The role of economic and social instruments in drought management: pricing, trading and awareness campaigns

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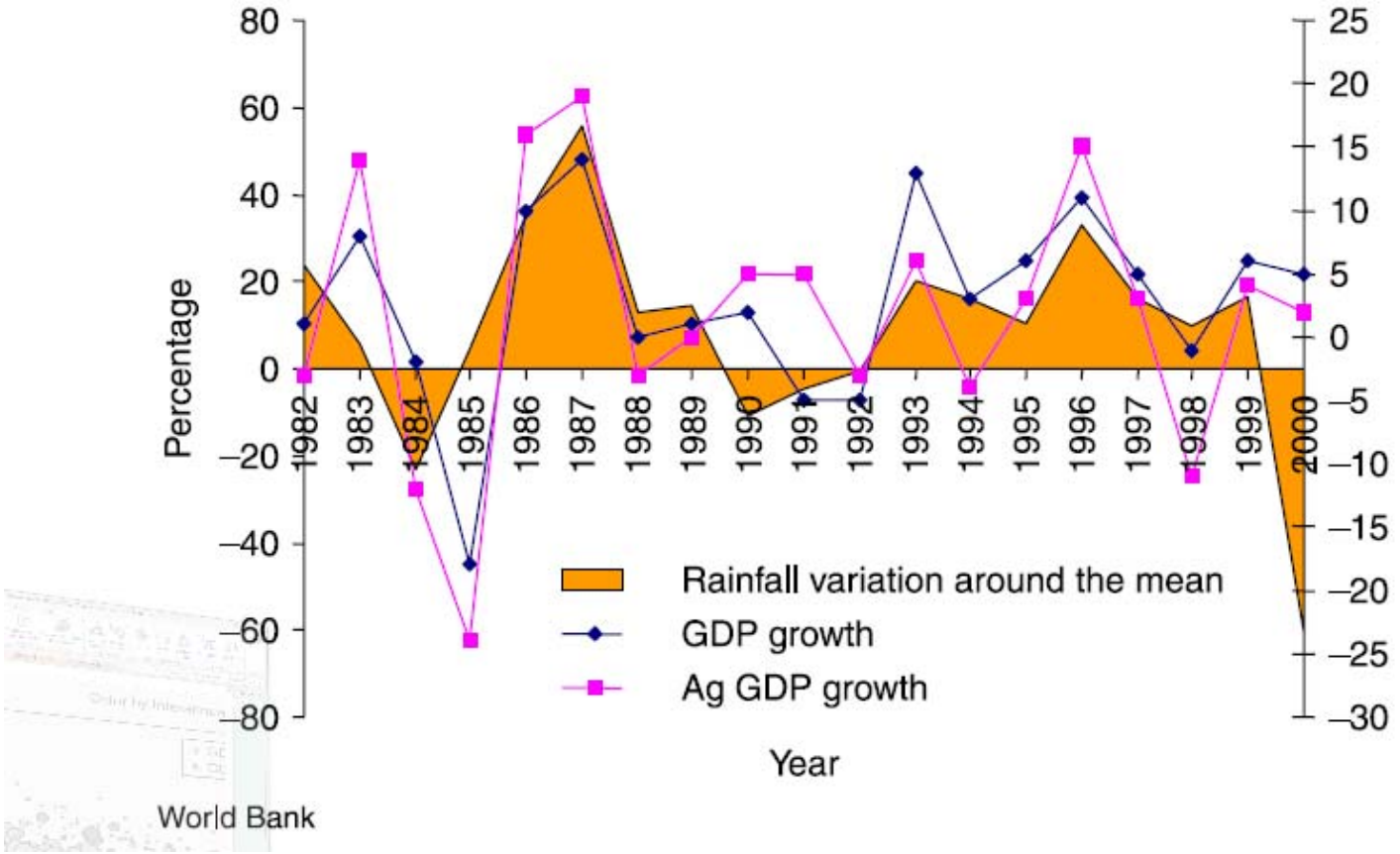
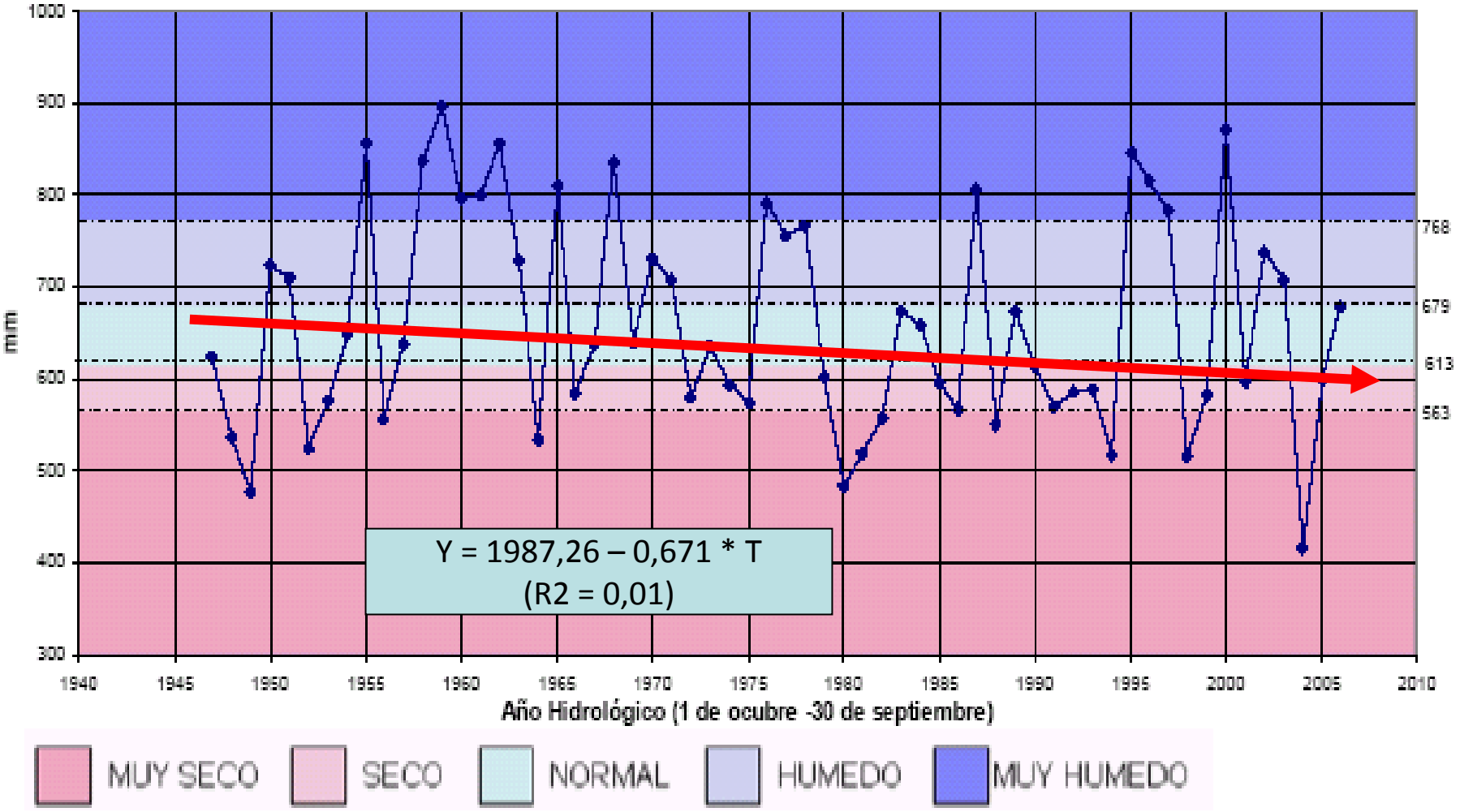
Hydrology and Low Development Traps

Rainfall, GDP and agricultural GDP for Ethiopia.



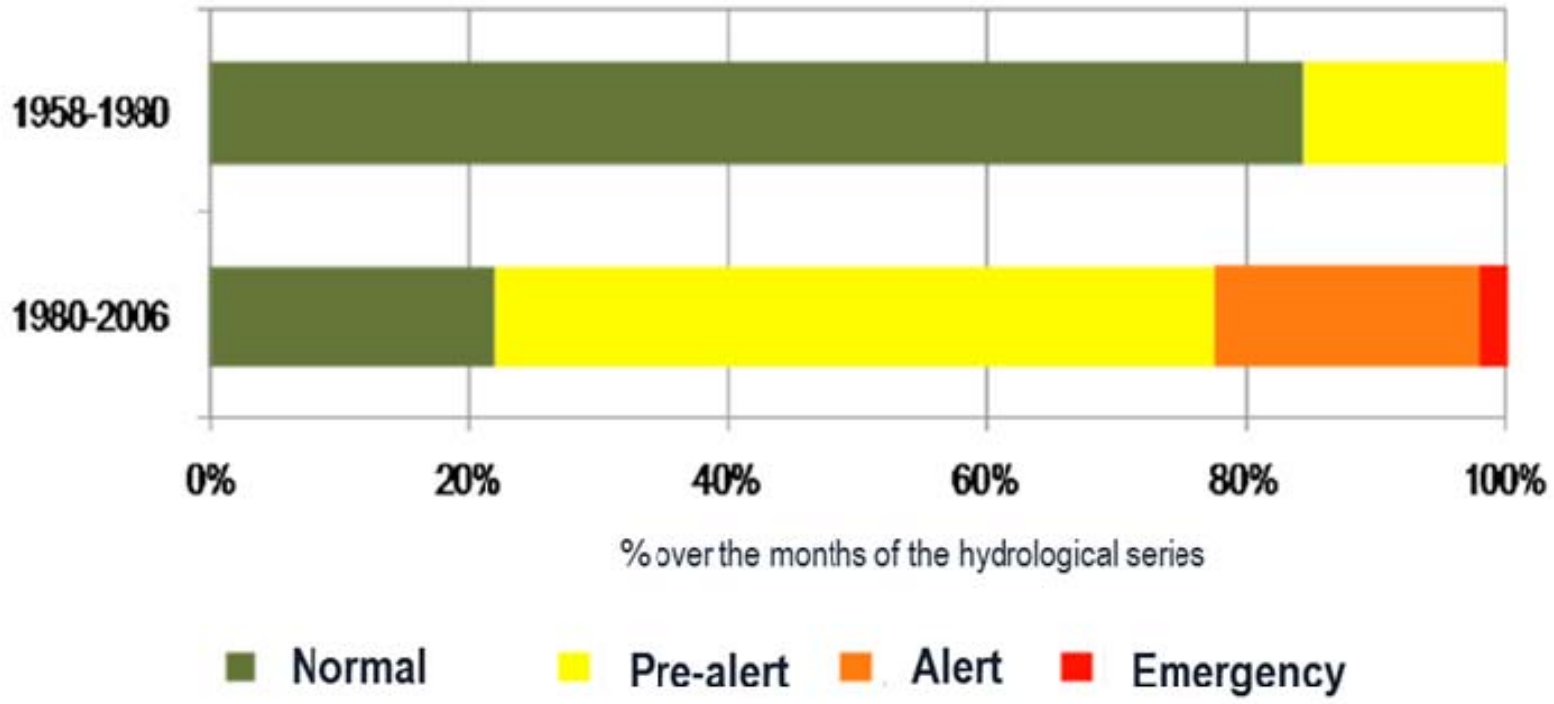
Evidence of reduction of average annual rainfall since 1947 to 2006: 0,67 MM per

Annual rainfall in Spain



Source: Ministry of the Environment, Rural and Marine Affairs, Spain

But droughts: not a meteorological problem anymore



Hydrological situation applying the drought thresholds in alert and drought situations

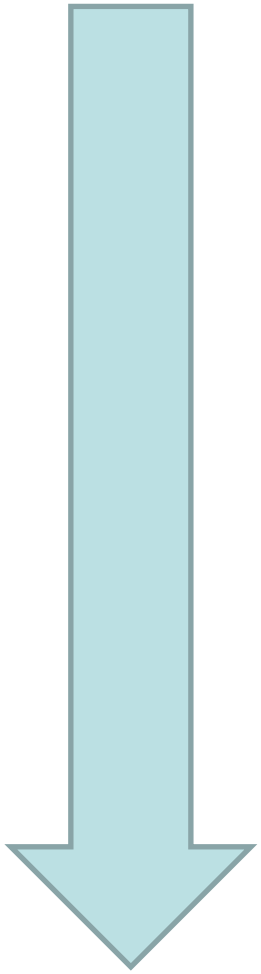
Source: TRBA, 2011

Economic Instruments

Key economic instruments

1. Prices and Taxes
2. Licensing and reallocation instruments (trading/voluntary agreements)
3. Subsidies and conditionality.
4. Insurances

European framework (Commission communication 2007) The hiarchy



- Water pricing
- Land use planning
- Financing improved technical efficiency
- Water supply infrastructures
- Water efficient technologies and practices
- Water saving culture
- Knowldege and data collection

Pricing and Managing Water

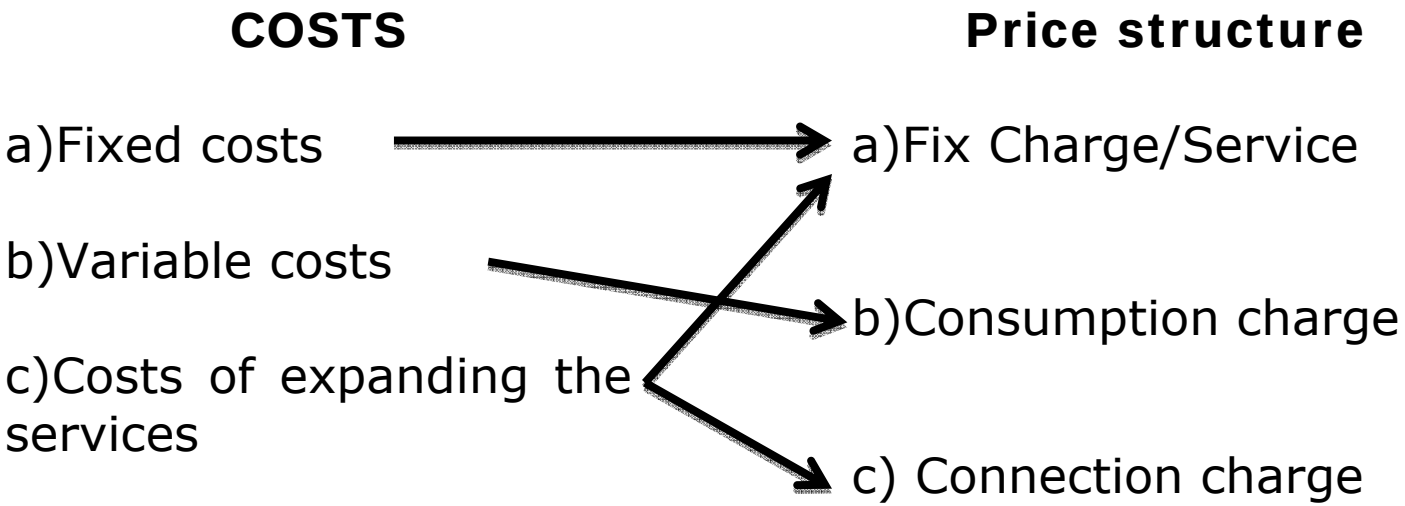
- [Financially] cheap sources may be overexploited and unreliable (surface water)
- [Financially] costly sources may be reliable but unused (desalinated water)
- In between there are reliable but increasingly overexploited and uncontrolled sources (groundwater) and reliable but limited (an expensive?) sources (wastewater).
- This may:
    - > Compromise the financial viability of the whole supply system.
    - > May lead to unsustainable use of freshwater and over sizing/overinvestment.
    - > It may increase water insecurity in the long run.

PRICING IN URBAN AREAS

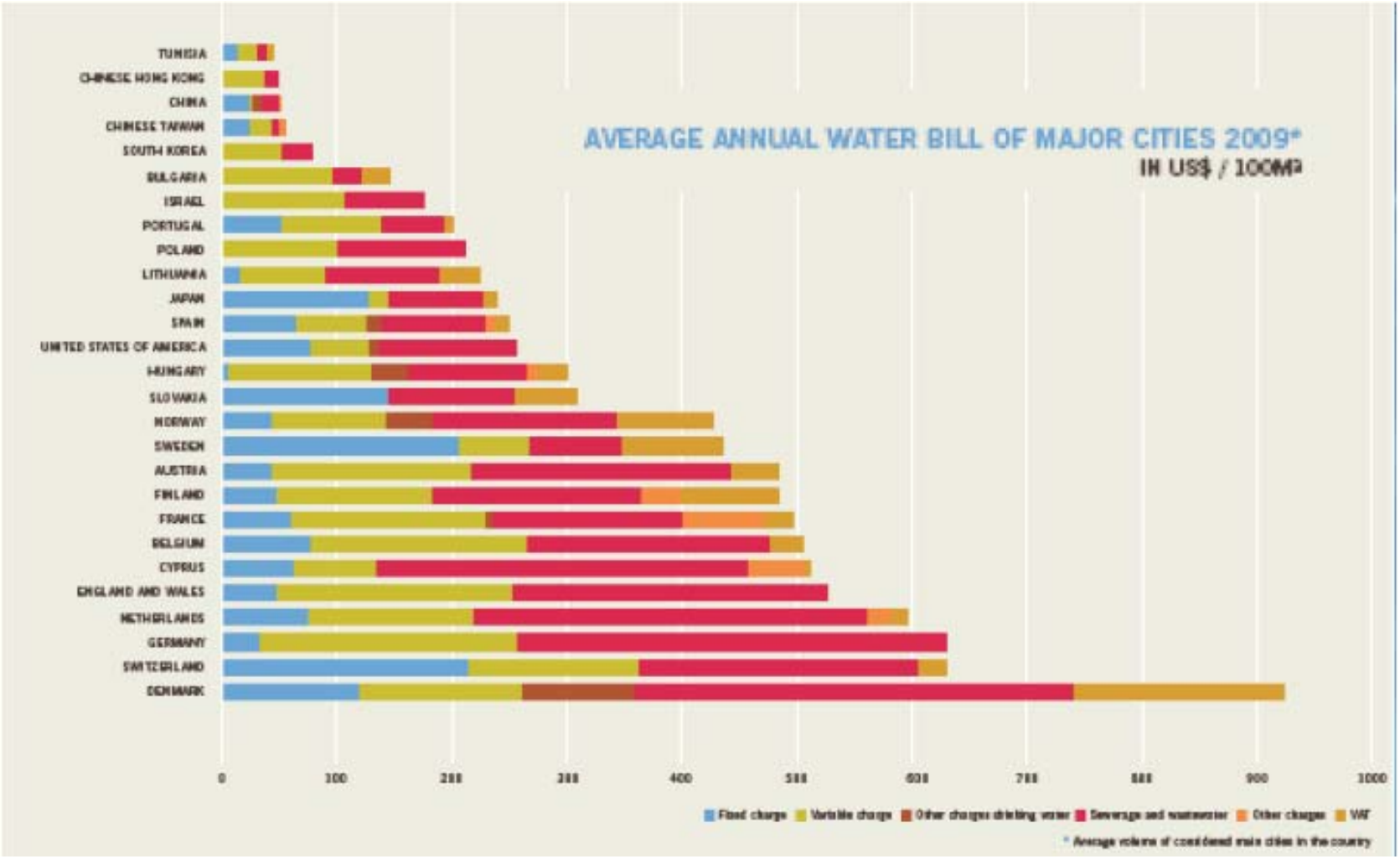
-The charges

-The structure

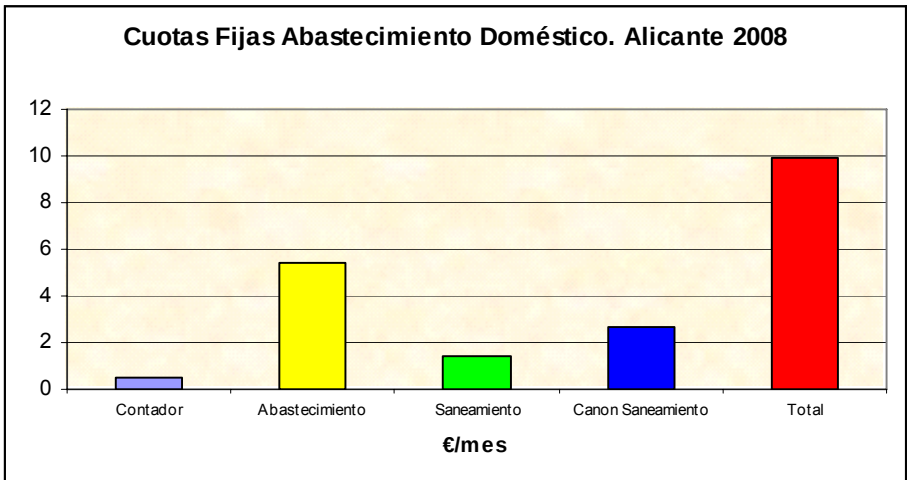
-The effects

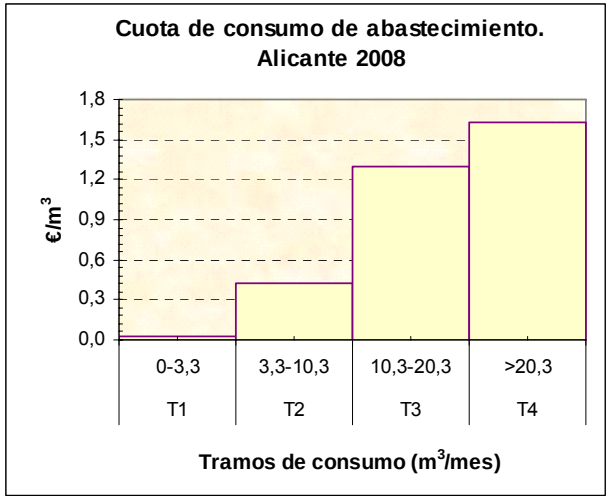

COSTS
Price structure
a)Fixed costs
b)Variable costs
c)Costs of expanding the services
a)Fix Charge/Service
b)Consumption charge
c) Connection charge

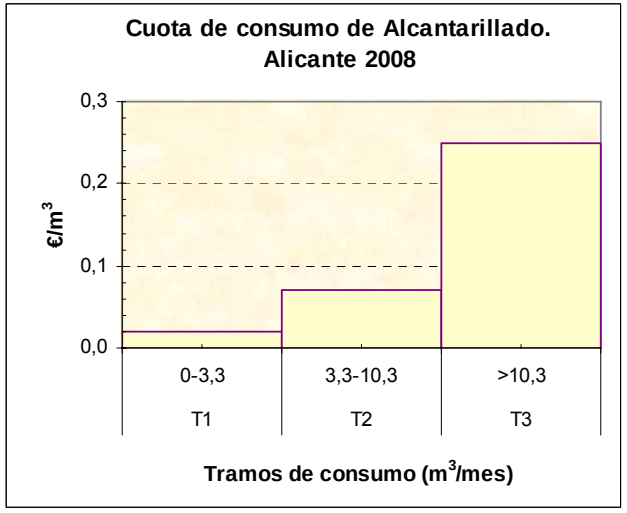
Structure of charges



Increasing costs of bulk water is reflected in volumetric and increasing block pricing Alicante

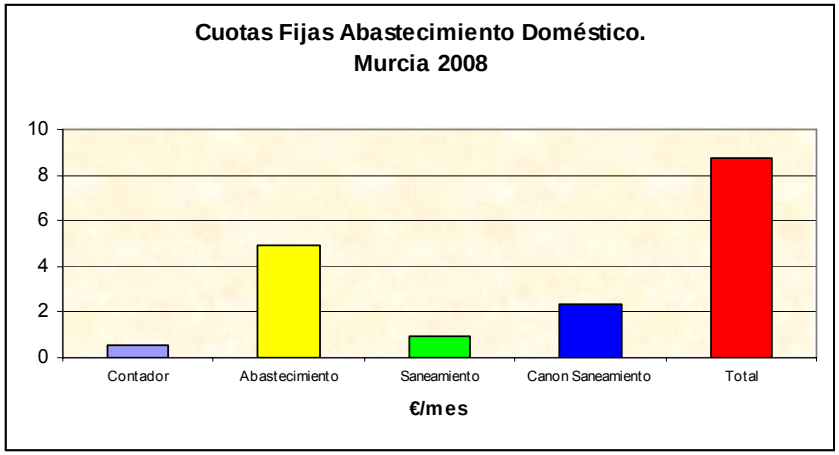


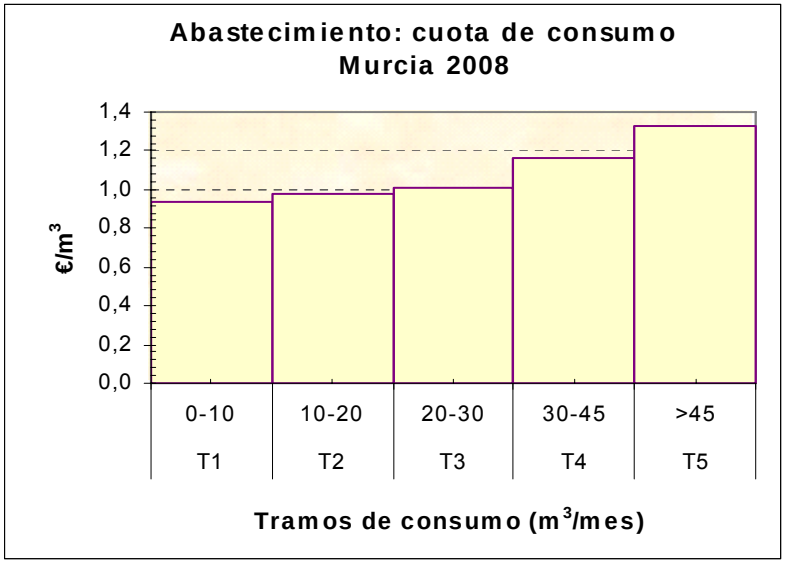




- **Average HH water use per capita 139 l/per day**
- **Average price paid by HH 1,64 €/m^3 (19,127 € per HH per month). Before Tax.**
- **On average the water bill is 0,7% of per capita income.**
- **HH with higher water consumption will pay more than double.**

In Murcia



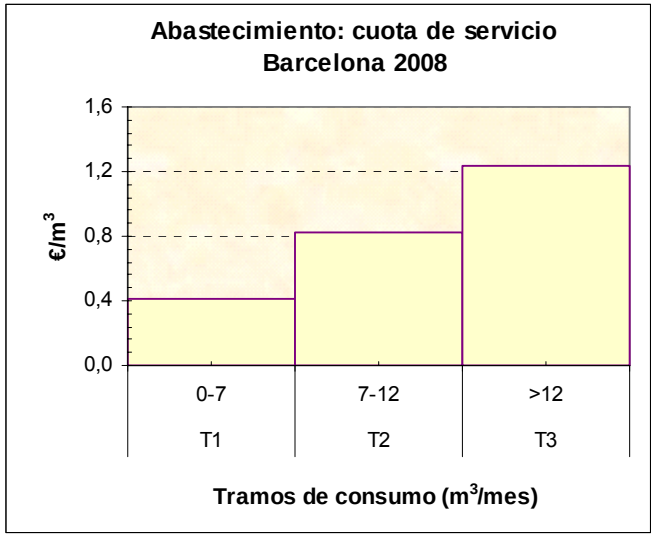


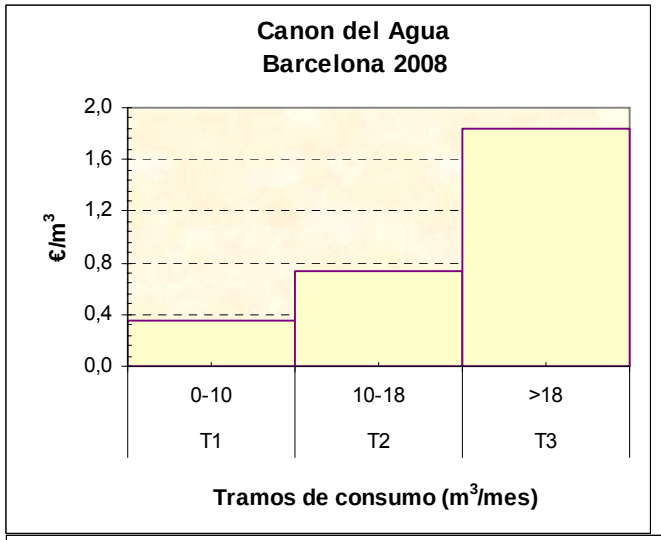
- The average per capita consumption in Murcia is 158 l/per day
- The average price is **1,99 €/m³** (30,682 € per HH per month). Excluding Taxes
- **The water bill is about 1,04% of per capita income**

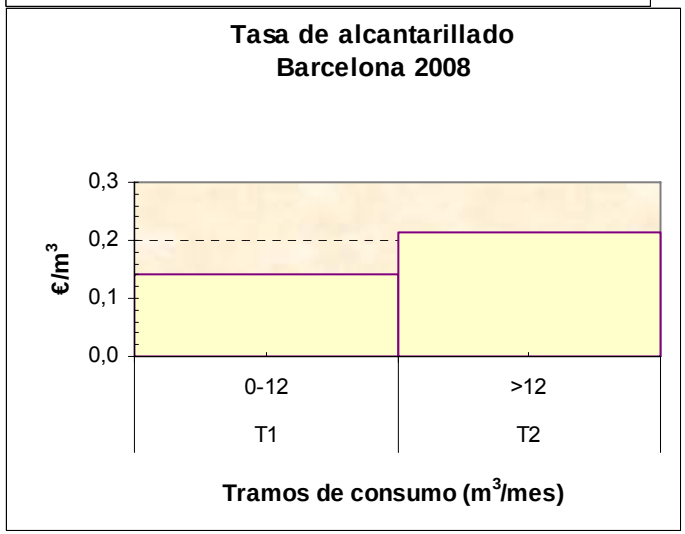
In Barcelona

Abastecimiento: Sist. 3 tramos: cuota de servicio

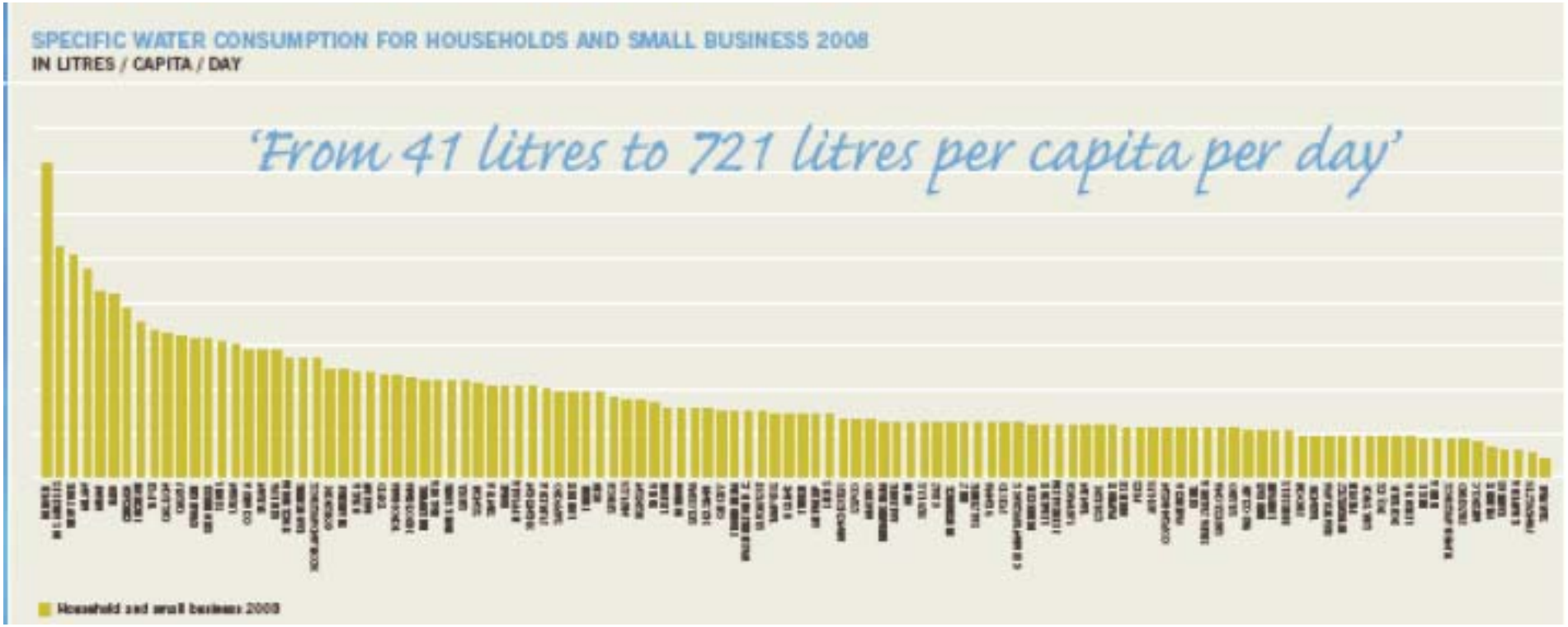
	€/mes	
13 mm	7,18	(vivienda D y E)
15 mm	4,52	(vivienda B y C)



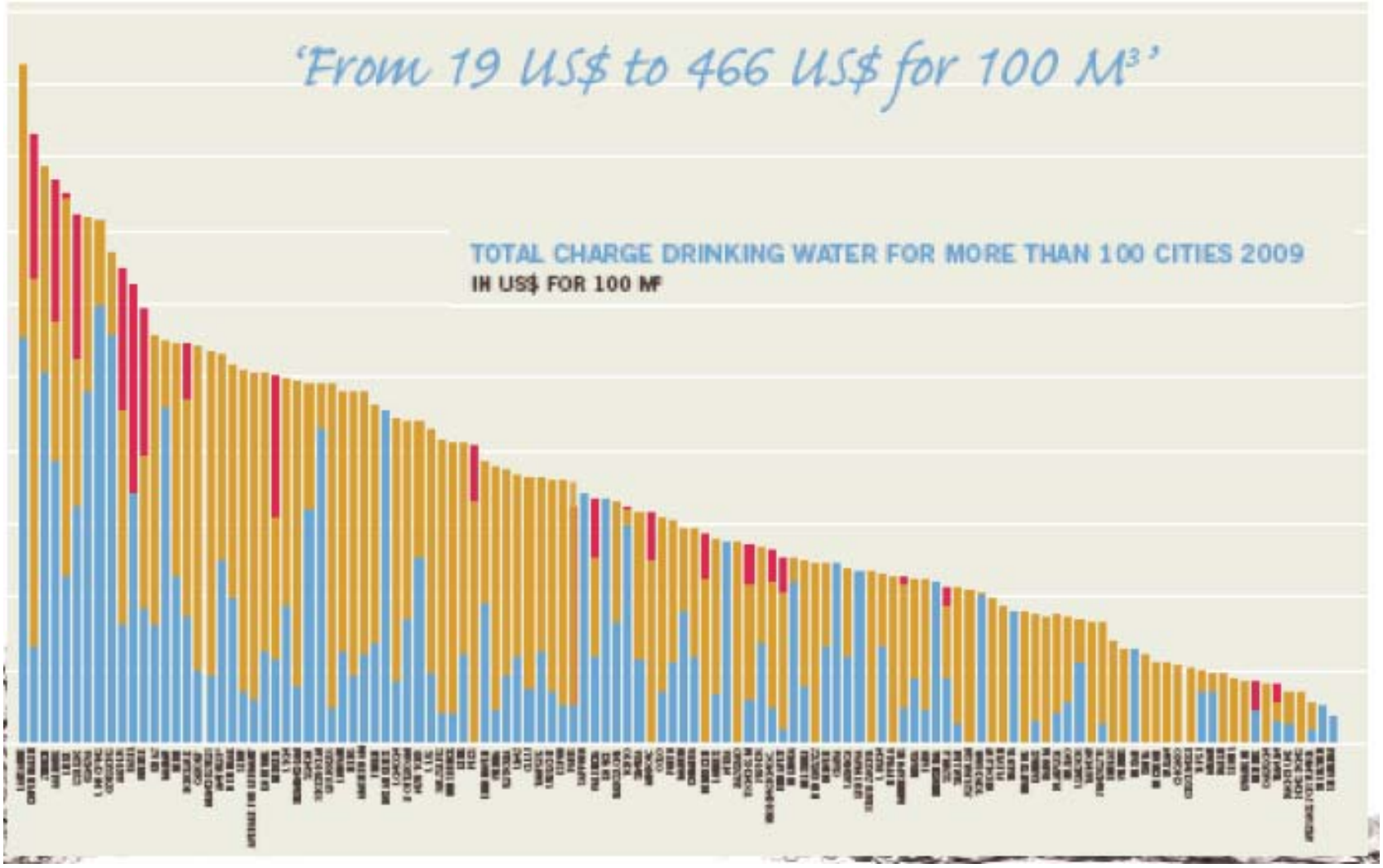




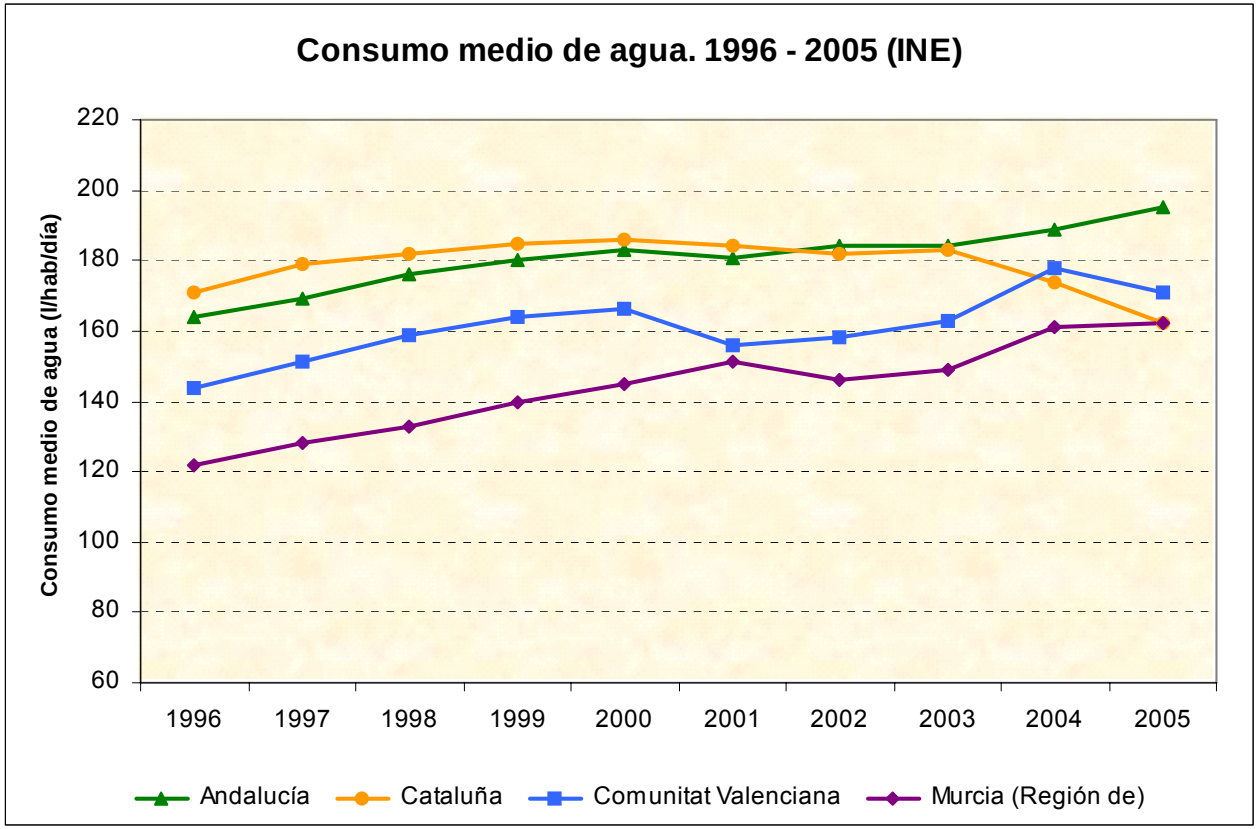
Water use varies..



Prices vary too …



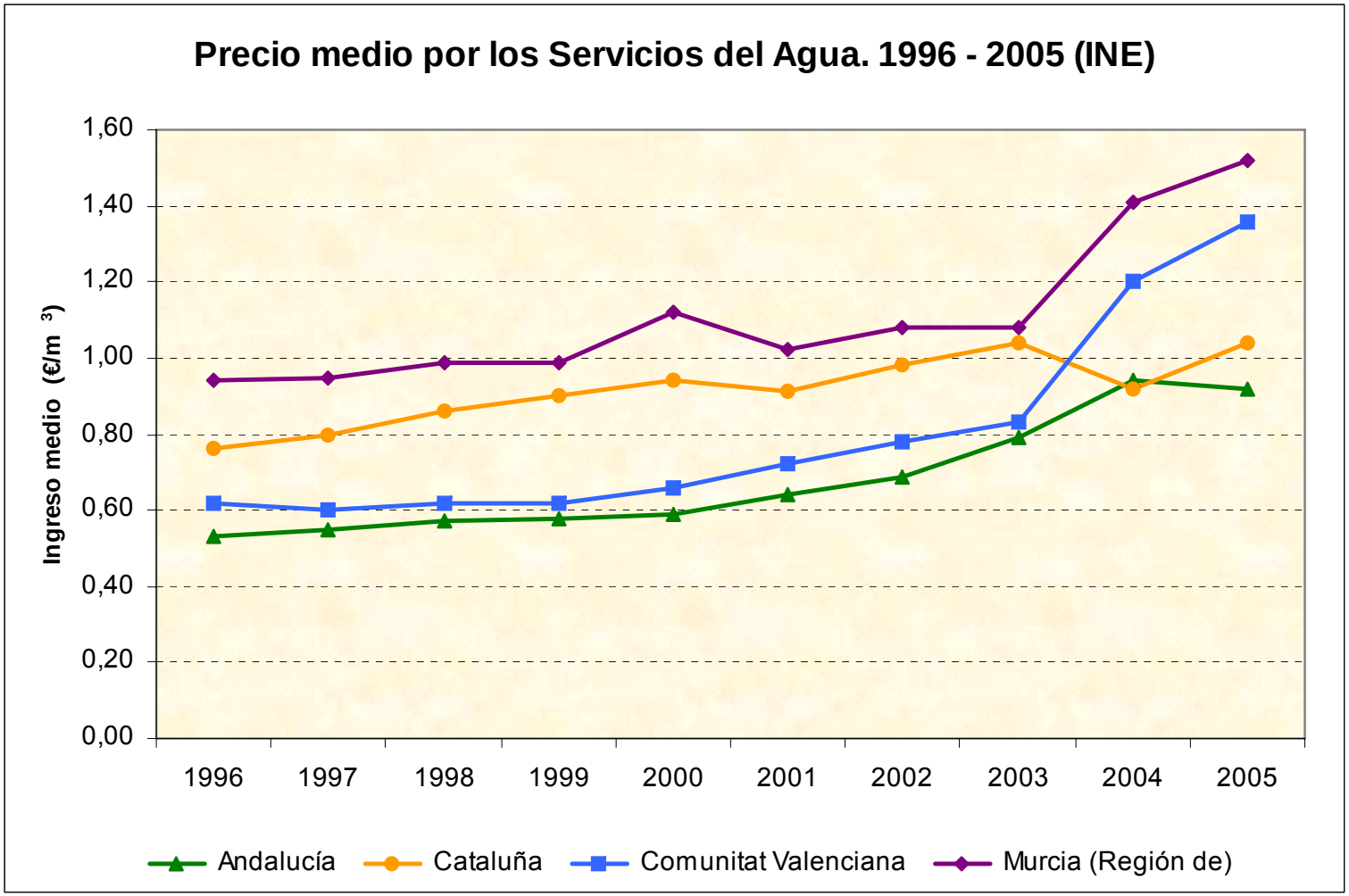
Trend of reduction of per capita consumption by Households in the Mediterranean Basins



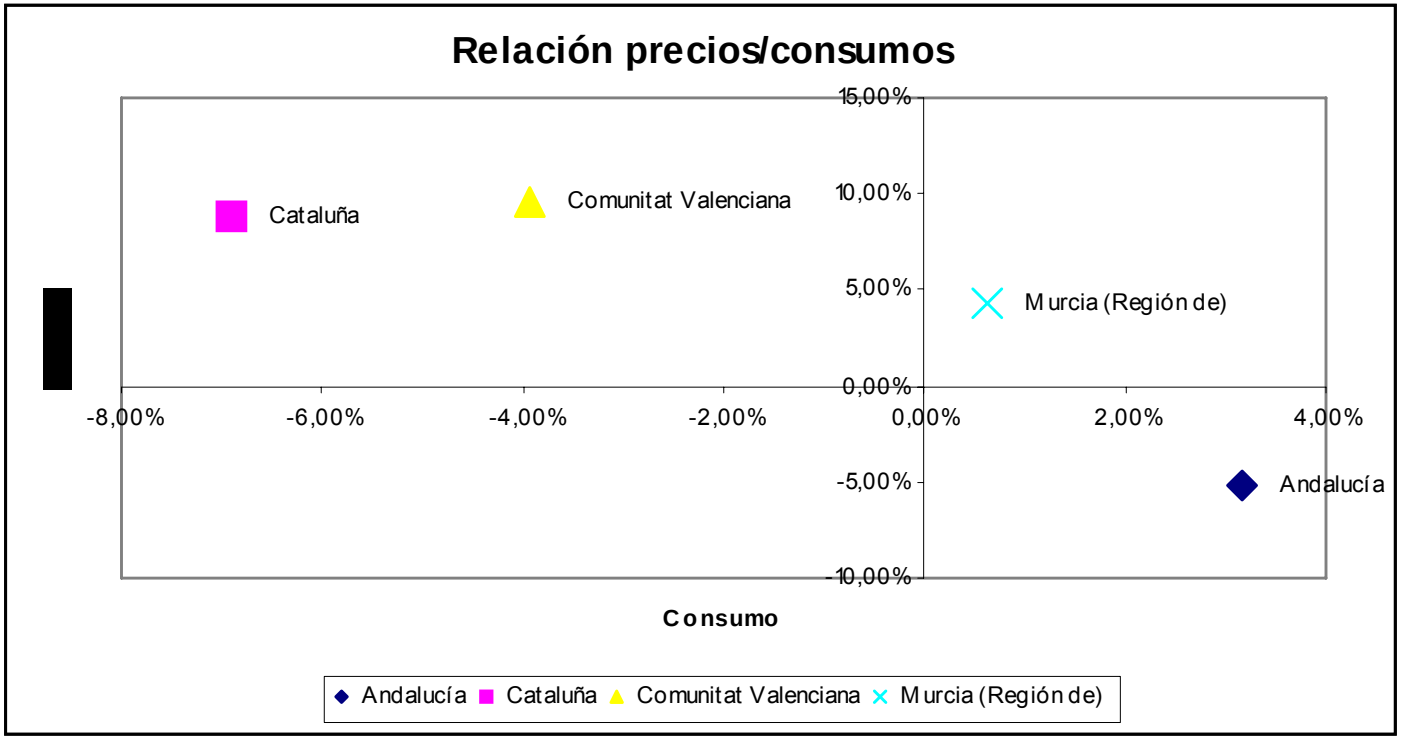
In Malaga and Almeria there has been a dramatic reduction of per capita consumption last year

- **Increasing in Andalucia with improvement of per capita income, except in Malaga and Almeria**

In paralel to sustained increases in prices over the last decade



In the regions with higher real increases in prices there has been an important reduction of per capita consumption



•Catalonia and Valencia with the highest prices increases have reduced per capita consumption above 9%

Differences in water prices (and per capita GDP)

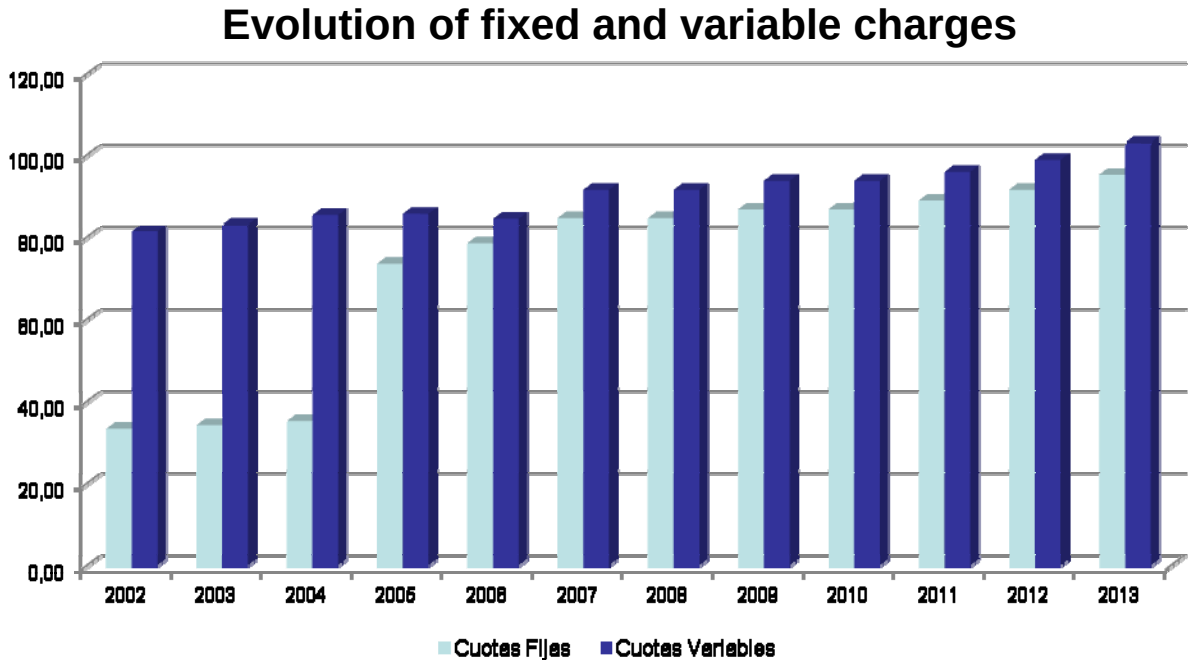
País	Precio $/m^3	Coste ($) 200 m^3	PIB ($) per cápita (PPA) 2006	% Agua s/PIB
Dinamarca	5,354	1.070,74	36.920	1,16%
Suiza	4,917	983,37	38.706	1,02%
Holanda	3,557	711,33	36.987	0,77%
Austria	3,443	688,65	36.368	0,76%
Francia	3,404	680,87	31.825	0,86%
Finlandia	3,258	651,51	35.559	0,73%
Suecia	3,011	602,12	34.735	0,69%
Bélgica	2,875	574,92	34.749	0,66%
Alemania	2,740	547,99	31.390	0,70%
Chipre	2,672	534,43	29.870	0,72%
Australia	2,305	460,94	33.037	0,56%
Noruega	2,180	435,97	44.648	0,39%
Grecia	2,126	425,26	33.004	0,52%
Hungría	1,877	375,32	30.047	0,50%
Japón	1,866	373,17	32.530	0,46%
Portugal	1,623	324,69	22.937	0,57%
España	1,507	301,40	27.914	0,43%
Italia	1,358	271,52	31.051	0,35%
Canadá	0,789	157,80	35.514	0,18%
Lituania	0,766	153,19	16.373	0,37%
Rumania	0,728	145,53	10.125	0,57%
Estados Unidos	0,658	131,60	43.223	0,12%
Argentina	0,203	40,65	16.080	0,10%

Price evolution in the Madrid Region

Canal Isabel II	2002	…	2012	2002-2012		
Cuota servicio aducción	6,70345		7,74	1,0366	15,46%	1,45%
Cuota servicio distribución	2,9458		3,51	0,5642	19,15%	1,77%
Cuota servicio alcantarillado	0,0000		0,9682	0,9682		0,00%
Cuota servicio depuración	2,850115		3,037	0,1869	6,56%	0,64%
Primer bloque aducción	0,285979		0,2871	0,0011	0,39%	0,04%
Segundo bloque aducción	0,412472		0,531	0,1185	28,74%	2,56%
Tercer bloque aducción	0,990021		1,2743	0,2843	28,71%	2,56%
Primer bloque distribución	0,128798		0,1292	0,0004	0,31%	0,03%
Segundo bloque distribución	0,158325		0,2036	0,0453	28,60%	2,55%
Tercer bloque distribución	0,377344		0,4856	0,1083	28,69%	2,55%
Primer bloque alcantarillado	0,070131		0,099	0,0289	41,16%	3,51%
Segundo bloque alcantarillado	0,077007		0,1088	0,0318	41,29%	3,52%
Tercer bloque alcantarillado	0,094196		0,1331	0,0389	41,30%	3,52%
Primer bloque depuración	0,18863		0,3015	0,1129	59,84%	4,80%
Segundo bloque depuración	0,21547		0,3443	0,1288	59,79%	4,80%
Tercer bloque depuración	0,328942		0,5257	0,1968	59,82%	4,80%

Overall reduction of per capita consumption from (166 l/h/day -> 137 l/h/d). 18%. reduction

EXAMPLE OF THE MADRID REGION- Impact of the structure of the tariff



- In 2002 the fixed part of the tariff was 29% of the total bill, in 2013 it has become 48%
- Advantages; financial reliability, less incentive (10% of savings in 2002 mean a 7% of reduction in the bill; in 2013 it would reduce the bill by 5%)

In the analysis of the impact of prices we need to consider

Income elasticity of water demand	0,04
Price elasticity of water demand (increase in price leads to reduction in water demand)	-0,1 -0,64
Discount rate	2%
Amortization period	30 years

Definition Price elasticity of demand is a measurement of the responsiveness of**water demand** to a change in price (rate). E = % change in Q j % change in P

Impact of price increase on demand

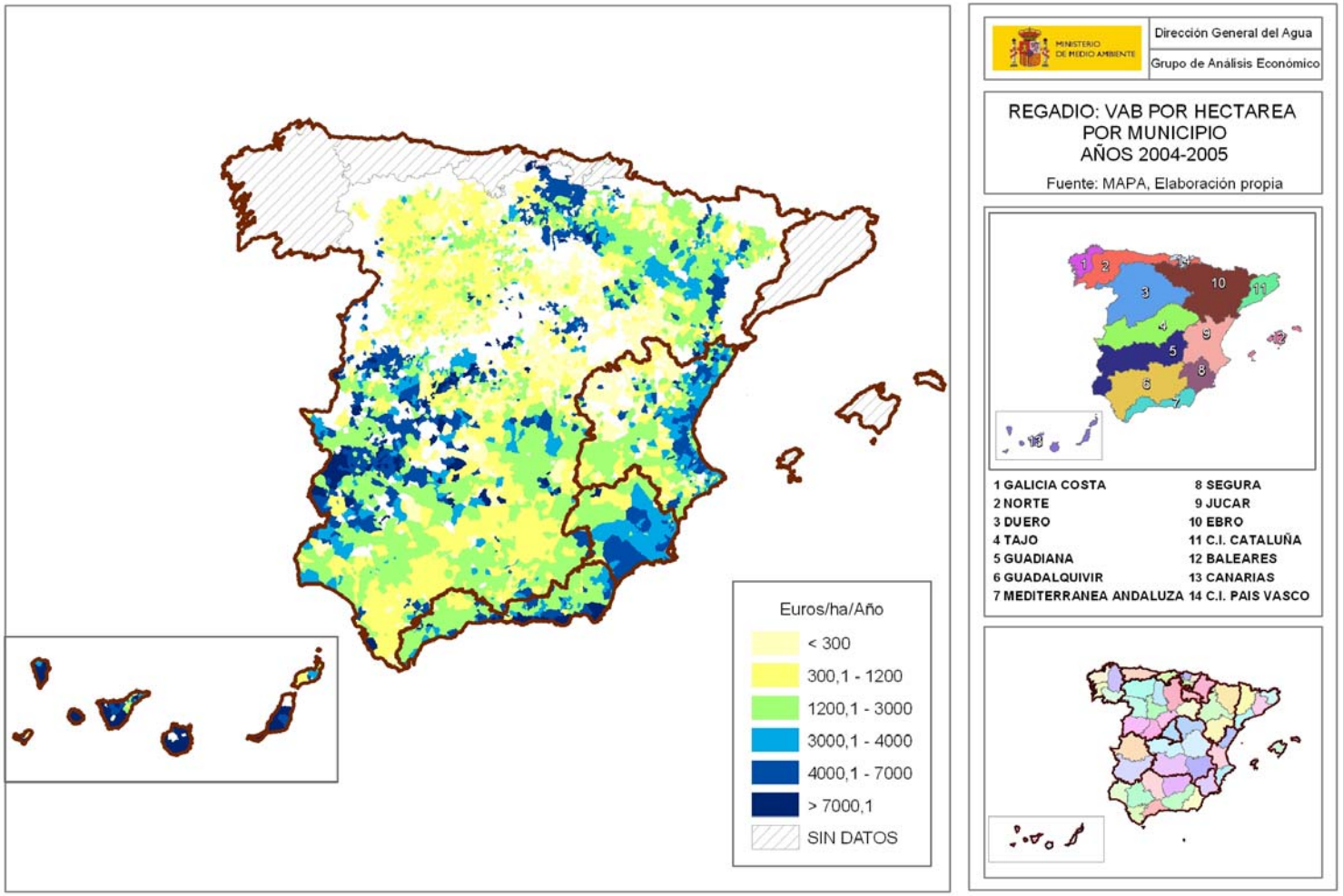
• ε = -0,64	• ε = -0,1
• High increase in prices • Leads to decrease in water use (between 4%-68%).	• With a moderated increase in prices • The water demand in maintained or there is a small reduction on water use per capita (0%-5%).

Importance of volumetric pricing reflecting increasing costs

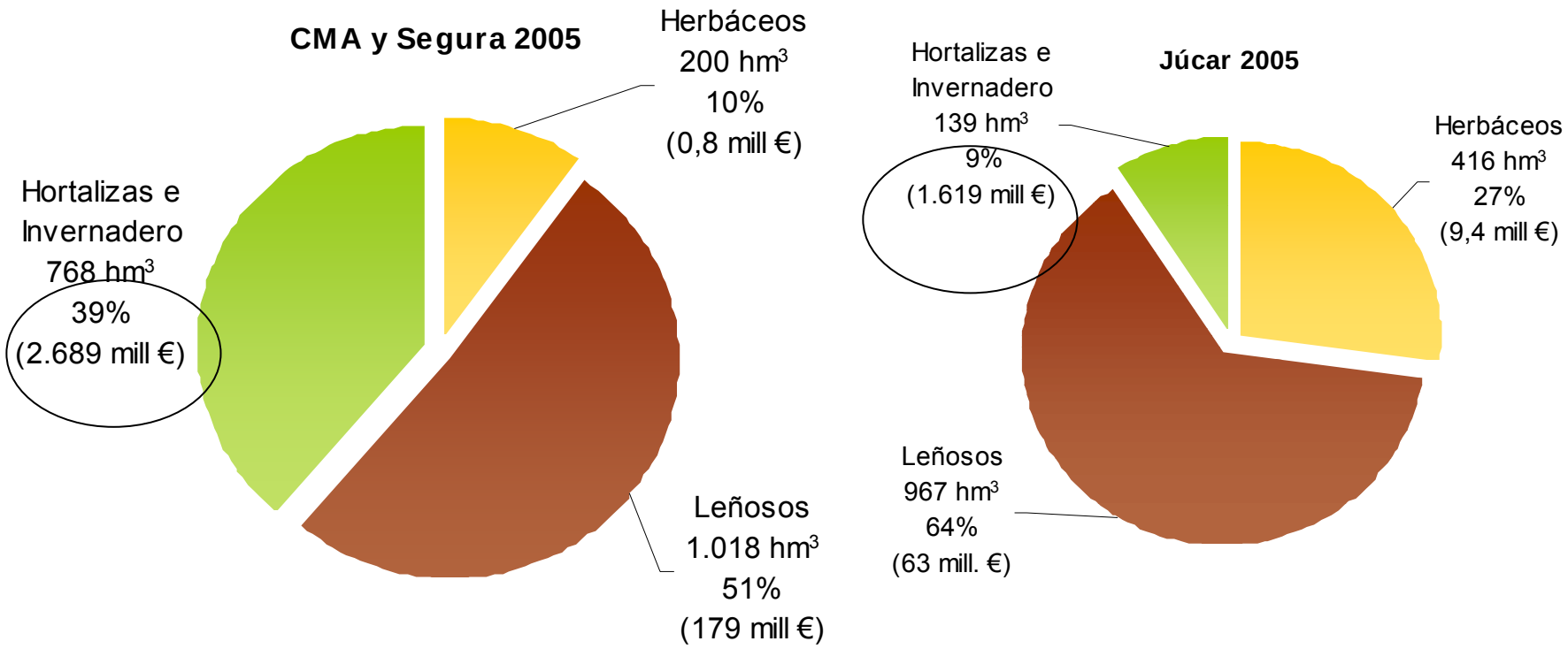
CUENCA	DENOMINACIÓN SOCIEDAD	CUOTA FIJA €/ha	CUOTA VARIABLE			CUOTA OTROS	TIPO TARIFA APLICADA
			€/ha	€/hora	€/m^3		
08	SINDICATO GENERAL DE AGUAS DE DOLORES		26,85				VARIABLE
08	LA ESTAFETA				0,3		VARIABLE
08	ASCOY, BENIS Y CARRASQUILLA	15,4			0,1705		MIXTA FIJA-VARIABLE
08	LA CORREDERA	6			0,0841		MIXTA FIJA-VARIABLE
08	FUENTE DEL PERAL	30			0,15		MIXTA FIJA-VARIABLE
08	JESUS DEL GRAN PODER	9			0,1		MIXTA FIJA-VARIABLE
08	MIRAFLORES				0,14		VARIABLE
08	MAZARRON		132,22		0,34		VARIABLE
08	RIO ALHARABE		2500		0,2		VARIABLE
08	SAN VICTOR		143,11				VARIABLE
08	PUERTO LUMBRERAS				0,28		VARIABLE
08	POZO DE LA DECARADA				0,12	13	MIXTA VARIABLE-OTROS
08	SERRANA - LOS ALBARES				0,13		VARIABLE
08	CANADAS DE SAN PEDRO				0,4		VARIABLE
08	HEREDAMIENTO REGANTE DE MOLINA DE SEGURA		126		0,12		VARIABLE
08	POZO DEL HORNO	6			0,06		MIXTA FIJA-VARIABLE
08	ONTUR-ALBATANA		13		0,036	148,5	MIXTA VARIABLE-OTROS
08	HEREDAMIENTO DE AGUAS HUERTA DE COLOMI Y TIRIEZA				0,3		VARIABLE
08	C.R. Sindicato de Riegos de Cuevas de Almanzora		10,97		0,38		VARIABLE
08	POZO DE PERDIGUERA	10			0,06		MIXTA FIJA-VARIABLE
08	JUZGADO PRIVATIVO DE AGUAS DE CALLOSA		25				VARIABLE
08	COMUNIDAD DE REGANTES DE CATRAL		42538				VARIABLE
08	ACEQUIA DE DAYA VIEJA		2,22				VARIABLE
08	JUZGADO DE AGUAS DE GUARDAMAR		85				VARIABLE
08	EL MOJON DE LA MATANZA				0,13		VARIABLE
08	JUZGADO PRIVATIVO DE AGUAS DE ROJALES		70,63				VARIABLE
09	CR DE MONFORTE DEL CID		180,3		0,27		VARIABLE
09	CR DE LA DEPURADORA DE LA SENIA		10				VARIABLE
09	CR DE ALCALA DEL JUCAR		85,4				VARIABLE
09	CR SAN ISIDRO (Villavieja)				0,145		VARIABLE
09	CR DE LA PRESA DEL PUENTE DE ALCARAZ		6				VARIABLE
09	C.R. DE PEDREGUER		2124		0,16		VARIABLE
09	C.R. ALICANTE		59,5				VARIABLE
09	C.R. MINEOLA				0,45		VARIABLE
09	C.R. POZO LA ,MONTANETA				0,18		VARIABLE
09	C.R. ALMIZRRA DE CAMPO DE MIRRA		43,32		0,15		VARIABLE
09	C.R. SINDICATO DE RIEGOS DE LA HUERTA DE ALICANTE		84,73				VARIABLE
09	SAT EL TESORO CADILLEJO				0,07		VARIABLE
09	C.R. DE CASTELLON		528		0,18		VARIABLE
09	C.R. CARBONARIA Y CABALLERA				0,13		VARIABLE
09	C.R. RIUS SANT JORDI	6139,1001			0,09		MIXTA FIJA-VARIABLE
09	CR DE LA CIUDAD DE TERUEL		69,3				VARIABLE
09	C.R. AYELO DE MALFERIT		168				VARIABLE
09	C.R. FUENTES , LAS		108				VARIABLE
09	SAT LAGUNA Nº 5370				0,07		VARIABLE
09	C.R. AZUD DE LORCA		12				VARIABLE
09	CANAL DE RIEGO DEL RIO TURIA (ACEQUIA DEL ORO)		182,4				VARIABLE
09	C.R. POZO FURELL		360	0,33	0,11		VARIABLE
09	CDAD. REGT. POZO LA PLACETA				0,21		VARIABLE
09	C.R. POZO PLA FILANER				0,12		VARIABLE
09	C.R. DE MATET		0,9				VARIABLE

Source: 2007-2009 WFD reports

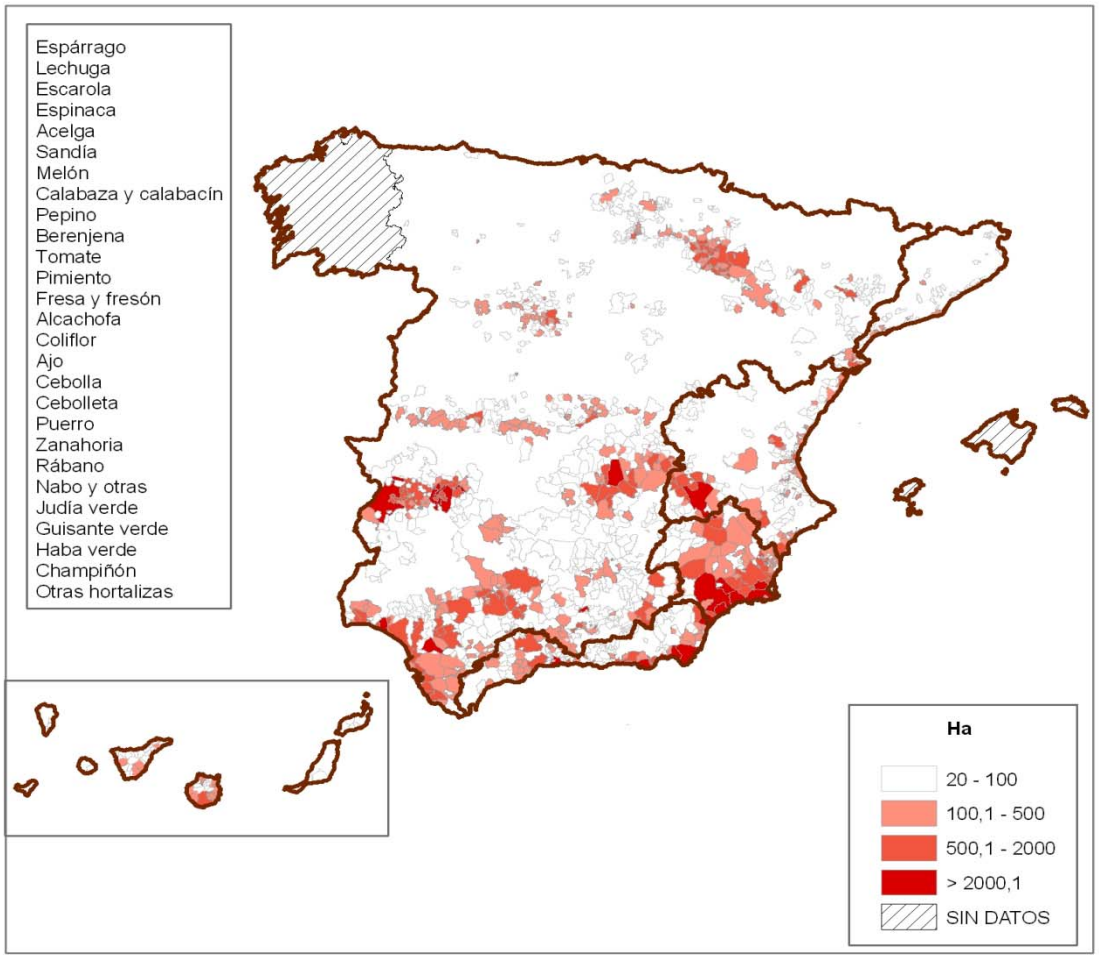
High value (GVA) of Mediterranean Agriculture – There is ability to pay for desalinated water (about 4500 €/ha)



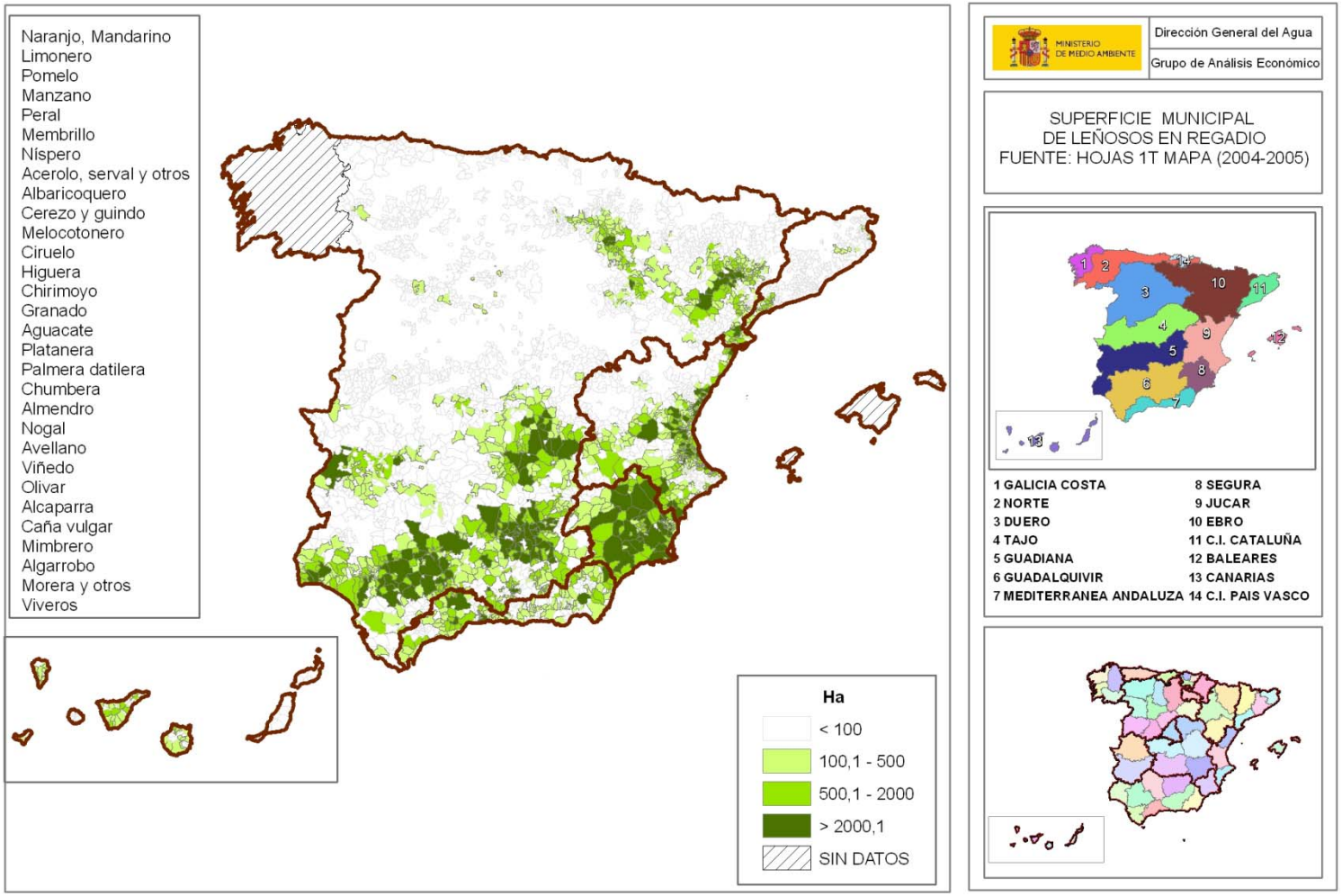
This is due to the importance of Horticulture and permanent crops . Importance of guarantee supply; and demand of quality water for internal and external markets



Horticulture

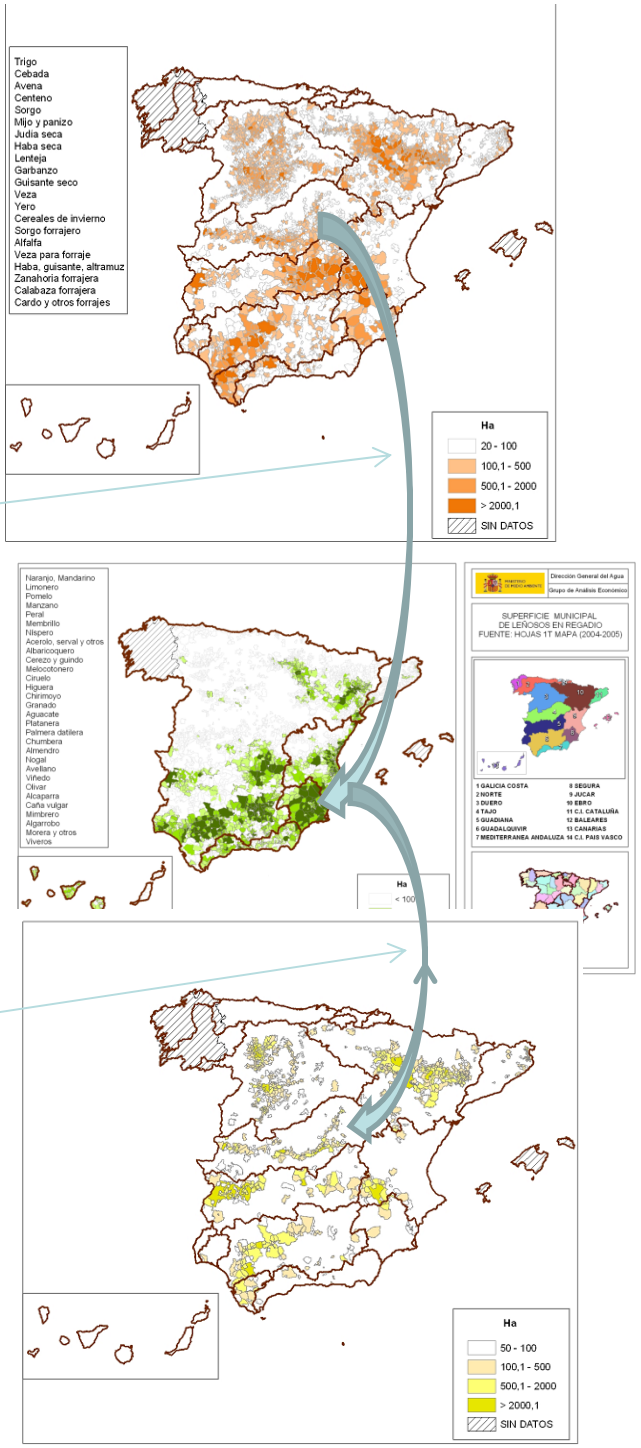


Permanent crops



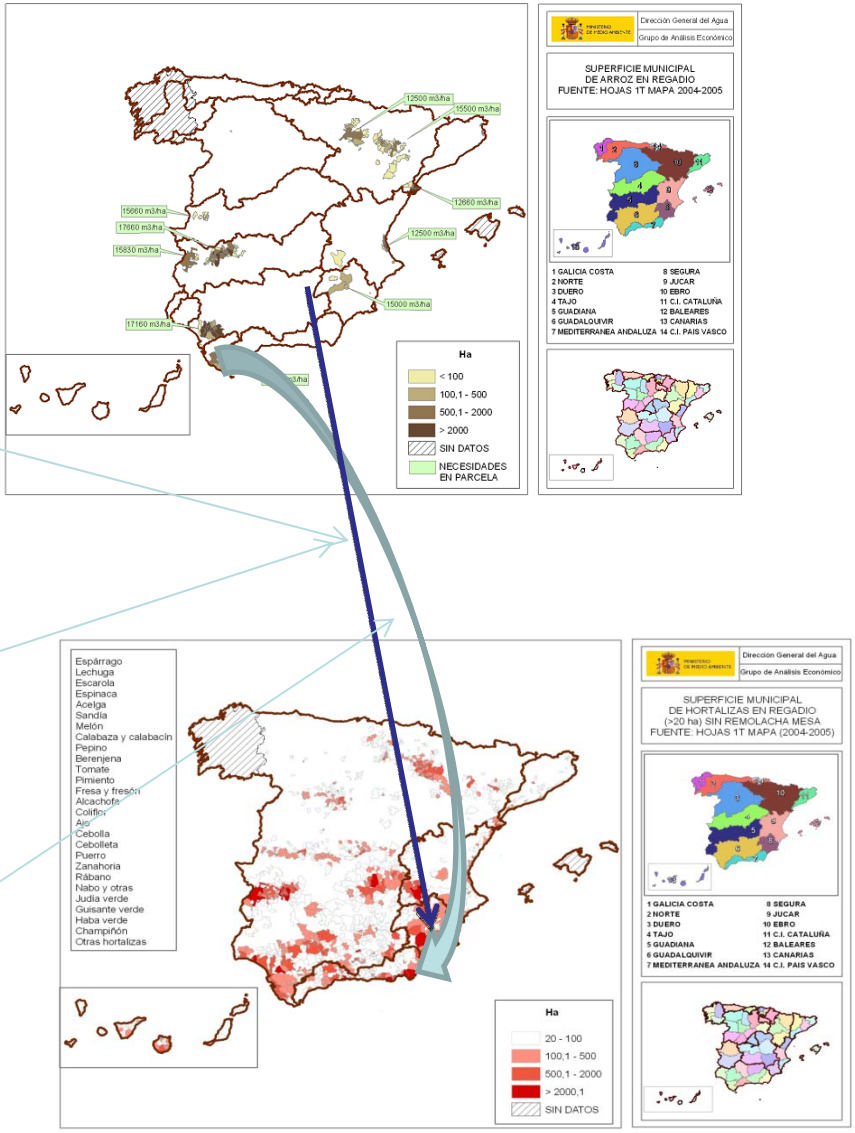
Examples

- **Between farmers with cereal crops –wheat- and farmers in horticulture and with permanent crops. “Canal de Estremera and Sindicato de Regantes ATS” (3 years)**
  - **31 hm³ (GL)**
  - **0.18 €/m³.**
- **Between farmers irrigating maize and water supply company for tourist destination and industrial area “C.R. del Canal de las Aves and Mancomunidad de los Canales del Taibilla”,:**
  - **36 hm³ (GL)**
  - **0,27 €/m3 .**
  - **Strategic reserve**

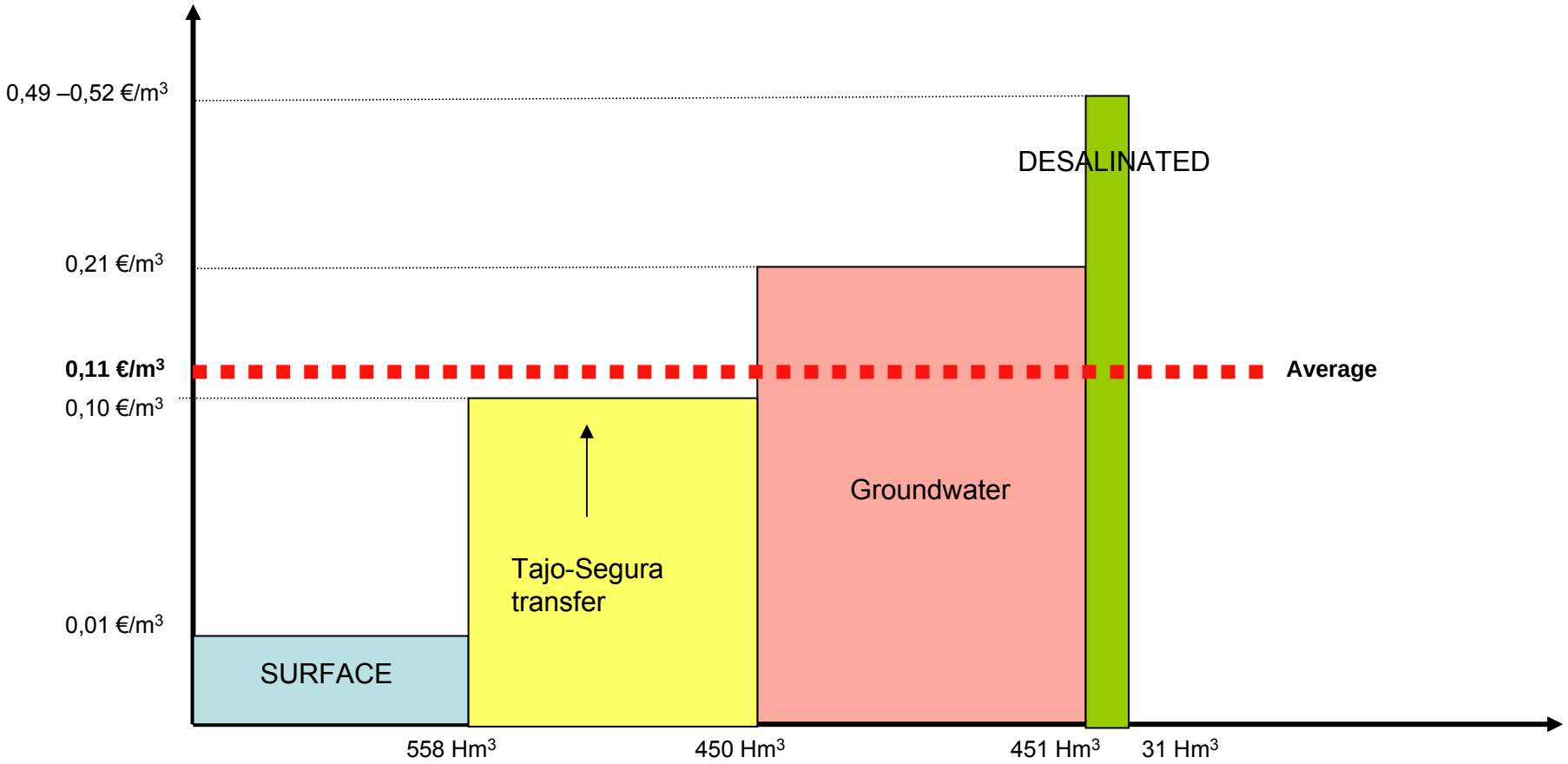


EXAMPLES

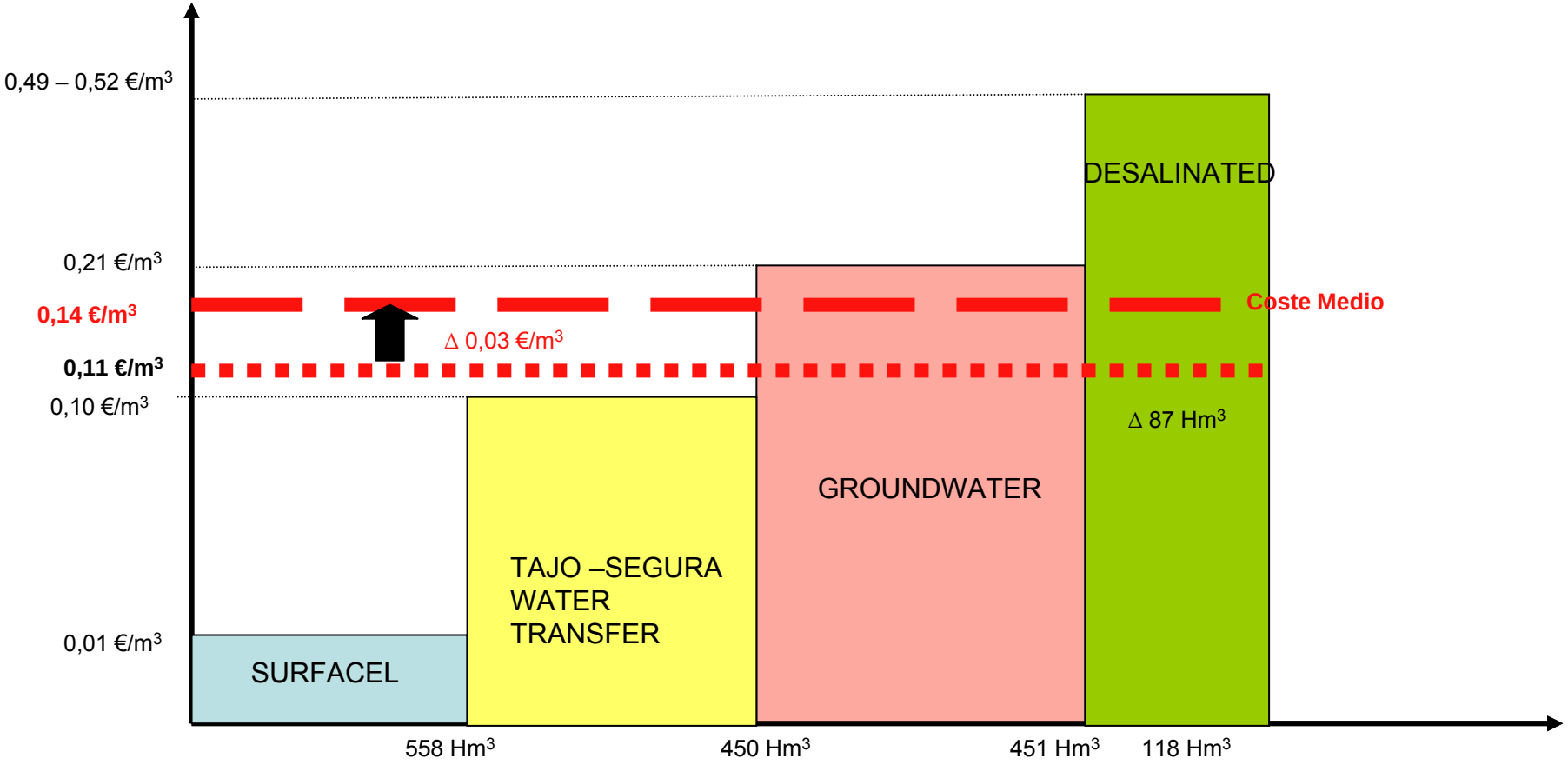
- **C.R. del Bembézar a Aguas de Almanzora S.A.**
  - **3.6 hm³ (GL)**
  - **0,18 €/m³**
- **C.R. de Pago de la Vega del Serón a Aguas del Almanzora.**
  - **0. 9 hm³ (GL)**
  - **0,15 €/m³ .**
- **Company bought Rice farmers properties to transfer water license to their horticulture farm in the Almanzora**
- **700 Has 9.3 (Hm3/GL)**
- **0.04 €/m3**



SEGURA Basin

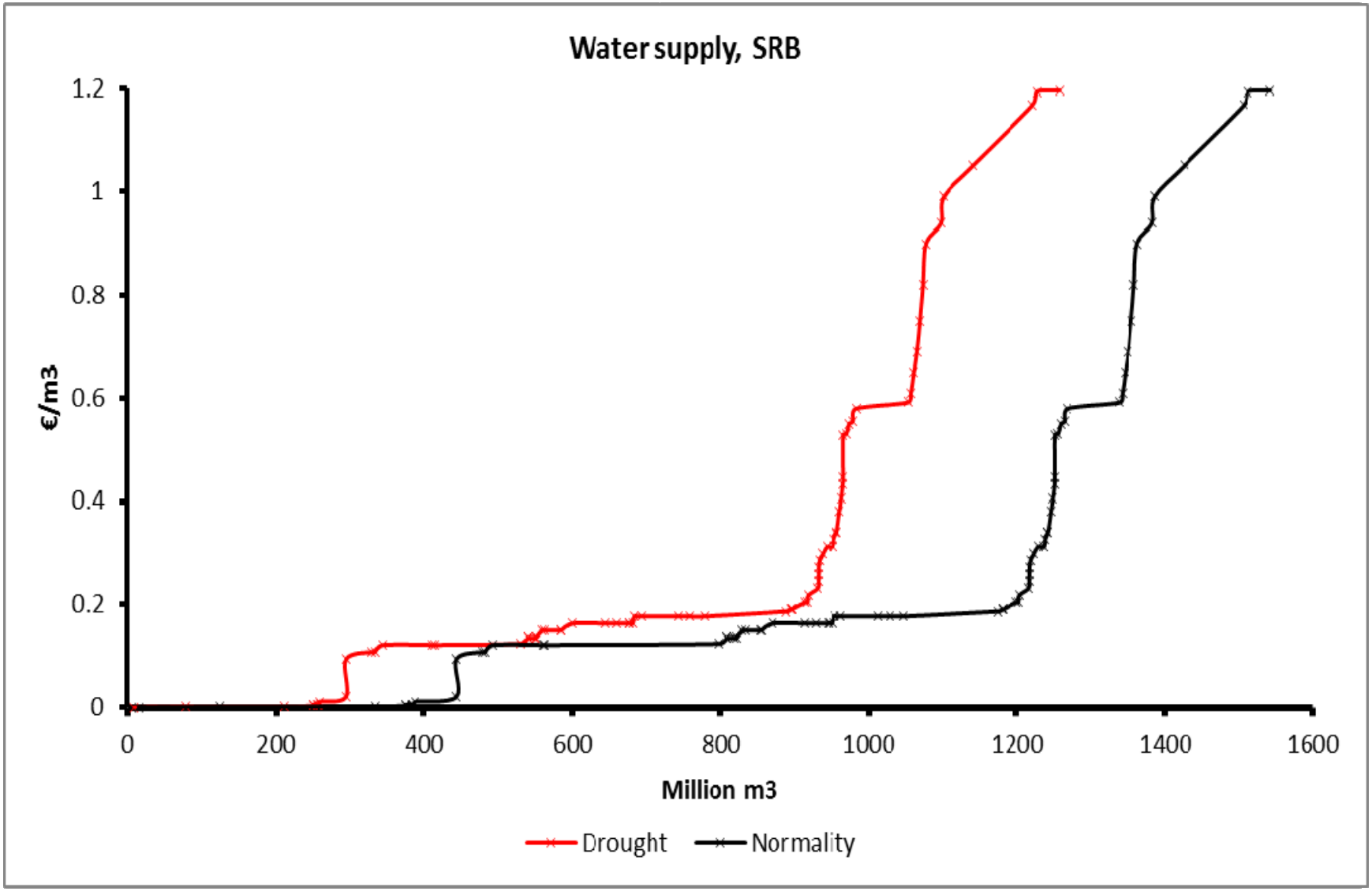


SEGURA Basin



Previsiones desalación (CEDEX, 2006)

Water pricing and water security



Two cases

- **Main irrigation area in Murcia (SCRATS)**
  - Increases in prices of water tranfers (Δ 32%) and desalination will mean an increase in average price of bulk water from 0,115 €/m3 to 0,16 €/m3 (Δ 39%).
  - Margins vary between 0,25-10,90 €/m^3, Average of 1,8 €/m^3.
  - Gross Value of increase production of 52,32 Million €

- **Main Water supply to Alicante and Murcia (Mancomunidad de los Canales del Taibilla)**
  - Supply to 2.4 million people; 50% of water of Tajus Transfer;
  - Present costs of bulk water between 0,14 €/m^3 y 0,52 €/m^3. Charges of the Mancommunity to distribution water suppliers are of 0,43 €/m3.
  - Expected increases of 19% (0,081 €/m3) with changes in the balance of the mix of water sources.
  - The increases in costs of bulk water means an increase of 5% in Alicante, 4% in Murcia, in the HH water bill
  - This means on average 0,10% of family income in Alicante and 0,14% in Murcia. Increase in resilience of water supplies in a tourist destination

Existing Communication Campaigns

Campaigns on…

- Droughts, water scarcity.
- Water Quality
- Health concerns.
- Service disruptions.

The important questions in communication

- Who communicates: WOPs responsibilities.
- What key messages we want to communicate about scarcity/water value, extreme events, health and sanitation, water quality,
- To whom: client groups, women, men, youth, rural, urban, illiterate, poor.
- Means for communicating: media, web, electronic and print material, workshops, ads with celebrities..
- Effects: IN WATER SAVED, IMPROVED HEALTH..

Communication campaigns: droughts
Aguas de Barcelona (AGBAR)

Date: Spring-Summer 2008

Objectives:

Encourage wise water use

Increased awareness about the importance of the drought

Actions

Inform about the drought situation that affected Barcelona in 2008

Inform the population about measures taken to guarantee water supply

Means:

Special section on the web

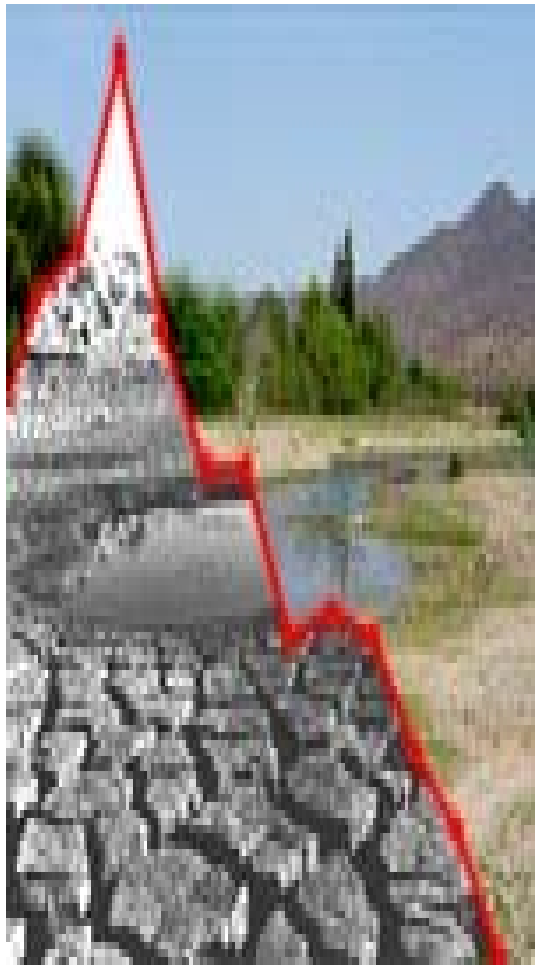
Information and messages on the bill invoice

Customer workshops, seminars, conferences

Effects: Decrease of 4% in household water consumption from Dec. 2007 to Dec. 2008

Communication campaigns: droughts
EMASESA: Seville Municipal Public Operator

- **Date:** 2005
- **Objectives:** Reduction in water consumption, Improvements in reservoir levels
- **Actions:** Inform and increase awareness about the drought situation that affected Seville in 2005
- **Means:** Exhibitions on the occasion of World Water Day and World Environment Day, Distribution and promotion of good practices among professionals, Radio messages, Information and Interviews on TV , Press releases, Special section on the web, Street campaigns, Messages on the invoice
- **Effects: water consumption decreased, improved dialog with citizens, behavior changes**



Educational activities

Objective

- Educate in specific values: Which values?
- Increase knowledge: Of which specific issues?
- Promo achieve what?

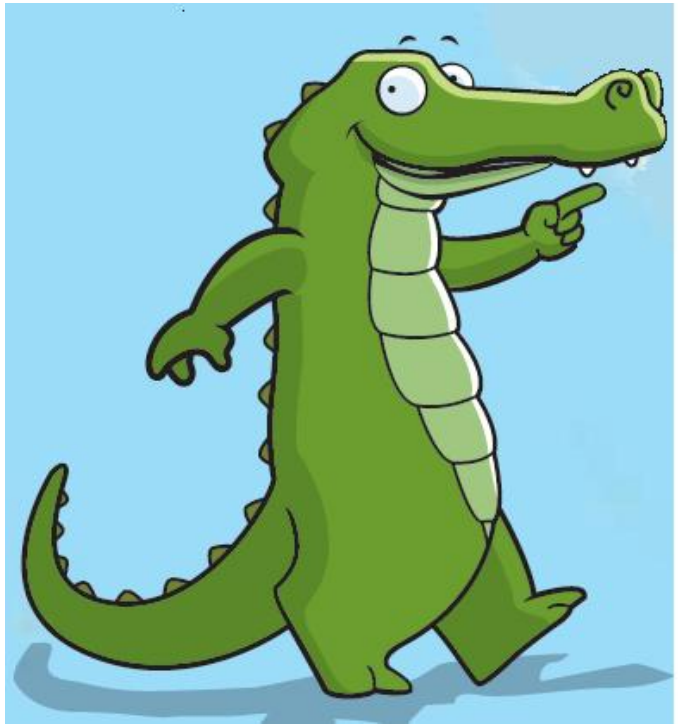
Most frequent modalities

- Visits to water/sewage treatment plants
- Preparation and distribution of educational materials
- Exhibitions
- Conferences, workshops, debates
- Contests

Morocco: Office National de l'Eau Potable (ONEP)

- **Initiative:** Kids corner
- **Educational levels:** primary and secondary education
- **Themes:** water cycle, water treatment, water consumption, water pollution
- **Means:** mainly materials to be downloaded from the web, painting contests
- **Main strengths:** materials available in French and in Arabic

Nicaragua: Enacal



- **Initiative:** Hablemos del Agua
- **Educational levels:** secondary education, university, communities
- **Themes:** wise use of water, pollution, wastewater management
- **Means:** conferences, distribution of books and notebooks containing key messages, competitions
- **Main strengths:** activities beyond the educational centre, implication of families

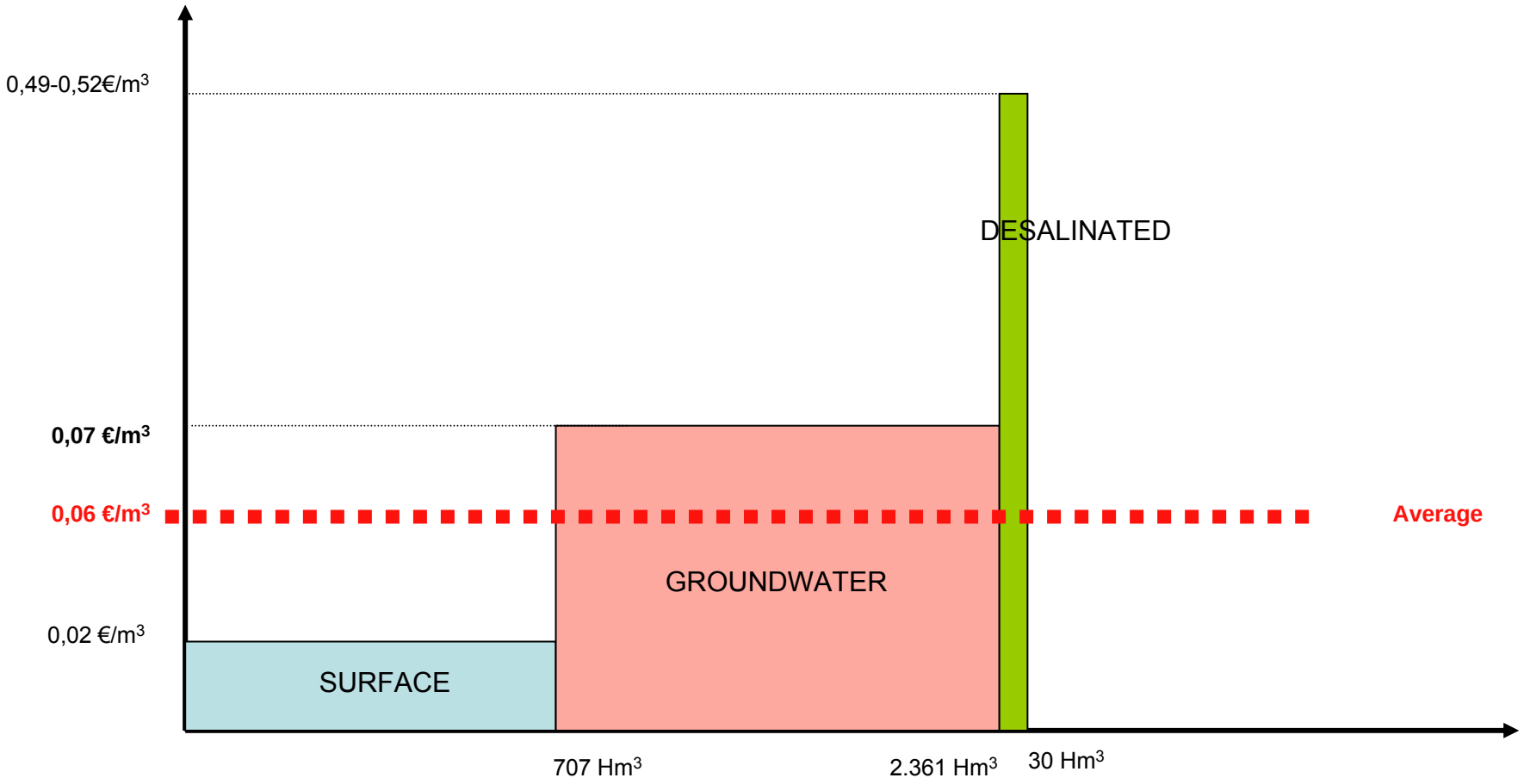
Spain: Canal de Isabel II

- **Initiative:** Canal Educa
- **Educational levels:** all, including adults and university
- **Themes:** different aspects of water consumption, water and wastewater management
- **Means:**
  - Children and youth: web, publications, games, blog, chat, etc.
  - University: conferences, research projects
- **Main strengths:** Variety of target audiences and means

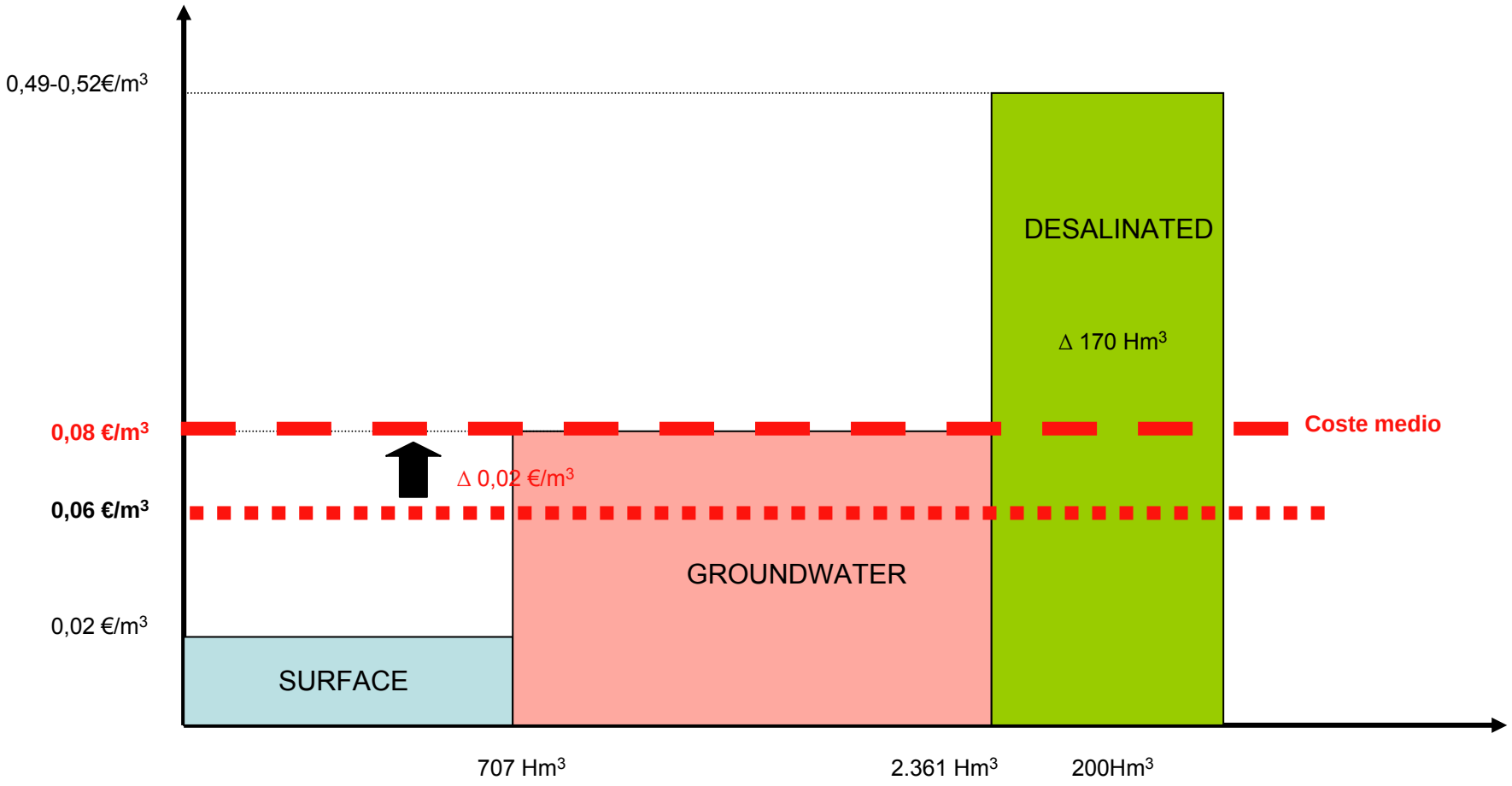
Irrigation water use and prices of water services to farmers

The cost of provision of bulk water supply in the Mediterranean Basins and the effects of desalination

JÚCAR Basin

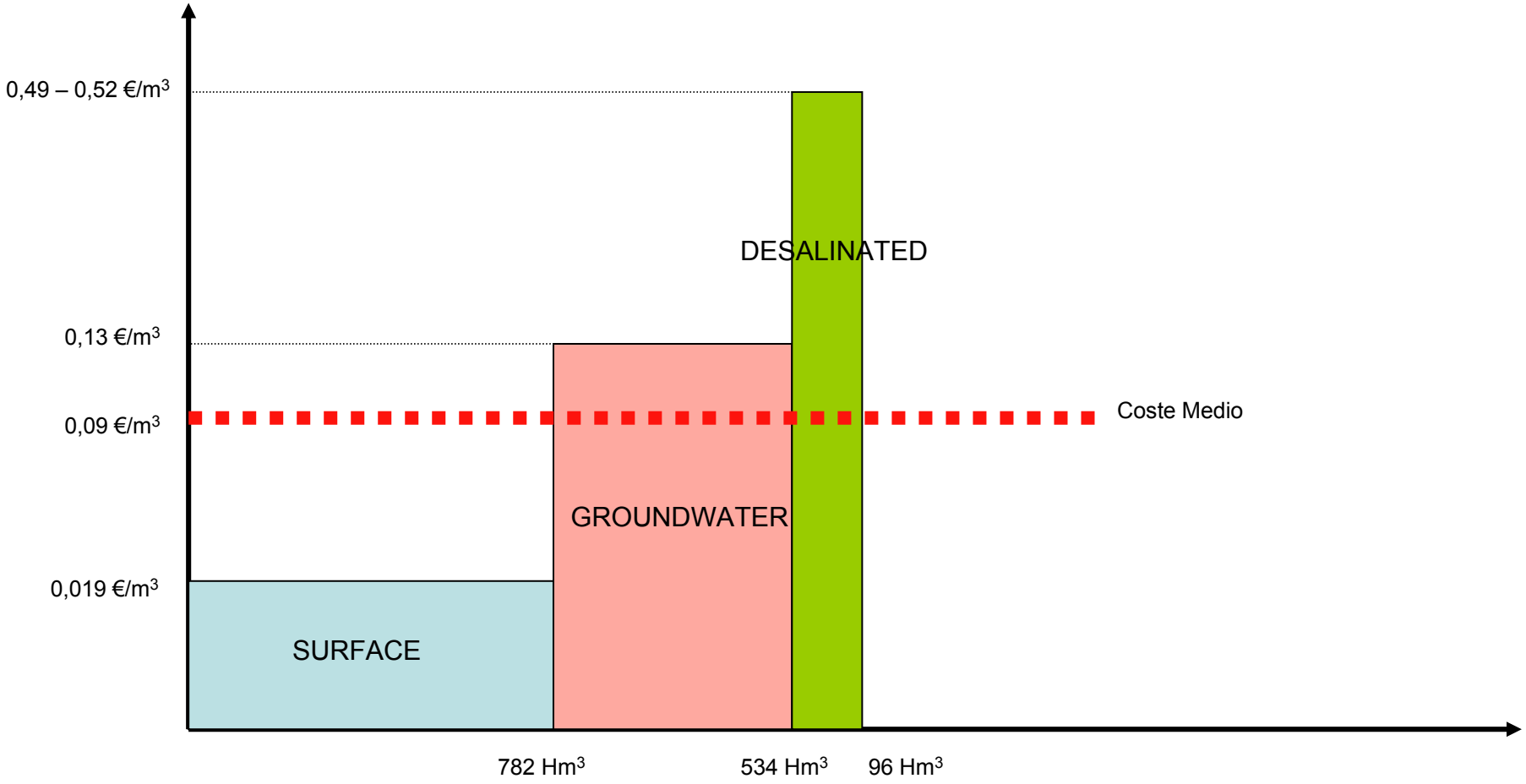

0,49-0,52€/m3
DESALINATED
0,07 €/m3
0,06 €/m3
Average
GROUNDWATER
0,02 €/m3
SURFACE
707 Hm3
2.361 Hm3
30 Hm3

JÚCAR Basin

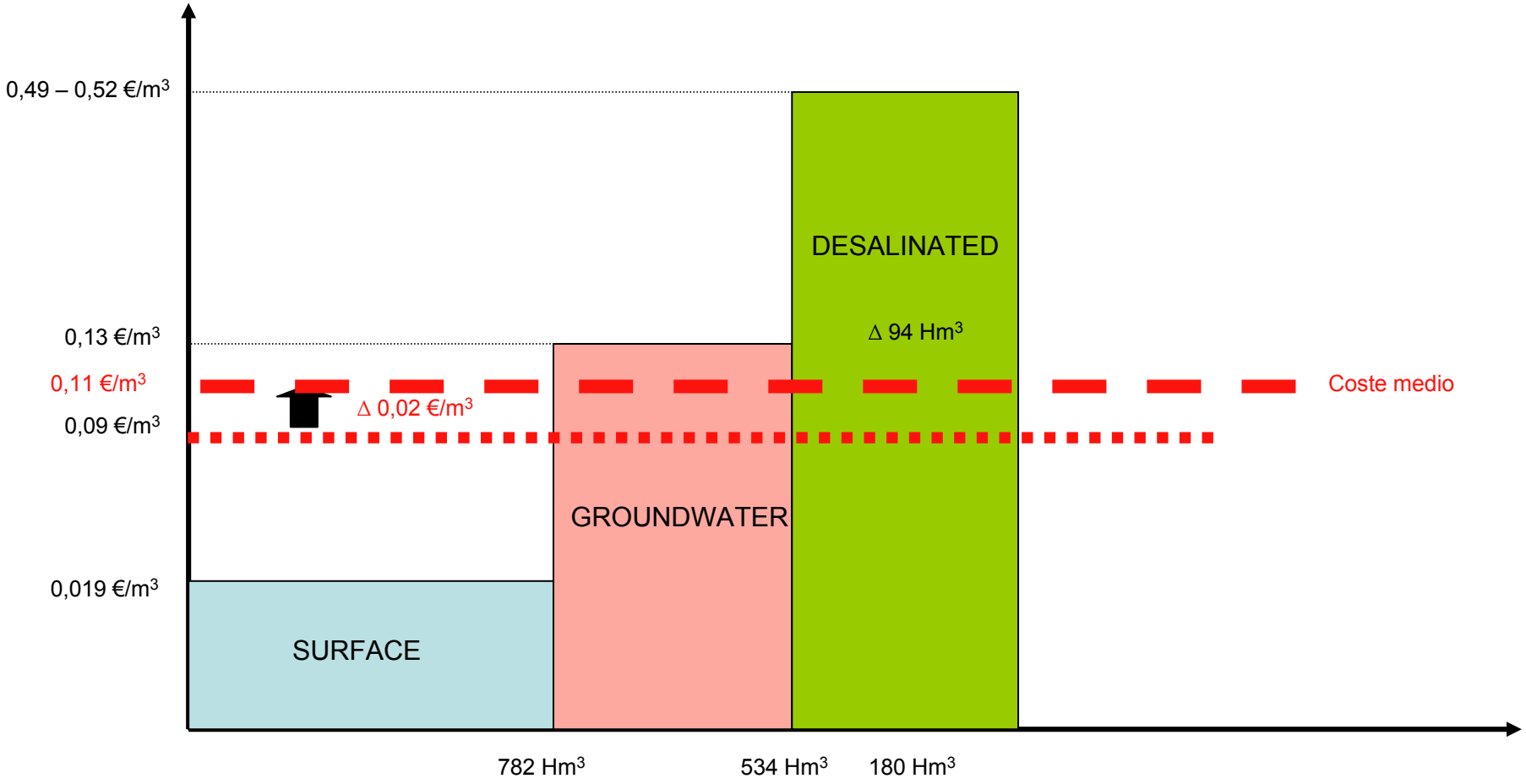


Previsiones desalación (CEDEX, 2006)

ANDALUCIA MEDITERRANEAN BASIN

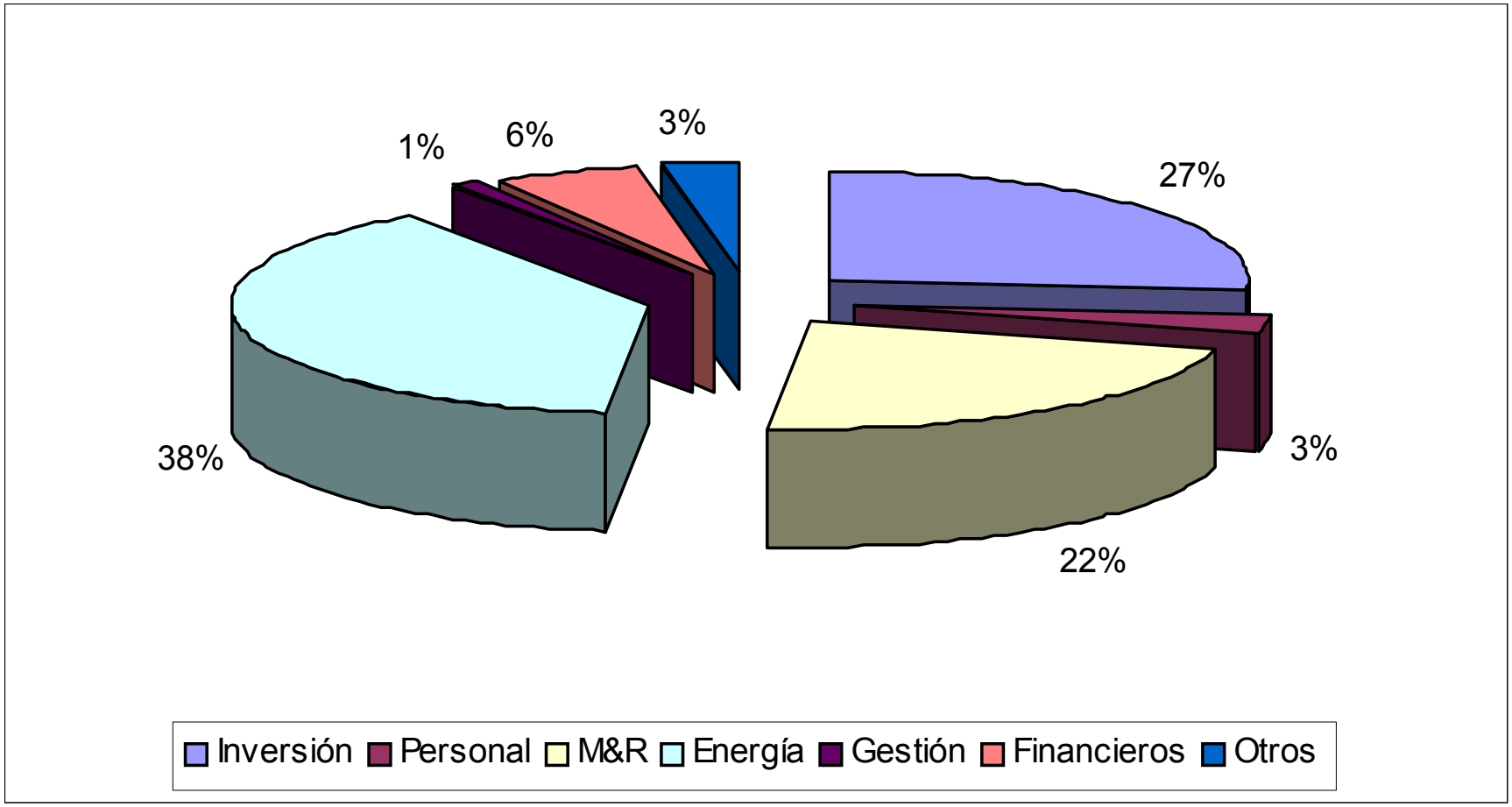


ANDALUCIA MEDITERRANEAN BASIN



Previsiones desalación (CEDEX, 2006)

COST STRUCTURE OF NEW DESALINATED WATER SUPPLY



Fuente: Informes de proyectos MMA

Conclusions

- Relatively low costs of bulk water supply because of economies of scale of conventional sources. Situation changing rapidly with less reliability of traditional sources of supply.

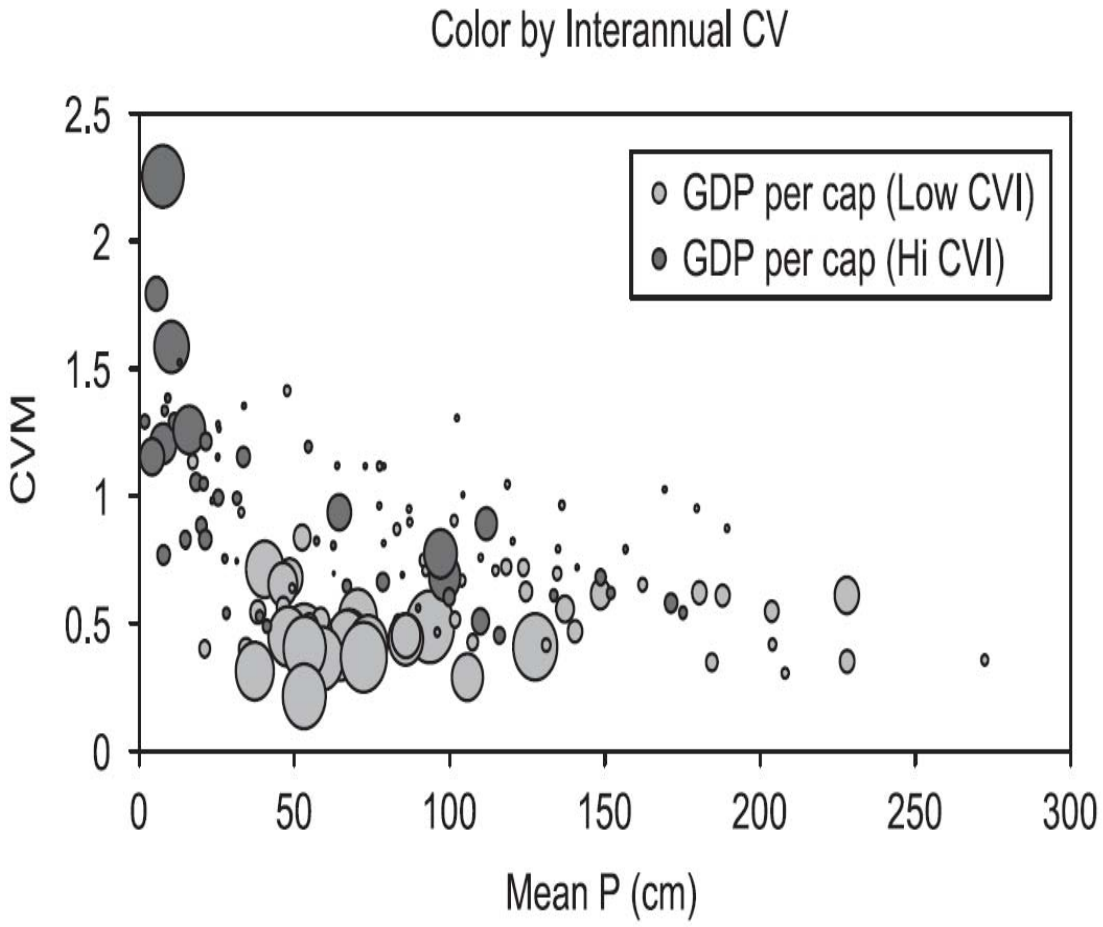
- Increases in average costs of bulk water with non conventional sources (desalination and WW reuse) (between 25% and 40%).

- Infrastructure costs of about 27% of total costs of desalinated water supply before distribution. Expected subsidies represent 7% of total supply costs (including O&M).

- Ability to pay of main users in the area. Linked to improved resilience to climate change and improved productivity.

ANNEX

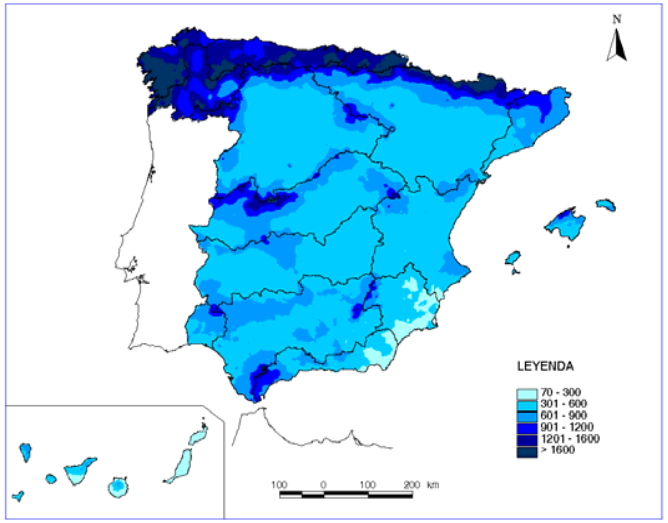
The Hydrologic environment: a key to explain long term economic performance



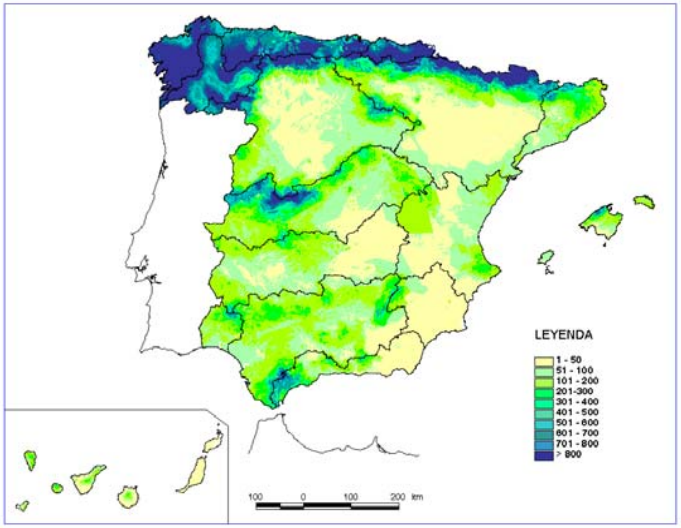
H Development

- **H**arnessed hydrology
- **H**ampered by hydrology.
- **H**ostage to hydrology.

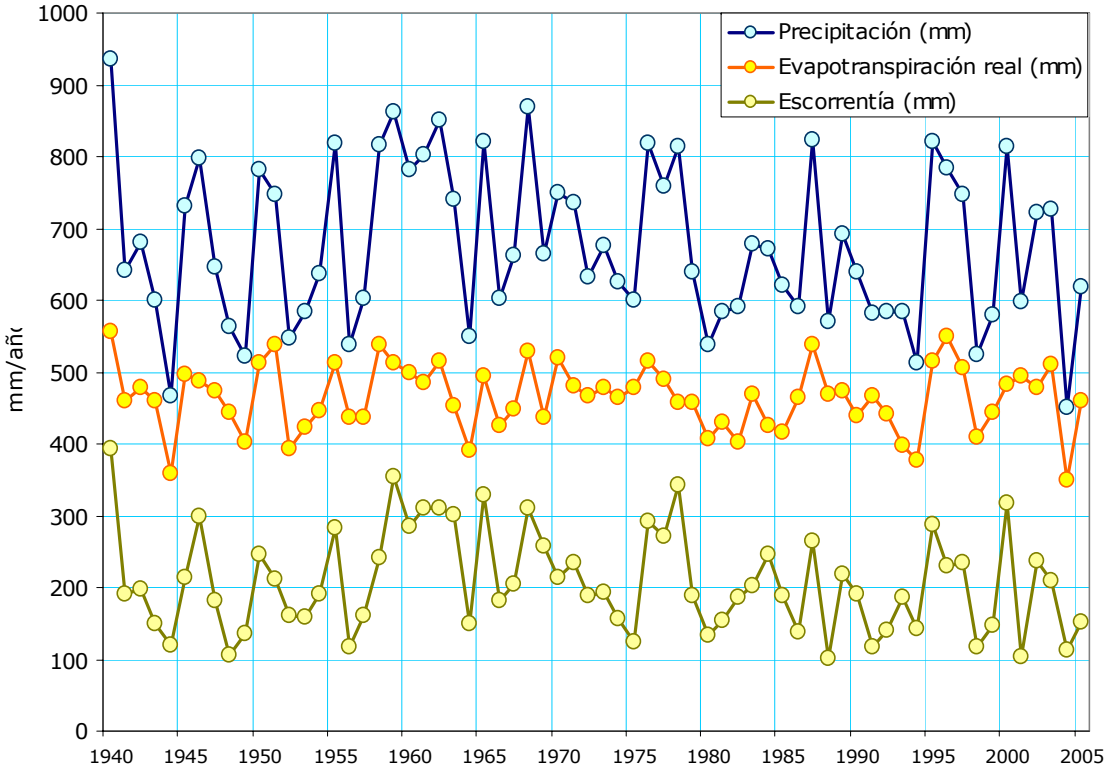
Irregular hydrological regimes in Spain



Mean annual precipitation (mm)



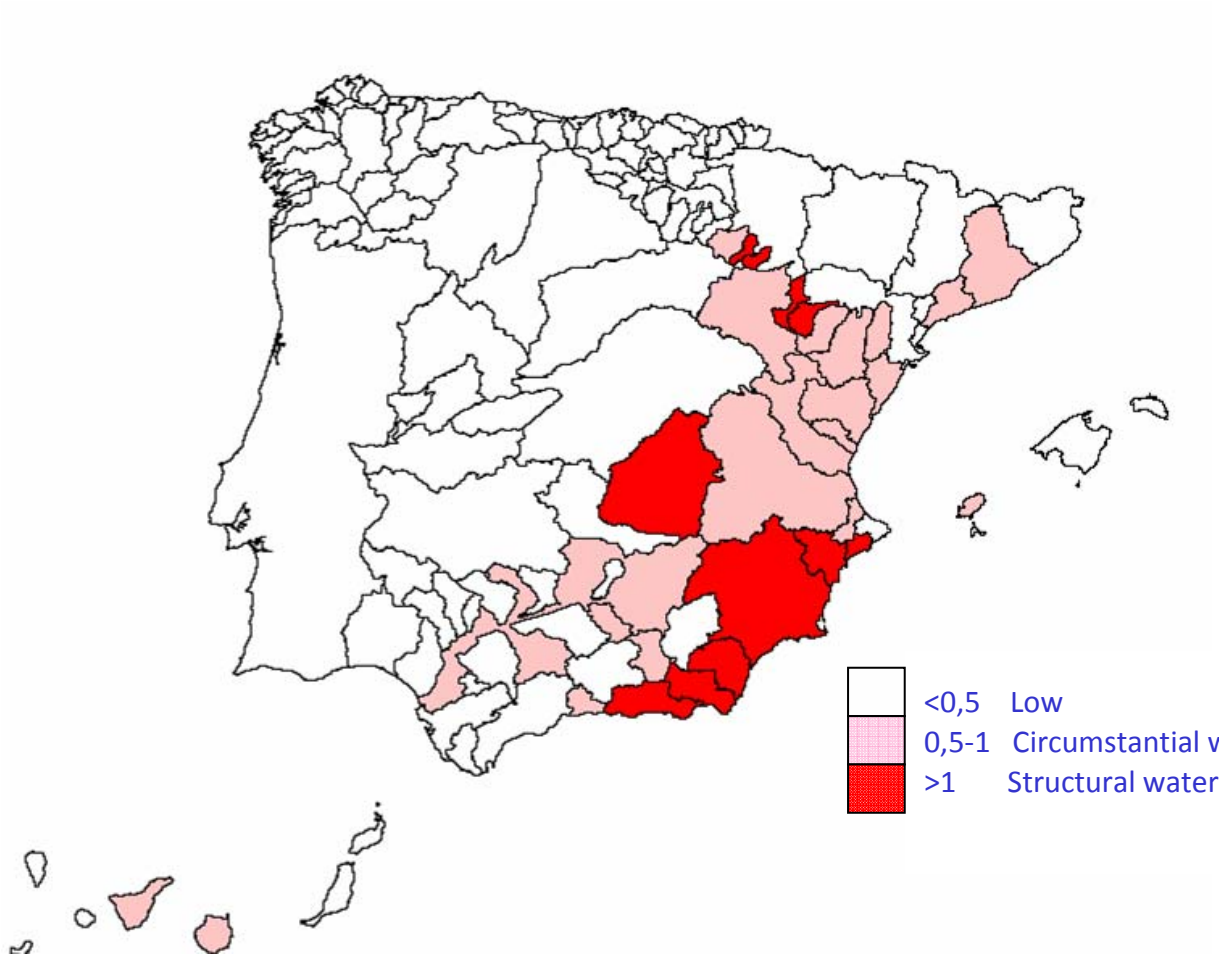
Mean annual runoff (mm)



Precipitation, actual evapotranspiration and runoff in Spain in mm (period 1940-2005)

Source: Ministry of the Environment, Rural and Marine Affairs, Spain

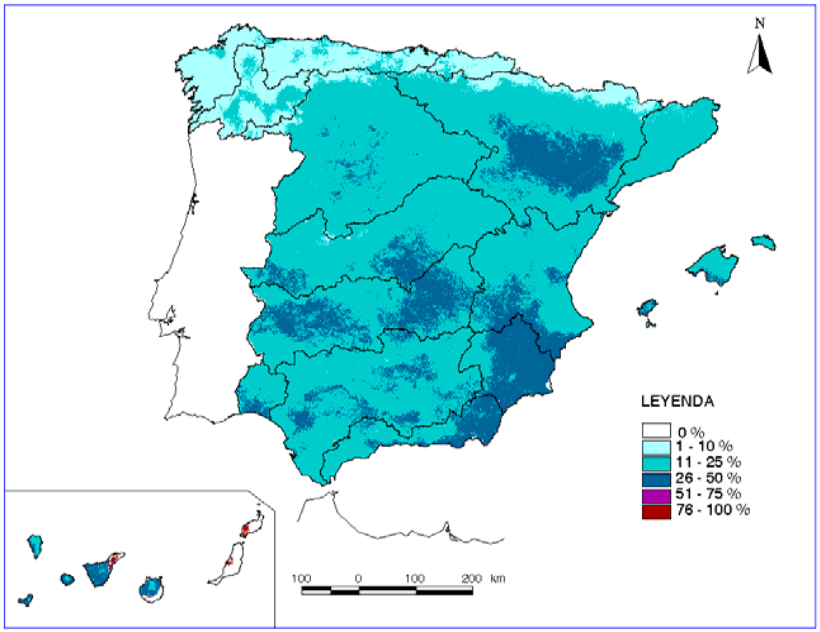
Water stress



Water pressure index: water use-return flows / potential water availability

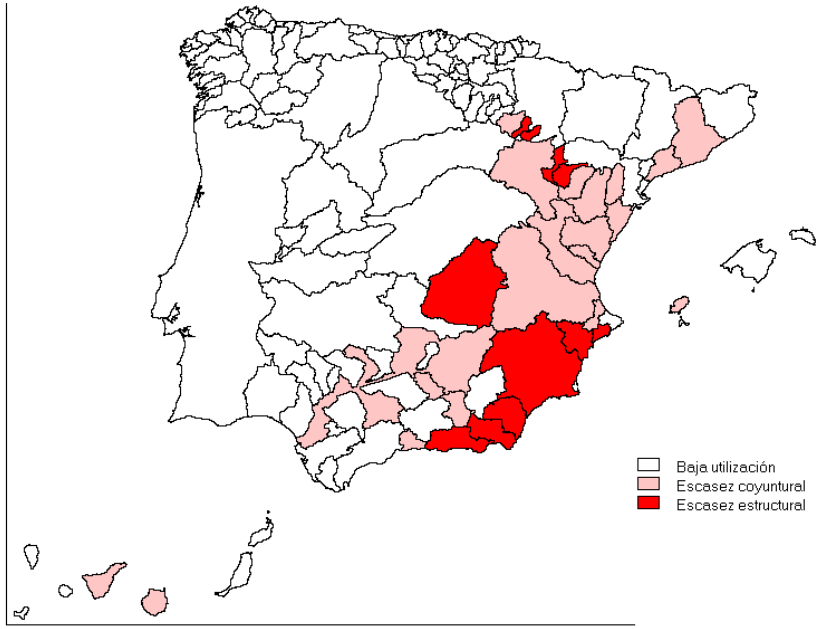
Source: Ministry of Environment, Rural and Marine Affairs

Impact on water resources and vulnerability in Spain



Impact on runoff reduction for a decrease of 5% in mean annual precipitation and an increase of 1ºC in mean annual temperature (year 2030) a decrease between 9 and 25% in runoff is expected depending on the river basin districts.

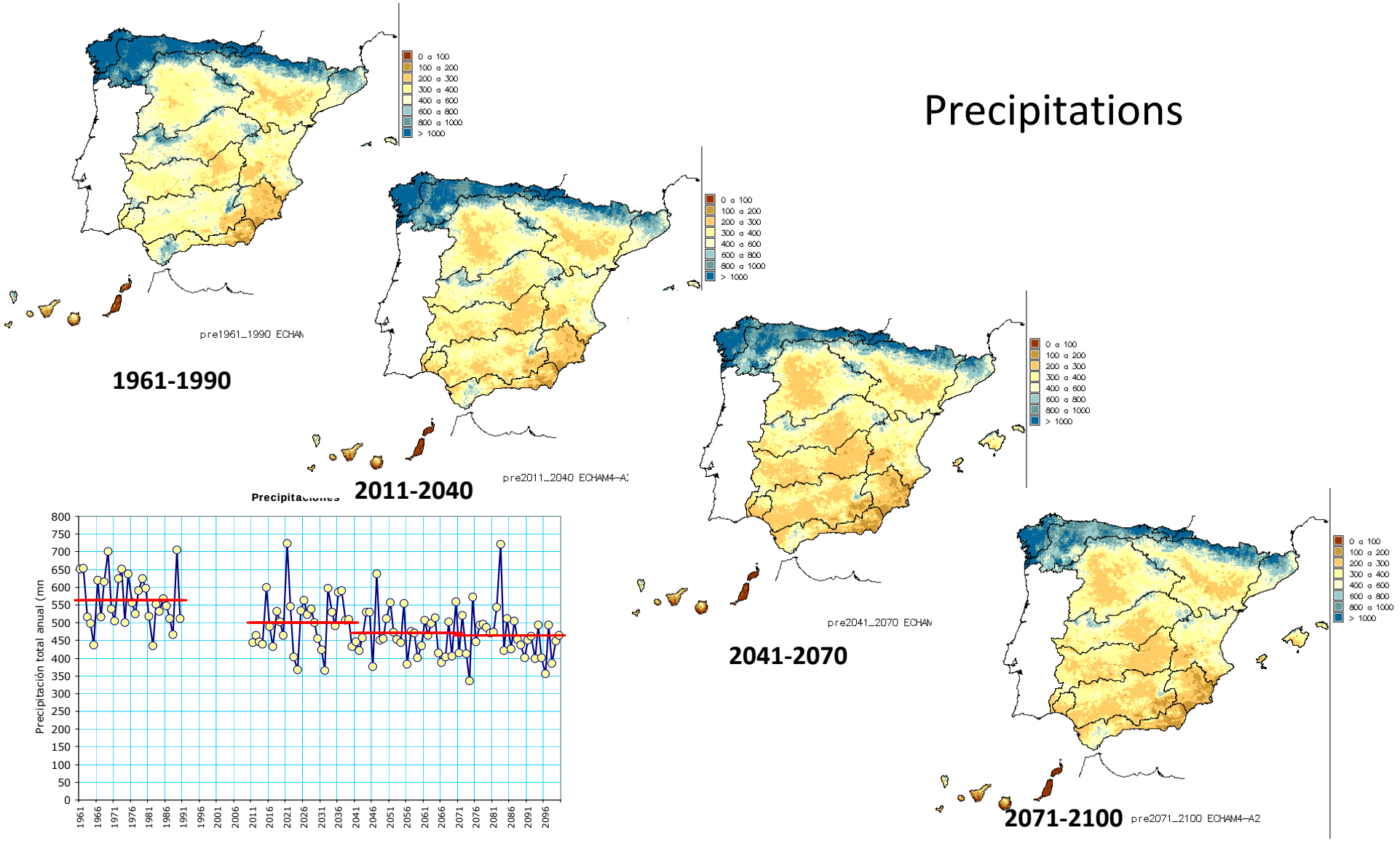
Source: White Paper on Water in Spain, MMA (2000)



Vulnerability: water scarcity risk in water resource systems. The most critical Spanish areas are arid and semiarid ones where water scarcity and drought problems are greater.

ECHAM4 Model. Escenario A2

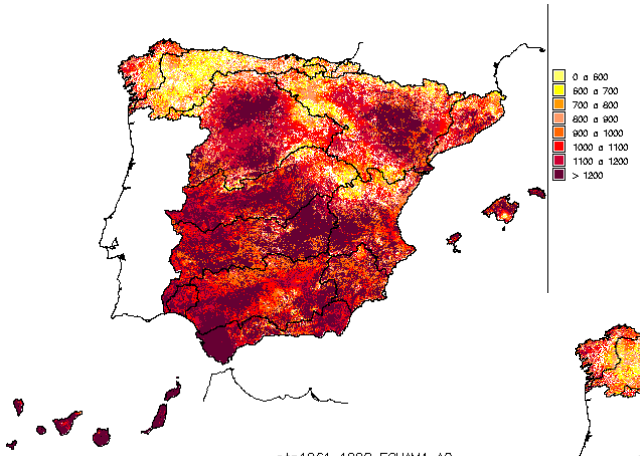
Precipitations



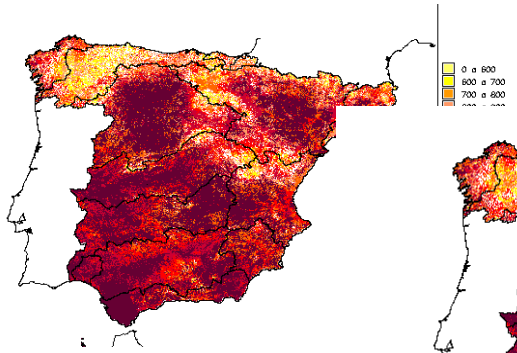
Source: Ministry of the Environment, Rural and Marine Affairs, Spain

ECHAM4 Model. Escenario A2

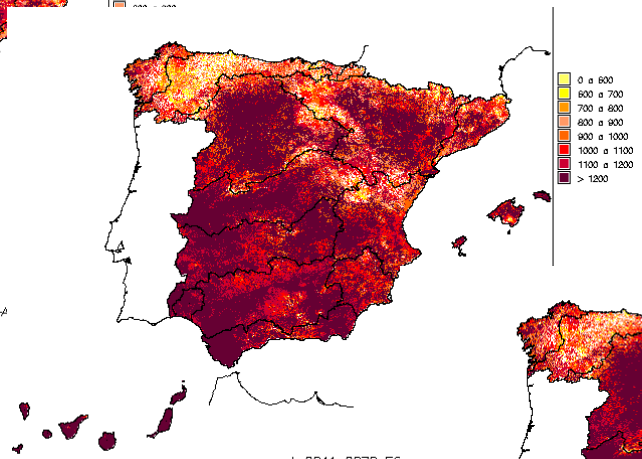
Potential evapotranspiration



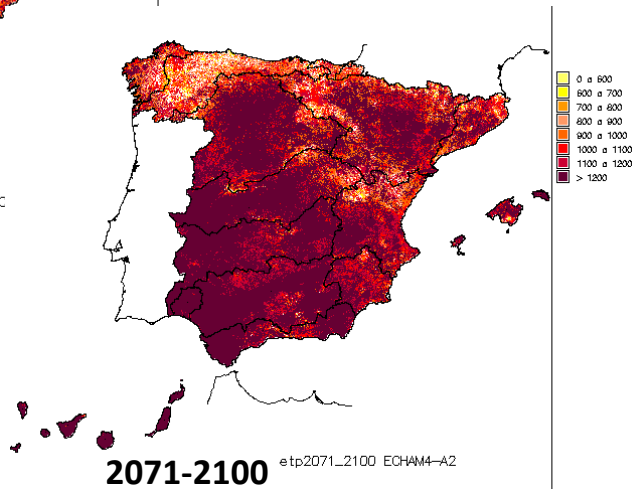
1961-1990



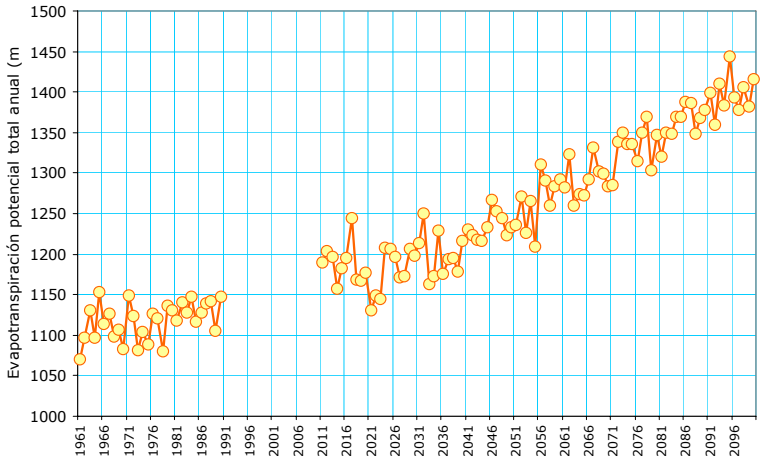
2011-2040



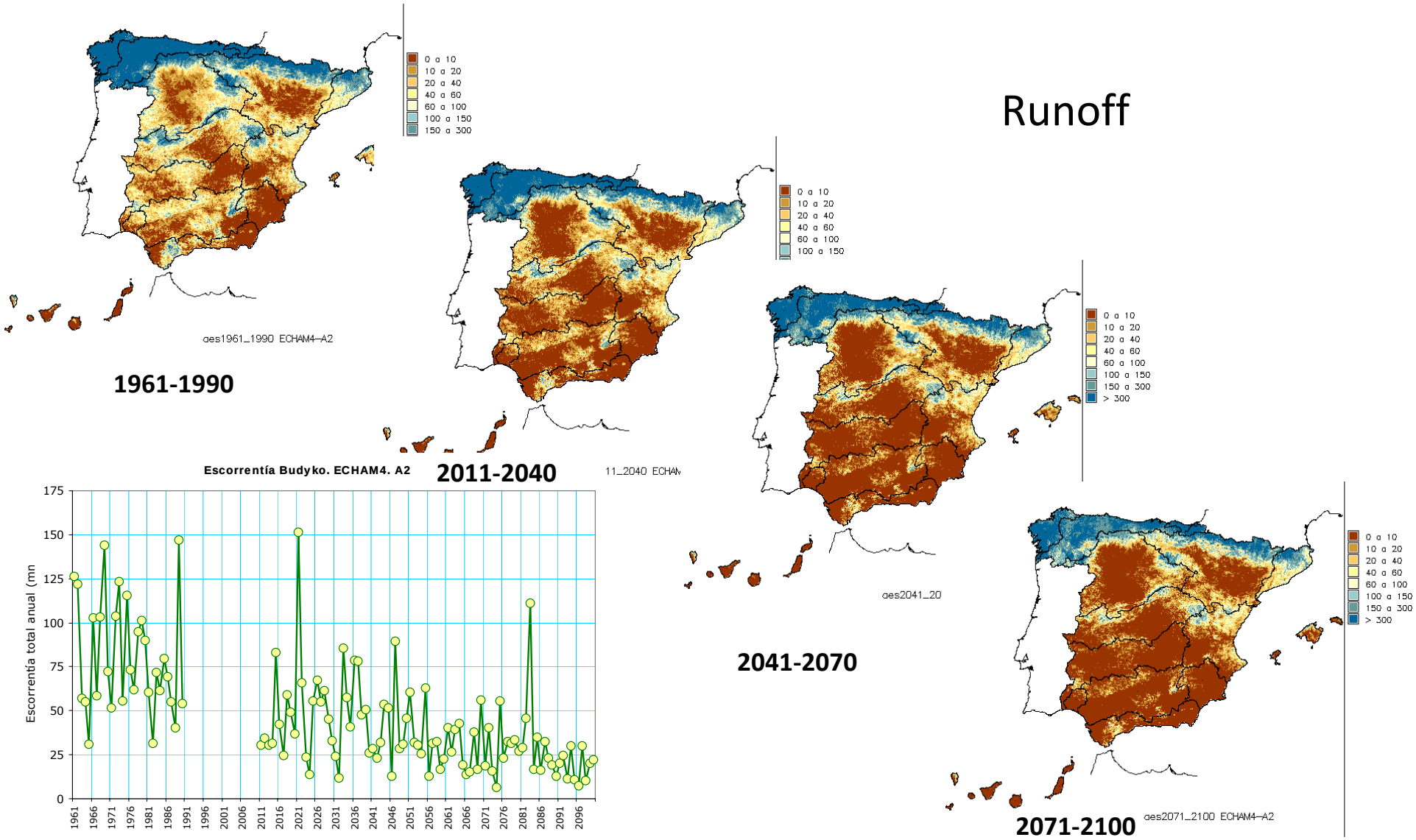
2041-2070



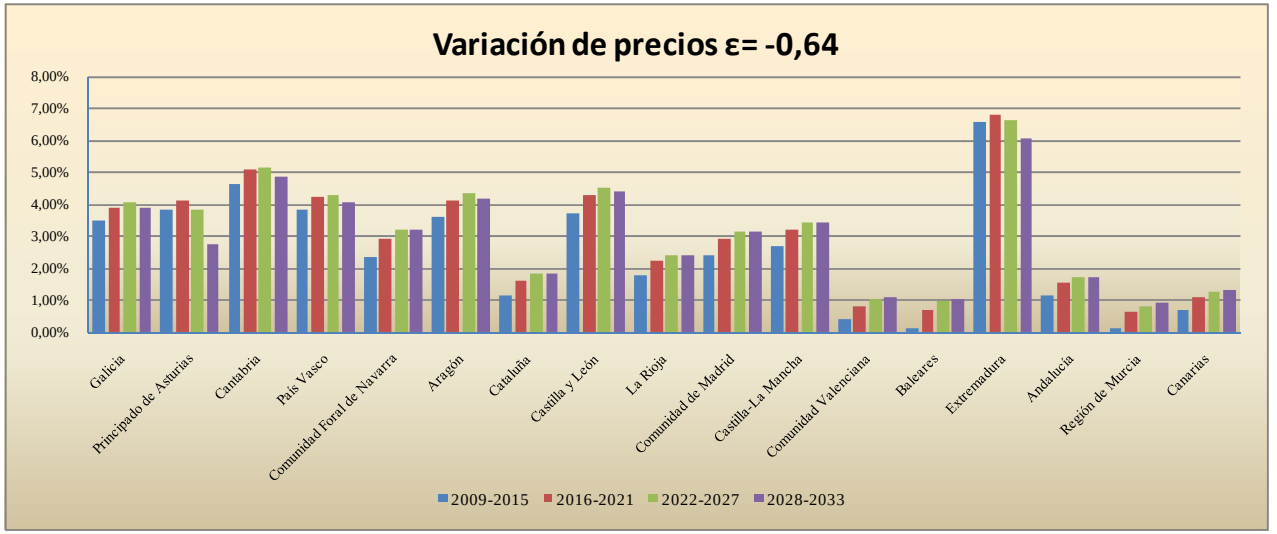
2071-2100

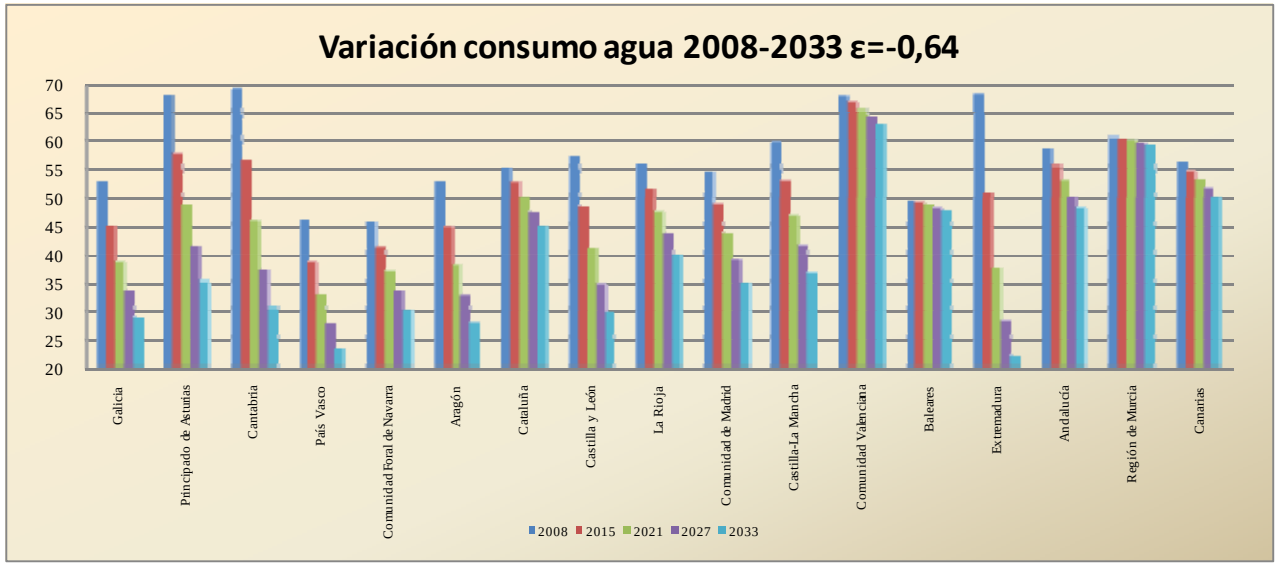


ECHAM4 Model. Escenario A2



Source: Ministry of the Environment, Rural and Marine Affairs, Spain


Variación de precios ε= -0,64
8,00%
7,00%
6,00%
5,00%
4,00%
3,00%
2,00%
1,00%
0,00%
Galicia
Principado de Asturias
Cantabria
País Vasco
Comunidad Foral de Navarra
Aragón
Cataluña
Castilla y León
La Rioja
Comunidad de Madrid
Castilla-La Mancha
Comunidad Valenciana
Baleares
Extremadura
Andalucía
Región de Murcia
Canarias
2009-2015
2016-2021
2022-2027
2028-2033


Variación consumo agua 2008-2033 ε=-0,64
70
65
60
55
50
45
40
35
30
25
20
Galicia
Principado de Asturias
Cantabria
País Vasco
Comunidad Foral de Navarra
Aragón
Cataluña
Castilla y León
La Rioja
Comunidad de Madrid
Castilla-La Mancha
Comunidad Valenciana
Baleares
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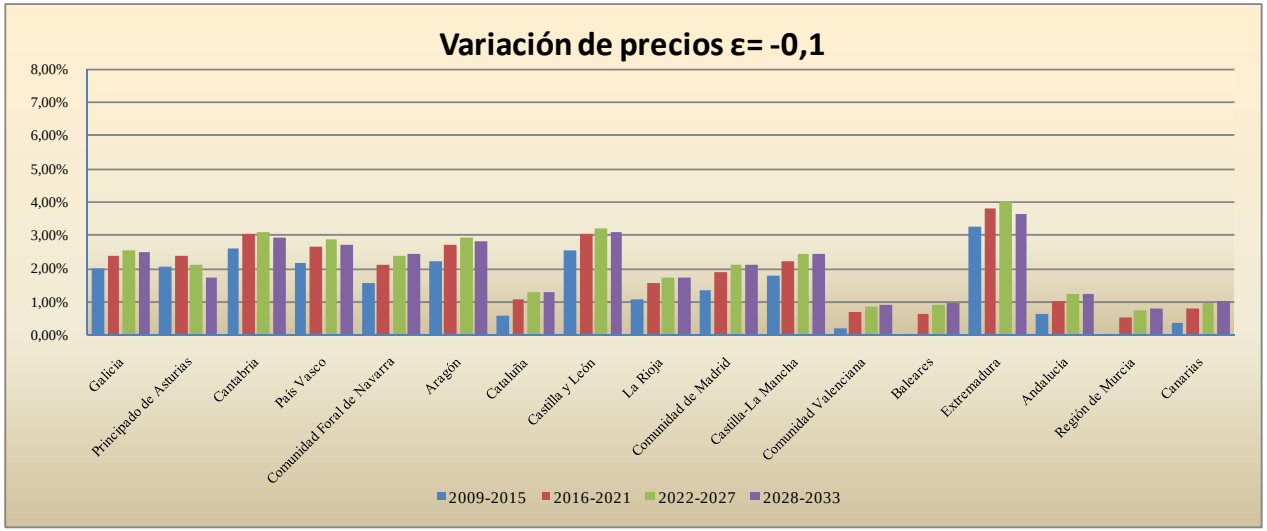
Andalucía
Región de Murcia
Canarias
2008
2015
2021
2027
2033


Variación de precios ε= -0,1
8,00%
7,00%
6,00%
5,00%
4,00%
3,00%
2,00%
1,00%
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Galicia
Principado de Asturias
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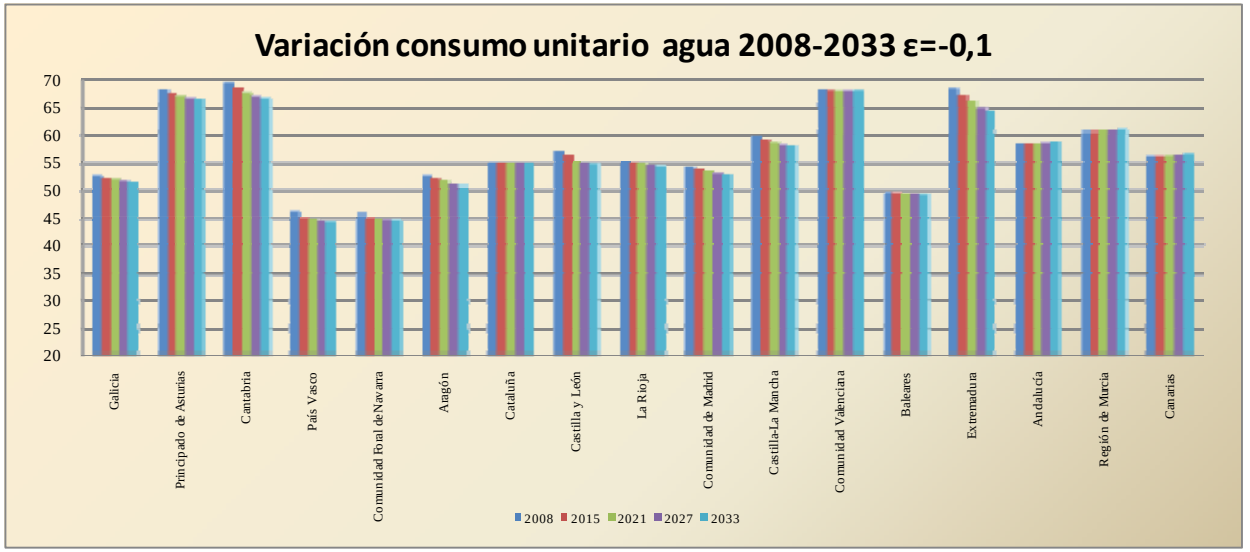
2028-2033


Variación consumo unitario agua 2008-2033 ε=-0,1
70
65
60
55
50
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40
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30
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Galicia
Principado de Asturias
Cantabria
País Vasco
Comunidad Foral de Navarra
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