Typology of water disputes, groundwater at risk of use and conflict indicators

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Plan

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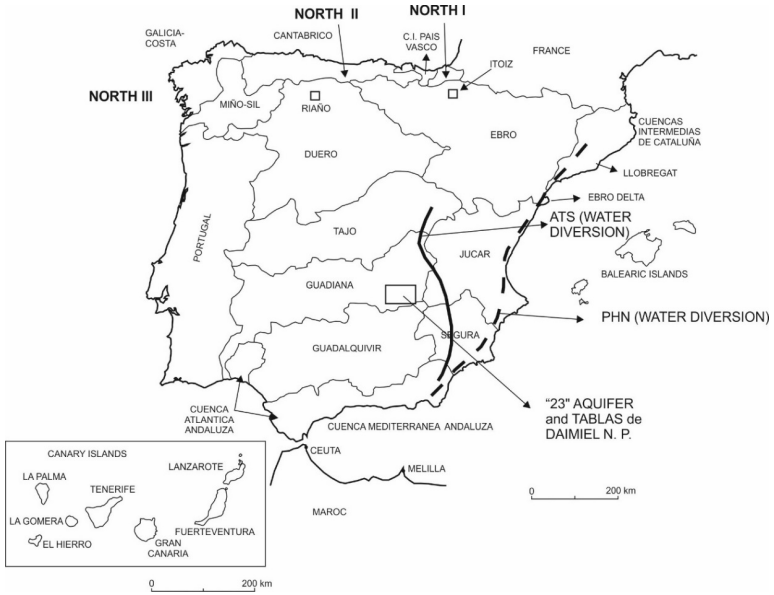
  - **Inter-basin Disputes**
  - **Groundwater – surface water interactions/impacts/conflicts**
- **Typology of potential Solutions**



Villarroya, Fornés and López-Gunn (in prep.)

Custodio el at (2009)

Introduction- Groundwater resources

- Groundwater Reserves 300,000 Mm^3
- Renewable groundwater volume est. 30,000 Mm^3/year
- 761 Groundwater bodies (EU Water Framework Directive)

- comparison----dams hold 55,000 Mm^3

Groundwater reserves per basin

Basins	Surface area x 10^3 km^2	Rainfall mm/year	ETP (1)	ETR (2)	Total runoff (3)	Base runoff (Groundwater) Mm^3/year	Dams Volume Mm^3
North I	17.60	1,284	709	563	12,689	2,745	
North II	17.33	1,405	653	604	13,881	5,077	-
North III	5.72	1,606	695	673	5,337	894	-
Galicia Coast	13.13	1,577	737	644	12,25	2,234	3,655
Duero	78.96	625	759	452	13,66	3	7,463
Tagus	55.81	655	898	460	10,833	2,393	10,974
Guadiana I	53.18	521	977	438	4,414	687	9,659
Guadiana II	7.03	662	1,075	511	1,061	63	-
Guadalquivir	63.24	591	991	455	8,601	2,343	8,782
Andalusian Mediterranean	17.95	530	969	399	2,351	680	1,041
Segura	19.12	383	963	341	803	588	1,129
Júcar	42.90	504	881	424	3,432	2,492	3,346
Ebro	85.56	682	792	472	17,967	4,614	6,504
Catalonian Basins	16.49	734	792	565	2,787	909	740
Balearics	5.01	595	896	463	661	508	11
Canary	7.44	302	1,057	247	409	681	101
Mean or total: km^2 mm hm^3	 506,470 -	 - 684 346,425	 - 862	 - 464 235,239	 - - 111,186	 - - 29,908	 - - 53,405

Introduction- Groundwater uses

Agricultural use: 4,300 Mm^3/year (74% groundwater withdrawals).

Urban use: 1,100 Mm^3/year (19% groundwater withdrawals).

Industrial use: 400 Mm^3/year (7% groundwater withdrawal).

Introduction- Groundwater uses- PWS

Table 1. Water uses in Spain in 2017 (excluded industrial refrigeration) (modified from De Stefano et al., 2013 a, b, 2014; Garrido & Llamas, 2009; MITECO, 2019; INE, 2019).

	WITHDRAWAL hm^3/year (%)	WITHDRAWAL Mm^3/year (%)	TOTAL Mm^3/year (%)
USE	Agriculture 24,500 (82%)	Urban and Industrial 5,500 (18%)	30,000 (100%)
ORIGIN	Surface water 24,200 (80%)	Groundwater 5,800 (20%)	30,000 (100%)
Agriculture	20,200 (82%)	4,300 (18%)	24,500 (100%)
Urban	2,600 (70%)	**1,100 (30%) (*)**	3,700 (100%)
Industrial	1,400 (78%)	400 (22%)	1,800 (100%)

(*) Public Water Supply-51% Andalusian Mediterranean basin; 49% in the Canary Islands (including desalination); 43% Júcar basin (De Stefano et al., 2014).

- **1,100 Mm^3 /yr** - 12.5 million people (26.7% of the population). 70% of small and medium size Spanish towns and cities (usually) rely upon groundwater (De Stefano et al., 2014).

Introduction- Groundwater uses- Agriculture

	SURFACE WATER	GROUNDWATER
AREA IRRIGATED (ha)	2,280,000 (71%)	920,000 **(29%)**
MEAN USAGE	8,860 m^3/ha/year	4,670 m^3/ha/year

- Agriculture- 29% of irrigated land – from groundwater (920,000 ha), = 18% of the overall quantity of water given over to irrigation (4,300 hm^3/year)
- Ratio of groundwater for irrigation is 4,670 m^3/ha/year; (surface water 8,860 m^3/ha/year).

EU and Groundwater bodies in Spain

- 729 groundwater bodies have been identified
- Area of 360,000 km^2 i.e. 71% of the national territory (Fernández Ruiz, 2016)
- Aquifers store between 150,000 and 300,000 Mm^3 first 200 saturated meters (Sahuquillo et al., 2009).

River Basin	Cycle	No of Water Bodies	Chemical Status		Quantitative Status		Water Body Status		
			Good	Bad	Good	Bad	Good	Bad	No data
	2º		4	2	6	0	4	2	0
Duero	1º	64	50	14	59	5	48	16	0
	2º		49	15	60	4	48	16	0
Tajo	1º	24	18	6	24	0	18	6	0
	2º		18	6	24	0	18	6	0
Guadiana	1º	20	7	13	9	11	5	15	0
	2º		5	15	9	11	4	16	0
Tinto, Odiel y Piedras	1º	4	2	2	3	0	2	2	0
	2º		1	3	4	0	1	3	0
Guadalquivir	1º	60	44	16	42	18	33	27	0
	2º	86	62	24	64	22	54	32	0
Guadalete y Barbate	1º	14	5	7	3	3	5	7	2
	2º		5	9	11	3	5	9	0
CC. MM. Andaluzas	1º	67	32	35	35	32	27	40	0
	2º		28	39	43	24	23	44	0
Segura	1º	63	39	24	22	41	16	47	0
	2º		38	25	23	40	17	46	0
Júcar	1º	90	63	27	60	30	50	40	0
	2º		67	23	60	30	49	41	0
Ebro	1º	105	82	23	104	1	82	23	0
	2º		81	24	104	1	81	24	0
Cataluña	1º	39	16	23	33	6	14	25	0
	2º	37	15	22	30	7	13	24	0
Islas Baleares	1º	90	55	35	53	37	47	43	0
	2º	87	43	44	53	34	33	54	0
Melilla	1º	3	0	3	0	3	0	3	0
	2º		0	3	0	3	0	3	0
Ceuta	1º	1	0	0	0	0	0	0	1
	2º		1	0	1	0	1	0	0
Canarias	1º	32	7	20	13	18	3	24	5
	2º	--	--	--	--	--	--	--	--
TOTAL	**1º**	**748**	**489**	**251**	**532**	**205**	**419**	**321**	**8**
	2º	**729**	**474**	**255**	**550**	**179**	**408**	**321**	**0**

Tabla 33. Valoración del estado químico, cuantitativo y global de las masas de agua subterránea en los dos ciclos de planificación.

Groundwater rights in the EU and in Spain

EU

- The Water Directives do not “enter” into water rights and water allocation issues which is deemed a national matter, ragulated under member states national laws

Spanish Water Law

- Before 1985: groundwater had been considered a private property
- After 1985: Water declared public (belongs to the State) with one exception- some groundwater
    - The current situation of the coexistence of public and private groundwater in a single aquifer has been a constant source of problems (Llamas et al., 2015).
    - Only half a million wells (out of est. 2 million) are registered (Fornés et al., 2005).
    - Additional management Powers:
        - To declare aquifer overexploited (Artículos 1 y 2, Ley 29/1985),
        - Regulate water abstractions (Artículo 54, Ley 29/1985). y catalogación se entendía como condición previa a la explotación sostenible del recurso

1. Typology of Conflicts-

Groundwater and land-use Water quantity-quality nexus

- ***Report on Progress from EU 2nd Cycle Plans***

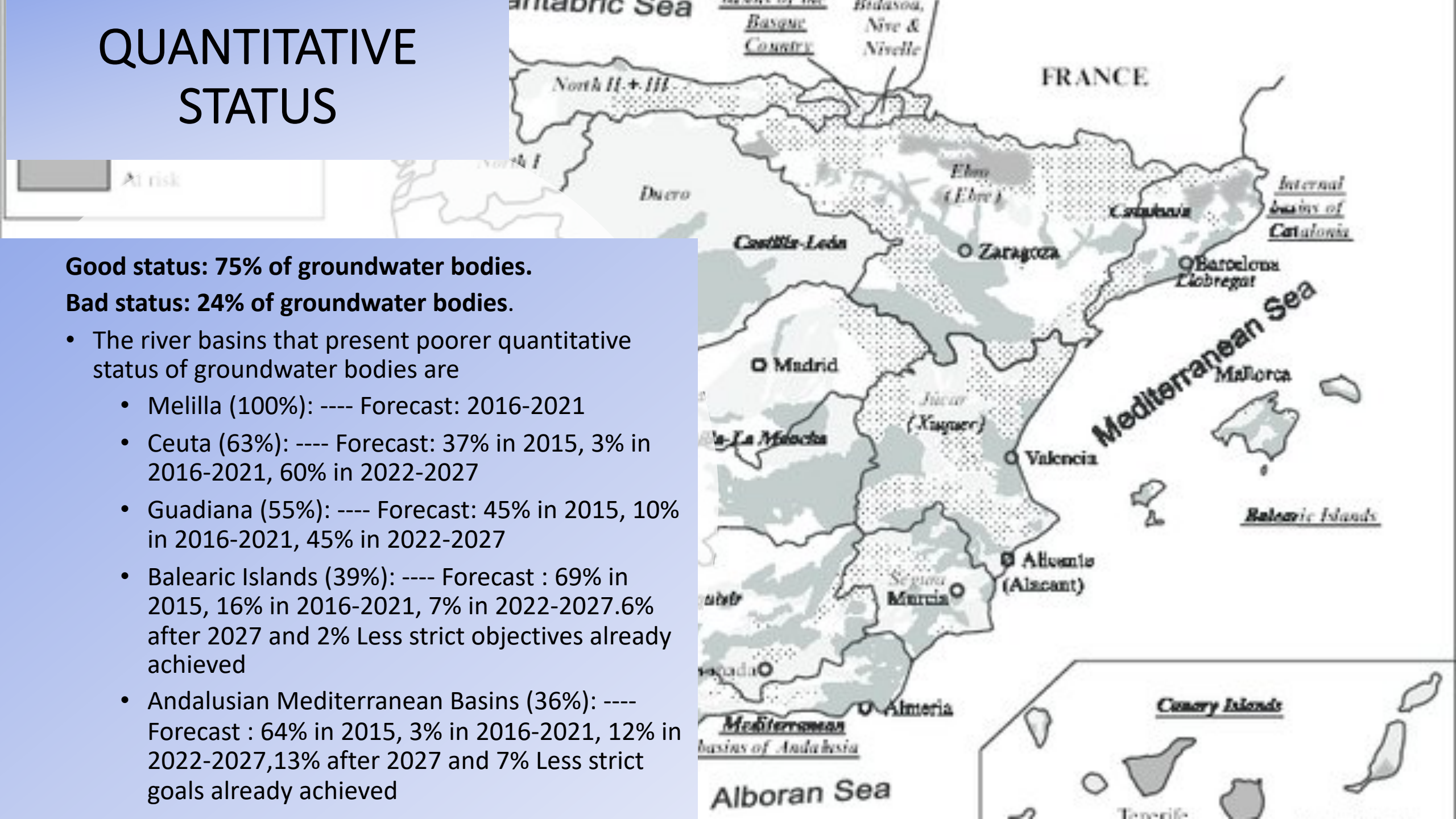
EU Report on 2nd Cycle Hydrological Plans
Monitoring, assessment and classification of quantitative status of groundwater bodies

"84 groundwater bodies are still not subject to groundwater quantitative monitoring. It has to be considered that information from the Canary Islands river basin districts has not been reported in the second cycle reporting. In river basin districts Ceuta and Melilla, there is no quantitative monitoring**. The number of monitoring sites increased by approximately 15** % when comparing the two planning cycles".

All groundwater bodies now have a clear status. **About 25 % of the groundwater bodies are at risk of failing good quantitative status**.

The overall status situation improved: for the RBDs for which information is also available from the first RBMP, the **number of groundwater bodies failing good quantitative status declined slightly**.

QUANTITATIVE STATUS



Good status: 75% of groundwater bodies.

Bad status: 24% of groundwater bodies.

- The river basins that present poorer quantitative status of groundwater bodies are
  - Melilla (100%): ---- Forecast: 2016-2021
  - Ceuta (63%): ---- Forecast: 37% in 2015, 3% in 2016-2021, 60% in 2022-2027
  - Guadiana (55%): ---- Forecast: 45% in 2015, 10% in 2016-2021, 45% in 2022-2027
  - Balearic Islands (39%): ---- Forecast : 69% in 2015, 16% in 2016-2021, 7% in 2022-2027.6% after 2027 and 2% Less strict objectives already achieved
  - Andalusian Mediterranean Basins (36%): ---- Forecast : 64% in 2015, 3% in 2016-2021, 12% in 2022-2027,13% after 2027 and 7% Less strict goals already achieved

QUANTITATIVE STATUS

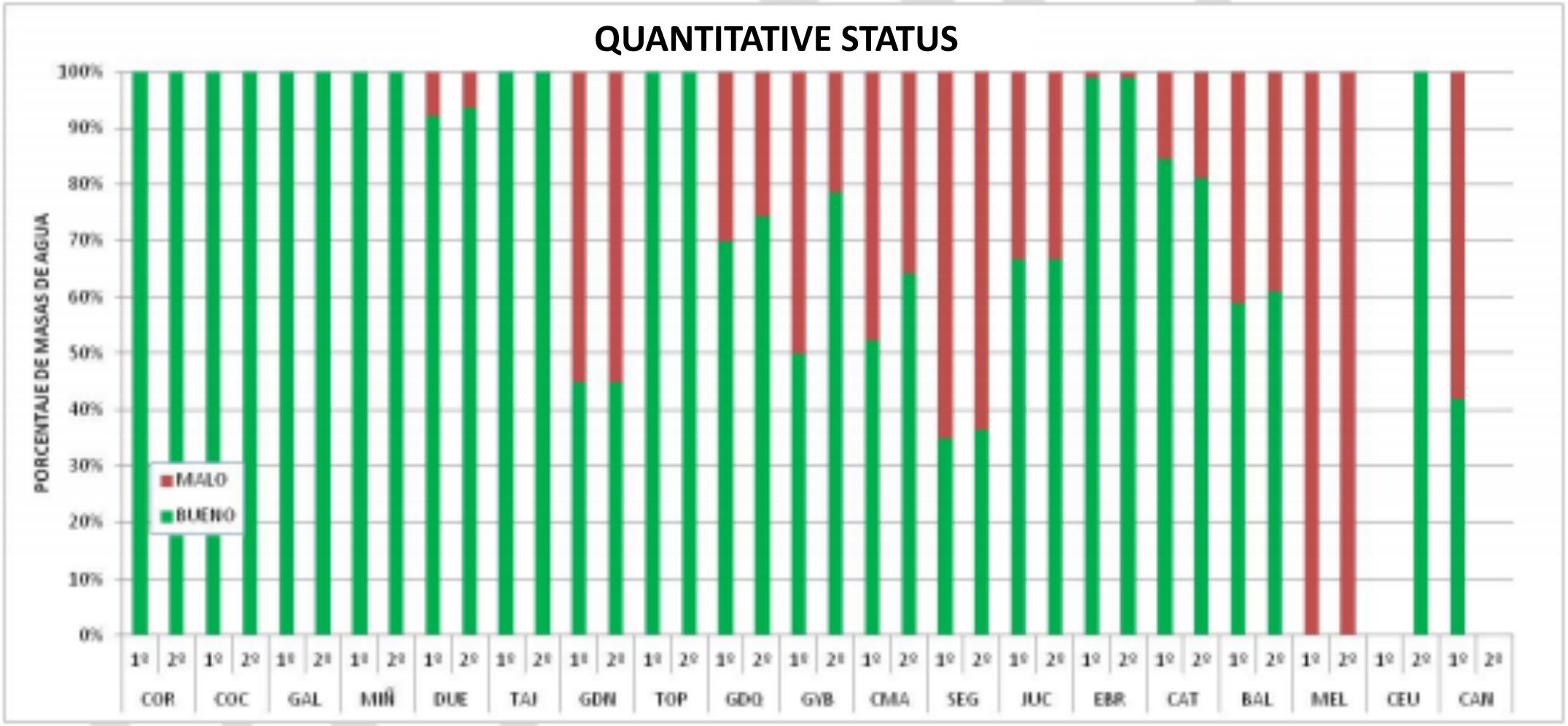


Figura 12. Estado cuantitativo de las masas de agua subterránea.

EU Report on 2nd Cycle Hydrological Plans
Monitoring, assessment and classification of chemical status of groundwater bodies

Efforts have been made in groundwater status assessment, so the number of groundwater bodies in unknown status has been significantly reduced since the first RBMPs (from 8 to 1 out of 729 groundwater bodies). **31 % of the total groundwater body area is failing good chemical status.**

The **coverage of groundwater bodies by monitoring of chemical status is not complete,** neither for surveillance monitoring nor for operational monitoring. The coverage of groundwater bodies at risk by operational monitoring has increased since the first RBMP (18 %)

Not all substances causing risk are subject to monitoring. All WFD core parameters are monitored in seven river basin districts but in nine river basin districts the coverage is incomplete.

for all substances causing risk and in two of 18 river basin districts natural background levels have not been considered

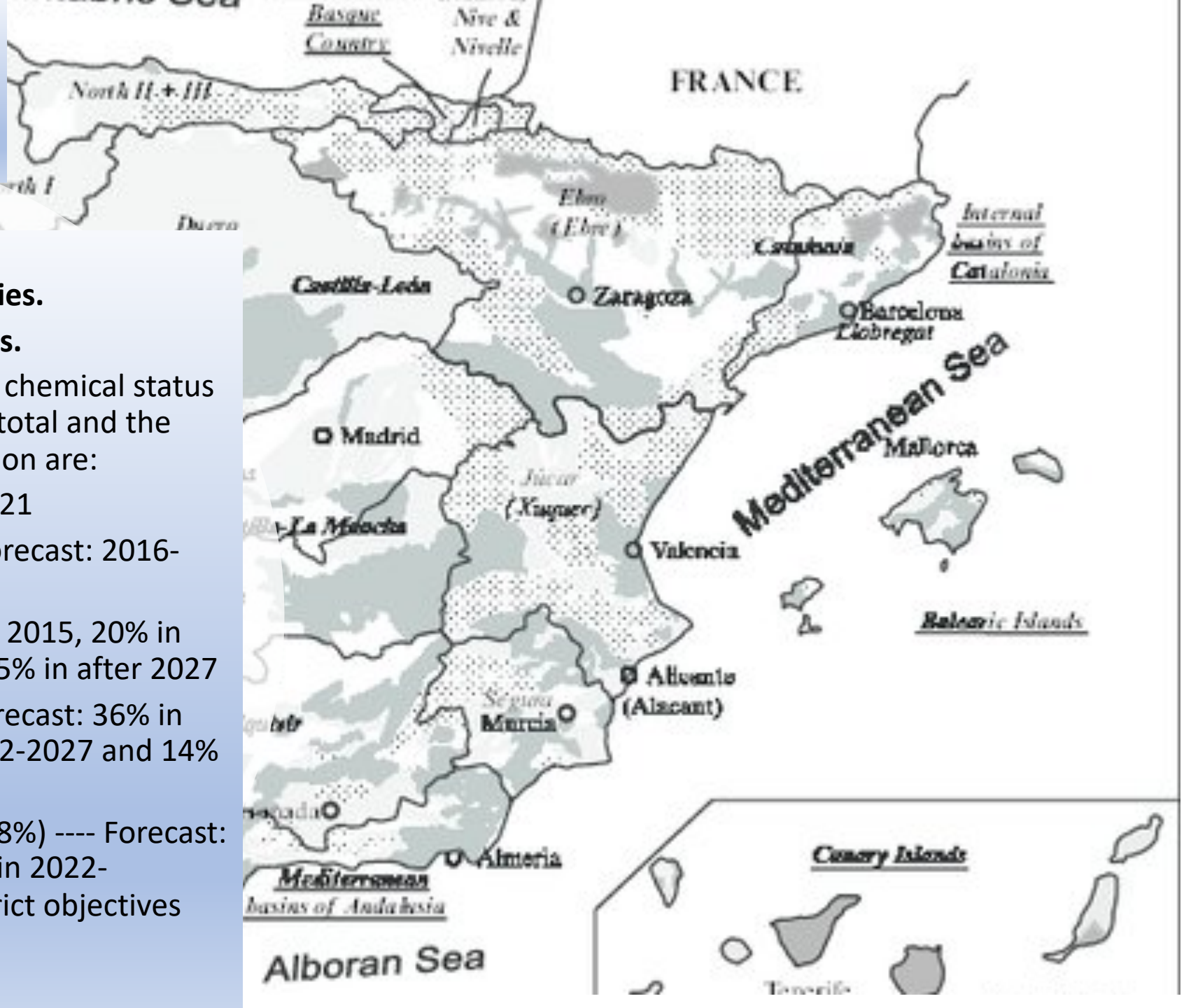
CHEMICAL STATUS

Good status: 65% of groundwater bodies.

Bad status: 35% of groundwater bodies.

The river basins that present the worst chemical status of its groundwater with respect to the total and the expected date of reaching good condition are:

- Melilla (100%) ---- Forecast: 2016-2021
- Tinto, Odiel and Piedras (75%) ---- Forecast: 2016-2021
- Guadiana (75%) ---- Forecast: 20% in 2015, 20% in 2016-2021, 45% in 2022-2027 and 15% in after 2027
- Guadalete and Barbate (64%) ---- Forecast: 36% in 2015, 29% in 2016-2021, 21% in 2022-2027 and 14% Less strict targets already achieved.
- Andalusian Mediterranean Basins (58%) ---- Forecast: 39% in 2015, 31% in 2016-2021, 9% in 2022-2027,16% after 2027 and 4% Less strict objectives already achieved.



CHEMICAL STATUS

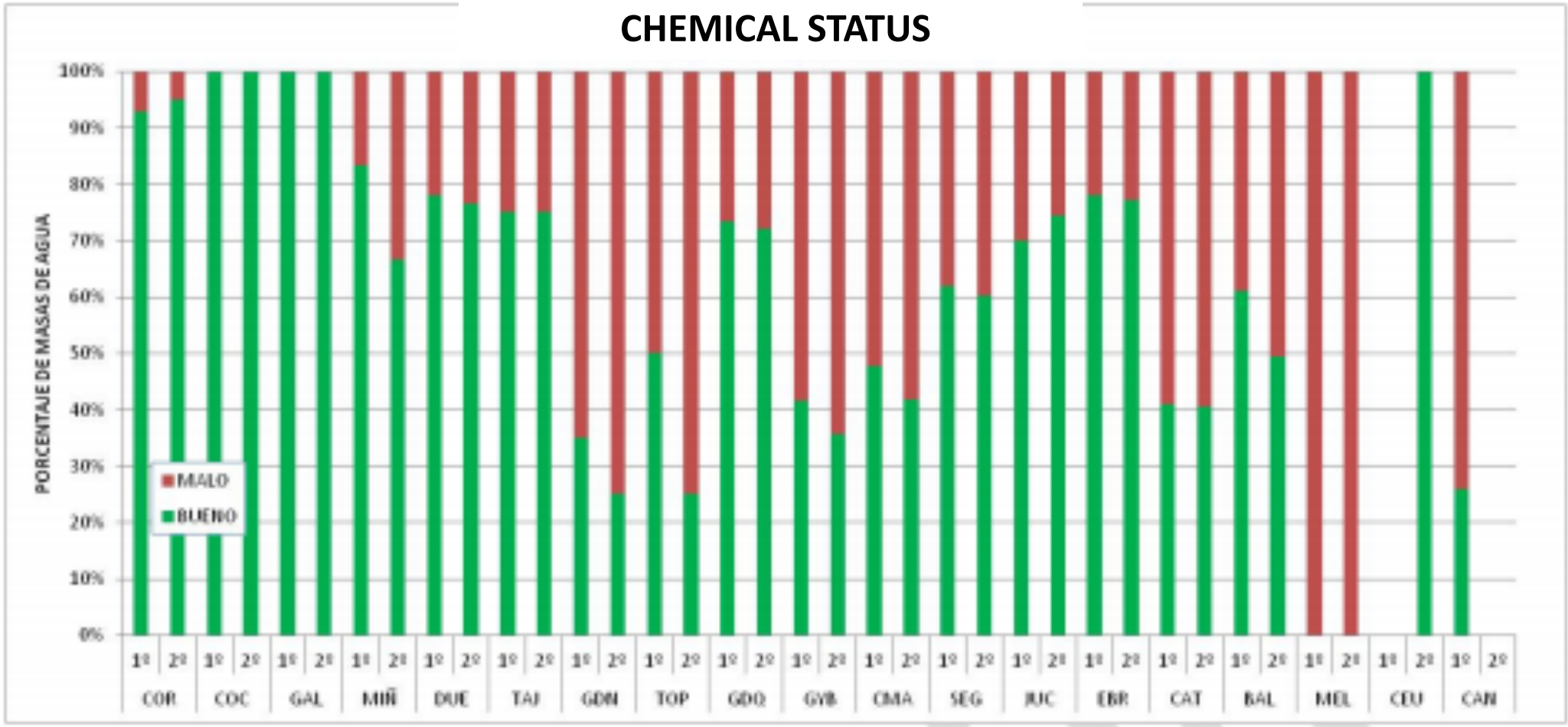


Figura 11. Estado químico de las masas de agua subterránea.

2. Typology of Conflicts- *Urban vs agricultural settings*

- In Spain it is not so much a conflict agricultural vs urban rather groundwater and land-use, as roles and responsibilities between different levels and thus difficulty in aligning interests
  - Water Planning- State
  - Land use Planning- regions (including agriculture as main use)
  - Public water supply- cities
- A strong legislative frame has a clear priority between uses which largely nulls conflict
- ***Conflict is more due to the pressures on groundwater from agriculture (quantitative and qualitative)***

Agriculture and Groundwater- intensive water use

"The most significant pressures on groundwater bodies in terms of proportion of groundwater bodies affected at the national level was diffuse agricultural (56 % of groundwater bodies), abstraction or flow diversion for agriculture (32 %), and abstraction or low diversion for public water supply (27 %) (Figure 2.2). The three most common pressures on groundwater at the country level were diffuse agriculture (significant in 14 of the 18 RBDs with reported information), abstraction or flow diversion for agriculture (12 RBDs) and abstraction or flow diversion for public water supply (10 RBDs).

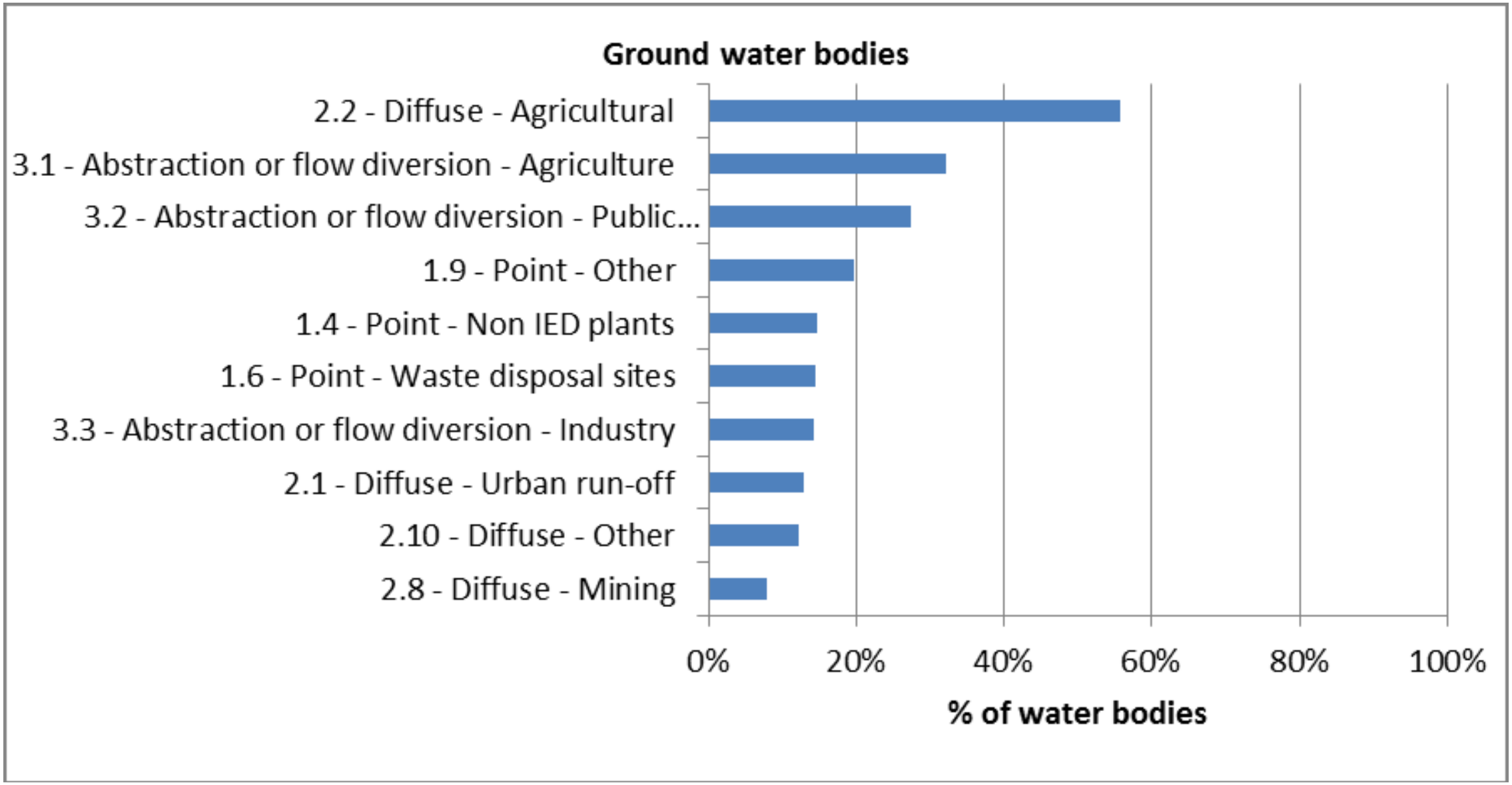


Fig. 2.2 The 10 most significant pressures on surface water bodies and groundwater bodies in Spain for the second cycle

3. Typology of Conflicts- *interbasin disputes*

- Tagus-Segura: recent ruling of Supreme Court (March 2019) on ecological flows will impose more constraints on transferring water to the Segura basin

- Jucar-Vinalopó: one of the main reasons for the transfer was due to the overexploitation of the aquifers in the area. Very conflictive transfer

4. Typology of Conflicts- *groundwater-surface water interaction*

- Groundwater dependent ecosystems- key aspect due to EU Water Framework Directive
- Frequent use of conjunctive use in Spain and alternate use (i.e. case of Madrid- groundwater seen as a strategic reserve in times of drought, “pozos de sequia”).
- There are 475 groundwater bodies linked to surface water bodies, representing 65% of the total groundwater bodies
- The river basins whose masses of groundwater are linked with respect to the total river basin area are: Miño-Sil (100%), Tinto, Odiel and Piedras (100%), and the Ebro (98%)
- There are 275 bodies of groundwater linked to terrestrial ecosystems, representing 38% of the total groundwater bodies
- The river basins whose groundwater bodies are linked with respect to the terrestrial ecosystems mass by DH are: Guadiana (100%), Ceuta (100%), and Guadalete and Barbate (85%)

Typology of solutions? -

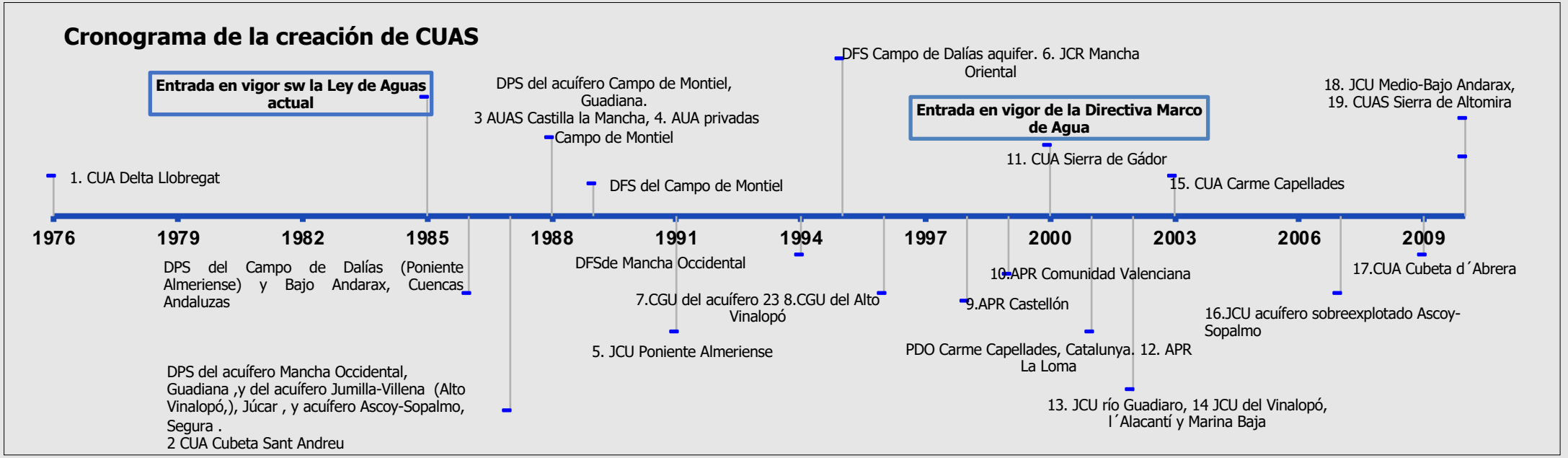
- Risk Management- diversify range of resources
- Groundwater User Groups
- Role of information

(Ground) Water User Groups

1975: first groundwater user community- lower Llobregat valley and delta (*Comunidad de Usuarios del Acuífero del Delta del Llobregat)*.

Now around 20 gathered around *Asociación Española de Usuarios de Aguas Subterráneas* (Spanish Groundwater Users Association) (Llamas et al., 2015; Rica et al., 2012; López-Gunn & Martínez Cortina, 2006).

Timeline of Groundwater User Groups creation



Typology of solutions?

- Climate change - groundwater as a strategic resource for socio-economic development in many areas in Spain.
- the cost recovery by groundwater users to increase water availability in intensively used aquifers;
- Increase transparency and accountability in relation to groundwater rights and to the actual cost of groundwater overdraft for the taxpayer;
- Influence on decisions that affect water use that are made outside the water planning sphere.

Thank you!

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