A GIS APPROACH FOR EVALUATING WASTEWATER REUSE FOR IRRIGATION IN SICILY

D. Ventura[1]
S. Consoli[1]
S. Barbagallo[1]
A. Marzo[2]
D. Vanella[1]
F. Licciardello
G.L. Cirelli[1]

1. Dipartimento di Agricoltura, Alimentazione, Ambiente (Di3A), Università degli Studi di Catania,Via S. Sofia, 100, 95123 Catania, Italy.
2. CUTGANA, Università degli Studi di Catania, Via S. Sofia, 100, 95123 Catania, Italy.

delia.ventura@unict.it*
simona.consoli@unict.it
salvo.barbagallo@unict.it
alessia.marzo@unict.it
d.vanella@unict.it
flicciar@unict.it
giuseppe.cirelli@unict.it.

ABSTRACT

In Italy, water reclamation for agricultural irrigation reuse still faces with restricted law standards and is conditioned by poor local endorsement. However, this practice is widely applied, sometimes without control. In fact, Italian regulation on wastewater (WW) reuse (Ministry Decree, M.D. n. 185/03) is quite limitative when considering some specific chemical and microbiological parameter, leading to standing-off scenery in WW reuse.

It should be underlined that the reuse of treated wastewater in agriculture could represent a valid alternative to the use of conventional resources at large-scale, for example at the irrigation district level. Sicily is affected by more than 30% gap between water availability by conventional sources and water demand.

The present work mainly focuses at the evaluation of the potential of the wastewater reuse in Sicily, where there is a consistent water resources shortage for agriculture sector due to climate changes. A Geographical Information System (GIS) at regional level was realized to quantify and locate the available WW volumes. In particular, the characteristics of the wastewater treatment plants (WWTPs) (location, altitude, person equivalent, treatment level, working state, treated volume...) were integrated, through the GIS, with data on irrigation district areas (surface, location, altimetry, potential evapotranspiration, water needs, available water resources, distance to the nearest WWTP,...). Furthermore, the Italian legislation for wastewater reuse for agricultural irrigation was compared to the WHO guidelines when analysing the water quality of different treatment effluents. The microbiological quality standards of Italian law were effectively too restricted. Finally, the Italian legislation needs to be considerably revised to allow sustainable wastewater reuse plans for irrigation, particularly in the case of small and medium communities.

SUSTAINABLE REUSE OF WETLAND-TREATED OILFIELD PRODUCED WATER FOR AGRICULTURAL IRRIGATION IN HYPER-ARID ENVIRONMENT

Alban Echchelh[1]
Tim Hess[1]
Ruben Sakrabani[1]
Stephane Prigent[2]

1. Cranfield University, Cranfield, Bedfordshire, MK43 0AL, UK, alban.echchelh@cranfield.ac.uk
2. Bauer Nimr LLC, P.O. Box: 1186, Postal Code 114, Al Mina, Muscat, Sultanate of Oman. stephane.prigent@bauer.de

ABSTRACT

Oil extraction generates significant volumes of produced water (PW) - a waste stream comprising water present in the hydrocarbon reservoir and water that has been injected into the reservoir and returns to the surface. Most PW is disposed by injection into deep wells, however, this is energy intensive, carbon intensive and costly. It also poses environmental risks such as groundwater contamination and induced seismicity. Reusing PW for irrigation could help to mitigate these risks while providing a substantial water resource in drylands. However, PW often has high electrical conductivity (EC) and/or Sodium Adsorption Ratio (SAR) posing a risk to soil fertility.

A large scale constructed wetland has been operated since 2010 on the South Eastern Arabian Peninsula treating 115,000 m^3/day of oilfield PW. A surface area of 22 ha of halotolerant crops are irrigated with treated PW and their growth and yield response to PW is being monitored.

Although field trials can demonstrate the practical feasibility of PW reuse for irrigation, they remain inadequate to address the sustainability of this practice because of the relatively long time required to obtain results. On the other hand, soil-water models can quickly simulate the long-term impact of PW on soil chemistry at the equilibrium state, that is, in the long term. This paper presents the results of a simulation of different irrigation strategies with PW on cotton in an hyper-arid environment (South Eastern Arabian Peninsula) using the SALTIRSOIL_M model. It shows that, in the long-term, the use of wetland-treated PW for irrigation would cause SAR to exceed critical values and the soil EC would affect crop productivity and dramatically decrease the yield compared to irrigation using freshwater. If gypsum is applied to the soil, the soil SAR can be controlled, nevertheless, the EC remains above the salinity tolerance of the crops and a poor yield would be expected. If wetland-treated PW water was blended with treated sewage effluent prior to irrigation, or treated by reverse osmosis (RO), the SAR can be managed, avoiding risk for soil structural stability. The soil EC would remain below the cotton threshold level and yield at an optimal level.

The long-term evolution of soil salinity and sodicity resulting from irrigation with PW can be anticipated using SALTIRSOIL_M. Although irrigating with low-quality PW may jeopardize long-term soil fertility, adapted PW treatment and soil amendment can make PW sustainable for irrigation. SALTIRSOIL_M offers a decision-support tool for sustainable management of irrigation projects involving PW. The cost of different irrigation strategies (e.g. soil amendment, blending and RO) need to be compared in a local context to help decision makers choosing the most efficient PW management option.