Spring 6-13-2014

Wastewater reuse in Apulia: between dream and reality

Antonio Lopez
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Istituto di Ricerca Sulle Acque
(Water Research Institute)

Consiglio Nazionale delle Ricerche
(National Research Council)

Agricultural wastewater reuse in Apulia: between Dream and Reality

Antonio Lopez

ECI – WBTR
13 June 2014
Otranto - Italy

MILANO

ROMA

BARI

PRELIMNAY STATEMENT:

From a technical stand point wastewater reuse is not a challenge anymore

Singapore:

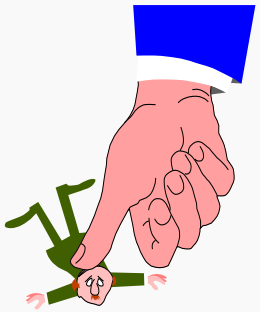
NEWater Project -
Bottled Reverse Osmosis Drinking Water from blended MWW

(since 2001)

Water Reuse

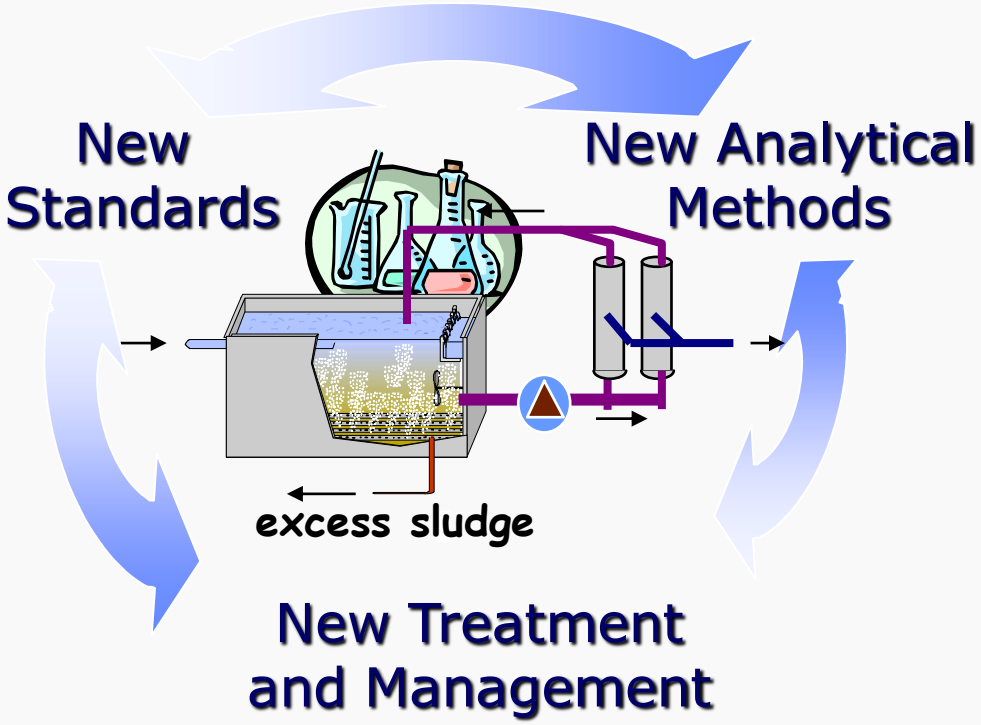
Main Drivers and Trends

Drivers



Water shortage
+
More stringent regulations
+
Social & Political & Market pressure

Trends

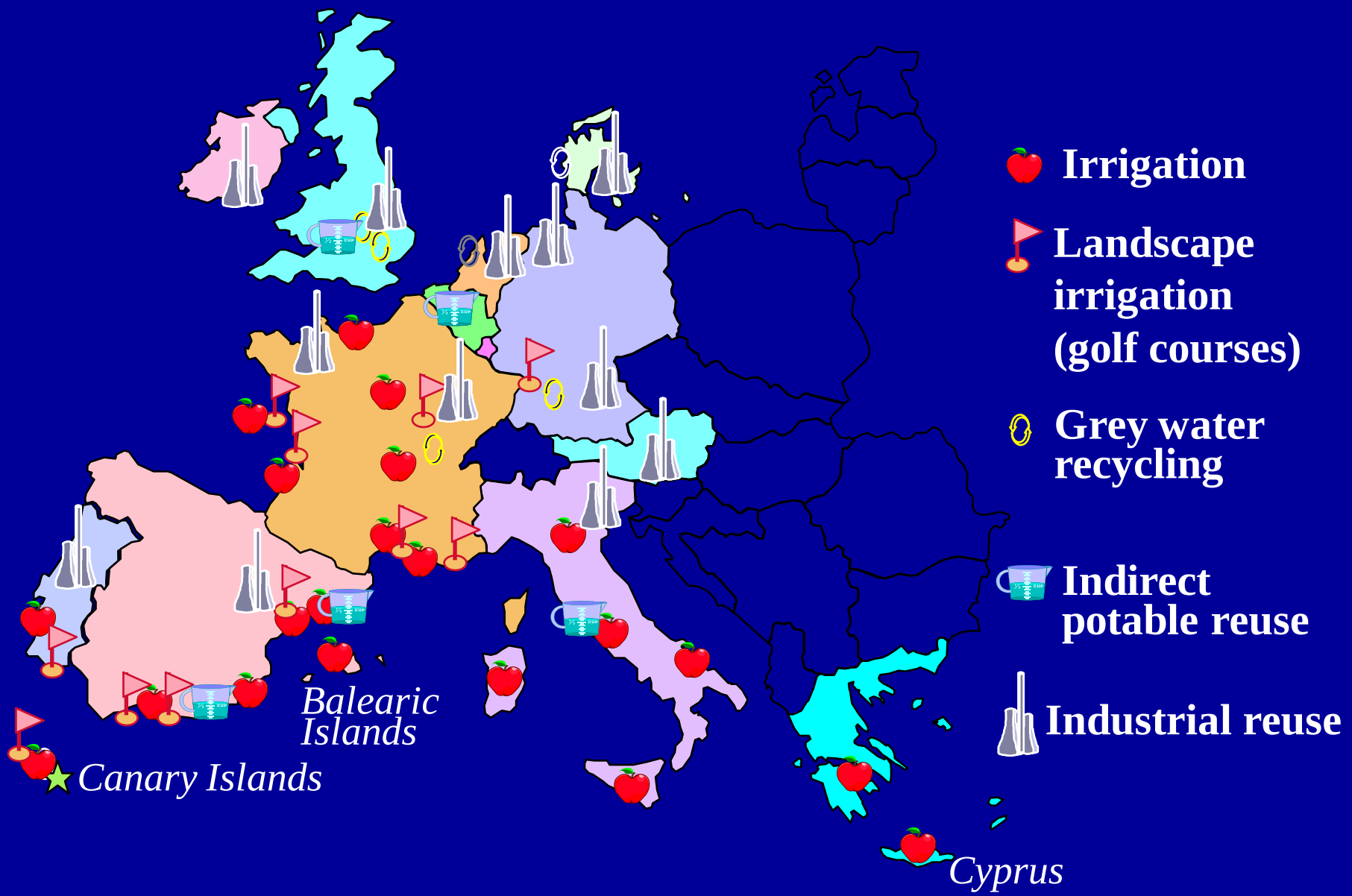


Wastewater reuse
-Types of reuse-

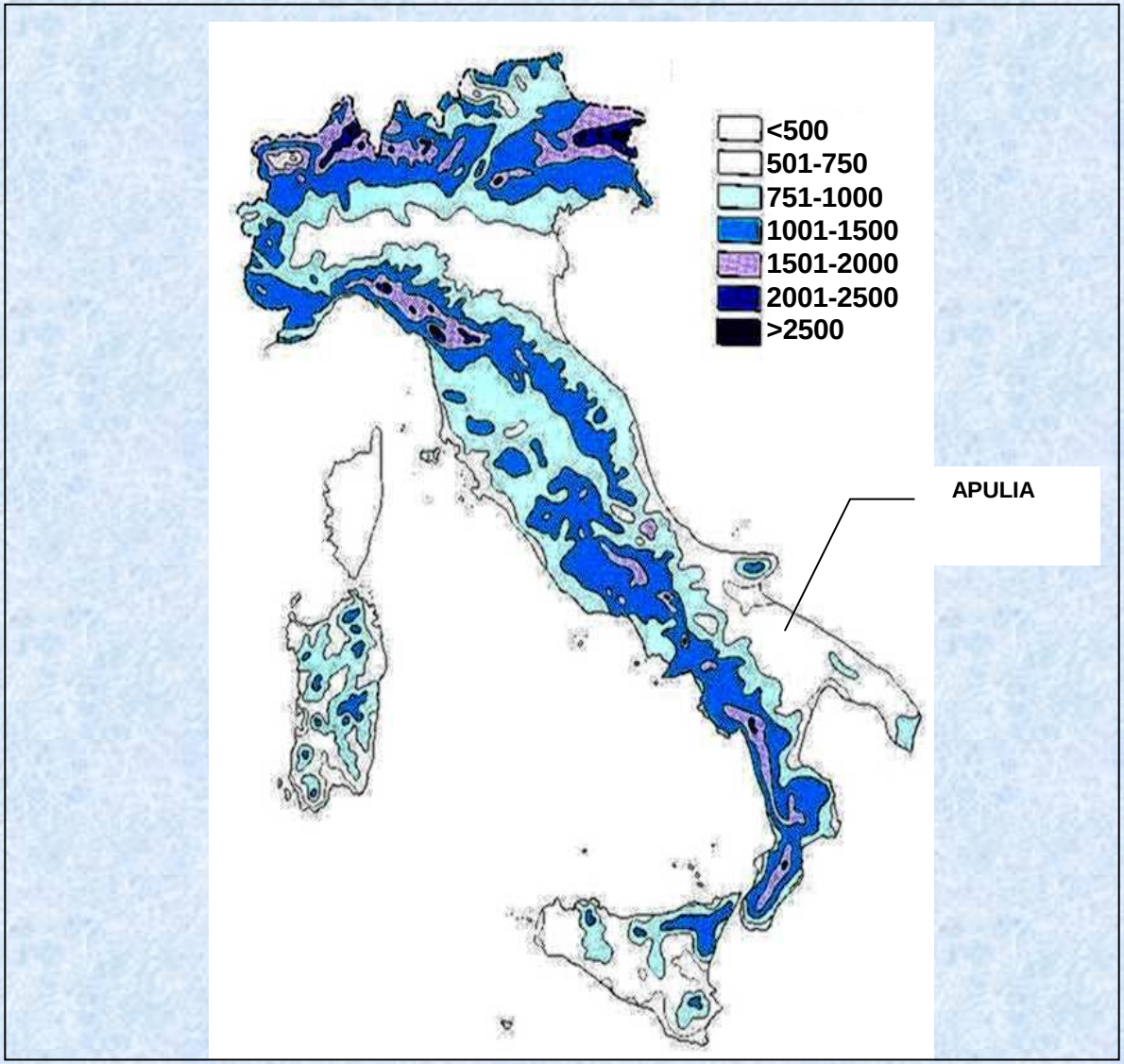
- **IRRIGATION**
- **INDUSTRY**
- **GROUNDWATER RECHARGE**
- **NON POTABLE CIVIC USES** (washing: roads, building, vehicles; feeding: cooling, heating, fire-fighting systems; washing toilets)
- **DRINKING PURPOSES**

Water reuse in EU Countries

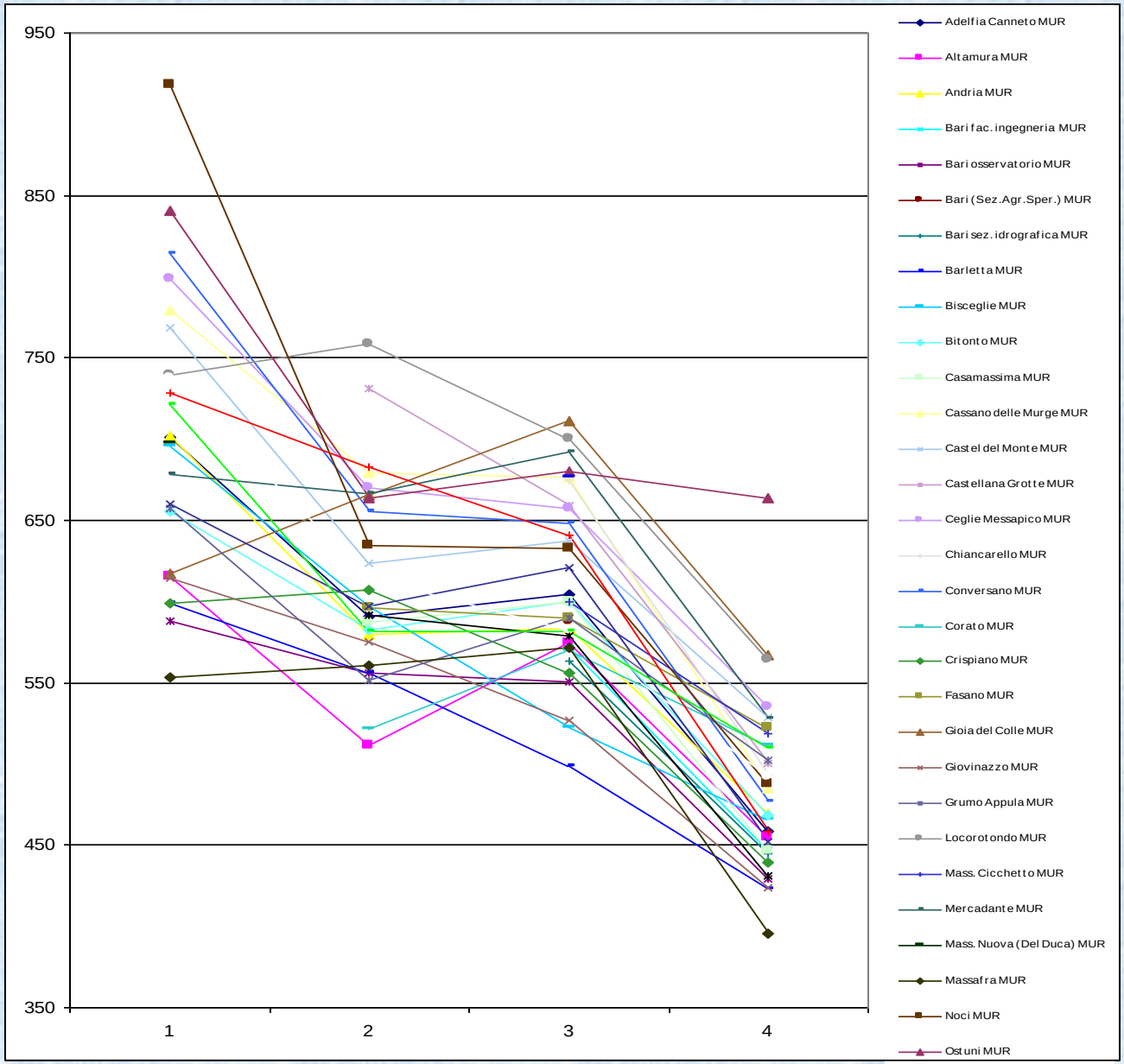
Diversification of types of reuse



Rainfall distribution in ITALY: average values (mm) in the period 1960-2010



Rainfalls trends in Apulia during the period 1970 -2010
(Ten years average values measured at some raifall stations)



APULIA

Population: 4,500,000 M

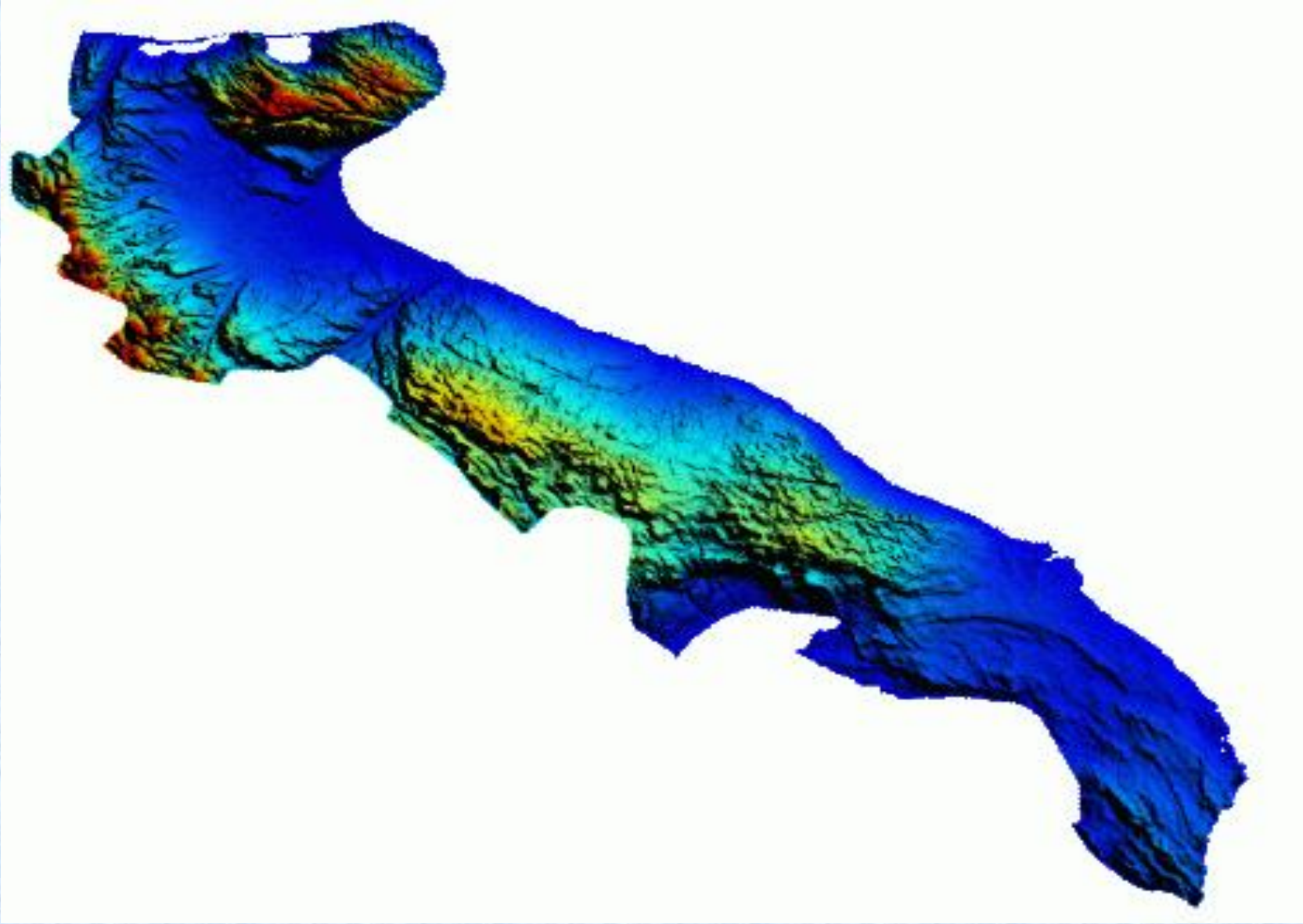
Area: 19,000 km^2

Coasts length: 800 km

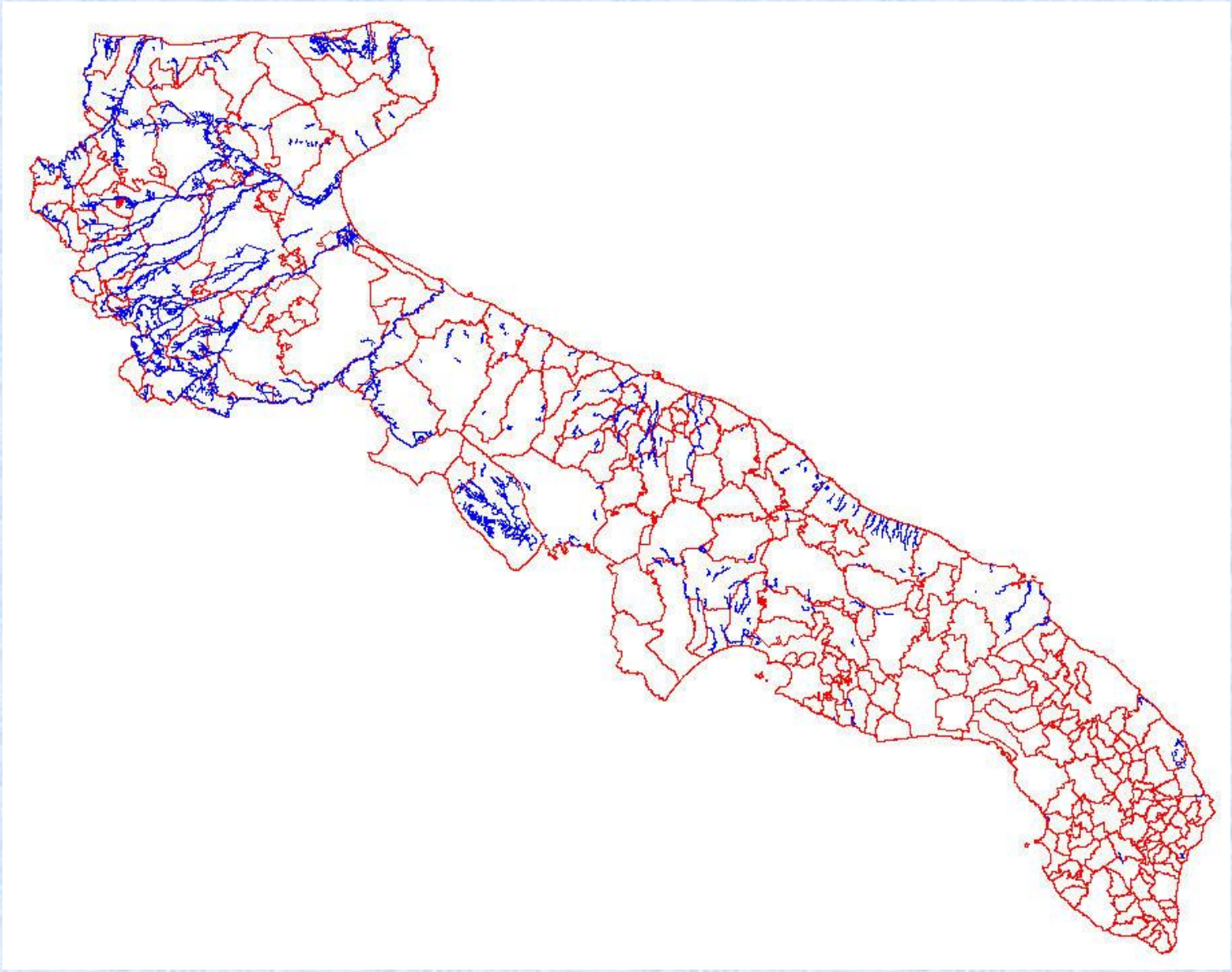
Inflows and Outflows average yearly values of the main Italian regional water basins (1965-2005)

Main regional water basins	INFLOWS		OUTFLOWS		OUTFLOWS COEFFICIENTS
	mm	10^9 m^3	mm	10^9 m^3	
Po	1070	71.8	670	47.0	0.62
Veneto	1160	42.8	810	30.0	0.70
Liguria	1340	6.4	990	4.8	0.74
Romagna + Marche	940	20.6	460	10.1	0.49
Toscana	1010	20.9	470	9.7	0.47
Lazio	1020	24.1	440	10.3	0.43
Abruzzo + Molise	900	11.9	490	6.5	0.54
Campania	1200	23.2	670	12.9	0.56
Puglia (APULIA)	660	13.2	150	2.9	(150/660) = 0.23
Basilicata	800	7.9	200	2.0	0.25
Calabria	1170	16.1	560	7.8	0.48
Sicilia	730	18.8	190	4.9	0.26
Sardegna	780	18.3	250	6.1	0.33
ITALY	990	296.0	510	15.5	0.52

Orography of Apulia



Hydrography of Apulia



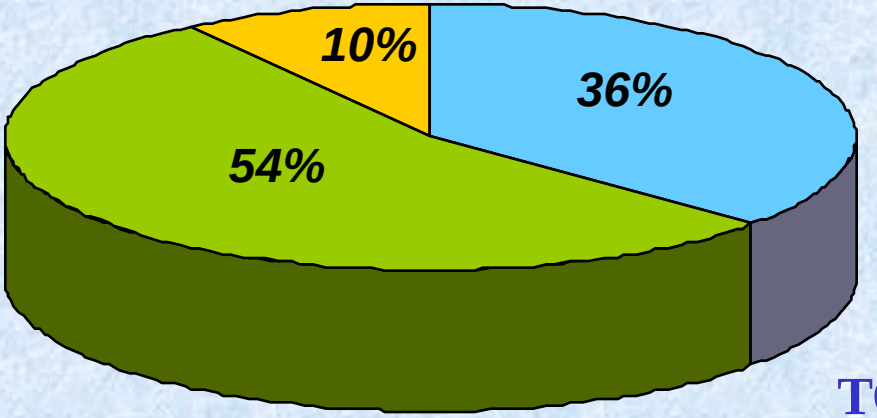
Yearly sectorial water needs in Apulia

INDUSTRY

(142 Mmc)

AGRICULTURE

(812 Mmc)



POTABLE

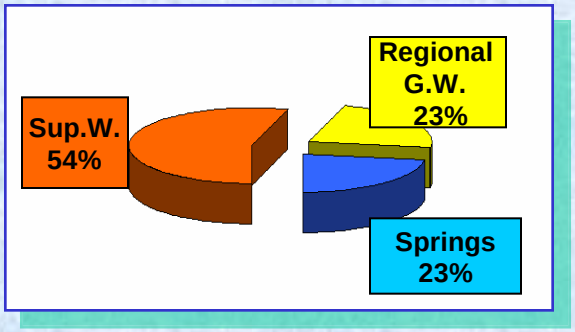
(546 Mmc)

TOTAL=1500 Mmc

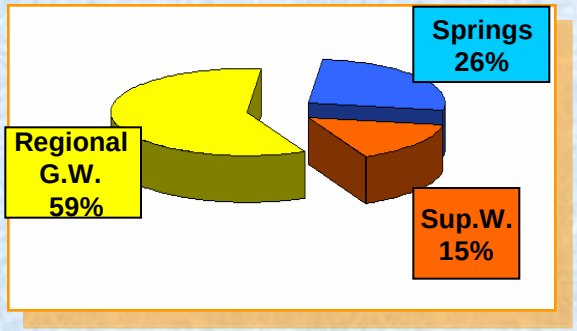
- 55% coming from regional groundwater [~ 200,000 wells]
- 45% coming from out of Region sources (11% from springs and 34% from superficial water bodies)

Sectorial water-sources contribution (%)

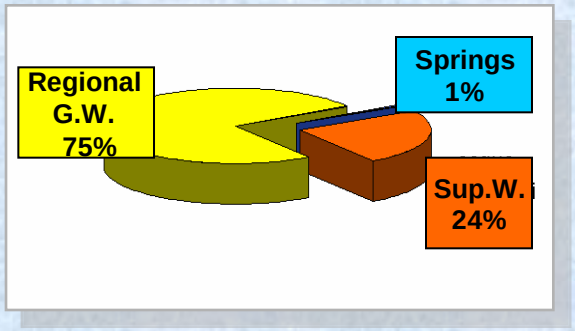
POTABLE



INDUSTRY



AGRICULTURE



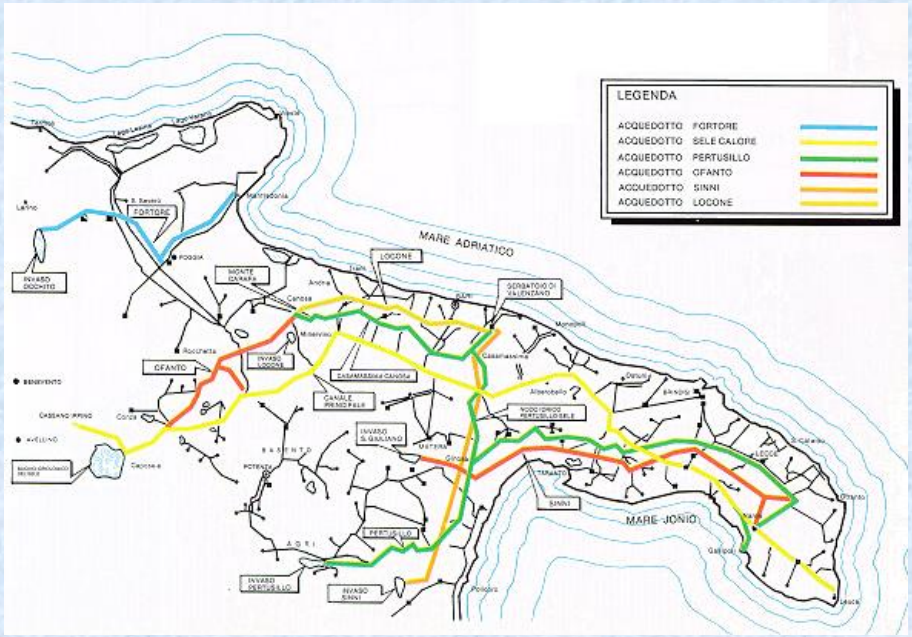
Water needs in Apulia

-Regional (R) and Extra-regional (E) sources-

	(Mm^3/y)
-Agriculture	812 (78% R + 22% E)
-Industry	142 (85% R + 15% E)
-Potable	546 (24% R + 76% E)
TOTAL	**1500 (55% R + 45% E)**

- **regional groundwater (55%) [~ 200,000 wells]**
- **springs from Campania Region (11%)**
- **superficial water from bordering Regions (34%)**

In Apulia potable needs are satisfied by the Apulian Aqueduct (AQP): the largest in Europe – the third in the World



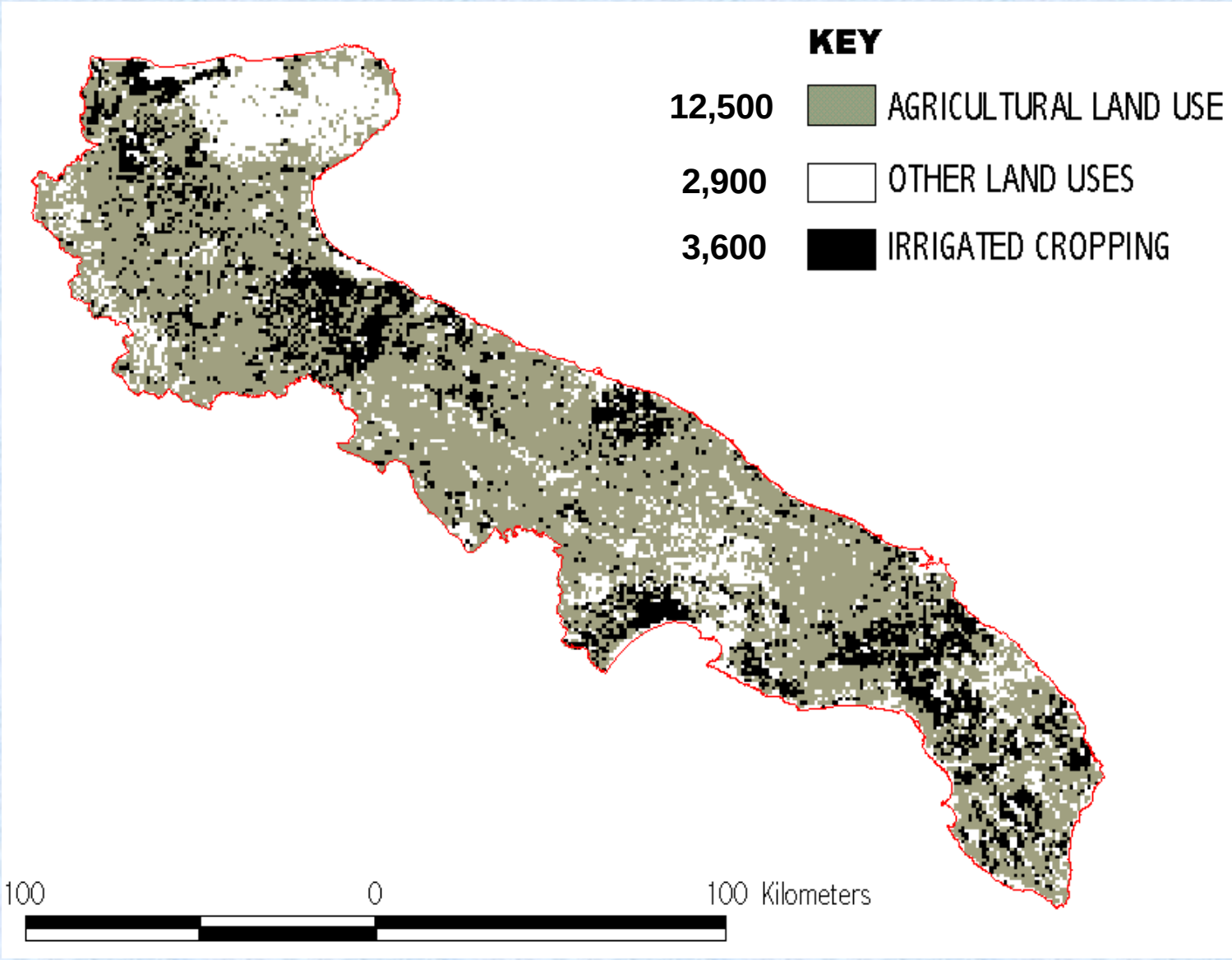
Main figures

- ✓ 250 (municipalities served)
- ✓ 4,000,000 (inhabitants)
- ✓ SERVICES PROVIDED – water: treatment, supply and distribution - wastewater: collection and treatment
- ✓ 20,000 Km^2 (territory served)
- ✓ 20,000 Km (distribution pipelines)
- ✓ 550,000,000 m^3/y (distributed water)

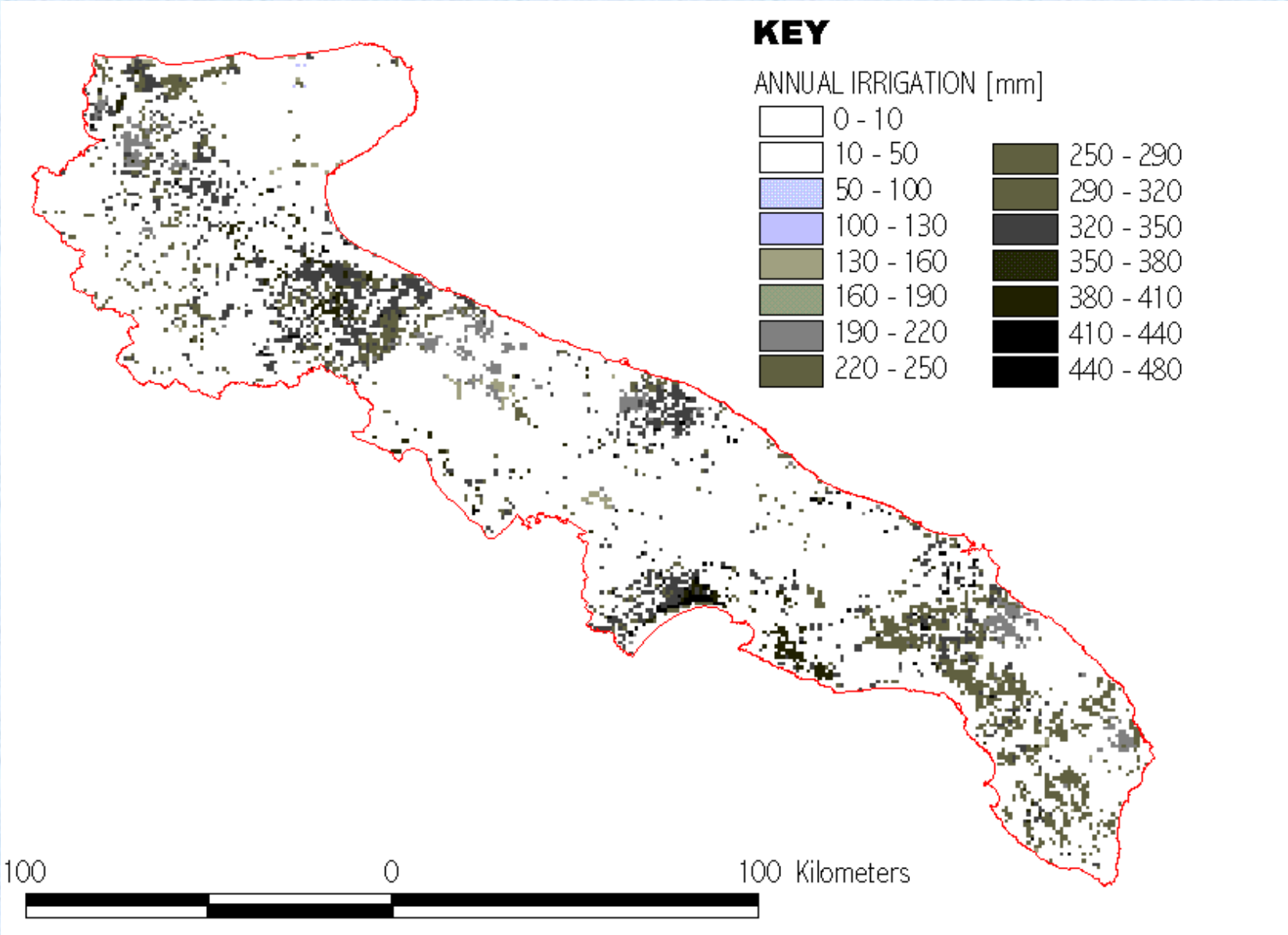
23% Regional GW

77% Bordering Regions

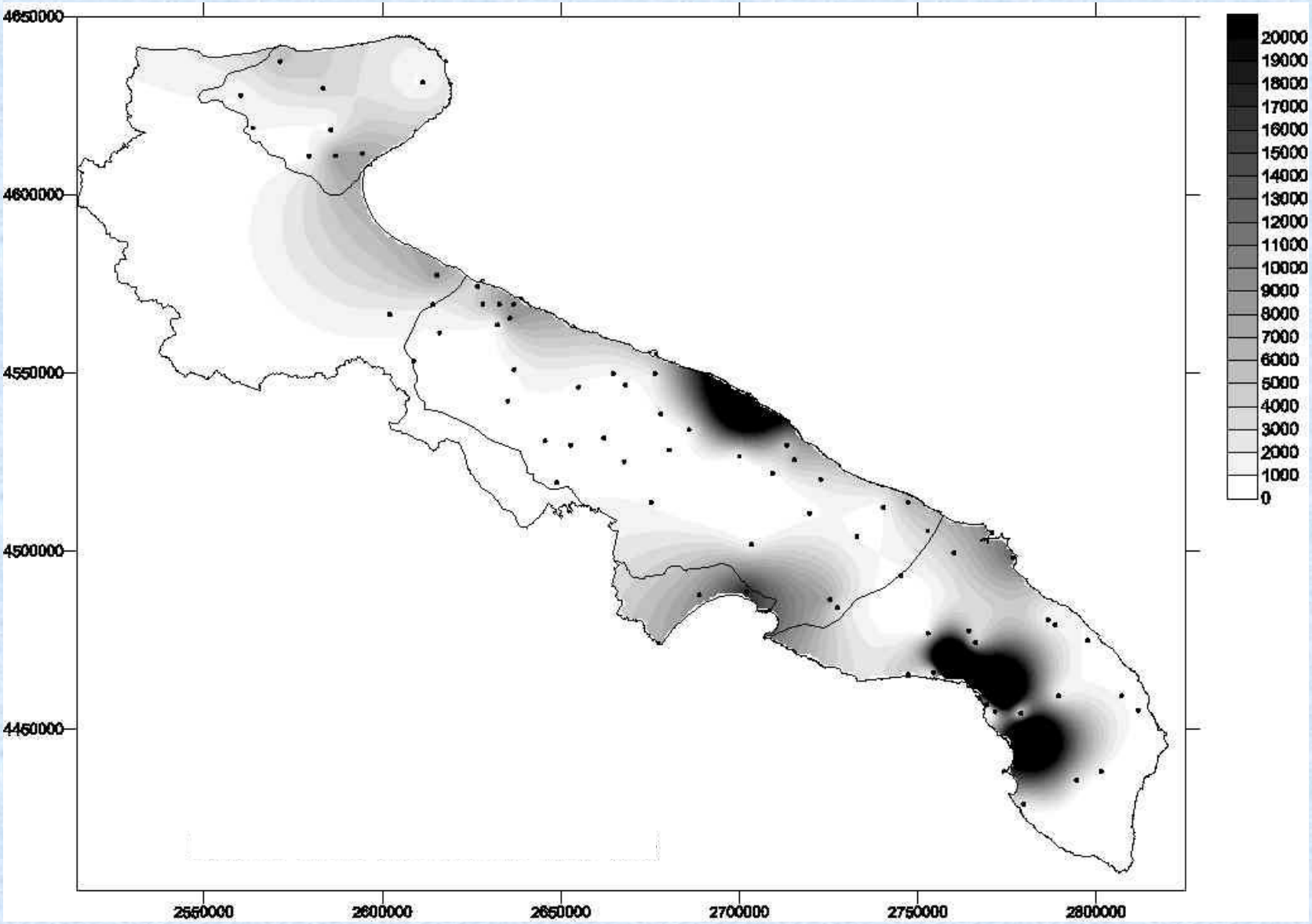
Land use in Apulia
(Regional Total Area: 19,000 km^2)



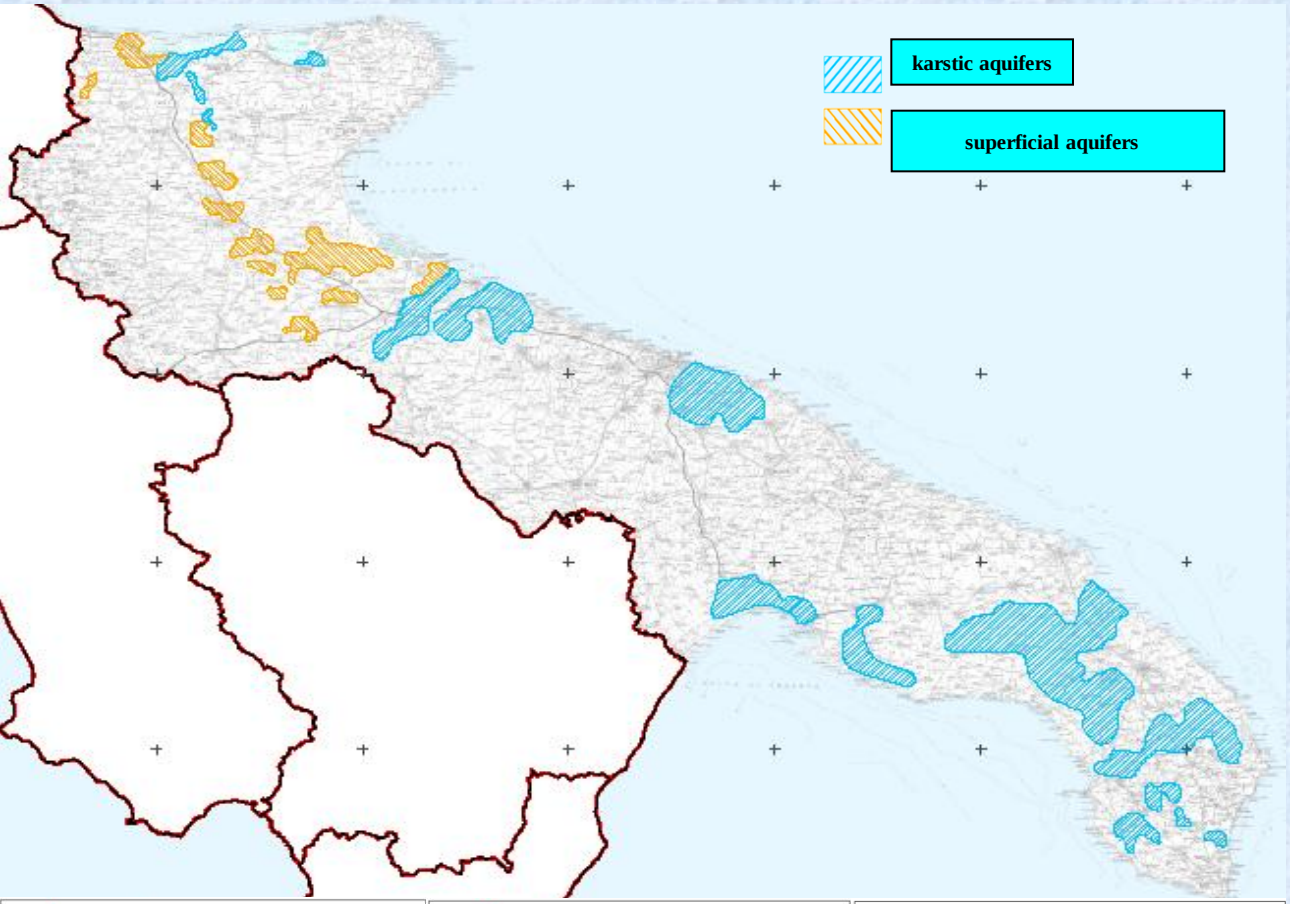
Groundwater withdrawals for irrigation purposes in Apulia (mm/y)

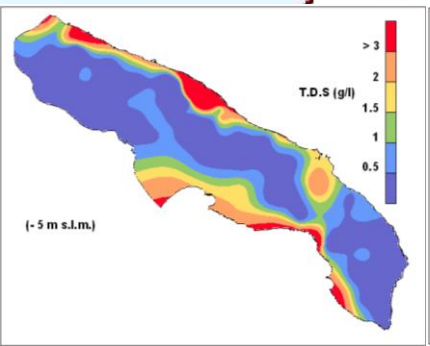


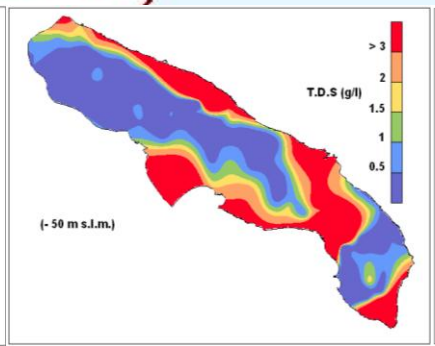
Electrical conductvity (µS/cm) in Apulian groundwater

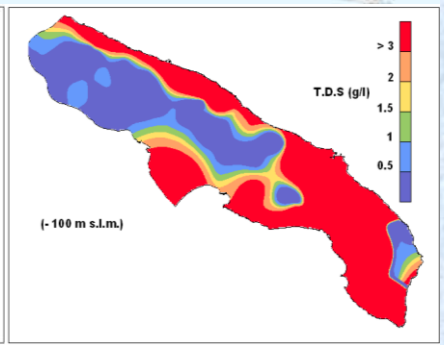


Apulian areas affected by groundwater overexploitation









SALT INTRUSION PHENOMENA

Dott. ACHILLE SCLAVO
Professore d'Igiene nella R. Università di Siena

Sul problema della fognatura in Puglia con speciale riguardo alla depurazione biologica delle acque di fogna.

Due conferenze tenute a Bari i giorni 17-18 Dicembre 1911

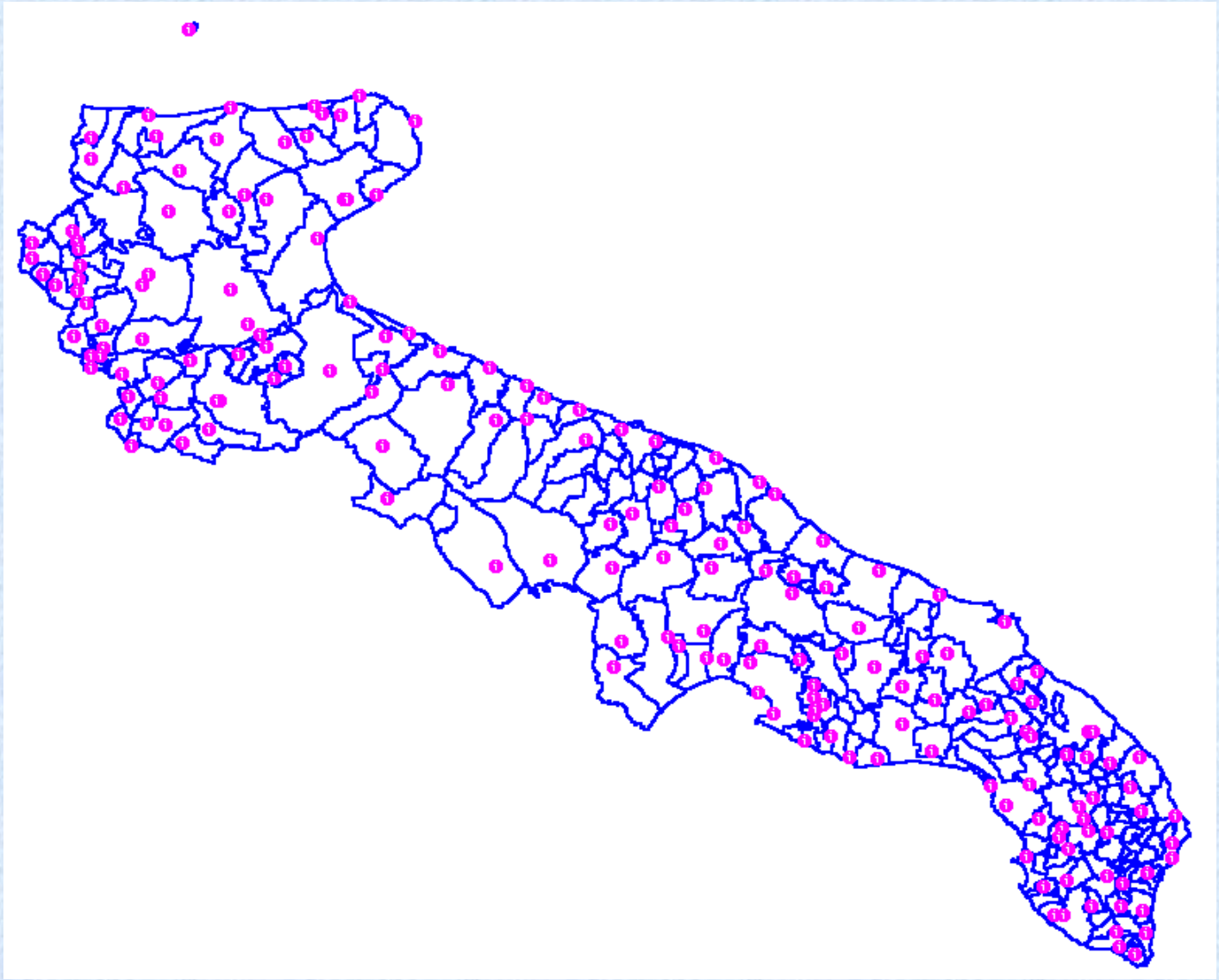
STAMPA ANASTATICA

SIENA
TIP. EDITRICE S. BERNARDINO
1912

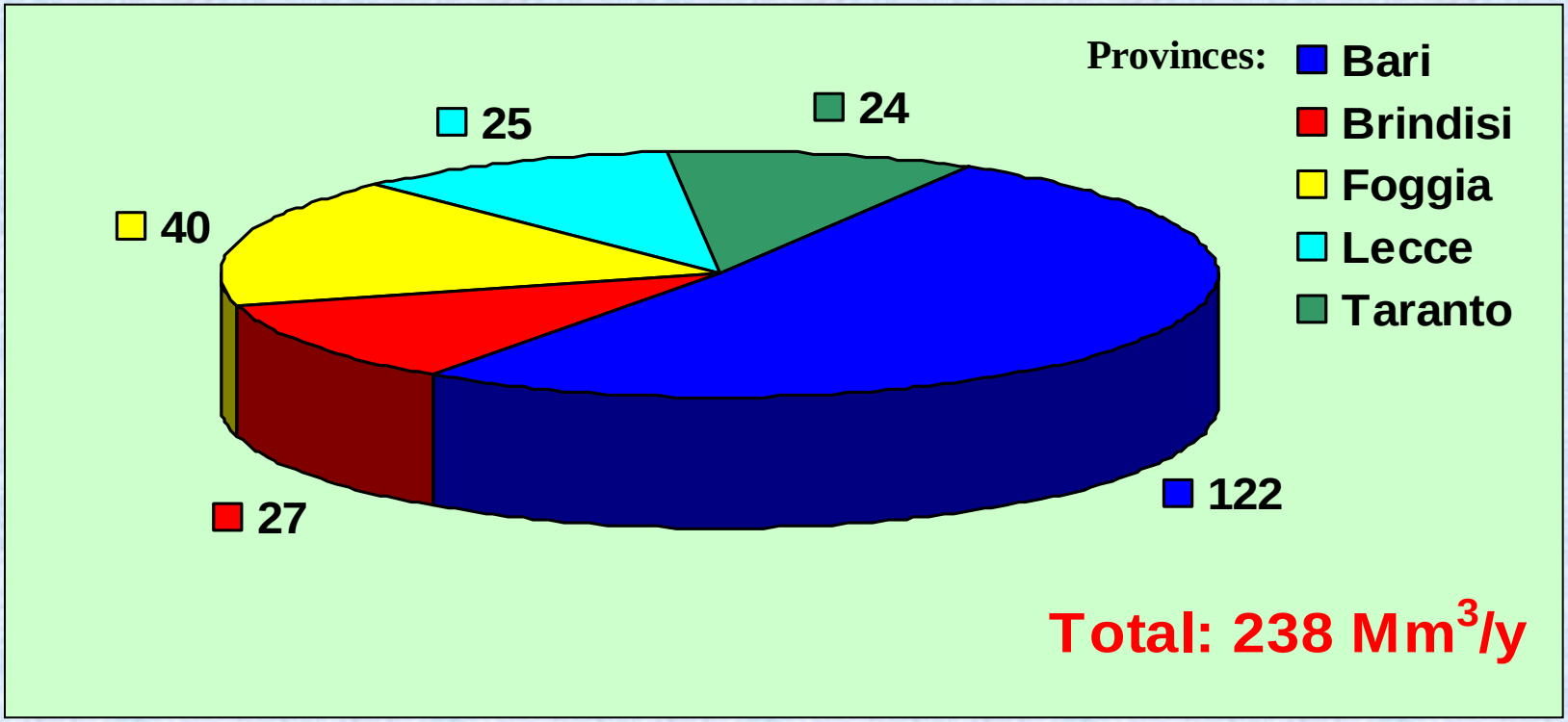
About the problem of sewage in Apulia with focus on biological treatment

1912 !

Municipal WW Treatment Plants distribution in Apulia



Total amount (Mm^3/y) of municipal wastewater treated in Apulia



The Apulian Water Protection Master Plan

"Piano di Tutela delle Acque (PTA)"

(definitively issued on 20th/October/2009)

Aim:

assessing the quality state of regional water resources and planning the implementation of the necessary measures for preventing their quali-quantitative worsening

Apulian PTA goals: IMPLEMENTING MWW REUSE

Volumes of reusable municipal wastewater in Apulia according to the PTA

1st phase

VOLUMES REUSABLE FROM THE POLISHING TREATMENT PLANTS ALREADY

- EXITING or
- UNDER CONSTRUCTION or
- FINANCED

POTENZIALITA' DISPONIBILE		
PROVINCIA		POTENZIALITA'
BARI	mc/anno	22.690.000
BRINDISI	mc/anno	4.480.000
FOGGIA	mc/anno	12.090.000
LECCE	mc/anno	12.080.000
TARANTO	mc/anno	41.058.000
TOTALE	mc/anno	92.398.000

92 Mm^3/y

2nd phase

VOLUMES THAT COULD BE REUSED WHEN ALL THE SUITABLE APULIAN WASTEWATER TREATMENT PLANTS WILL BE EQUIPPED WITH A POLISHING STEP

POTENZIALITA' TOTALE		
PROVINCIA		POTENZIALITA'
BARI	mc/anno	42.473.510
BRINDISI	mc/anno	9.392.619
FOGGIA	mc/anno	16.780.644
LECCE	mc/anno	29.752.337
TARANTO	mc/anno	49.219.631
TOTALE	mc/anno	147.618.741

NOTE THAT THIS IS JUST THE VOLUME PRESENTLY REQUIRED BY THE WHOLE APULIAN INDUSTRIAL SECTOR

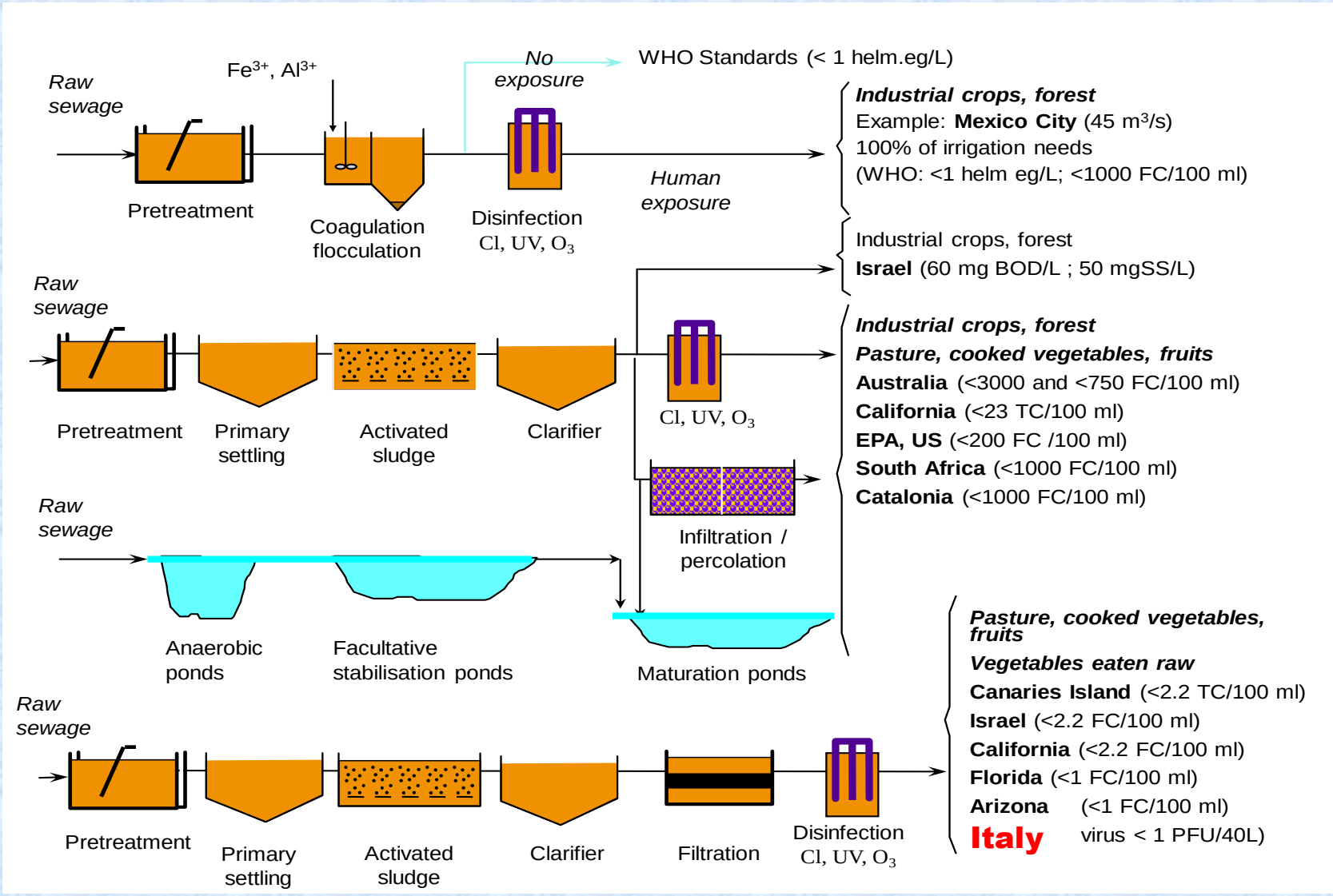
147 Mm^3/y

Main quality parameters fixed by the in force Italian Law (D.M.185/03) for agricultural reuse of municipal wastewater. (*) exceptions valid in Apulia.

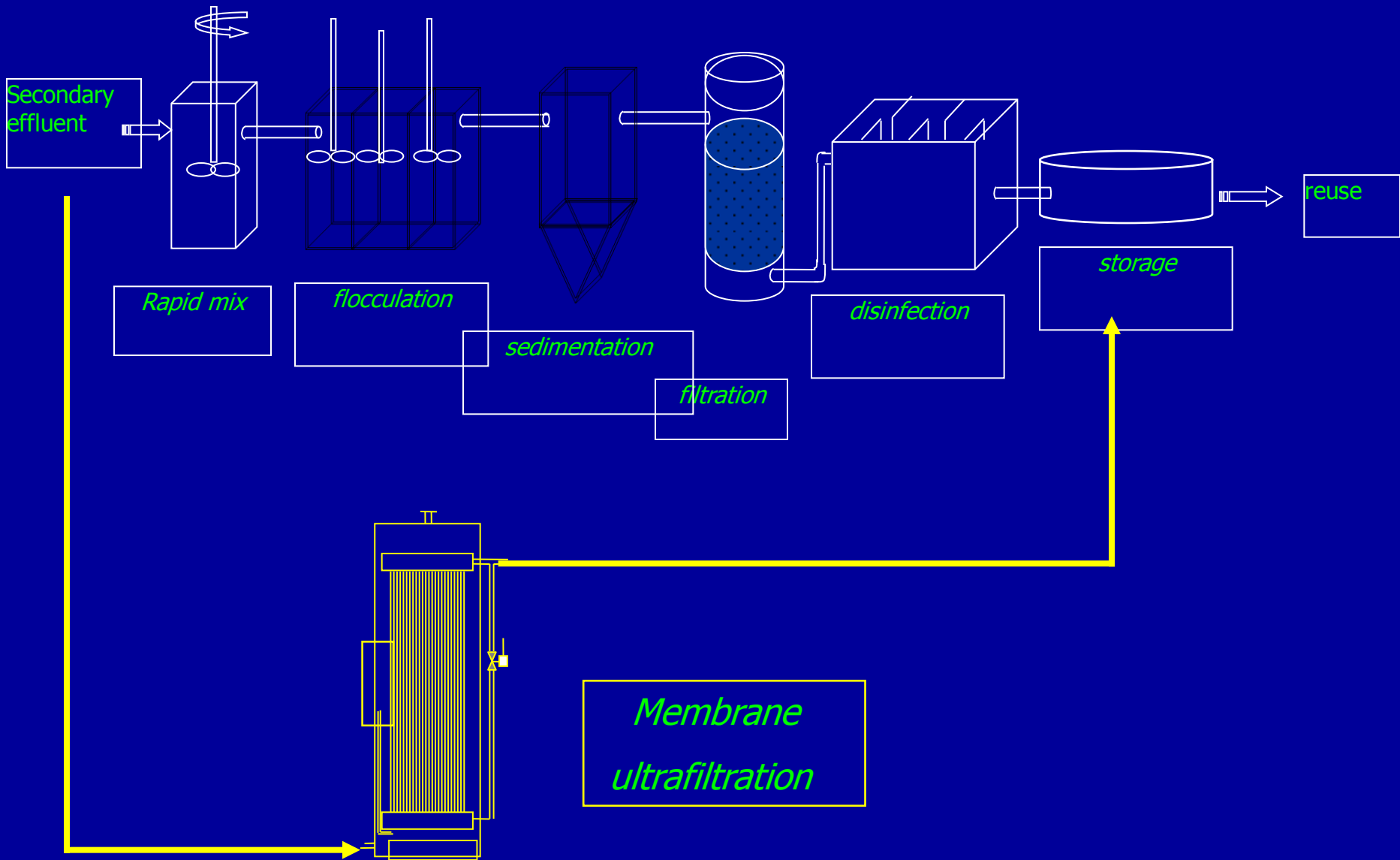
PARAMETER	VALUE	PARAMETER	VALUE
pH	6-9.5	Total Phosphorus (mg/L)	10
Coarse solids (mg/L)	absent	Total Nitrogen (mg/L)	35
TSS (mg/L)	10	Grease and Oil (mg/L)	10
COD (mg/L)	100	Aldehydes (mg/L)	0.5
BOD_5 (mg/L)	20	Surfactants	0.5
Boron (mg/L)	1.0- (2.0)*	Chlorinated Pesticides	0.0001
Chlorides (mg/L)	250-(500)*	Escherichia coli (CFU/100ml)	10
Sulphates (mg/L)	500	Salmonella (CFU/100ml)	absent
Electrical Conductivity (µS/cm)	3,000	Sodium Adsorption Ratio	10

<u>Notes</u>: In addition to Boron even Al, As, Ba, Be,Cd, Cr, Cu, Fe, Hg, Mn, Ni, Pb, Se, Si, Th, V, Zn, THM, CN, SO_3, Benzene, Benzo(a)pyrene plus other organics are considered in the D.M.

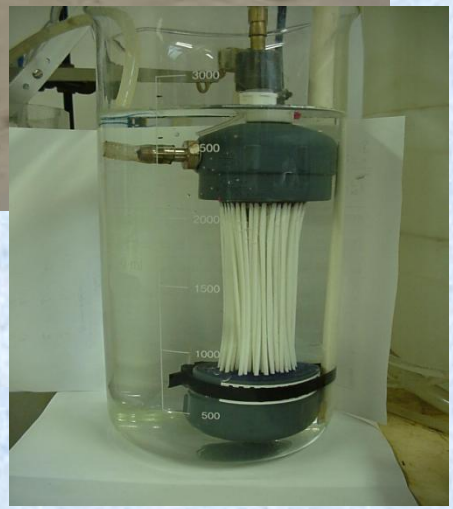
Common treatment schemes used to achieve different water quality objectives for agricultural irrigation



Conventional polishing treatment train used to achieve the quality standards fixed for agricultural reuse of municipal wastewater



Membrane Filtration pilot plant at CERIGNOLA (FG)

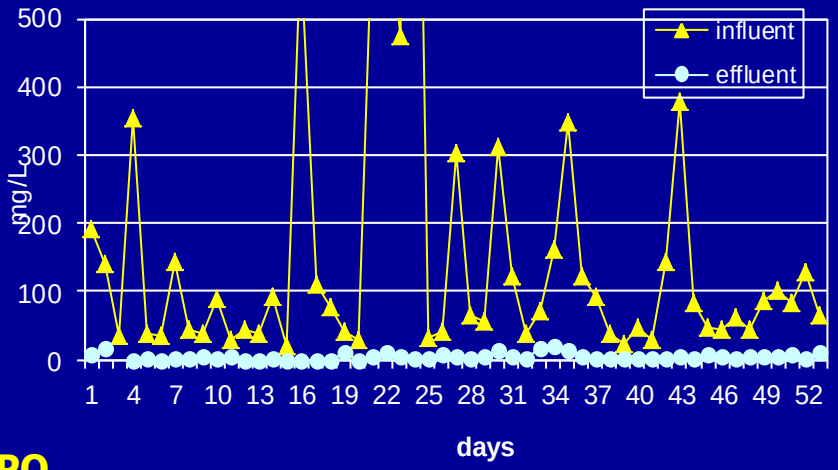


Total membrane surface area **23.5 m²**

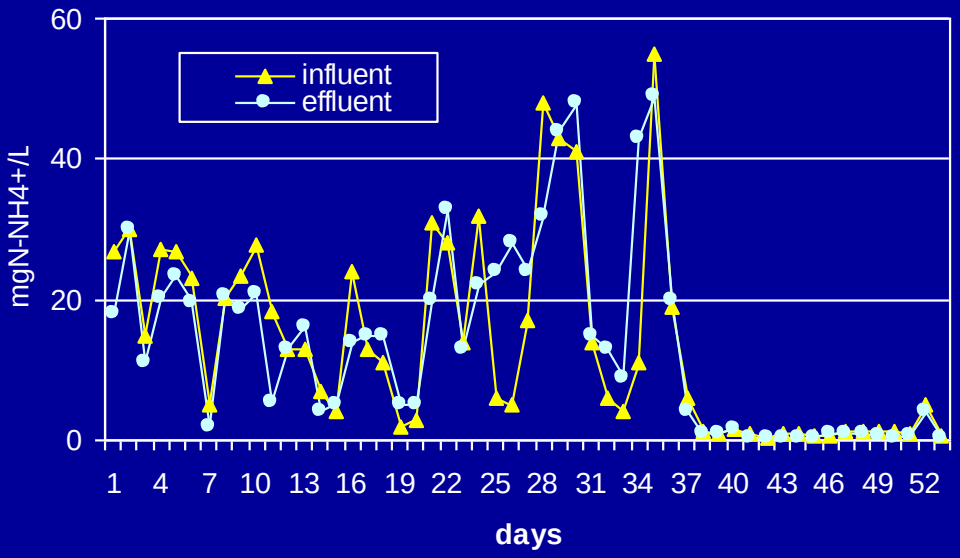
∅ ext. **1.9 mm**
∅ int. **1.0 mm**
∅ pores: **0.03 µm**
Material: **Polyethylene**
Surface: **Hydrophilic**

Municipal wastewater membrane filtration at CERIGNOLA plant: some performances

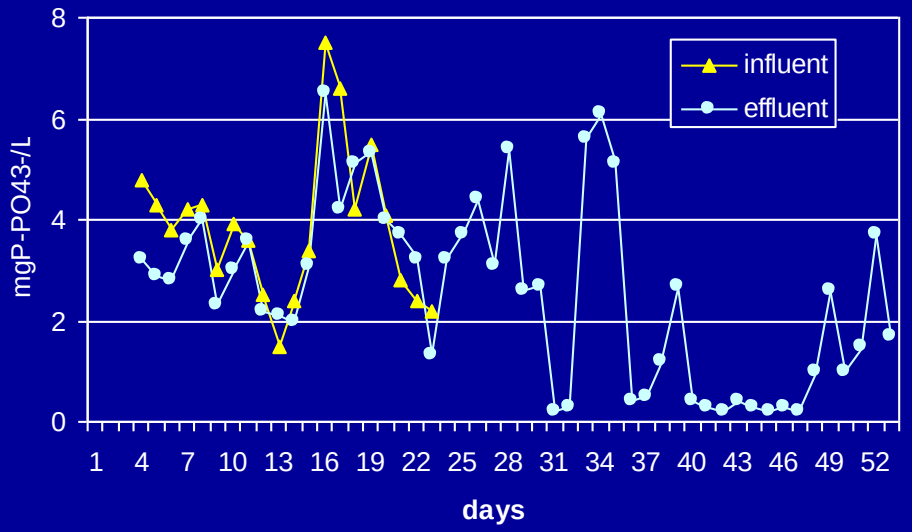
TOTAL SUSPENDED SOLIDS



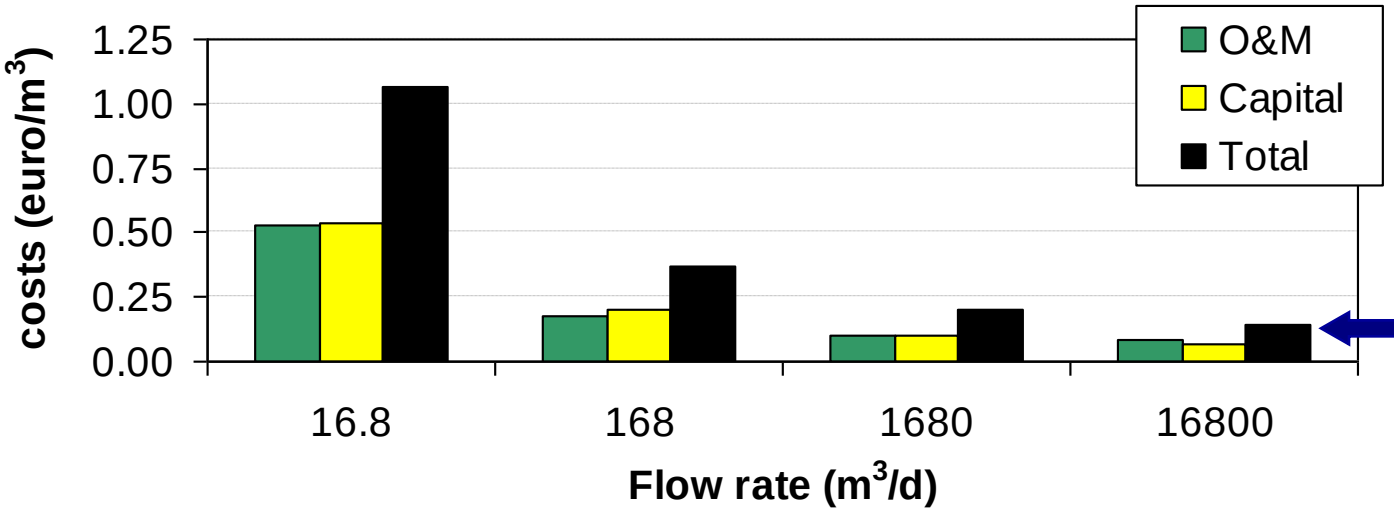
$P\text{-}PO_4$



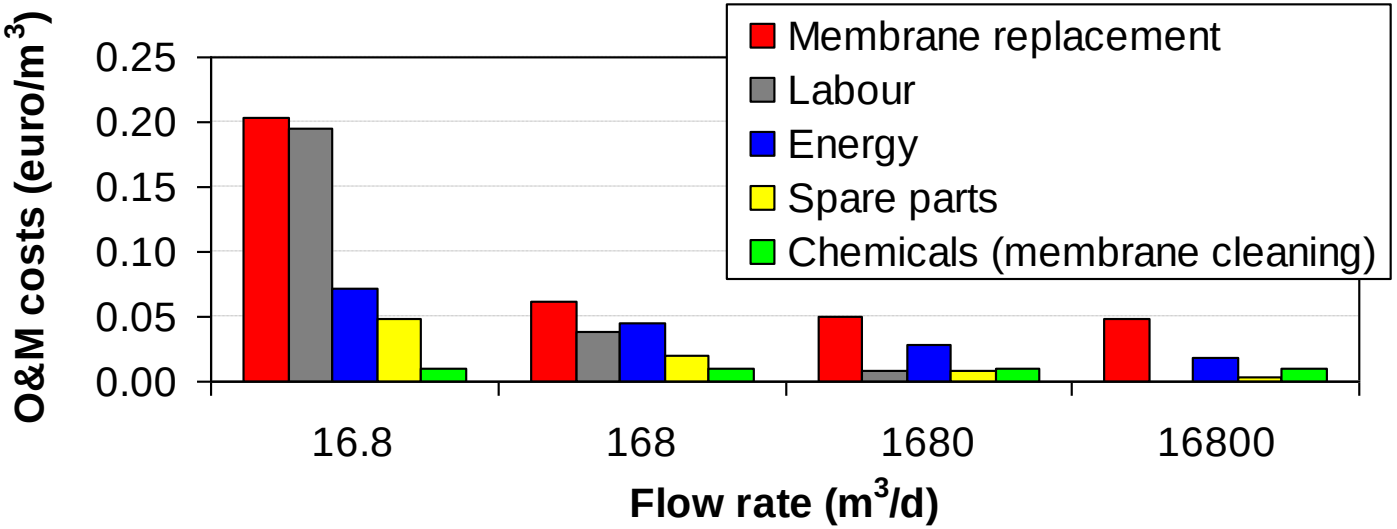
$N\text{-}NH_4$



Wastewater Membrane Filtration: Costs Estimation

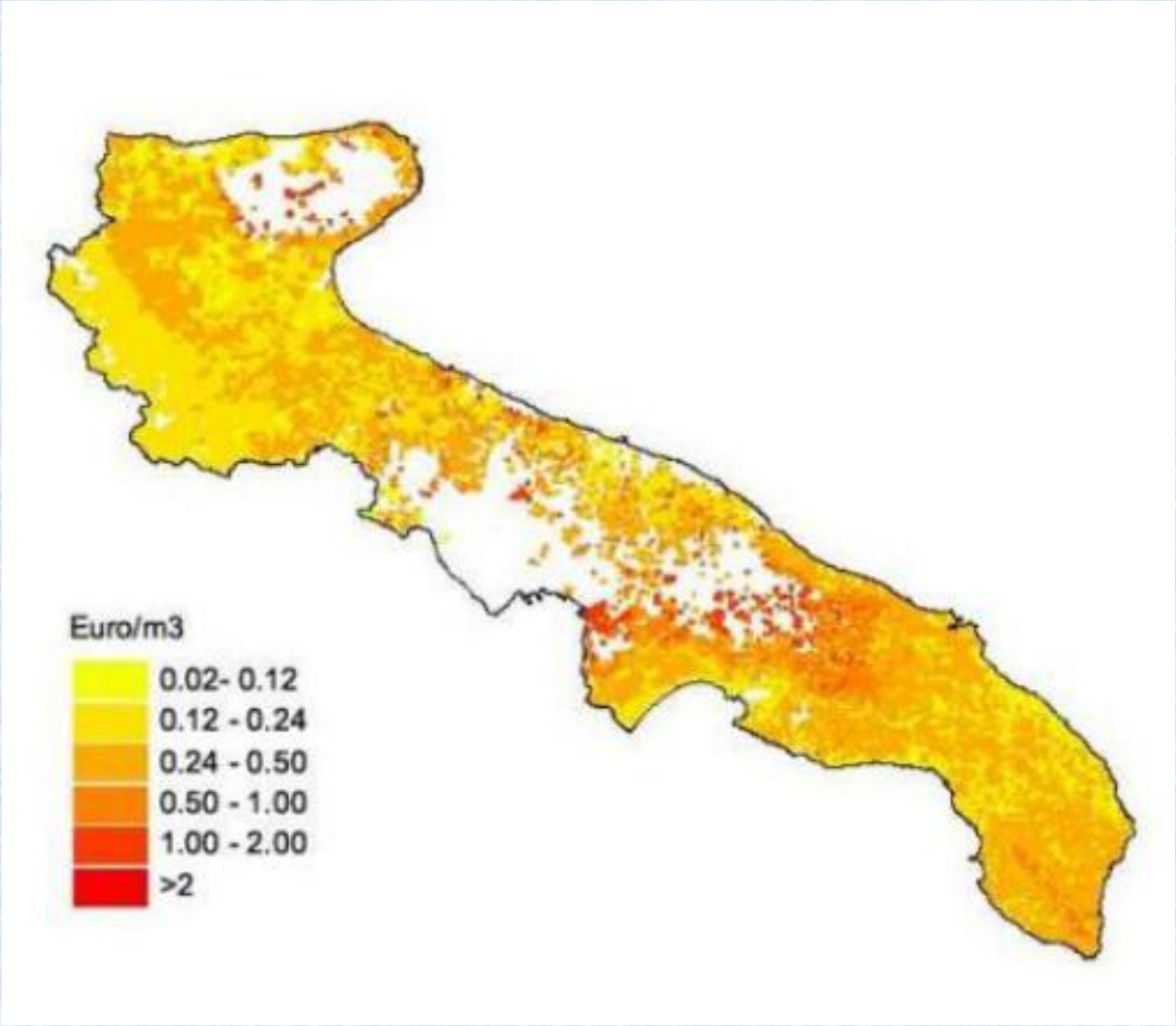


0.15 €/m³



Equivalent Inhabitants	50	500	5000	50000

Groundwater Extraction costs in Apulia



Field of fennels irrigated with membrane filtered municipal wastewater at CERIGNOLA (FG)

Long term effects on crops and soil have been investigated at the University of Bari by the Department of Science of Vegetable Production

PON Ricerca e Competitività 2007-2013
investiamo nel vostro futuro

Ministero dell'Istruzione, dell'Università e della Ricerca

Ministero dello Sviluppo Economico

Fondo europeo di sviluppo regionale

Technological and process innovations for agricultural reuse of municipal and agro-food industry wastewater for sustainable management of water resources

(Acronym: In.Te.R.R.A)

Project Duration: 42 months

Starting date: June 2011

Funds: 6 Mio €

Main Objective: **In.Te.R.R.A.** is aimed at studing, sperimenting and proposing innovative and sustainable strategies, technological as well as managerial to favor a more diffuse implementation, at regional and national level, of agriculture wastewater reuse.

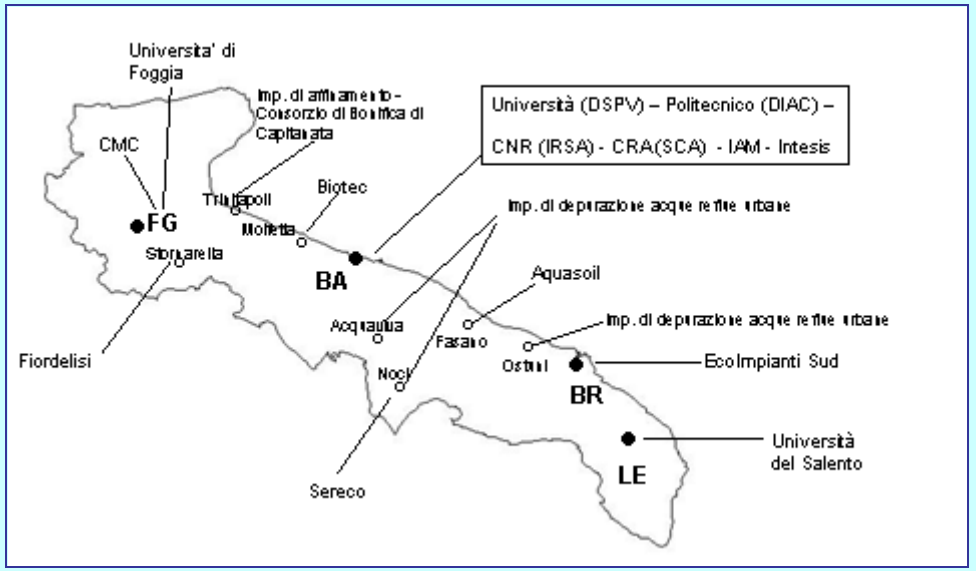
Partners and Locations

•**ACADEMIC**

- **Università degli Studi di Bari –** Dipartimento di Scienze Agro-Ambientali e Territoriali (DiSAAT)
- **Università degli Studi di Foggia –** Dipartimento di Scienze Agro-ambientali, Chimica e Difesa vegetale Foggia
- **Università del Salento -** Dipartimento di Scienze e Tecnologie Biologiche e Ambientali - Lecce
- **Consiglio Nazionale delle Ricerche –** Istituto di Ricerca sulle Acque (IRSA) di Bari
- **Consiglio per la Ricerca e la Sperimentazione in Agricoltura –** Unità di ricerca per i sistemi colturali degli ambienti caldo-aridi (CRA-SCA) - Bari
- **Politecnico di Bari –** Dipartimento di Ingegneria delle Acque e di Chimica - Bari
- **Istituto Agronomico Mediterraneo di Bari -** Valenzano (BA)

•**INDUSTRIAL**

- **AQUASOIL srl -** Fasano
- **INTESIS srl -** Bari
- **BIOTEC srl -** Molfetta (BA)
- **FIORDELISI srl -** Stornarella (FG)
- **SERECO srl -** Noci (BA)
- **ECOIMPIANTI SUD srl -** Brindisi
- **ELETTROMECCANICA CMC srl -** Foggia



Expected Results

- technical and economical optimization of WW treatment systems through **process-simplification** avoiding the removal of substances useful for crops and soil.
- **defining new guidelines** for reusing wastewater with different microbial contents according to different crops and agronomic practices with the aim to support a revision of the current in force too severe regulations.
- evaluating the effectiveness of cheap and rapid tests for **assessing the eco-toxicity of soils and waters.**
- developing low-cost sensors for continuous monitoring of wastewater quality and remote data acquisition.
- development of **participatory approaches** and information and involvement methodologies for stakeholders (farmers, plant managers, institutions and consumers) aimed at a shared water resource management.
- **Life Cycle Assessment** of different methodologies of wastewater management

APULIA REGION's Norms issued

TO FAVOUR WW REUSE

Regional Law 21 October 2008 n.27

"Includes the polishing step among the SII (Integrated Water Services) and its costs into the SII tariff"

Regional Regulation R.R. 18 April 2012

"Norms and provisions for reusing treated wastewater"

APULIA REGION's INVESTMENTS

TO FAVOUR WW REUSE

APQ 11 marzo 2003 *"TUTELA DELLE ACQUE E GESTIONE INTEGRATA DELLE RISORSE IDRICHE"* MEF, MATTM, MPAF, MIT, REGIONE all.D) *interventi prioritari per il riutilizzo delle acque reflue depurate*

16 INTERVENTI

€ 45.786.134,96

POR PUGLIA 2000/2006 - MISURA 1.2 - Azione B) *"Affinamento e riuso delle acque reflue depurate"*

14 INTERVENTI

€ 38.171.080,89

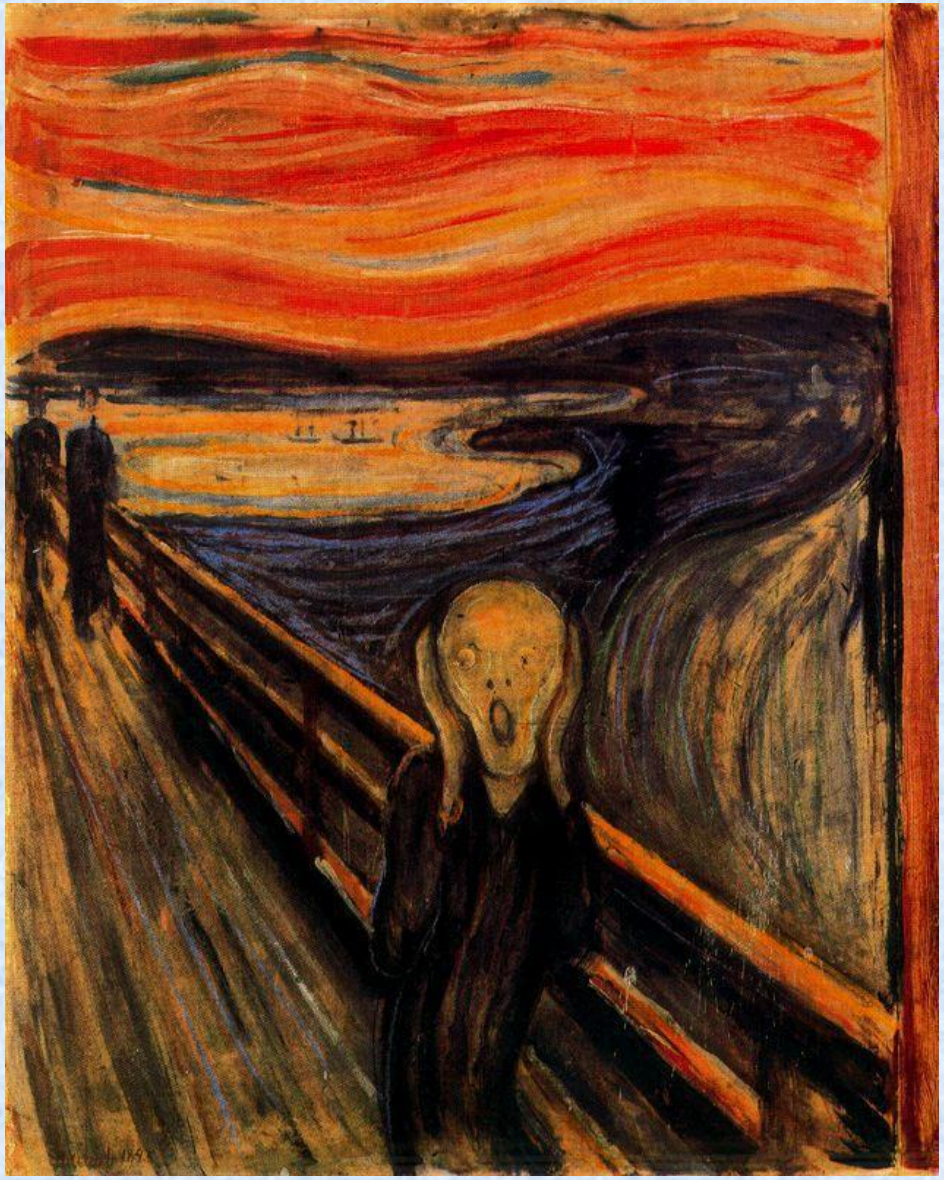
PO FESR 2007/2013 – Azione 2.1.2 – *Attuazione misure del PTA finalizzate a garantire il raggiungimento/ mantenimento degli obiettivi di qualità per i corpi idrici, nonché per la tutela quali-quantitativa degli stessi*

3 INTERVENTI

€ 11.716.517,42

€ 96 Milioni

…….. and after all these efforts what is the present status of agricultural wastewater reuse in Apulia ?



The Scream - Eduard Munch (1983)

Polishing plants actually in operation

- December 2013 data -

Tot Mm3 planned in the PTA: 147 Mm^3/y

Yearly distributed polished m3 / Yearly potentially recoverable m3

Ostuni
59,167/450,000
Gallipoli
181,958/2,800,000
Corsano
156,000/450,000
San Pancrazio Salentino
0/600,000
Trinitapoli
0/630,000

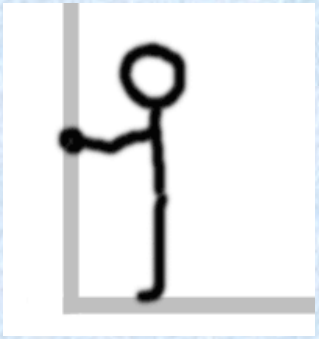
TOT 347,115/4,930,000 (~7%)

CONCLUSION (or INTRODUCTION ?)

After many years spent discussing and «fighting», since several years Apulia Region defined a solid framework of plans and rules, technical as well as financial, aimed at promoting wastewater reuse.

Nevertheless in a region chronically featured by water resources scarcity such apparently «logic» option is far to be actually implemented.

Its our task to remove real and HIDDEN obstacles.



THE DISCUSSION SEEMS JUST OPENED !

La Primavera (Allegory of Spring) - Alessandro Filipepi detto il Botticelli (1482)

THE FASANO WWTP !

THANKS

FOR YOUR ATTENTION