

Wastewater Reuse Code in Egypt

By

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Presentation Outline

✓ **Wastewater Reuse Code 2014-Final Draft Version**

- *Why revising the current WW reuse code?*
- *Axis for new code preparation to achieve economic targets*
- *Degree of treatment, permitted for agriculture use*
- *Plants and crops prohibited and permitted for irrigation by TWW*
- *Irrigation Methods*
- *Health Protection Measures*

✓ **Wastewater Reuse in Egypt**

- *Current Status,*
- *HCWW-Initiatives*
- *Future Prospective*

Why revising Egyptian code for wastewater reuse (no.501 /2005)?

- According to the code, *no edible crops or export crops* can be cultivated and irrigated on wastewater – regardless of the treatment level
- Considered as barrier for wastewater reuse projects with short “Return On Investment” (ROI)
- Too strict comparing to WWR codes of other countries

Why revising Egyptian code for wastewater reuse (no.501 /2005)?

- Egypt has to face the water scarcity challenge as 7.6 Billions m³ /Year of wastewater are available
- About 40,000 hectare are available for WWR projects in different governorates.
- Forestations projects should not be the ultimate goal of wastewater reuse projects

Final Draft *Wastewater Reuse Code 2014*



New Code - Approach منهجية الكود

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

1. Degree(s) of wastewater treatment (Characteristics)
2. Specifying crops
3. Specifying methods and conditions for irrigation
4. Specifying public health requirements, in relation to the circulation of crops
5. Specifying public health requirements in relation to agricultural workers
6. Specifying monitoring and control systems

مرجعية تطوير الكود - *Referential of Code Development*

3 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

Working Axis for New Code Preparation to Achieve Economic Targets

- Axis 1:** Level of wastewater treatment (four degrees of wastewater treatment)-**Chapter 4.**
- Axis 2:** Types of plantations and crops for which irrigation by treated wastewater is permissible-**Chapter 5.**
- Axis 3:** Regulations for irrigation and drainage systems-**Chapter 6.**
- Axis 4:** Regulations to control the extent of direct exposure of workers and the public-**Chapter 7**
- Axis 5:** Institutional system (responsibility & commitment of concerned agencies, inspection and corrective actions)
(Chapter 8)

Degree of Treatment Permitted for Agriculture Use

Degree of Treatment Permitted for Agriculture Use (WWR Code 2005)

<i>Requirements & Max. Limitations</i>		<i>Degree of Treatment</i>			
			<i>Grade A</i>	<i>Grade B</i>	<i>Grade C</i>
<i>Physical & Chemical Standards</i>	<i>TSS</i>		20	60	250
	<i>Turbidity, (NTU)</i>		<i>Undefined</i>	<i>Undefined</i>	<i>Undefined</i>
	<i>BOD₅</i>		20	50	400
<i>Pathogens Standards</i>	<i>F. Coliforms MPN/100 ml</i>		1000	5000	<i>Undefined</i>
	<i>Intestinal nematodes/liter</i>		1	1	<i>Undefined</i>

Degree of Treatment Permitted for Agriculture Use

<i>Requirements & 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 & Chemical Standards</i>	<i>TSS</i>	10	30	50	300
	<i>Turbidity, (NTU)</i>	5	Undefined	Undefined	Undefined
	<i>BOD₅</i>	10	30	60	350
<i>Pathogens Standards</i>	<i>Fecal Coliforms MPN/100 ml</i>	100	1000	5000	Undefined

Treated Wastewater Chemical Standards (FAO)

Guidelines for Chemical Standards in Treated Wastewater Reused For Irrigation Purposes

Component	Long Term Use ⁽¹⁾ Maximum Level of Concentration mg/liter	Short Term Use ⁽²⁾ 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 meter³ / m² 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 ⁽¹⁾ Maximum Level of Concentration mg/liter	Short Term Use ⁽²⁾ 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
Phenol	0.002	0.002
TDS	2000	3000
Total PO ₄	30	30
Cl	400	400
SO ₄	500	500
HCO ₃	400	400
(SAR) %	6-9%	6-9%
Na	230	230
Mg	100	100
Ca	230	230

WWR Code 2014-New Vision



WWR Code 2014-New Vision

Grade (A)

- This *code allows* production of treated wastewater of Grade (A) in the treatment plant site only, or through doing additional treatment 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)

- This *code allows* producing water grade (B) through doing additional treatment for Grade (C)
- The code *does not allow* upgrading wastewater grade (C) to wastewater grade (B) through adding fresh water

WWR Code 2014- New Vision

Plantations Prohibited to be Irrigated by TWW:

- This *code prohibited* to use treated wastewater – whatever the level of treatment is – in irrigating vegetable crops eaten raw
- This *code prohibited* to use treated wastewater grade D in irrigating any food crops (vegetables, field crops, all types of fruits and medicinal plants)
- This *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 and crops allowed for irrigation with treated Wastewater

Plants and Crops Permitted for Irrigation by Treated Wastewater

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

Plants and Crops Permitted for Irrigation by Treated Wastewater

<i>Grade of Treatment</i>	<i>Agricultural Group</i>	<i>Description</i>
B (3 Groups)	Group 2-1 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
	Group 2-2: 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
	Group 2-3: Medicinal Plants	Anise - hibiscus - Cummins - Marjoram - Ammi - Fenugreek - moat - fennel - Chamomile – sage herb الينسون – الكركديه – الكمون – البردقوش – الخلة – الحلبة – المغات – الشمر – ⁸ البابونج - المرمرية

Grade of Treatment	Agricultural Group	Description
C (9 Groups)	<u>Group 3-1</u> Dry grain crops, fruits, medicinal plants contained group (B)	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 بالرش
	<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, which are then transplanted in permanent fields	Seedlings of Olive - pomegranate - citrus - bananas - palm - figs - mango - apples – pears شتلات الزيتون – الرمان – الموالح – خلفات الموز – فساتل النخيل – شتلات التين – المانجو – التفاح – الكمثرى

<i>Grade of Treatment</i>	<i>Agricultural Group</i>	<i>Description</i>
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.

Plants and Crops Permitted for Irrigation by Treated Wastewater

<i>Grade of Treatment</i>	<i>Agricultural Group</i>	<i>Description</i>
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

<i>Grade of Treatment</i>	<i>Agricultural Group</i>	<i>Description</i>
D <i>(3 groups)</i>	<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 كإيثانول 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

Irrigation Methods

Irrigation Methods

Furrow Irrigation:

In this method, water only dampens the part where the furrows are located.

As for the area between the Furrows, it remains dry or semi-dry and can transfer water from source to furrows through hoses or siphons.



Irrigation Methods (continue..)

Drip Irrigation:

In this method, water runs under pressure through tubes leading to emitters which are directly connected to the soil surface that is adjacent to the roots of plants.

This system ensures the least contact of TWW with stems of plants and workers.



Irrigation Methods (continue..)

Subsurface Drip Irrigation:

The flow running through the buried drip tubes drips directly onto the root zone of plants below the soil surface.

Emitters here are put in places where they are in contact with the roots of all plants.

The advantage of this system is that it leaves no trace of the irrigation Water above the ground surface.



Irrigation Methods (continue..)

Bubbler Irrigation:

It is a pressurized irrigation method that regulates the flow of the TWW.



Irrigation Methods (continue..)

Mini pop-up sprinklers:

Mini pop-up sprinklers that are characterized by low pressure and high discharge at an angle of no more than 11° with the horizontal plane.

This method can be used with class (A) and (B) wastewater. However, it is not allowed for class (C) and (D) wastewater.



Health Protection Measures



Protection requirements for workers trading crops

Measures	Description
Irrigation timing	Crops must not be irrigated two weeks before harvest time.
Ongoing training	Training courses to raise the workers' awareness of the risks of trading contaminated crops.
Sign boards	Sign boards shall be installed to remind the workers during the trading and packing of crops.
Vaccination	Workers shall receive vaccination in accordance with the Ministry of Health's requirements.
Protective measures	Gloves, clothing and shoes shall be provided to farm workers.
Supervision	Farm supervisors shall ensure the workers are committed to using means of protection and following instructions.
Medical examinations	Periodic Medical tests shall be conducted once every six months
Records	Prepare record to the six aforementioned measures.

Health Protection Measures

Cultivation Location	Degree	Health protection Requirements
Green areas in tourist villages, hotels in coastal governorates, educational and health facilities within the new cities' cordon.	A	■ Banning the use of high pressure sprinkler irrigation. ■ Banning daytime irrigation. ■ Banning irrigation whenever there is a wind. ■ Installation of sign boards.
Cultivating desert lands devoted to reusing TWW to produce food crops.	B	

Health Protection Measures

Cultivation Location	Degree	Health protection Requirements
Forestation along highways and their median strips and planting green belts around cities.	C,D	• Banning the use of high pressure sprinkler irrigation. • Banning irrigation whenever there is a wind. • Land location: ▪ <i>500 meters separating it from the nearest residential block or vegetable and fruit crops,</i> ▪ <i>At least 50 meters from the nearest main road.</i>

WWR-Current Status in Egypt

Current Exploitation of WW Reuse

The current agriculture exploitation of wastewater in Egypt is done in two ways:

- Indirect exploitation by discharging treated wastewater in agricultural drains
- Direct exploitation by using treated/or partially treated wastewater in irrigation in most of desert governorates and Upper Egypt.

Wastewater Production and Treatment

7.6 Billions m³ /Year

3.8 Billions m³ /Yr (Treated)

*3.8 Billions m³ /Yr
(not Treated)*

**22 % Primary
(0.84 BCM)**

**78% Secondary
(2.96 BCM)**

Wastewater Reuse: Facts & Figures

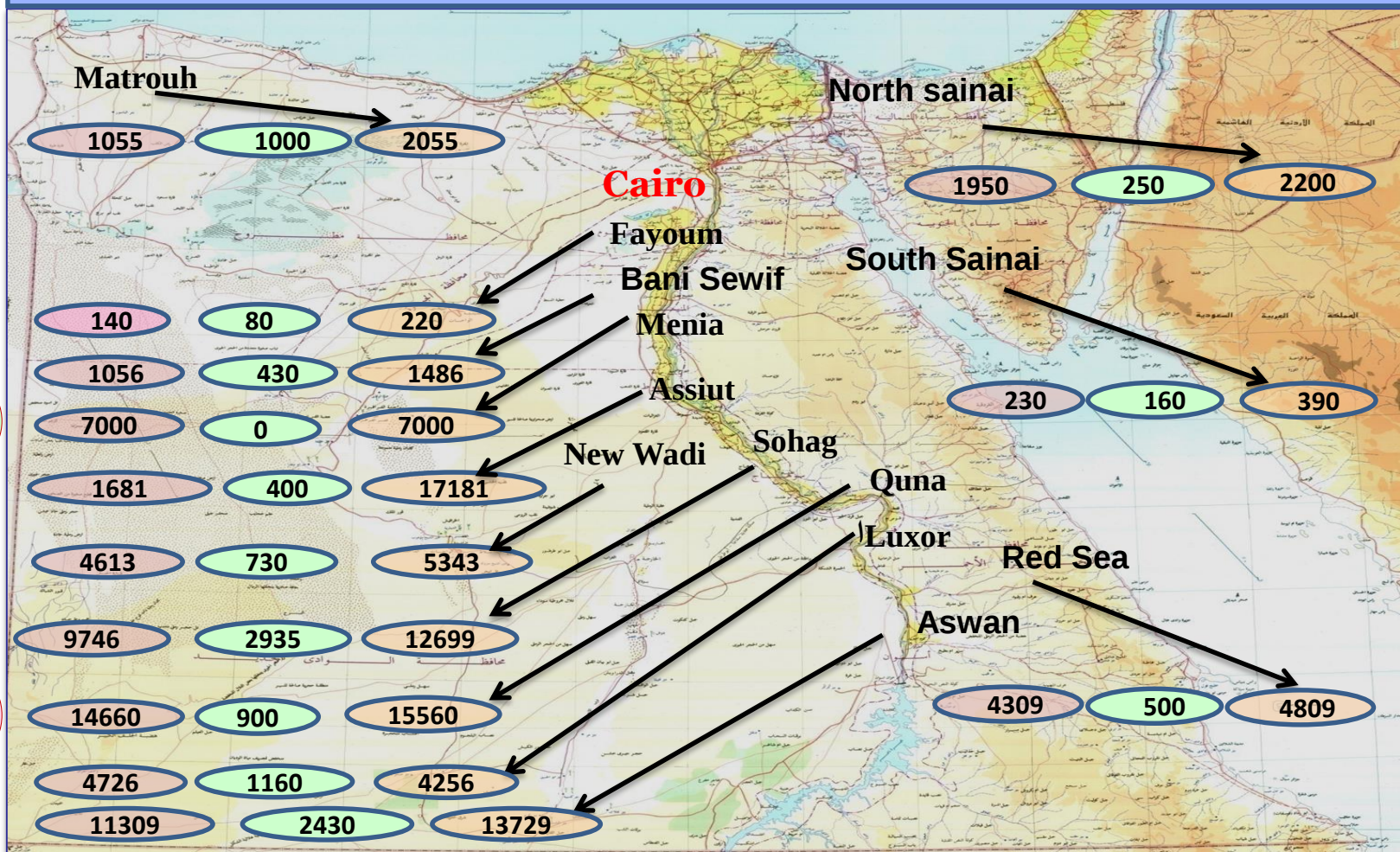
- 3.8 BCM/Yr is pumped to drains in Cairo & Delta
- 2.96 BCM (secondary treated) and 0.84 BCM(primary treated)
- 0.7 BCM/yr of treated WW is reused in irrigation
- About 40,000 hectare are available for WWR projects in different governorates.



Holding Company for Water and Wastewater

الشركة القابضة لمياه الشرب والصرف الصحي

WWR Projects Map 2014



Total
88,558
Feddan

Cultivated
10,965
Feddan

Uncultivated
77,573
Feddan

HCWW Initiatives & Future Prospective

HCWW Future Strategic Vision in WWR Projects

HCWW is adopting three main axes to achieve future strategic vision in wastewater reuse projects:

1. Improve Sanitation Services
2. Improving the Quality of Treated Wastewater
3. Stimulating the Involvement of Private Sectors in Reuse Projects

1.Improve Sanitation Services

Rural Sanitation

- In the light of limited resources in Egypt, HCWW is studying an approach for rural sanitation coverage in phases, with low-cost advanced primary sanitation technologies.

Expected Outcomes

- Increasing the coverage with appropriate sanitation systems in rural areas
- Get rid of sanitation problems outside the boundaries of the village
- Protect water resources from untreated WW & reduce the pollution loads in drains to minimum.
- Low levels of maintenance and control.

Low Cost & Appropriate Advanced Primary Wastewater Treatment Technologies for Rural Villages in Egypt

1. Up flow Anaerobic Sludge Blanket (UASB)
2. Modified Septic Tank (MST)
3. Anaerobic Baffled Reactors (ABR)
4. Anaerobic Pond (AP)
5. Constructed Wetland (CW)

2.Improving the Quality of Treated Wastewater

Industrial Wastewater Management

- Industrial wastewater is one of the main challenges that face wastewater reuse programmes in Egypt, affecting the performance of WWTPs.
- It must be treated before discharging onto public network !

Current Initiatives

- **HCWW/EWRA** are coordinating with the concerned Ministries for monitoring, compliance of industrial establishments and law's enforcement
- **HCWW** is studying an approach to treat **IWW** of each industrial City in a **Central IWW Treatment plant(s)**.

3. Stimulating the Involvement of Private Sectors in Reuse Projects

Egyptian Code for Wastewater Reuse (501/2005)

HCWW is adopting an initiative to develop & review Egyptian Code for reuse to allow for cultivation of industrial crops & some edible crops that are not eaten raw, taking into consideration the required measures.

Significant Outcomes

- ✓ Flexible reuse new code to encourage investors to invest in reuse projects, with short ROI
- ✓ Tender documents already prepared for reuse projects in Sohag, and Qena

3. Stimulating the Involvement of Private Sectors in Reuse Projects (continue....)

Research & Development

- **HCWW** cooperates with international donors (JICA, UNEP, ..etc) to prepare studies & researches, aiming to investigate the health matters and to cultivate new crops of higher productivity

Expected Outcomes

- **R & D** results will encourage the private sector to invest in WW reuse projects

***Thank You
for Your Attention!***

