Wastewater reuse : alternative resource for agriculture in Provence?

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ACTION 1 : Opportunities within regional territory

SCP is a regional company of South-East France, in charge of a public service of irrigation and water transfer. SCP, which board is mainly composed of local and regional councils as well as of agricultural chambers, assists farmers to develop, implement and optimize irrigation techniques, taking into account environmental challenges.

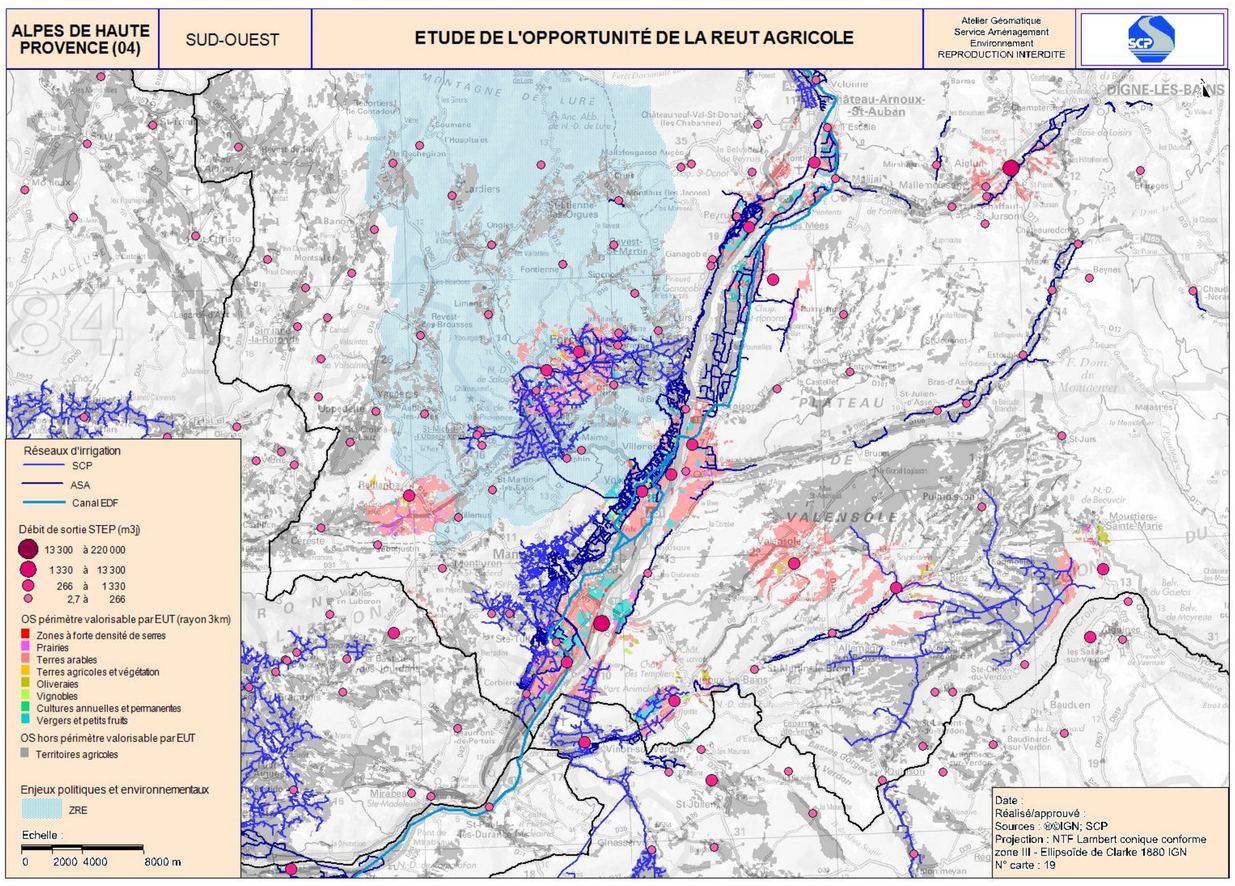
Wastewater reuse (WWR) may be considered as an alternative and complementary resource for irrigation in Provence, as this territory bears contrasting features.

Combination of four selection criteria

Opportunity of WWR schemes was assessed in four departments of the region (04, 13, 83, 84), using GIS analysis and according to the four following territorial criteria :

- wastewater treatment plants (WWTP) location and nominal capacity, that indicates the amount of treated wastewater available
- presence of suitable agricultural areas, within a 3 km distance from the treatment plant
- absence of conventional irrigation networks, essentially diverted form Durance or Verdon rivers, which competitiveness in quantity and quality would be a major hindrance for WWR
- conventional water scarcity (either surface or underground water), based on local regulations, such as ZRE (French ‘Zone de répartition des eaux’)

GIS crossing of selection criteria
round dots = wastewater treatment plants (WWTP), according to the size
colored surface circles around WWTP = suitable agricultural zones
blue linear networks = existing irrigation infrastructure
light transparent blue surface = water scarcity area ‘ZRE’



Crossing the selected criteria highlights around 40 favorable sites on the territory, where WWTP capacity exceeds 4 000 people equivalent (PE) (around 600 m³/day), where proximity farmland is suitable, and where irrigation networks are remote. These sites cumulate 440 000 PE of treatment capacity, and a 52 000 m³/day peak flow. The numbers are high comparing to permanent resident population, which reflects the region summer tourist traffic. It has to be noted that WWTP production peak period matches with irrigation needs.

Two local features may also be relevant to appraise potential wastewater reuse projects:
- local water scarcity, as water reuse may divert from river or aquifer uptake,
- WWTP upgrading requirements, as agricultural water reuse can be considered as a component of the treatment process, and thus could lead to lighter treatment technology.

Mediterranean streams are characterized by severe summer low-flow periods. WWTP discharge is often considered as a quantitative supply to rivers, and to their biological function. In some cases, a competition for treated wastewater may occur between ‘river’ and ‘reuse’, notwithstanding a water quality that, especially for nutrients, is obviously more suitable for agricultural uses than for hydrobiology.

ACTION 2 : Field tests

The objective of this second action was to demonstrate that a non-technological low energy scheme could be designed for wastewater reuse in agriculture. The main concept is to use, after WWTP discharge, natural purification processes such as solar UV, oxygenation, and ecosystem trophic interaction to reach good water sanitary quality standards. As a matter of fact, the project applies the sanitary multi-barriers approach developed in the 2006 WHO guidelines on wastewater reuse.

Field investigations were conducted in Moissac-Bellevue rural community, in the Haut-Var Department, in order to assess feasibility of a communal wastewater reuse scheme on agricultural lands.

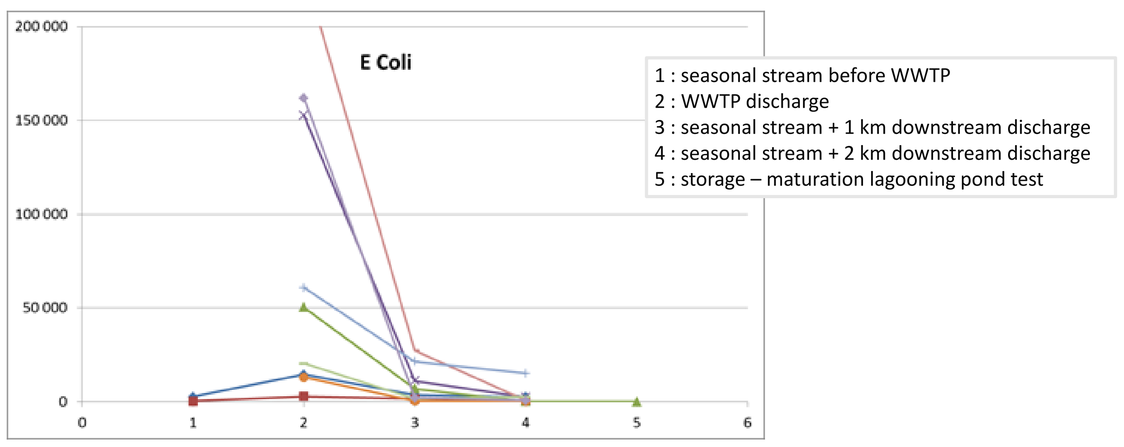
The agricultural area covers 50 ha, and is located in a valley, on the right and left banks of a seasonal stream. 1 or 2 km upstream, a WWTP discharges a daily effluent amount of 450 m³. Hydrometric measurements confirmed that, except during rainfalls, the stream flow is only composed of the WWTP discharge.

A wastewater reuse scheme was designed, that includes :
- 1 or 2 km natural flow in the seasonal stream, from WTTP to agricultural area
- uptake, and storage in a double-use pond : storage and maturation lagoon
- irrigation equipment and uses.

Natural purification in the water cycle, along a seasonal stream

The analysis of wastewater reuse parameters (suspended solids, COD and bacteriology), from the treatment plant raw wastewater influent to the treated wastewater and to the seasonal stream, show how purification process occur along the water cycle. Reduction of bacterial charge is 1,5 log in the seasonal stream on the 2 km course between WWTP exit and agricultural area.

Sanitary parameter evolution from WWTP to the agricultural zone
9 sampling dates, in 2012 and 2013 summers
1 to 5 sampling points, along the water course



Further impact of a storage – maturation pond on water purification

Setting up a storage – lagooning pond for an irrigation test
1 000 m³ temporary pond and 50 m³/h pumping system

Flooding temporarily the bottom of a prairie, a storage / maturation pond was set up for 8 days, preceding an irrigation test. Water depth was 1 m maximum, thus allowing solar UV rays to penetrate and contribute to microbial removal.

1 log more of bacteriological reduction occurred during storage. The following results were observed for 4 key parameters of the French wastewater reuse regulations, and compared to the limit set up for the best level of water sanitary quality (A)

	Test	Ref A
Suspended solids (mg/l)	4	< 15
Chemical oxygen demand (mg/l)	37	< 60
E Coli (NPP/100ml)	40	< 250
Enterococci (log reduction)	5 log	4 log

The A quality was reached on the parameters investigated during the storage / maturation test. Additional analysis would be required to confirm the observation.

Conclusion

ACTION 1 illustrates that wastewater reuse can be seen as a local solution to local contexts. In this case, some areas of hinterland Provence are suitable. It is also noticeable that water transfer networks from Durance and Verdon rivers already serve large parts of rural Provence, and would curb reuse schemes emergence.

Comparing with many other Mediterranean countries, France Provence situation regarding wastewater reuse may seem peculiar : there is a need, but the need remains local, and doesn’t call for global and systematic projects, such as in coastal Spain, Tunisia, Israel or Jordan.

ACTION 2 demonstrates that simple and rustic tertiary treatment installations, downstream WWTP and using natural disinfection processes (i.e. circulation in small dry valleys, storage in maturation ponds) can reach water sanitary requirements for high quality agricultural uses.

World health organization guidelines on wastewater reuse focus on a multi barrier approach, that consider sanitary risk management as a cumulative reduction of contamination from the WWTP to the final agricultural product. The present experiment illustrates this approach,

Thus, treated wastewater quality shall not be considered as a major obstacle to agricultural wastewater projects. Any scheme must be thought more widely, including storage, irrigation techniques, harvest condition and even product conservation.