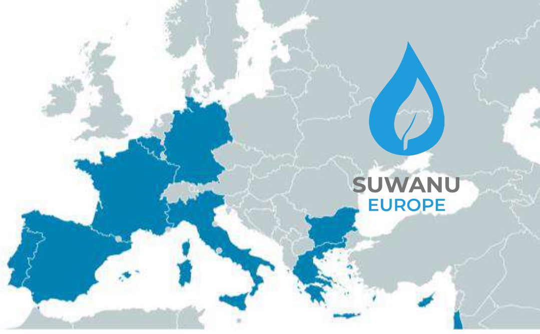
Sustainable **Water treatment** and Agricultural reuse options in Europe



Info-package 3
Water Reclamation Operators

Fact Sheet 3.1 – **Reclaimed Water quality requirements: facts and figures**

Reclaimed Water quality requirements | Contaminants of emerging concern | Potential Antibiotic resistance and health impacts linked to irrigation with reclaimed water | Key for success in Israel (and Cyprus?) | Phosphorus recovery in water reuse

SUWANU EUROPE is a H2020 project aiming to promote the effective exchange of knowledge, experience and skills among practitioners and relevant actors on the use of reclaimed water in agriculture. This factsheet is part of a total of 5 factsheets in Info-package 3 aimed at water reclamation operators, that describe the basic quality requirements for a safe and profitable water reuse in agriculture.

1. Introduction:

Water quality is a highly relative concept that greatly influences the suitability for a particular use or the impacts on soils, irrigation equipment and crops productivity. The quality has to ensure effective protection of human health, environment and agriculture, beside fulfilling the requirements of the user. The latter become particularly true when it comes to water reuse water quality standards, that must be set on a fit for purposes criteria. The assessment of the minimal water quality requirements for reuse shall be based on case specific risk analysis. The principal components of the water quality impacts risk analysis are : i) irrigation / fertigation technology used and impact on the equipment functionality; ii) soil characteristics and impact on soil fertility; iii) impact on the crop and on the produces; iv) impact food hygiene; v) protection of the operator's health. A safe water reuse can be granted by a multiple barrier approach.

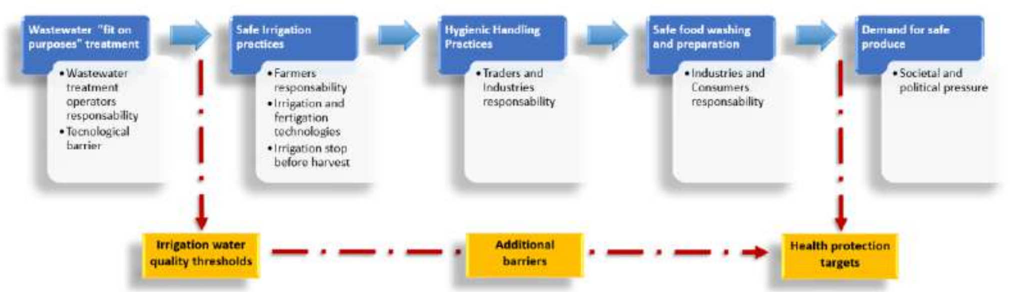


Figure 1: Water quality multi-barrier approach

2. Biological Hazard :

Reclaimed water quality class	Iundicative Technology Target	E.coli MPN./100 ml	BOD_5 mg/l O_2	TSS mg/l	Turbidity NTU	Other
A	Secondary treatment + filtration and disinfection	≤ 10	≤ 10	≤ 10	≤ 5	*Legionella spp* <1000 cfu/l where there is risk of aerosolization *Intestinal nematodes (helminth eggs)* ≤ 1 egg/l for irrigation of pastures or forage
B	Secondary treatment + disinfection	≤ 100	≤ 25	≤ 35 WWTP>10000 PE ≤ 60 2000>WWTP<10000 PE	-	*Legionella spp* <1000 cfu/l where there is risk of aerosolization *Intestinal nematodes (helminth eggs)* ≤ 1 egg/l for irrigation of pastures or forage
C	Secondary treatment + disinfection	≤ 1000	≤ 25	≤ 35 WWTP>10000 PE ≤ 60 2000>WWTP<10000 PE	-	*Legionella spp* <1000 cfu/l where there is risk of aerosolization *Intestinal nematodes (helminth eggs)* ≤ 1 egg/l for irrigation of pastures or forage
D	Secondary treatment + disinfection	≤ 10000	≤ 25	≤ 35 WWTP>10000 PE ≤ 60 2000>WWTP<10000 PE	-	*Legionella spp* <1000 cfu/l where there is risk of aerosolization *Intestinal nematodes (helminth eggs)* ≤ 1 egg/l for irrigation of pastures or forage

Figure 2: Bio-hazards Minimum requirements

Excreta-related pathogens (viruses, bacteria, protozoan, helminths and multicellular parasites) pose serious risks to human and animal health. Pathogens can survive for long periods of time in soil or on crop surfaces. Infection can follows several exposure pathways, but in particular: ingestion or inhalation of water/droplets; ingestion of food produces; ingestion of meat from animals grazing on pastures or fed with forage crops irrigated with reclaimed water. Legally binding quality standards for water reuse have been developed by several Member States, besides non-binding standards developed by international organisations. The recently published “Proposal for a Regulation of the European Parliament and of the Council on minimum requirements for water reuse” is setting minimum standards for a safe water reuse in agriculture (figure 2).

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3. Other Hazards:

Although when it goes for water quality the main focus is on biological hazards, there are also other aspects that must be considered. Irrigation involves many aspects and has great impacts not only on food higiene. The agriculture success and ecosystem health are highly dependable on the quality of water applied. Given the complexity of the matter and the growing attention from the legislator, from various production sectors and from civil society, any attempt to define the water quality standards must take into due consideration the potential short/long term impacts on irrigation and irrigation systems, on plants, on agricultural land and soil biota, on the agricultural products quality, on the rural landscape. Figure 3 reports the main physical and chemical parameters to be checked defining the water quality for any specific water reuse schema. The reported threshold can vary in function of the crop, the soil characteristics (salinity, acidity/alkalinity or structure), the irrigation method. To protect the irrigation equipment from clogging or deterioration also the water corrosivity, incrustability, salt precipitation, biofilm and algae proliferation need to be considered.

.	Ec_w	SAR	Sodium	Chloride	Boron	pH	Arsenic	Cadmium	Chromium	Copper	Manganese	Nickel	Lead	Selenium	Zinc
	dS/m		me/l	me/l	mg/l	$logH^+$	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
OPTIMAL	0.70	0.70	-	-	0.70	6.50	0.05	-	-	0.10	-	-	-	-	-
CRITICAL	3.00	0.20	3.00	3.00	3.00	8.00	5.00	0.01	0.10	0.20	0.20	0.20	5.00	0.02	2.00

Figure 3: Physical and chemical water quality

4. More strict means more safe?:

Although of high relevance, there are very few health risk quantification studies (QMRA) and epidemiological studies on the reuse of properly treated reclaimed water. Scientific literature, does not report cases of human diseases caused by reclaimed water in the EU. The EU-funded SAFIR project assessed the potential effects on human health of eating vegetables irrigated with reclaimed water (SAFIR, 2009). QMRA analysis results show that the microbiological health risks as a result of eating tomatoes or potatoes irrigated with recycled water produced by the SAFIR project were minimal. A bacterial strain DNA analysis proved that the E. coli bacteria found in soil and on produce doesn't stem from the irrigation water, they originated in the environment by, e.g., wild animals faecal contamination. The food safety in water reuse schemas is confirmed by the experience of Cyprus or Israel, countries with a long experience of reusing water for irrigation and groundwater recharge, and where almost all the treated effluents are now being reused. However, farmers should be aware that accidental ingestion of soil irrigated with recycled water could pose a health risk. The SAFIR project carried out a worst case analysis including peak E. coli concentrations found in soil, but never in the water, in the health risk calculations. In the worst case some irrigation practices exceeded the WHO maximum permissible risk level of 1 case of mild diarrhoea in 1,000 farmers occupationally exposed to this soil quality per year, and in one of the study areas the QMRA modelling found that roughly 7.5 farmers per 1,000 farmers per year could expect a mild case of diarrhoea. This scenarios are more likely when water reuse is combined with sludge distribution. Hence, the application of the WHO thresholds (2006) resulted in safe food production: there is no need to more stringent measures.

Reference/further readings

BIO by Deloitte (2015) Optimising water reuse in the EU – Final report prepared for the European Commission (DG ENV), Part I. In collaboration with ICF and Cranfield University.
Proposal for a Regulation of the European Parliament and of the Council on minimum requirements for water reuse. COM(2018) 337 final
Wastewater treatment and use in agriculture - FAO irrigation and drainage paper 47
Guidelines for the safe use of wastewater, excreta and greywater - Volume 4. Excreta and greywater use in agriculture

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