

# SWIM and Horizon 2020 Support Mechanism

Working for a Sustainable Mediterranean, Caring for our Future

## SWIM-H2020 SM Regional Training on Technical, Regulatory and Cultural Aspects of Treated Wastewater Reuse (REG-8)

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## Module 2. Strengthening and Updating of Knowledge on New Developments of Wastewater Reuse Guidelines Showcase (Egypt)

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# Presentation Outline

- I. Showcase (Egypt)
- II. Classification of plants & crops allowed for irrigation with treated Wastewater
  - Degree of Treatment Permitted for Agriculture Use
  - Requirements Related to Health Protection
- III. Constrains & Challenges of WWR projects in Egypt & some other Developing Countries

# Why new Egyptian code for wastewater reuse?

- I. Mix up between laws & regulation regulating the discharge of treated wastewater and degree of treatment permitted for agriculture use.
- II. No edible or export crops can be irrigated with wastewater – *regardless of the treatment level !*
- III. Too strict comparing to WWR standards of other countries
- IV. Considered as barrier for wastewater reuse projects with short “Return On Investment” (ROI)
- V. Egypt has to face the water scarcity challenge as 7.6 Billions m<sup>3</sup> /Yr of wastewater are available
- VI. About 40,000 hectare are available for WWR projects in different governorates
- VII. Forestations should not be the ultimate goal of wastewater reuse projects

# Scope of the WWR Code

Egyptian WWR Code developed to Identify the requirements and standards for direct use in irrigation of the following cases:

- I. Irrigating desert land by treated wastewater to produce agricultural crops.
- II. Irrigating landscapes in tourist villages and the like.
- III. Irrigating green areas within the boundaries of residential blocks in the new cities.
- IV. Irrigating green belts around cities.
- V. Afforestation of the highways.
- VI. Irrigating of bio-fuel and energy oils producing crops and the production of cellulose and wood trees.

# Wastewater Reuse Code 2015 - The Approach

This code takes the approach suggested by (*WHO 2006*) to reduce health risks to the minimum by using a package of barriers such as:

- I. Degree(s) of wastewater treatment (Characteristics)
- II. Specifying crops
- III. Specifying methods and conditions for irrigation
- IV. Specifying public health requirements, in relation to the circulation of crops
- V. Specifying public health requirements in relation to agricultural workers
- VI. Specifying monitoring and control systems

# Referential of Code Development

*Three Main Principals* has been taken into consideration:

- ☐ Studies available from the Egyptian experience
- ☐ International experience, specially that from the Middle East and North Africa.
- ☐ Evidence guidelines of FAO, WHO, US-EPA and UNEP on wastewater reuse in agriculture purposes

# Wastewater Treatment Processes

Process	Description
Primary Treatment	<ul style="list-style-type: none"><li>▪ First phase of wastewater treatment,</li><li>▪ Screens, settling tanks, and/or skimming devices.</li><li>▪ Removal of solid objects and gross, suspending solids</li><li>▪ BOD is reduced by 20-30% &amp; TSS by 50-60%.</li></ul>
Secondary Treatment	<ul style="list-style-type: none"><li>▪ Removal of biodegradable organic substances and SS,</li><li>▪ Microbes consume organic matter, convert it to CO<sub>2</sub>, water, and energy.</li><li>▪ Suspended solids are then removed through use of settling tanks.</li></ul>
Tertiary Treatment	<ul style="list-style-type: none"><li>▪ Filtration to extract microscopic particles from wastewater.</li><li>▪ Remove up to more than 99% of the contaminants in wastewater</li></ul>
& Disinfection	<ul style="list-style-type: none"><li>▪ Last step in the tertiary treatment process.</li><li>▪ Sodium hypochlorite or chlorine</li><li>▪ UV light is an alternative method of disinfection.</li><li>▪ Destroy pathogenic organisms.</li></ul>
Advanced Treatment	<ul style="list-style-type: none"><li>▪ Removal of residual trace constituents</li><li>▪ Micro- and ultrafiltration.</li></ul>

# Degree of Treatment Permitted for Agriculture Use

<i>Requirements &amp; Limitations</i>		<i>Degree of Treatment</i>			
		<i>Grade A</i>	<i>Grade B</i>	<i>Grade C</i>	<i>Grade D</i>
<i>Physical &amp; Chemical Standards</i>	<i>TSS</i>	$\leq 15$	$\leq 30$	$\leq 50$	$\leq 300$
	<i>Turbidity, (NTU)</i>	$\leq 5$	<i>Undefined</i>	<i>Undefined</i>	<i>Undefined</i>
	<i>BOD<sub>5</sub></i>	$\leq 15$	$\leq 30$	$\leq 80$	$\leq 350$
<i>Pathogens Standards</i>	<i>E. Coli MPN/100 ml</i>	$\leq 20$	$\leq 100$	$\leq 1000$	<i>Undefined</i>
	<i>Intestinal Nematodes /liter</i>	$\leq 1$	$\leq 1$	$\leq 1$	<i>Undefined</i>



# Chemical Standards (FAO)

**Guidelines for Chemical Standards in Treated Wastewater Reused For Irrigation Purposes**

Component	Long Term Use <sup>(1)</sup> Maximum Level of Concentration mg/liter	Short Term Use <sup>(2)</sup> Maximum Level of Concentration mg/liter
Sodium Absorption rate (SAR) %	6-9%	6-9%
Sodium Cations (NA)	230	230
Magnesium Cations (Mg)	100	100
Calcium Ion (CA)	230	230

- (1) Water can be constantly used in all types of soil.  
 (2) Water can be used for up to 20 years in types of soft soil textures, whether neutral or alkaline.  
 (3) Amount of Irrigation water should not exceed 1 meter<sup>3</sup> / m<sup>2</sup> of land cultivated annually.

Table Source:  
 FAO, 1992, National Academy of Science-National Academy of Engineering (1973).

**Guidelines for Treated Wastewater Chemical Standards Reused for Irrigation**

Component	Long Term Use <sup>(1)</sup> Maximum Level of Concentration mg/liter	Short Term Use <sup>(2)</sup> Maximum Level of Concentration mg/liter
Al	5.00	20.00
As	0.10	2.00
Be	0.10	0.50
Cu	0.20	5.00
F	1.50	15
Fe	5.00	20
Li	2.50	2.50
Mn	0.20	10
Ni	0.20	2.00
Pb	5.00	10
Se	0.02	0.02
Cd	0.01	0.05
Zn	5.00	10
Cr	0.10	1.00
Hg	0.002	0.002
V	0.10	1.00
Co	0.05	5.00
B	1	2.00
Mo	0.01	0.05
Phanol	0.002	0.002
TDS	2000	3000
Total PO <sub>4</sub>	30	30
Cl	400	400
SO <sub>4</sub>	500	500
HCO <sub>3</sub>	400	400
(SAR)%	6-9%	6-9%
Na	230	230
Mg	100	100
Ca	230	230

# WWR Code 2015-New Vision

## Grade (A)

- The code allows production of treated wastewater of Grade (A) through doing additional treatment process on the agriculture site
- This code allows producing water grade (A) by mixing fresh water to grade (B) with suitable quality – in case it is available

## Grade (B)

- The code allows producing water grade (B) through doing additional treatment for Grade (C) but not through mixing with fresh water.

# WWR Code 2015-New Vision

## Crops Prohibited to be Irrigated by TWW:

- The code *prohibited* to use treated wastewater – *whatever the level of treatment is* – in irrigating vegetable crops eaten raw
- The code *prohibited* to use treated wastewater grade D in irrigating any food crops (vegetables, field crops, all types of fruits and medicinal plants)
- The code *prohibited* to use treated wastewater grades B, C, D, in irrigating green landscapes and educational establishments as well as public and private parks



# ***Classification of plants & crops allowed for irrigation with treated Wastewater***

# Degree of WW Treatment versus Crops Permitted for Irrigation

Grade of Treatment	Agricultural Group	Description
<b>A</b> (One Group)	<p><u>Group 1-1:</u> Green landscapes in Educational establishments, public and private parks</p> <p>المسطحات الخضراء للمنشآت التعليمية والمتنزهات العامة والخاصة</p>	<p>All types of grass and fence plants and all kinds of flowers</p> <p>النجيل بكافة أنواعه ونباتات السور والزهور بجميع أنواعها</p>

# Degree of WW Treatment versus Crops Permitted for Irrigation (continue...)

Grade of Treatment	Agricultural Group	Description
<b>B</b> (3 Groups)	<a href="#">Group 2-1</a> Dry grains crops, cooked & processed vegetables	All Kinds of Vegetables (manufactured) and strategic dry crops of all types such as wheat - corn - barley - rice - beans - lentils – sesame . القمح – الذرة- الشعير – الأرز – الفول – العدس – السمسم
	<a href="#">Group 2-2:</a> Fruit Crops	Fruit trees with sustained and deciduous leaves such as: citrus fruits - olive - palm - mango - pecan - pomegranate for the purpose of drying الموالح – الزيتون – النخيل – المانجو – الرمان بغرض التجفيف
	<a href="#">Group 2-3:</a> Medicinal Plants	Anise - hibiscus - Cummins - Marjoram - Ammi - Fenugreek - moat - fennel - Chamomile – sage herb الينسون – الكركديه – الكمون – البردقوش – الخلة – الحلبة – المغات – الشمر – البابونج - المرمرية

# Degree of WW Treatment versus Crops Permitted for Irrigation (continue..)

Grade of Treatment	Agricultural Group	Description
C (9 Groups)	<u>Group 3-1</u> Dry grain crops, fruits, medicinal plants	Same species in addition to sunflower plant providing that spray irrigation is not used. نفس الأنواع بالإضافة الى نبات عباد الشمس بشرط عدم استخدام طريقة الري بالررش
	<u>Group 3-2</u> Non-food seeds	All seeds of propagation for major food crops such as wheat, corn and all kinds of vegetables' seeds جميع بذور الإكثار للمحاصيل الغذائية.
	<u>Group 3-3</u> All types of seedlings	Seedlings of Olive - pomegranate - citrus - bananas - palm - figs - mango - apples – pears شتلات الزيتون – الرمان – الموالح – خلفات الموز – فسائل النخيل – شتلات التين – المانجو – التفاح – الكمثرى

# Degree of WW Treatment versus Crops Permitted for Irrigation(continue...)

Grade of Treatment	Agricultural Group	Description
C	<u>Group 3-4</u> Roses and Cut flowers	Roses farmyard – Rosa Canina - bulbs such as Algeladiols, bird of paradise and all kinds of ornamental plants. الورد البلدي – ورد النسر – مجموعة الأبصال مثل الجلاديولس وعصفور الجنة وكافة أنواع نباتات الزينة.
	<u>Group 3-5</u> Trees suitable for planting in highways and green belts	Alcazurina - camphor - oleander - tamarisk - types of ornamental palms. الكازورينا – الكافور – الدفلة – الأثل – أنواع نخيل الزينة
	<u>Group 3-6</u> All types of fiber crops	Such as cotton - linen - Jute - kenaf. القطن – الكتان – الجوت – التيل.



# Degree of WW Treatment versus Crops Permitted for Irrigation (continue..)

Grade of Treatment	Agricultural Group	Description
C	<u>Group 3-7:</u> Grassy forage crops and leguminous crops	Sorghum types and kinds of shamrock أنواع السورجم وأنواع النفل.
	<u>Group 3-8</u> Mulberry to produce silkworm silk	All kinds of Berries جميع أصناف التوت
	<u>Group 3-9</u> All plants and ornamental trees nurseries	Such as Ficus décor - Ficus Natda - Ambassndr – Acacia مثل الفيكس ديكورا – الفيكس نيتدا – السفندر – الأكاسيا

# Degree of WW Treatment versus Crops Permitted for Irrigation

Grade of Treatment	Agricultural Group	Description
D (3 groups)	<u>Group 4-1</u> Solid biomass crops	All crops for the production of bio-diesel fuel and energy oils such as: soybean - rapeseed - Jojoba - and Jatropha - Castor. فول الصويا – بذور اللفت – الجوجوبا – والجاتروفا – الخروع.
	<u>Group 4-2</u> Crops to produce cellulose	All non-food crops for the production of glucose and its derivatives like ethanol and acetic acid - ethanol – Generation جميع المحاصيل غير الغذائية لإنتاج الجلوكوز ومشتقاته كالايثانول وحمض الخليك – الإيثانول - الجيل
	<u>Group 4-3</u> Timber trees	All trees for timber production such as Alcaaa - camphor - and mahogany جميع الأشجار لإنتاج الأخشاب مثل الكايا – الكافور - والماهونجي

# Requirements Related to Health Protection

Cultivation Crops	Degree of Treatment	Health Protection Requirements
Green areas in tourist villages, hotels, educational and facilities	A	<ul style="list-style-type: none"><li>• Banning the use of high pressure sprinkler irrigation.</li><li>• Banning daytime irrigation.</li><li>• Banning irrigation whenever there is a wind.</li><li>• Installation of sign boards.</li></ul>
Cultivating desert lands to produce food crops.	B	
Forestation along highways and planting green belts around cities.	C	<ul style="list-style-type: none"><li>• Banning the use of high pressure sprinkler.</li><li>• Banning irrigation whenever there is a wind.</li><li>• Building a fence and a gate</li><li>• Selecting the land location: 500 meters separating it from the nearest residential area or vegetable &amp; fruit crops, and 50 meters from the nearest main road.</li></ul>
Crops for the production of biofuel, energy oils, and wood trees.	D	Same as for treatment degree (C)

# Constraints & Challenges of WWR projects in Egypt & other Developing Countries

1. Inadequate/Inappropriate Water Pricing
2. Insufficient control over freshwater abstraction
3. Technical & Economic uncertainties
4. Too strict water reuse standards in some countries
5. Reuse not seen as a component of integrated water management approaches

# Constraints & Challenges of WWR Implementation in Egypt & other Developing Countries (continue..)

## 1-Inadequate/Inappropriate Water Pricing

- Subsidizing conventional water resources
- Limited economic attractiveness of water reuse projects
- Improper decisions by decision makers

## 2- Insufficient control over freshwater abstraction

- Access to conventional water resource is insufficiently controlled by public authorities.
- Illegal abstraction ,where permits are not enforced, in particular because of no monitoring of actual abstractions).

# Constraints & Challenges of WWR projects in Egypt & other Developing Countries (continue..)

## 3-Technical & Economic uncertainties

This will lead to limit investor's willingness to pay for reused water and hence its ability to compete with freshwater , due to the following reasons:

- A lack of stakeholders' awareness concerning the benefits of water reuse;
- A lack of public acceptance towards water reuse;
- A fear of potential trade barriers on agricultural goods that have been grown using reclaimed water; and
- In some countries , no water reuse standards are in place, a lack of regulatory to manage health and environmental risks.

# Constraints & Challenges of WWR projects in Egypt & other Developing Countries(continue..)

## 4-Too strict water reuse standards in some countries

- stringency of the existing water reuse standards has been reported to be an obstacle
- High administrative burden and associated costs for local authorities.

## 5-Reuse not seen as a component of integrated water management approaches

- Integrated water management is not sufficiently implemented
- Lack of communication and cooperation among stakeholders involved in the whole water cycle
- A fragmentation of responsibilities for and authority over different parts of the WWR projects (see figure!)

# A Fragmentation of Responsibilities!





# Constraints & Challenges of WWR projects in Egypt & other Developing Countries.

## **There are some other constraints as follows:**

- 6- Low levels of public and government enthusiasm for water reuse
- 7-Poorly developed business models for water reuse schemes, and markets for reclaimed water
- 8-Inconsistent and unreliable methods for identifying and optimizing appropriate WWT technologies for reuse applications,
- 9-Significant challenges in assessing the environmental and public health risk/benefit of water reuse across a range of geographical scales
- 10-Lack of financial incentives for reuse schemes

# SWIM-H2020 SM

## For further information

### Website

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