwater well is being drilled in place of a dried licensed well, it is not illegal. However, according to legislation separate licenses are required for each well and a license cannot be transferred to another well.

Even though DSI has the legal responsibility to keep track of and close unlicensed wells, it is not a very common practice in the basin. There are multiple reasons: First, on the national scale, the governing party has had very strong support in the region since the early days of

their rule (early 2000s) and an important aspect of their political agenda has been to make farmers richer in the region. This aspect regarding the national government has other repercussions besides unlicensed wells, which will be covered in the following paragraph. Some farmers explicitly articulate that the state allows unlicensed wells, especially in times of drought, and even guides farmers to bring electricity to their wells – farmers can easily get the necessary infrastructure to be installed with a warehouse license and use the electricity for their unlicensed wells. Second, identifying and closing every unlicensed well requires human and financial capital at this point. If the enforcement of the rules had been strict from the beginning, the number of unlicensed wells in the basin would probably have been much lower than what it is today, and it would have been much easier to keep the situation under control with the capital at hand. Relatedly, a third reason is that after years of exemption, the rules are considered void. Today, any attempt to close an unlicensed well causes strong opposition in the villages. Interviewees from DSI tell stories of people chaining themselves to their wells to stop the operation, and security forces accompanying DSI engineers during the whole process to protect them. The stakeholders state that if the responsible parties receive information on drilling of an unlicensed well these days, they fine the field owner and the driller; however, do not close the well.

On the national scale, there has been some unsuccessful attempts to control water use and crop pattern. DSI is responsible for allocation of groundwater resources and provide groundwater use permits for each well, as stated in the *Groundwater Code* and *Regulation for Groundwater*. The quota is calculated per unit area, based on the gross irrigable land in the basin and the yearly groundwater potential. For KCB, the groundwater quota for irrigation is identified as 200 tons/decare/year. However, the quota has never been implemented because even the licensed wells are not being monitored, and there are more unlicensed/unknown wells than licensed ones. Therefore, there is a crucial information gap on how much water is being extracted each year from the basin (making it hard to calculate the water budget in the basin as well). The *Regulation for the DSI Groundwater Measurement Systems* was declared by the government in 2013 but it faced strong public opposition from the farmers. The regulation entails installing proper measurement systems for each and every groundwater well. The farmers perceived the regulation as the first step of a plan to control and restrict their groundwater extraction and rejected to install measurement systems in their wells. Since then,

the regulation is “in force” but is not enforced. In the following years, the basin-based agricultural production scheme has been discussed in the parliament, which would have ended maize production in KCB. Farmers with social power and management roles in powerful NGOs (such as KSB) reached out to Konya deputies and prevented the implementation of the plan. Overall, it is for the government’s political interests to keep farmers content. Therefore, even if the state has the power and capital to enforce abovementioned legislations and agricultural production schemes, the government seems to simply let farmers be to keep their votes – in this case, at the cost of groundwater depletion.

A regime change can be observed in irrigation cooperatives as well. From the early days of cooperatives to today, cooperative fields have expanded, and the number of members has increased. With the added impact of crop pattern change on groundwater demand, the irrigation schedule in the cooperatives have tightened. Even though cooperative managements have increased the number of their groundwater wells in the meantime, implementing an ideal irrigation schedule is hard for cooperative members today. While the severity of the situation varies among different cooperatives, some farmers can register only once or twice a month in the cooperative irrigation schedule. During the growth season, which corresponds to dry summer days for most green plants, farmers struggle to get in cooperative’s irrigation line as frequent as possible to keep a desirable yield. The crowd leads to some kind of a collective hoarding behavior, i.e., farmers who are already displeased with the schedule try to maximize the duration of irrigation each time their turn to irrigate comes, further tightening the schedule. As a result of this behavior, farmers end up irrigating their fields once every two weeks, for 10-24 hours, which is far from ideal for crop health and yield. Besides, there are private and unlicensed wells in the areas of irrigation cooperatives. The situation is worse in small cooperatives with less institutional power. For example, Mantar Irrigation Cooperative management states that there are more than 100 unlicensed wells drilled by field owners, while the cooperative itself operates only 45 licensed wells. The number of unlicensed wells in the larger cooperatives like İçeriçumra is also increasing, however the cooperative still has institutional power, which is supported by the political power of individuals in management.

In legislation, the property and use rights of groundwater are explicitly stated. In cooperative areas, groundwater is common property and community (cooperative) rules are pertinent.

Cooperative management is selected through democratic processes, with the participation of all members. However, the increase in groundwater demand incapacitated the institutional power of cooperatives. Cooperative managements are under political pressure, i.e., they overlook some self-ordained behavior of members to be reelected in the following terms. That members ignore cooperative management and their community rules and start individually extracting groundwater from their own wells in the region hints to a regime change in groundwater governance, from community control to de facto open access, resulting in the so-called tragedy of the commons.

Overall, as the water demand increased in the region, the adoption of high-yield irrigation technologies, land consolidation, and inter-basin water transfers have been the go-to solutions for all stakeholders. All these solutions are aimed at managing the supply of groundwater, whereas the ever-increasing groundwater demand is the critical point in groundwater depletion in the basin. The attempts to manage demand have failed so far; although Turkey has strong legal foundation for groundwater use and protection, implementation and enforcement is weak because of both deficiencies in capital and political interest of different parties (local and national). On the other hand, the awareness in the region regarding groundwater depletion is high, but farmers, who are the main users of groundwater in the region, are divided. While some are more optimistic and argue for a collective transformation in agricultural practices with adequate financial support from the government; others are more pessimistic and fatalist, they state that the groundwater will be depleted eventually one way or another. DSI's recent attempt in regular monitoring of groundwater tables in 128 pilot wells is promising in tracking the water budget in the basin, but then again, groundwater demand management, institutional make-over, and more participation in governance seems to be required to be able to stop the tragedy of the commons.

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2.2. Requena-Utiel, Spain Case Study

2.2.1. System Characterization

The plain of Requena-Utiel is located in the western part of the Valencian region, in the southeast of Spain. In particular, it is located within the Júcar river basin district, in its central part. The study site has an area of approximately 1.274,3 km^2 and comprises the Requena-Utiel aquifer, together with the Cabrillas-Malacara aquifer. The majority of their surface is within the Júcar river exploitation system, while in the northeast, a small area of about 42,35 km^2 is within the Turia river exploitation system. Practically the entire area of Requena-Utiel aquifer, 987,91 km^2, is situated in the province of Valencia, although in the north, a small area of approximately 21,5 km^2 extends through the province of Cuenca, Castilla la Mancha. Figures 9 and 10 show the location of Requena-Utiel and Cabrillas-Malacara groundwater masses While Cabrillas-Malacara aquifer, which has an extension of 286,34 km^2, is situated entirely in the province of Valencia. The entire study site is located within the Júcar Hydrographic Demarcation.

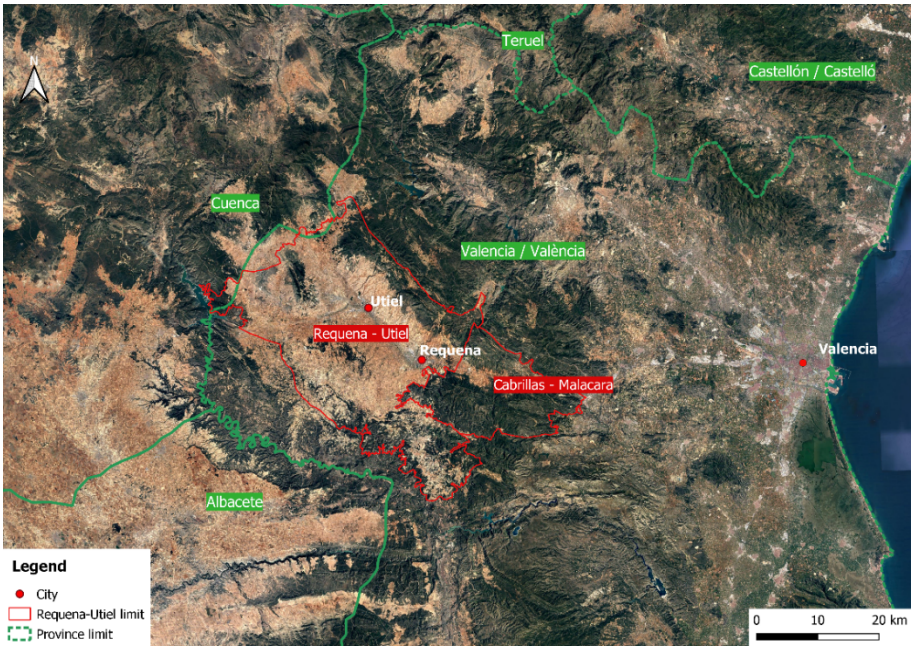

Figure 9. Location map of Requena-Utiel and Cabrillas-Malacara aquifers and the limit of provinces, Spain

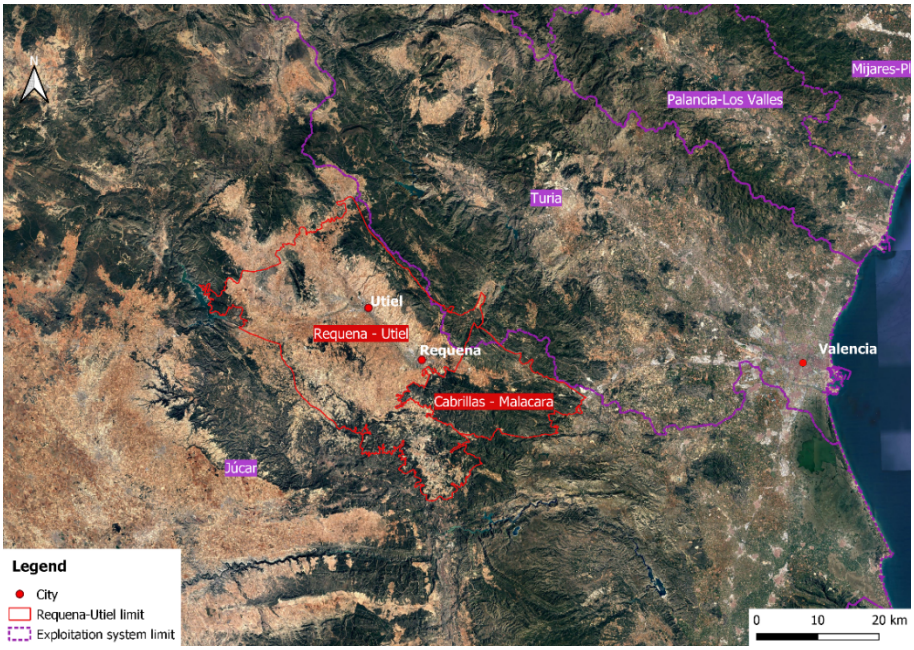

Figure 10. Location map of Requena-Utiel and Cabrillas-Malacara aquifers

In the basin, more than half of the surface corresponds to agricultural areas, approximately 52.5 %. Essentially, the other half of the surface pertains to forest and semi-natural areas, approximately 46.3 %. The remaining 1.2 % corresponds to artificial areas such as urban fabric

and roads. Therefore, agriculture is the most prominent sector in water and land use in the system. Conjunctive use of groundwater and surface water for irrigated agriculture is used, entailing around 88% of the total water use in 2017. The main cultivation in the area is vine for winemaking, woody crops such as fruit trees, almond trees and olive groves, as well as herbaceous crops [15].

The main irrigation users are grouped into three agricultural demand units (ADU), which are presented in Table 4. Among these three ADU, there are 1,001 registered wells in 080.133 Requena-Utiel groundwater mass and 55 wells in 080.139 Cabrillas-Malacara, their location is displayed in Figure 68. Riegos de Alto Magro has the highest pumping.

The second largest use of the water resources of the system is urban supply, representing approximately 13% of the resources. Finally, industrial production is the third water demand, comprising approximately 12% of the resources. Among the industries that can be found in the study area, it can be highlighted the tanning, food and furniture industries. There are 63 registered wells in 080.133 Requena-Utiel groundwater mass and 7 wells in 080.139 Cabrillas-Malacara

Table 4. Agricultural Demand Units (ADU) and irrigation users at Requena-Utiel case study [4]

ADU Code	ADU Name	Irrigation User
082033A	Hoya de Buñol y Chiva	C.G.U. Godelleta, Aguas de Cheste-Chiva IC, Buñol IC, Chica IC, La Redonda de Yátova IC, San Jaime de Alborache IC and Santa Bárbara de Macastre IC
082044A	Alto Magro irrigations	Fuencaliente Irrigation Community (IC), Fuente de las Reinas IC, Fuente del Pino IC, Gollizno IC, Las Casas-Los Corrales de Utiel IC, Regajo IC, Riegos Las Cuevas de Utiel S. COOP., Riegos La Mina IC, Regantes de La Vega de San Antonio IC and Central Union of the Irrigation Communities of Requena
082044B	Mixed irrigations of the Utiel plain	Riegos los Ruices IC

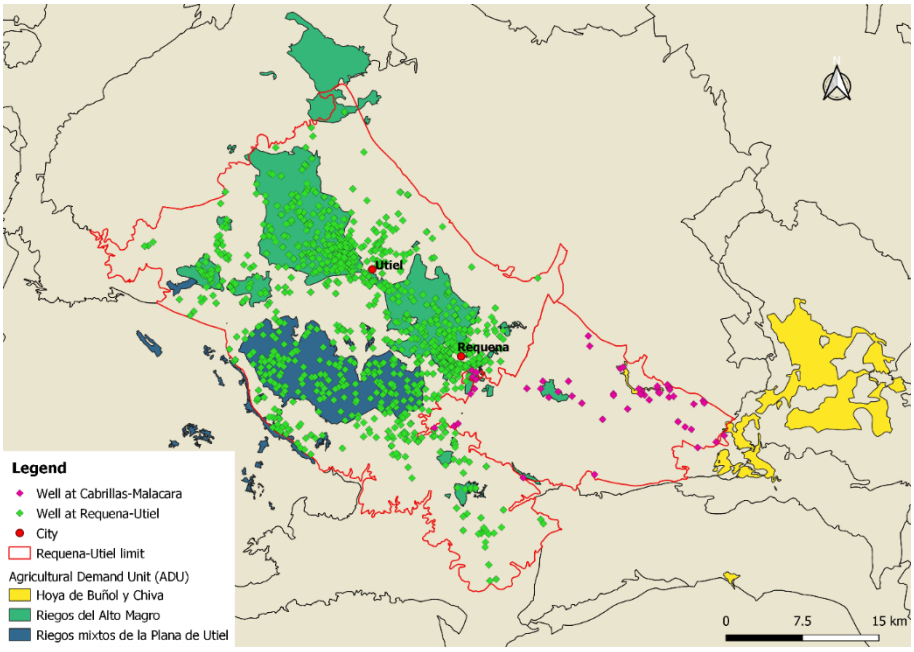

Figure 11. Agricultural demand units and their corresponding wells at Requena Utiel case study, Spain

In addition to the direct benefits of the Requena-Utiel aquifer to basin stakeholders, the site provides further ecosystem services. A large part of the study site is declared as Sites of Community Importance (Lugares de Importancia Comunitaria, LIC) (Council Directive 92/43/EEC, of May 21 1992, on the conservation of natural habitats and of wild fauna and flora) and as Special Bird Protection Zones (Zonas Especial Protección para las Aves, ZEPA) (Directive 2009/147/EC of the European Parliament and of the Council of November 30, 2009 on the conservation of wild birds), integrated into the Natura 2000 network (Directive 92/43/ECC).

Furthermore, over the 080.133 Requena-Utiel groundwater mass, there are three perimeters classified as protection zones for mineral and thermal waters, covering an area of 8,15 km^2. The designation of the protection perimeters is defined by Directive 2009/54/EC of the European Parliament and of the Council, of 18 June 2009, on the exploitation and marketing of natural mineral waters, and Law 22/1973, of Mines (articles 23, 24, 25 and 26). Finally, there

are 7 springs associated with the 080.133 Requena-Utiel groundwater mass, while for the 080.139 Cabrillas-Malacara there are 2 springs (Figure 12).

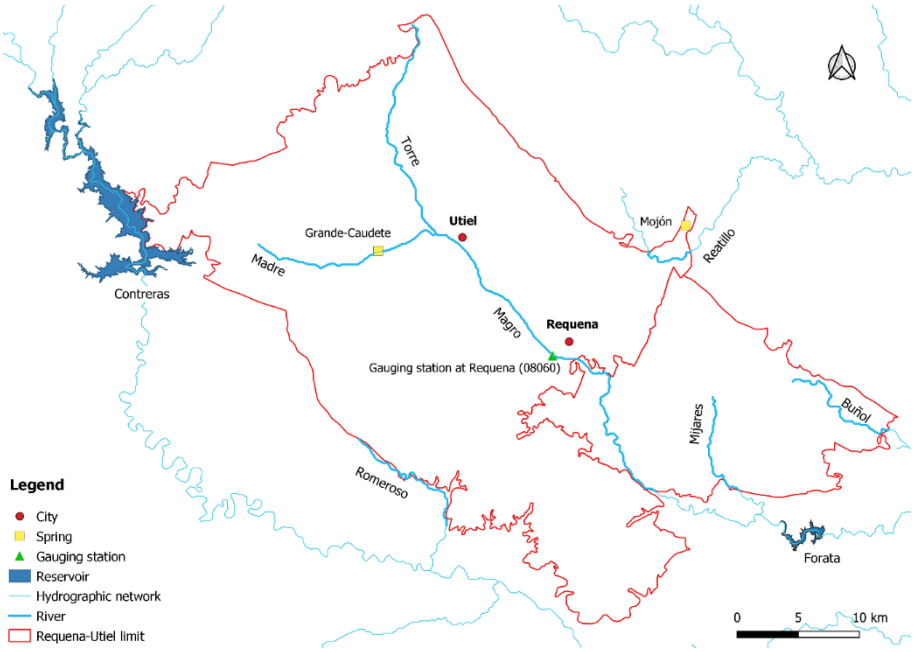

Figure 12. Location map of the springs, hydrographic network and reservoirs of the Requena-Utiel case site, Spain

2.2.1.1. Main Issues

The main issue in the Requena-Utiel aquifer (080.133 Requena-Utiel and 080.139 Cabrillas-Malacara groundwater masses), would be described as unsustainable use of groundwater resources caused by irrigated agriculture. Numerous pumping began in the 1980s and they have been increasing since 2001, due to farmers moving from vine crops to vines growing in trellises. The latter is more productive but requires irrigation to adequately control the stress at which the plant grows. The water level series show a progressive decrease and the aquifer storage balance is negative, which indicates the emptying of the aquifer. If this situation continues in the future, system recovery could be jeopardized.

This consistent drop in the water table may have caused other issues in surface water resources that depend on groundwater. The river-aquifer flow exchange between the Magro river and the aquifer system has diminished, which may be due to the loss of aquifer storage. Furthermore, a streamflow depletion in the Magro river has been noted, which may be

owning to the decrease in rainfall that has been experienced in recent decades. Consequently, the inflows to the Forata reservoir have been lower, which has led to supply problems to its users (irrigation purposes).

For the stakeholders in the basin, the groundwater level and water quality are important attributes, as they are heavily relying on agricultural production for their livelihoods. In a similar vein, soil quality and the health of the agricultural land has been vital indicators of their livelihood as well. Since the production levels are significantly dependent on climatic parameters such as precipitation and temperature, stakeholders have been paying attention to the changes in these parameters and consequently on the drought risk as well. Any change in the aforementioned attributes reflects on the socio-economic attributes of the basin such as population change, per capita income change and unemployment rates.

Water level measurements have been monitored since the 1980s and a sustained decline is perceived in the entire series that worsens from 2010. Despite not having piezometric information prior to 1980, climatic information, precipitation and temperature, and flow measurements in the Magro river as it passes through Requena and at the entrance to Forata reservoir are available since the 1940s. Thus, it would be appropriate to use the information available from the 1940s to the present.

Figure 13 shows the evolution of pumping in the study area from 1980 to 2017. It is noted how the groundwater supply for irrigation maintains a progressive growth throughout the series. However, it began to be really relevant from year 2001. When it started to account for more than 30 % of the demand, the pumping rate for the Requena-Utiel mass was 2.6 hm^3 and 0.3 hm^3, for Cabrillas-Malacara. The most current data, from 2017, shows that agricultural supply has risen to 15.3 hm^3 in Requena-Utiel and 1.1 hm^3 in Cabrillas-Malacara. In the case of urban supply, it remains constant throughout the series and despite being a smaller number of wells, the extracted volume is considerable.

In addition to groundwater stress exerted due to agricultural activity, the aquifer is also stressed by the climate change. The Mediterranean area is one of the regions that will be most affected by the effects of climate change. Meteorological information is available from the hydrological year 1940/41 to the present, and it has been noted that since 1980 the average temperature has risen slightly, while precipitation has decreased.

Various studies have been performed to characterize the effects of climate change in the Júcar Hydrographic Confederation, concluding that the anomaly in rainfall is defined by a great dispersion in its values according to the selected climate scenario. The Júcar Hydrological Plan establishes, for medium-term studies (up until 2027), the use of the global reduction coefficient of 12% on the average values of the system inflows for the period 1980/81-2011/12.

One of the most detrimental consequences of climate change is the increase in the severity of meteorological and hydrological droughts, due to the reduction on rainfall and increase in evapotranspiration. In 2013, there was a great drought in the study area that lasted until 2016, producing a shortage of resources that forced the users of the Forata reservoir to make use of the resources from the Júcar-Turia canal, after signing the corresponding agreements for the transfer of rights to use the resource.

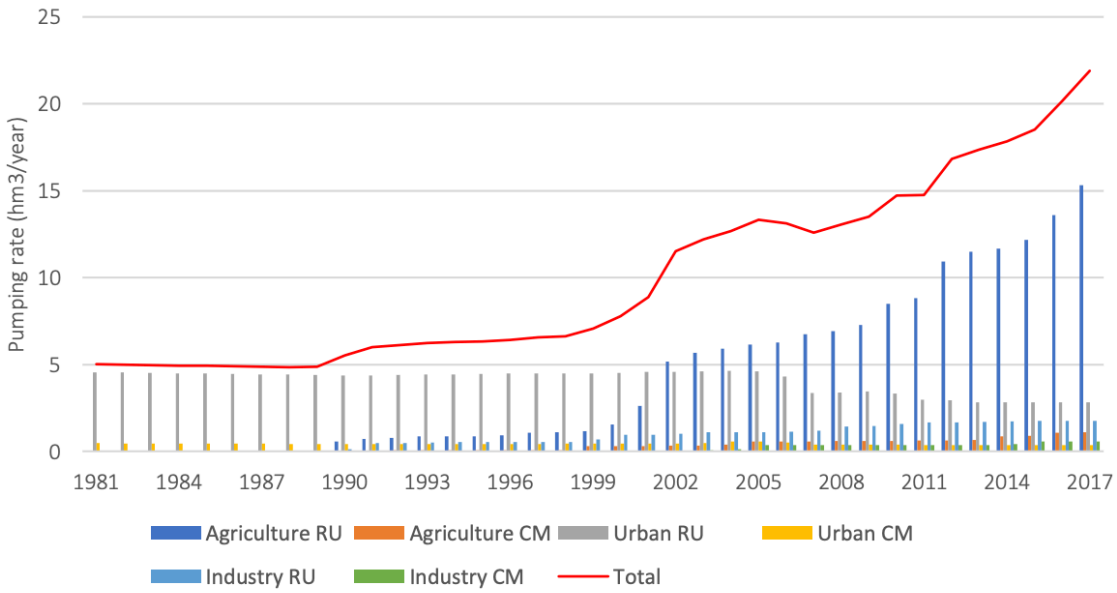

Figure 13. Pumping in Requena-Utiel and Cabrillas-Malacara groundwater masses, Spain

2.2.2. Stakeholder Mapping

Spanish water governance system unites common efforts of Public Administrations and private enterprises. Moreover, this system relies on strong public participation by civil society dating back centuries. The user communities are involved in the process of preparing the different plans and laws in relation to water management.

On a national scale, the Ministry for Ecological Transition and Demographic Challenge (Ministerio para la Transición Ecológica y el Reto Demográfico, MITECO) of the Spanish Government has the authority over water governance. Its office is located in Madrid, the capital of the country.

On a river basin scale, Water Authorities manage the water resources of the hydrographic demarcations, which refers to terrestrial and marine area composed of one or more nearby hydrographic basins and the transitional, groundwater and coastal water associated to these basins. These basin organizations are autonomous public bodies attached to the Ministry for Ecological Transition and Demographic Challenge (Ministerio para la Transición Ecológica y el Reto Demográfico, MITECO) of the Spanish Government, through the General Directorate for Water (Dirección General del Agua), under the superior direction of the Secretary of State for the Environment (Secretaría de Estado de Medio Ambiente). The organization chart of the authorities in relation to water governance in Spain is displayed in Figure 14. The Júcar Water Authority is the body responsible for the management of 080.133 Requena-Utiel and 080.139 Cabrillas-Malacara groundwater masses. It has several offices distributed throughout the territory it governs, in Teruel, Albacete, Alicante and Valencia, the latter being its head office.

The Spanish water governance system relies on public participation from user communities. Irrigation communities are governed by the legal framework of the Law of Water in force, they have the right to attend and intervene in matter that are submitted for debate, as well as the right to vote. They are involved in the process of preparing the different plans and laws in relation to water management. Regarding irrigation users in Requena-Utiel case study, they are mainly grouped into the following agricultural demand units:

- 082044A - Alto Magro irrigation.
- 082044B - Mixed irrigations of the Utiel plain.
- 082033A - Hoya de Buñol y Chiva.

Thanks to the collaboration with the Irrigation Communities, we can benefit from their experience and knowledge. Likewise, several wine companies (Vegalfaro, Vereda Real and Coviñas) are interested in sharing their experience in water use. It is necessary to establish a close connection with these stakeholders, since the trend to install irrigation systems in vineyards is an increasingly widespread method.

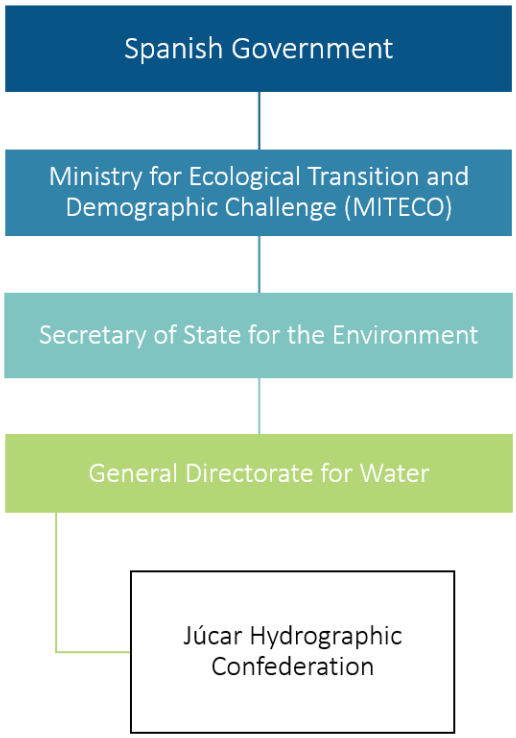

Figure 14. Organization chart of the authorities in relation to water governance in Spain, case study of Requena-Utiel

2.2.3. Governance Analysis

2.2.3.1. Existing Management Plans

National Hydrological Plan [20] in effect was approved by the Spanish Congress through Law 10/2001, of July 5, National Hydrographic Plan [21], and it was modified by Law 53/2002, of December 30 [21], Law 62/2003, of December 30 [23], Royal Decree-Law 2/2004, of June 18 [24] and Law 11/2005, of June 22 [25]. It contemplates measures to satisfy the water resources planning objectives for the different Spanish river basin districts in a balanced manner.

Basin Hydrological Plans are adapted to the strategies defined in the National Hydrological Plan [20]. Likewise, the composition of these documents is executed considering the principles of the Directive 2000/60/EC of the European Parliament and of the Council, of 23 October 2000 [26], which establishes a framework for Community action in the field of water policy, also

known as the EU Water Framework Directive, and the principles of the consolidated Water Law (*texto refundido de la Ley de Aguas*, TRLA), approved by Royal Legislative Decree 1/2001, of July 20 [27]. As described in the article 40.2 of the consolidated Law of Water (TRLA), the territorial scope of each Basin Hydrological Plan must conform to the limits of the corresponding river basin district. Additionally, the article 40.1 of the same law states that these documents will be developed by the corresponding basin organization or by the competent hydraulic Administration. These Plans determine the specific guidelines to be followed in order to execute an optimal water management in each basin district.

InTheMED Spanish case study is regulated by the Hydrological Plan of the Júcar Hydrographic Demarcation for the 2015-2021 term [4], approved by Royal Decree 1/2016, of January 8 [28], and it was written by the Júcar Water Authority. The territorial scope of the Júcar Water Authority is defined by the article 2.3 of Royal Decree 125/2007, of February 2 [29]. Currently, the Júcar Water Authority is immersed in the preparation of the future Hydrological Plan for the 2021-2027 term [15].

The Hydrological Plan of the Júcar Water Authority for the 2015-2021 term [4] declares the 080.133 Requena-Utiel groundwater mass in bad quantitative state. Consequently, and with the purpose of accomplishing efficient management and planning to ensure a reliable service to users and to restore the good quantitative status of the groundwater mass, the Exploitation Plan for the Requena-Utiel groundwater mass [30] was created in December 2016. The implementation of this Exploitation Plan was for a period of three years from the beginning of the hydrological year 2016/2017, with annual follow ups of the evolution of surface and groundwater resources. In December 2020, the Exploitation Plan for the Requena-Utiel groundwater mass was reviewed and updated. Nevertheless, once the Hydrological Plan of the Júcar Hydrographic Demarcation for the 2021-2027 term comes into force, this Exploitation Plan must be reviewed again within a maximum period of six months [31].

In this Exploitation Plan, the vegetative cycle of the main crops presents in the area of Requena-Utiel and the evaluation of the rainfall recorded in the area in two different periods: a winter period (from December to March) and another period that only considers the month of April, are considered so as to characterize each year as a dry, normal or wet year and,

thereafter, establish the average gross irrigation water requirements for each year. The Júcar Water Authority applies the following criteria:

- Dry year, when the precipitation in April is equal or less than 30 mm. Likewise, when the precipitation in April is between 30 mm and 50 mm and the accumulated precipitation in the winter period is equal or less than 100 mm. The average gross irrigation water requirements for the cultivation of vine, olive grove and dried fruit trees will be 600 m3/ha/year, which can be increased up to 900 m3/ha/year as maximum.
- Normal year, when the precipitation in April is between 30 mm and 50 mm and the accumulated precipitation in the winter period exceeds 100 mm. Likewise, when the precipitation in April exceeds 50 mm and the accumulated precipitation is the winter period is equal or less than 100 mm. The average gross irrigation water requirements for the cultivation of vine, olive grove and dried fruit trees will be 600 m3/ha/year, without exceeding this value.
- Wet year, when the precipitation in April exceeds 50 mm and the accumulated precipitation in the winter period exceeds 100 mm. The average gross irrigation water requirements for the cultivation of vine, olive grove and dried fruit trees will be 600 m3/ha/year, which can be reduced to 450 m3/ha/year as maximum.

To date, only precipitation and plant water needs has been analysed to establish agricultural supply rules. InTheMED aspires to elaborate rules using more sophisticated techniques, which consider a greater number of variables.

The effective control of the water volumes employed along with the conditions under which measurements and records must be executed are established in Order ARM/1312/2009, of May 20 [32]. User communities and private users are obliged to provide the Júcar Water Authority their consumption data in each catchment every six months, also including the irrigated area and the type of crop.

Furthermore, in 2018 the Special Drought Plan for the Júcar Hydrographic Demarcation [33] was approved through Order TEC/1399/2018, of November 28 [34], which aims to minimize environmental, social and economic impacts of droughts, differentiating situations of prolonged drought (meteorological and hydrological droughts), associated with the decrease

in rainfall and water resources in natural regime, and temporary shortages, related to temporary issues of lack of resources to meet the various socioeconomic water uses. Structural scarcity, produced when the water resources scarcity issues in a given area are permanent, is managed within the scope of general planning.

To combat groundwater contamination, Europe count on Directive 2006/118/EC of the European Parliament and of the Council, of 12 December 2006, on the protection of groundwater against contamination and deterioration [35], whereby the criteria for evaluating the chemical status of groundwater are defined. In Spain, Directive 2006/118/EC was transposed by Royal Decree 1514/2009, of October 2, which regulates the protection of groundwater against contamination and deterioration [18].

Spain has a proper policy framework on the treatment and discharge of wastewater. The regulations to consider with regard to urban wastewater rejects are Royal Decree-Law 11/1995, of December 28 [36], and the Royal Decree 509/1996, of March 15 [37], which establish the rules applicable to the treatment of urban wastewater. In order to request a discharge authorization, the Regulation of the Public Hydraulic Domain [38] must be considered, which develops the preliminary, I, IV, V, VI, VII and VIII tittles of the consolidated text of the Water Law, approved by Royal Legislative Decree 1/2001, of July 20 and also, Order AAA/2056/2014, of October 27, by which the official models of application for authorization and declaration of discharge are approved [39]. Moreover, since 2007, Spain has its own legislation on wastewater reuse by Royal Decree 1620/2007, of December 7, which establishes the legal regime for the reuse of reclaimed wastewater [40].

2.2.3.2. Analysis

Spain has a solid water governance system since the beginning of the 20th century. Hydrological planning by hydrographic demarcation is established with the Water Law of 1985, and the EU is based on it for the adoption of the Water Framework Directive.

The National Hydrological Plan in effect was approved by the Spanish Congress through Law 10/2001. Afterwards, Hydrological Plans were composed by the Hydrographic Confederations. A first term (2009-2015) Hydrological Plan was approved and currently, a second term (2015-2021) Hydrological Plan is in force, while the Hydrographic Confederations work on the third

term (2021-2027) Hydrological Plan. These basin organizations are public bodies attached to the Ministry for Ecological Transition (Ministerio para la Transición Ecológica) of the Spanish Government.

Requena-Utiel is regulated by the Hydrological Plan of the Júcar Hydrographic Demarcation for the 2015-2021 term, approved by Royal Decree 1/2016, of January 8, and it was written by the Júcar Hydrographic Confederation. This Hydrological Plan declares Requena-Utiel groundwater mass in bad quantitative state and, consequently, in December 2016 the Exploitation Plan for the Requena-Utiel groundwater mass was created.

Thanks to the Exploitation Plan, a more exhaustive study of the Requena-Utiel area and its piezometric levels has been performed in recent years. In the hydrological year 2016/2017 an improvement was noted, due to heavy rainfall. Nevertheless, years later, the downward trend in water level remains.

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2.3. Grombalia, Tunisia Case Study

2.3.1. System Characterization

The Grombalia region is located in south-western part of the Cap Bon Peninsula (Tunisia) and covers a surface of about 363 km^2, and brings together several urban agglomerations including Soliman, Bou Argoub, Grombalia, Beni Khalled and Menzel Bouzelfa. The basin is bordered by the Gulf of Tunis (N), the Takelsa Syncline (N-E), the anticlinal of the Abderrahmane Mountain and the oriental coastal plain (E), the plain of Hammamet (S) and the Bouchoucha and Halloufa reliefs (W) (Figure 15).

Figure 15. Geographic location of Grombalia Region, Tunisia (Google earth credit)

The Grombalia aquifer is dominantly used for intense agricultural activities such as vegetable crops, viticulture, arboriculture, cereal crops and livestock. The Grombalia basin is principally dominated by citrus, vines, grain, and vegetable crops. In the Beni Khalled and Menzel Bouzelfa regions 77% of the irrigated areas are intended for citrus cultivation. The latter has an important economical income to the region since it accounts for more than 78% of the citrus production at the national level (Lakani, 2014).

However, industrial as well as urban activities are also developed in the region. Many industrial units are installed in the study area, where the largest gathering are the industrial zones of Grombalia, Bouargoub and Solilman. The main sectors for industrial production are food industry, textiles, dairy, and stationery.

The Grombalia basin has a RAMSAR site, Soliman sabkha, an important ecological value in particular for migratory waterbirds which are concentrated in these areas in large numbers. Soliman sabkha is important for many species including some vulnerable and threatened species. The ecological and landscape qualities of this area located near the capital, the vicinity of Cap Bon and its various preserved natural areas promotes the integration of this wetland into a regional network of coastal protected areas which would strengthen the preservation of natural spaces and biodiversity.

Natural resources provide touristic value to the area (for example Soliman beach: a development plan for the tourist area of Borj Cédria - Soliman has been programmed and revised as part of the policy of restructuring and densification of existing tourist areas).

2.3.1.1. Main Issues

The Grombalia basin is threatened by anthropogenic pressures such as overexploitation of groundwater resources. This aquifer represents the principal source of water supply. In 2009, the annual exploitation in the region was estimated at 250 Mm^3/year. An increasing trend was recorded in the quantities of water withdrawn from the shallow and deep aquifer (Figure 16). Agricultural and industrial activities in the study region use significant quantities of water which is extracted mainly from the deep groundwater. Indeed, the farmers use deep aquifer in citrus irrigation especially in Beni Khalled, Menzel Bouzelfa, and Soliman regions because of its good quality. At the same time, an increase in the number of illegal wells is concerning. 600 wells are the total number of illegal wells installed until the end of 2017 estimated by the DGRE with an average annual volume of 6000 m^3/well (Slama et al., 2020).

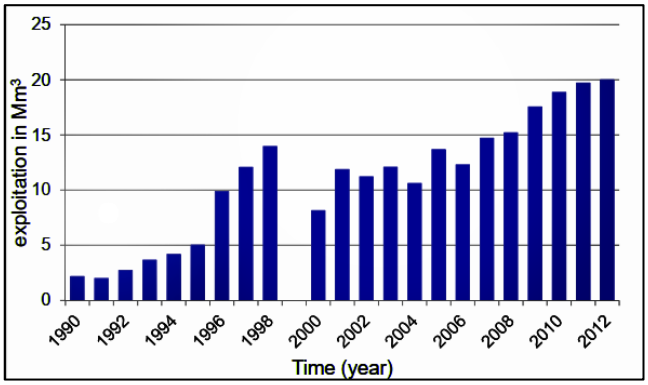

Figure 16. Evolution of Grombalia deep aquifer abstraction during 1989-2013 period (Lachaal et al., 2016)

The Grombalia aquifer is challenged by degradation in water quality and saltwater intrusion as well. The combination of excess irrigation with over-fertilization has led to deleterious effects on the environment through water contamination and increased Grombalia groundwater salinity. The TDS values of groundwater range from 0.75 to 5.6 g/l (Charfi et al., 2013). According to WHO standards (WHO, 2017), 50 mg/L is defined as the nitrate concentration threshold for drinking water. However, the average nitrate concentration of Grombalia groundwater is about 138.69 mg/L which is higher than the above threshold value (Lachaal et al., 2016). On the other hand, the deep aquifer is less polluted by nitrate than the shallow aquifer with nitrate concentrations ranging between 7.3 and 38.5 mg/L (Lachaal et al., 2016) which remained well below the WHO limit.

Indeed, the shallow aquifer is more likely exposed to the anthropogenic activities compared to the deep aquifer and then to the contamination which due mainly to the use of fertilizers in agricultural activities which have intensified in the area between Grombalia, Soliman, Beni Khalled, and Menzel BouZelfa (Lachaal et al., 2016).

2.3.2. Stakeholder Mapping

The Ministry of agriculture, hydraulic resources, and fishing is responsible for water resources management. The regional department of agriculture implements the water resources public policy at the regional scale. The Ministry of agriculture and its regional departments control water use at the quantitative level. The National agency of environmental protection is the environmental regulator while the Ministry of health watches over water safety.

At the regional level, the Regional Department of Agricultural Development (CRDA) manages water resources and sets up the public water policy at the regional scale. The Water Users Associations (GDA), which are private non-profit organizations, recognized as being of public utility, manage water for irrigation purposes in the agricultural areas equipped by the state. The GDA signs a management and irrigation contract with the CRDA in order to have access to water for irrigation.

The stakeholders of the Grombalia basin can be summarized as below:

Public Actors

- Commissariat régionale du développement Agricole à Nabeul (CRDA-Nabeul) (Regional department of agriculture Nabeul governorate)
- CTV : Territorial agricultural extension unit of Grombalia
- Municipalities of Soliman, Menzel Bouzelfa., Bouargoub and Grombalia
- Regional department of ANPE (National Agency for the Protection of the Environment)
- Regional department of ONAS (National sanitation utility)
- Grombalia District- SONEDE (National Drinking water utility)

Private Actors

- Industries: Maghreb Tanning Factory - TMM / SOTIPAPIER (Paper Industry)/ CHAMS (Production of "Brik", ARALCO (Production of food flavor), SIPAC (Production of Food additives), SNBG (Soft drinks), Blanchisserie Centrale Hôtelière, Coccinelle (Laundry), SPIM (Metal industry promotion company), Establishment Latrous Driss (Wine production), GTS (Jeans washing), SOTUFRA (manufacturer of automotive harnesses and radiators), YAB (Dairy plant), Industrial Zone Management Company of Bouargoub
- Farmers

Civil Society Actors

- Association of Environment and Development in Soliman (AEDS); Environmental association (REACT); JCI Grombalia; Radio Jeunesse Soliman

- GDA Marja, GDA Boucharay, GDA Turki, GDA Nianou, GDA Menzel Bouzelfa (Water users associations
- CERTE (Water Research and Technology Center)
- Scientific and Technical Association for Water and the Environment in Tunisia (ASTEET which organize scientific events, seminars and conferences in the field of water and environmental science and technology. Its aim is to raise citizens' awareness of the importance of protecting water resources within the framework of sustainable development.
- Water and development association (ADE) which is a multi-stakeholder platform offering a space for exchanging experiences, information and discussing the various subjects related to the field of water in order to meet the challenges of the sector and contribute to sustainable development and the improvement of the quality of life.

2.3.3. Governance Analysis

The water governance in Tunisia functions according to a centralized model. The water resources are managed according to a hierarchical approach and the water planning authority makes decisions centrally. The Ministry of Agriculture, Hydraulic Resources, and Fishing (MARHP) is designated as the main water authority, which plans water development, decides on allocations, and coordinates and controls the interests. Its mandate includes the protection of the national water resources. Its regional departments (CRDA) execute the national water policy, while at the local level, water user associations manage water in irrigated lands, but they do not participate in the decision-making process. The National Water Utility (SONEDE), which is under the control of the Ministry of Agriculture, holds the monopoly on drinking water supply over the entire country, otherwise some water user associations manage drinking water for some rural populations (Mellah 2018).

The water resources are considered as a public hydraulic domain according to the Tunisian Water Act. Access to water is regulated by a water abstraction-licensing scheme. Users apply for licenses and the Water Commission of the Ministry of Agriculture, assesses the applications

and then issues or denies licenses. The General Directorate of Water Resources (DGRE-MARHP) prepares the technical decision that will be examined by the Water Commission.

The mandate of the ministry of Agriculture includes the protection and the monitoring of the water resources. In addition, the Ministry of Health monitors drinking water safety and the National Agency of Environmental Protection (ANPE) plays the role of the environmental regulator. The inspectors under the Ministry of Health and the ANPE ensure that the official regulations are respected.

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