

EUROPE-INBO 2016

Workshop on circular economy and water re-use

October 19, 2016, Lourdes, France

**Treated wastewater reuse in Puglia region (Southern Italy):
Experimental demo-scale activities**

Alfieri POLLICE

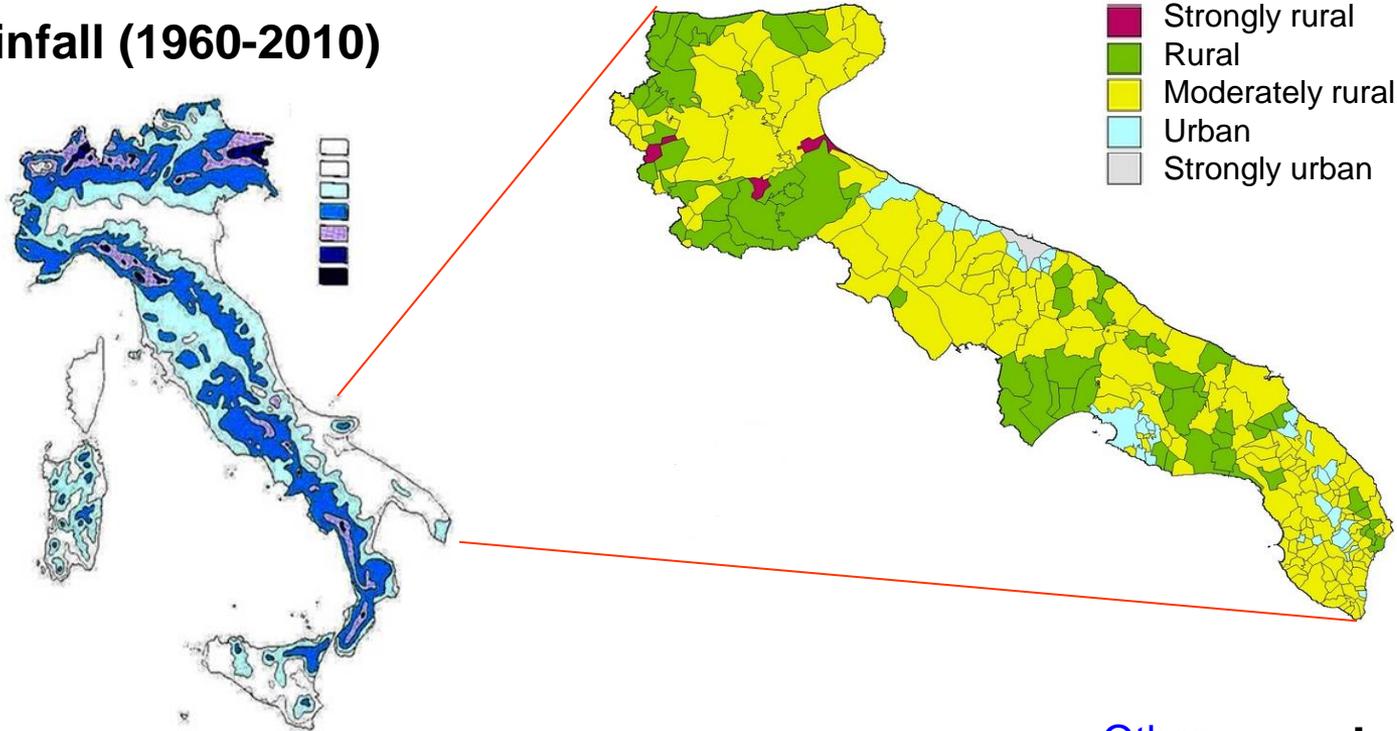


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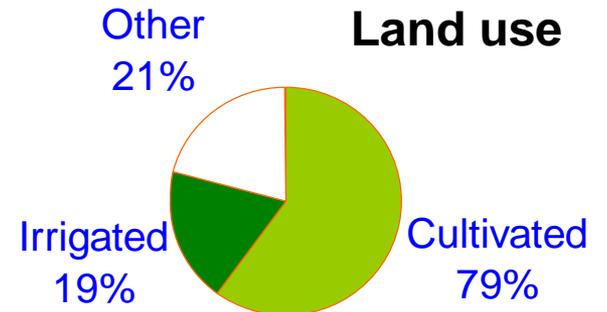


Puglia – Available water and land use

Rainfall (1960-2010)



Puglia: 600-650 mm/year
136 m³/capita per year
absence of permanent rivers/natural lakes

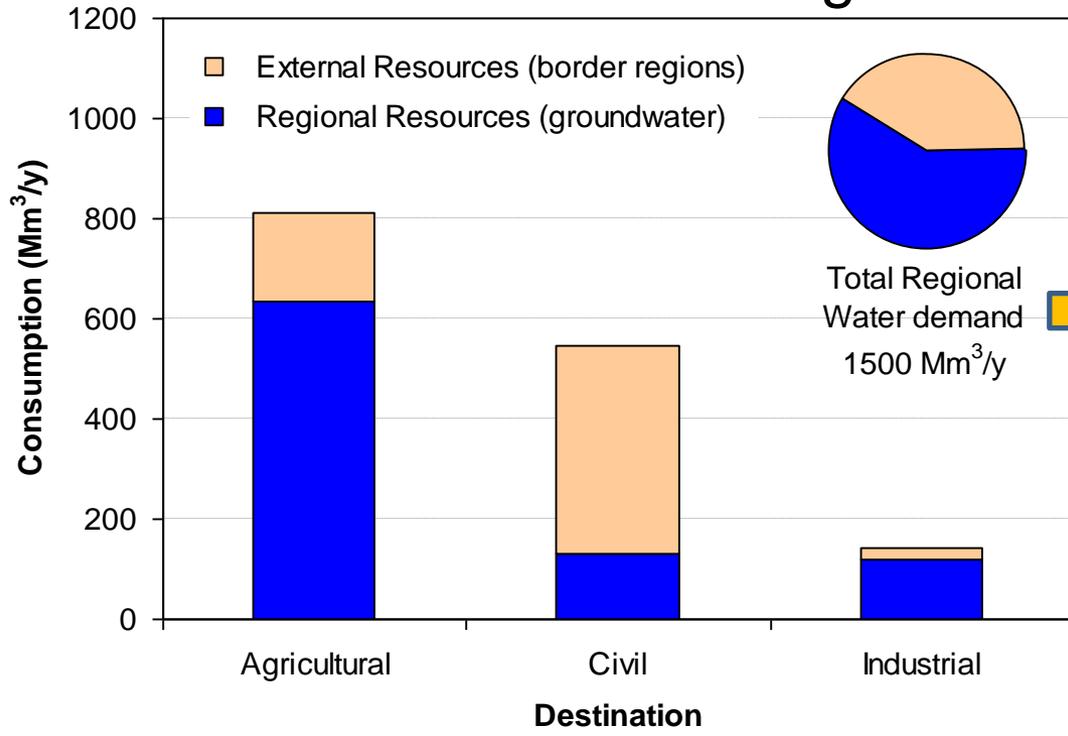




Wastewater treatment and effluent reuse

Opportunities of reuse for irrigation in Puglia

Water demand in Puglia



Savings on primary resources = 10%

- Further advantages:
- Nutrient recovery
 - Continuous supply

Municipal wastewater potentially available for reuse in irrigation:

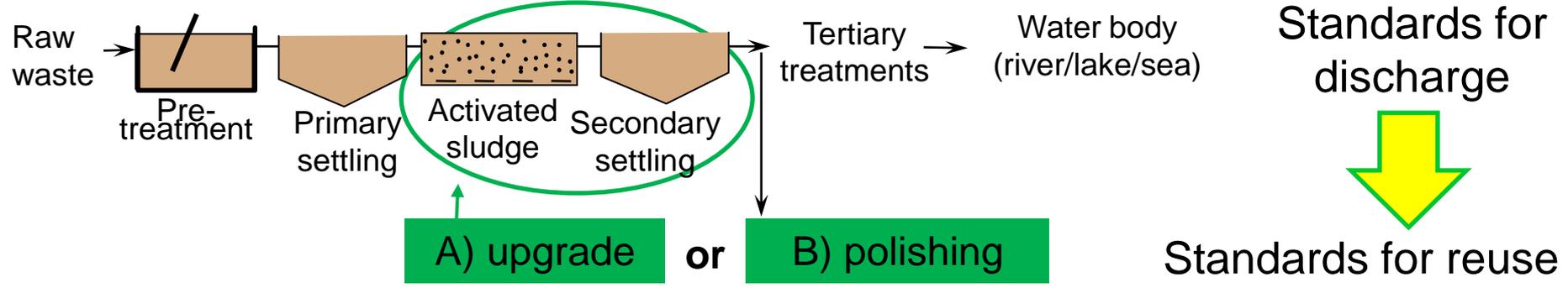
- Total estimate → 150 Mm³/year
- Tertiary wastewater treatment plants currently available → 90 Mm³/year



Treated wastewater reuse in irrigation

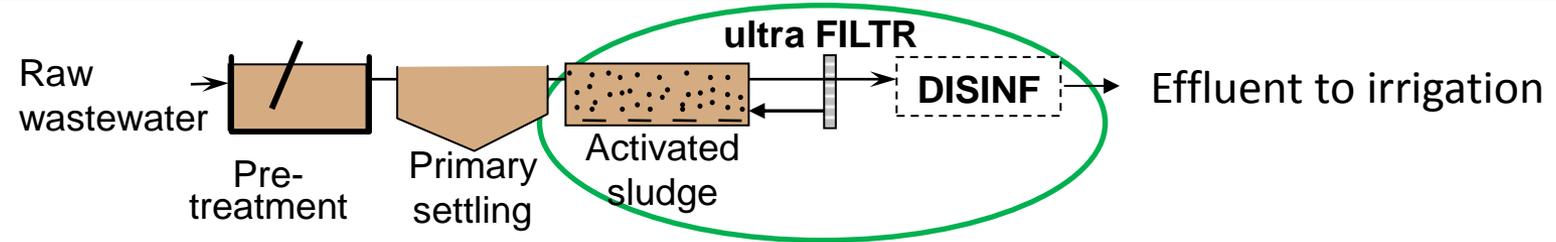
From treatment for effluent disposal to water production for irrigation

Conventional wastewater treatment (activated sludge)

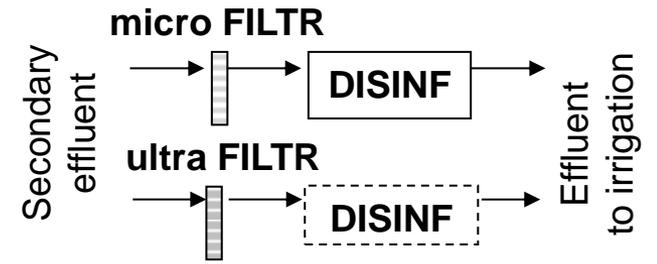


IRSA demo-scale activities: Surface filtration combined to biological processes

A) Upgrade of activated sludge process (Membrane Bioreactors – MBR)



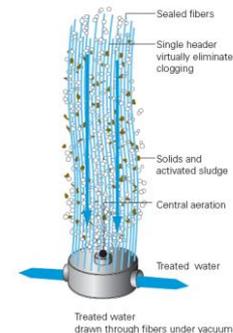
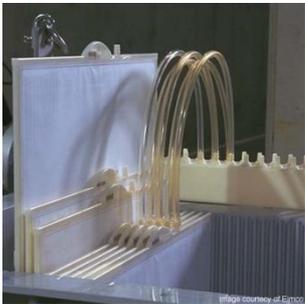
B) Polishing: Tertiary surface filtration processes



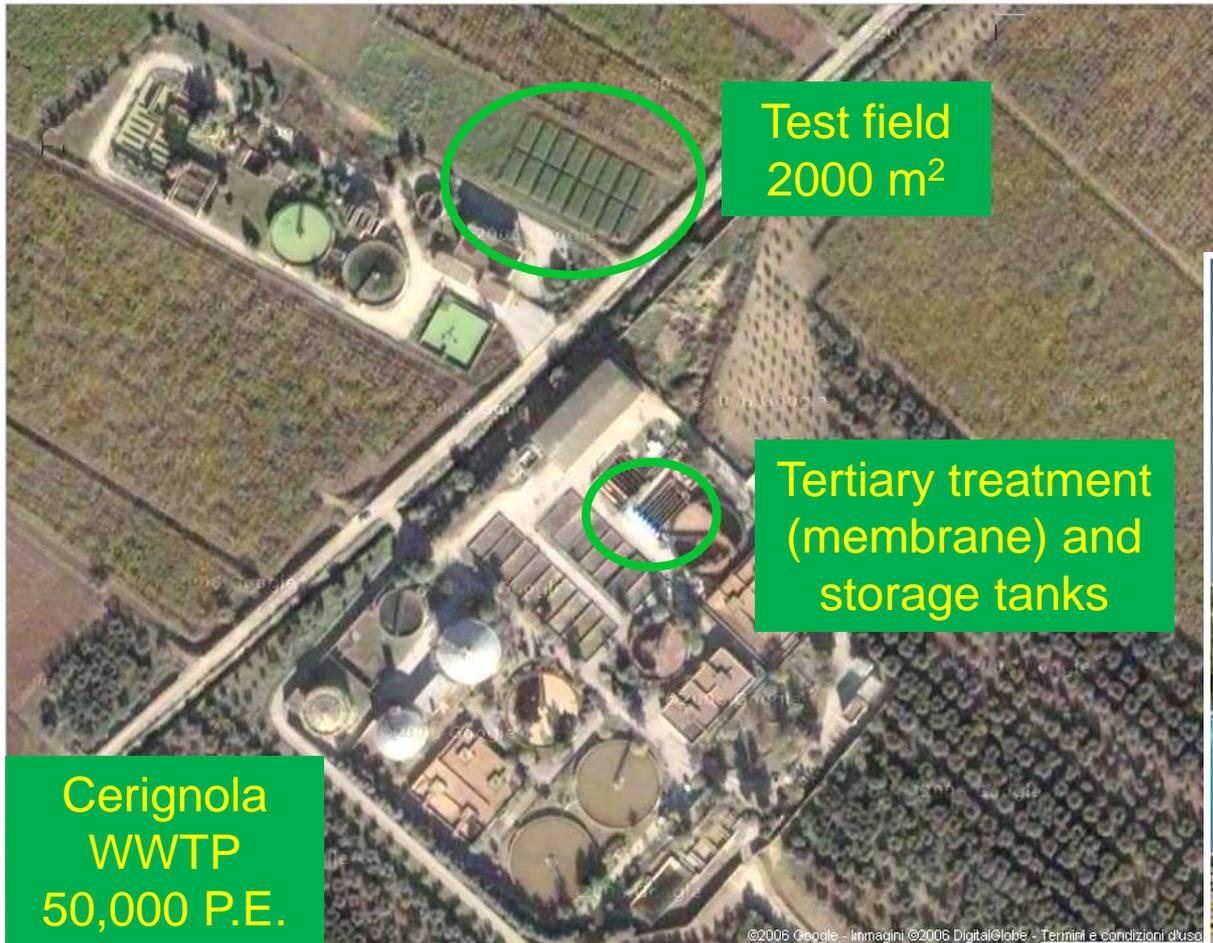


IRSA activities on surface filtration for wastewater treatment and reuse

- Study of processes based on low pressure surface filtration for the production of water suitable for irrigation, study of microbiological quality and nutrient conservation.
- IRSA's main research projects on treated effluent reuse:
 - 2000-2002: POM - national,
 - 2002-2006: PON – Aquatec - national,
 - 2005-2008: FP6 – Reclaim Water – EU,
 - 2006-2009: FP6 – Aquastress – EU,
 - 2010-2012: PRIN - national,
 - 2011-2015: PON – Interra (also agro-industrial ww) - national,
 - 2012-2016: FP7 KBBE – Water4Crops - EU-India,
 - 2013-2016: FP7 Inno-Demo – Demoware - EU,
 - 2016-2018: Water JPI/ERANET Waterworks 2014 – MeProWaRe – EU.



Case study 1 (Aquatec 2000/2006): Tertiary membrane filtration



Pilot plant of 700 L/h

Membrane flux: 30 L/m²/h

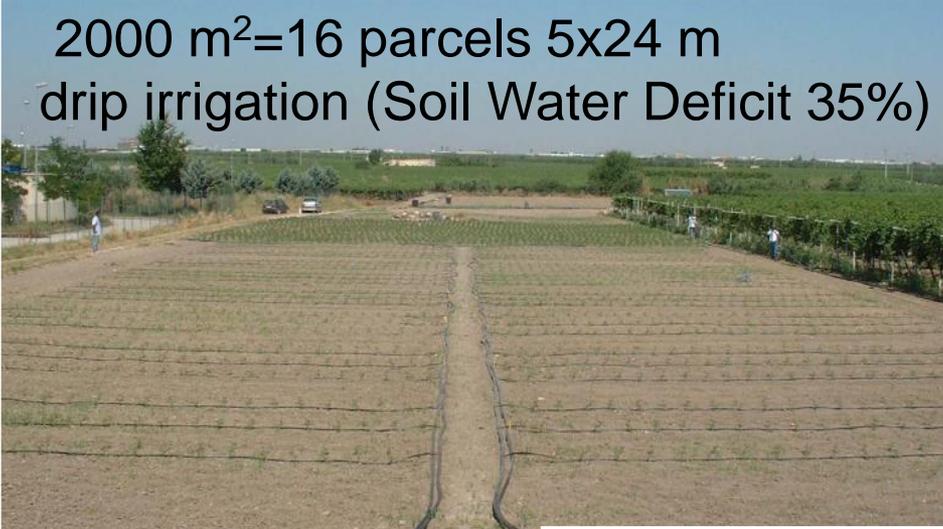
Membrane surface: 23,5 m²





Case study 1 (Aquatec 2000/2006): The pilot plant and the test field

2000 m²=16 parcels 5x24 m
drip irrigation (Soil Water Deficit 35%)



Storage tanks 30 m³





Case study 2 (PRIN 2010-2012): Fate of *E. Coli* in irrigation with treated wastewater

TEST FIELD irrigated with treated wastewater (MBR effluent) + *E. coli*



Persistence of *E. coli* in surface soil and on grass ?



MBR

Pilot scale MBR

Q=15 L/h

SRT=25 days; HRT=6 h

Prod./Relax=3h/6min



SOIL COLUMNS irrigated with partially treated real wastewater

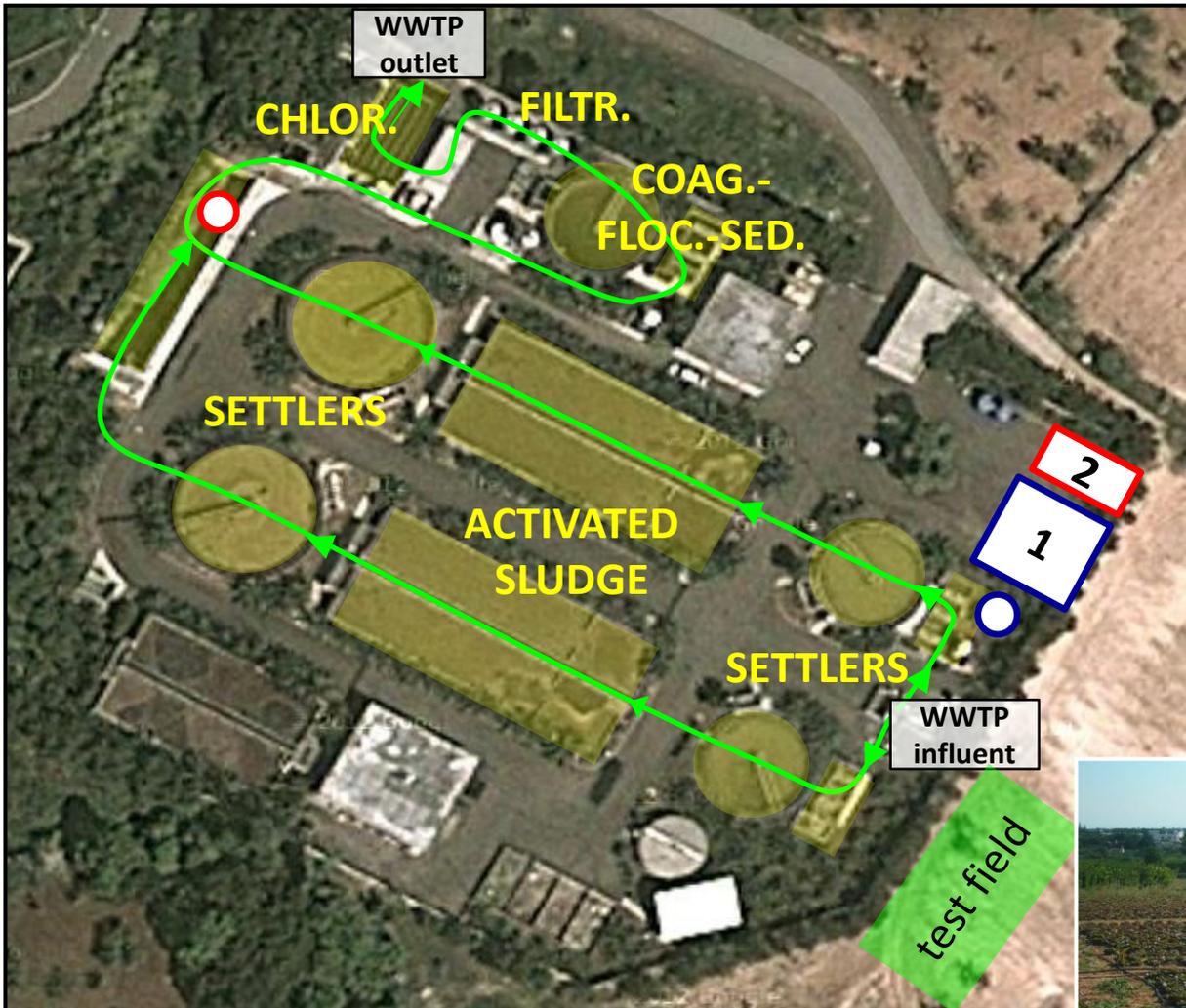


E. coli (and NO₃) transfer through soil layers... possibly to groundwater ?

Vergine et al. (2015) - Fate of the fecal indicator *Escherichia coli* in irrigation with partially treated wastewater. *Water Research*, 85, 66-73.



Case study 3 (Water4Crops 2011/2016): IFAS-MBR and GDF for direct irrigation



1) IFAS-MBR + UV
Pre-screened wastewater

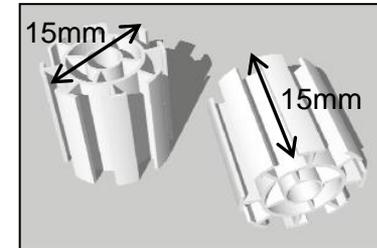
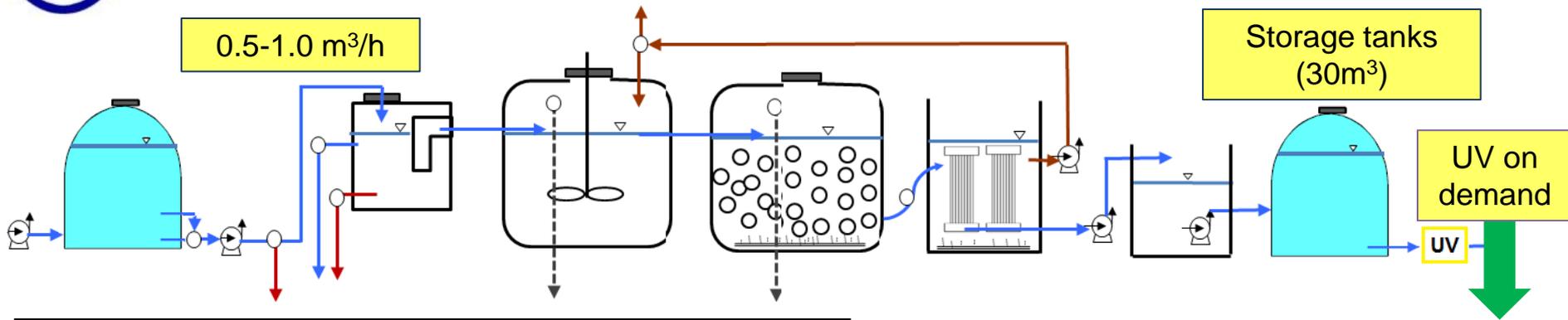
2) GDF + UV
Secondary effluent

Test field (3000 m²)
Horticulture irrigated with
treated effluents (including
the **WWTP outlet**) and
control (**well water**)





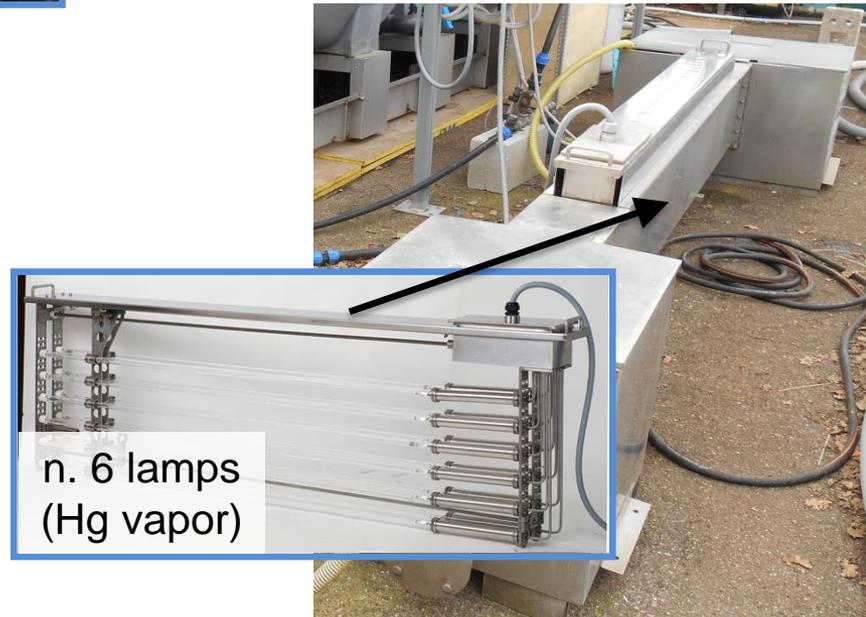
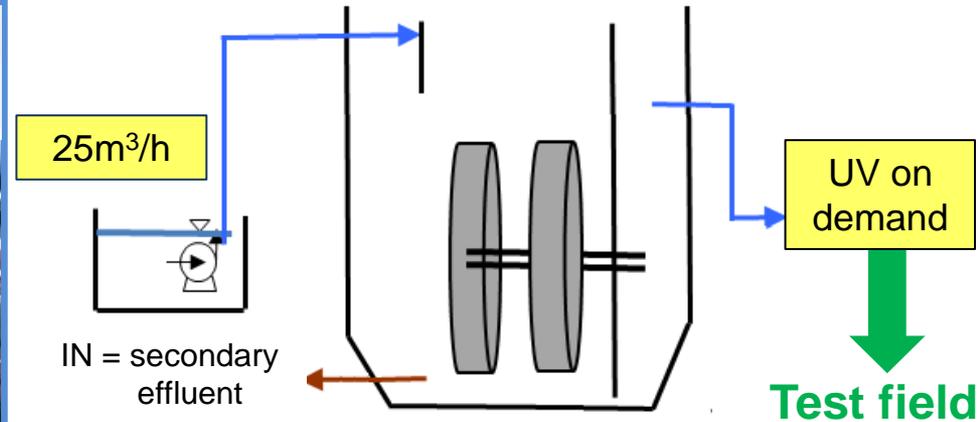
Case study 3 (Water4Crops 2011/2016): IFAS-MBR(*) with on-demand UV disinfection



(*) Integrated Fixed film-Activated Sludge Membrane BioReactor

Case study 3 (Water4Crops 2011/2016): GDF(*) with on-demand UV disinfection

GDF – Cloth filtration
(polyester), pores of 20 μ m



Open channel UV-C disinfection

(*) Gravity Disk Filter

Case study 4 (Demoware 2011/2016): Treated agro-industrial wastewater for irrigation



Agro-ind. WW:

- 12-15 mc/h
- Quality + flowrate fluctuations

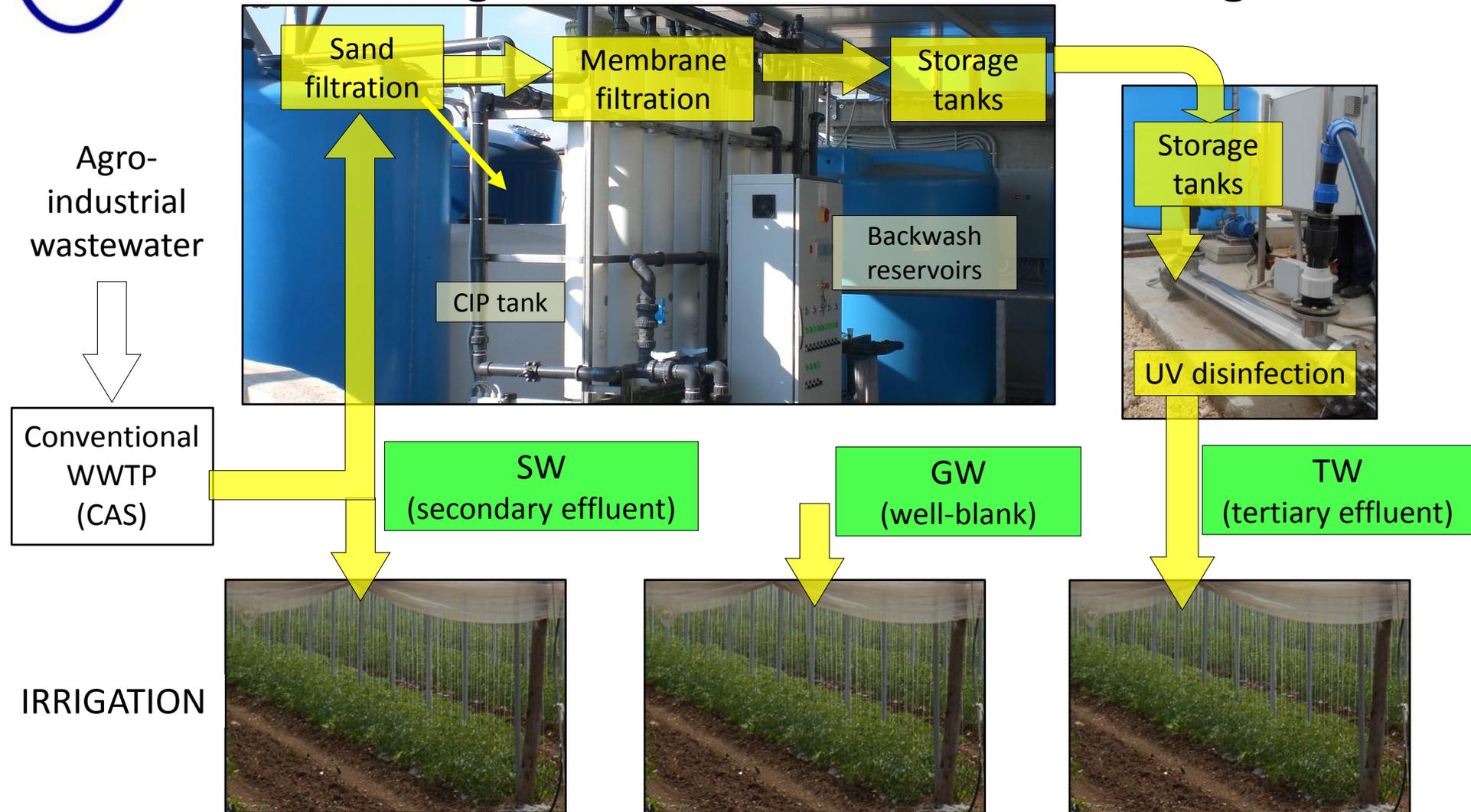
Tertiary treatment:

- Sand filtration
- Membrane filtration
- UV on-demand





Case study 4 (Demoware 2011/2016): Treated agro-industrial wastewater for irrigation



Tomato (summer 2012, 2013 e 2014) and broccoli (winter 2012/13, 2013/14, 2014/15)



Case study 5 (Fasano full scale plant): Tertiary treatment for water distribution to farmers

Initial configuration

- Pre-chlorination (NaClO)
- Clariflocculation (AlCl_3)
- Post-disinfection (O_3/UV)



WWTP: 25.000 PE



Irrigation network:

- 1500 hectares
- 30 km piping
- 48 farms



New configuration

1. Simultaneous dosage of:
 - AlCl_3 (clariflocculation)
 - NaClO or PAA (disinfection)
 - PAC (adsorption)
2. Lamellar packs settlers



Storage lake: 40.000 m³



Cost of tertiary treated water: 0,16-0,25 €/m³ (on the water bill)
Cost of distribution: depends on volume, distance, irrigation type
(contracts with farmers)

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THANKS FOR YOUR ATTENTION



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