



# The potential of water reuse in the Arab region as a management option for water security under climate change condition

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# Some key questions



**What is the potential of wastewater?  
what are the different uses in the  
Arab region**



**Why is Wastewater Reuse Important for  
Arab Countries? And what are the  
Constraints?**

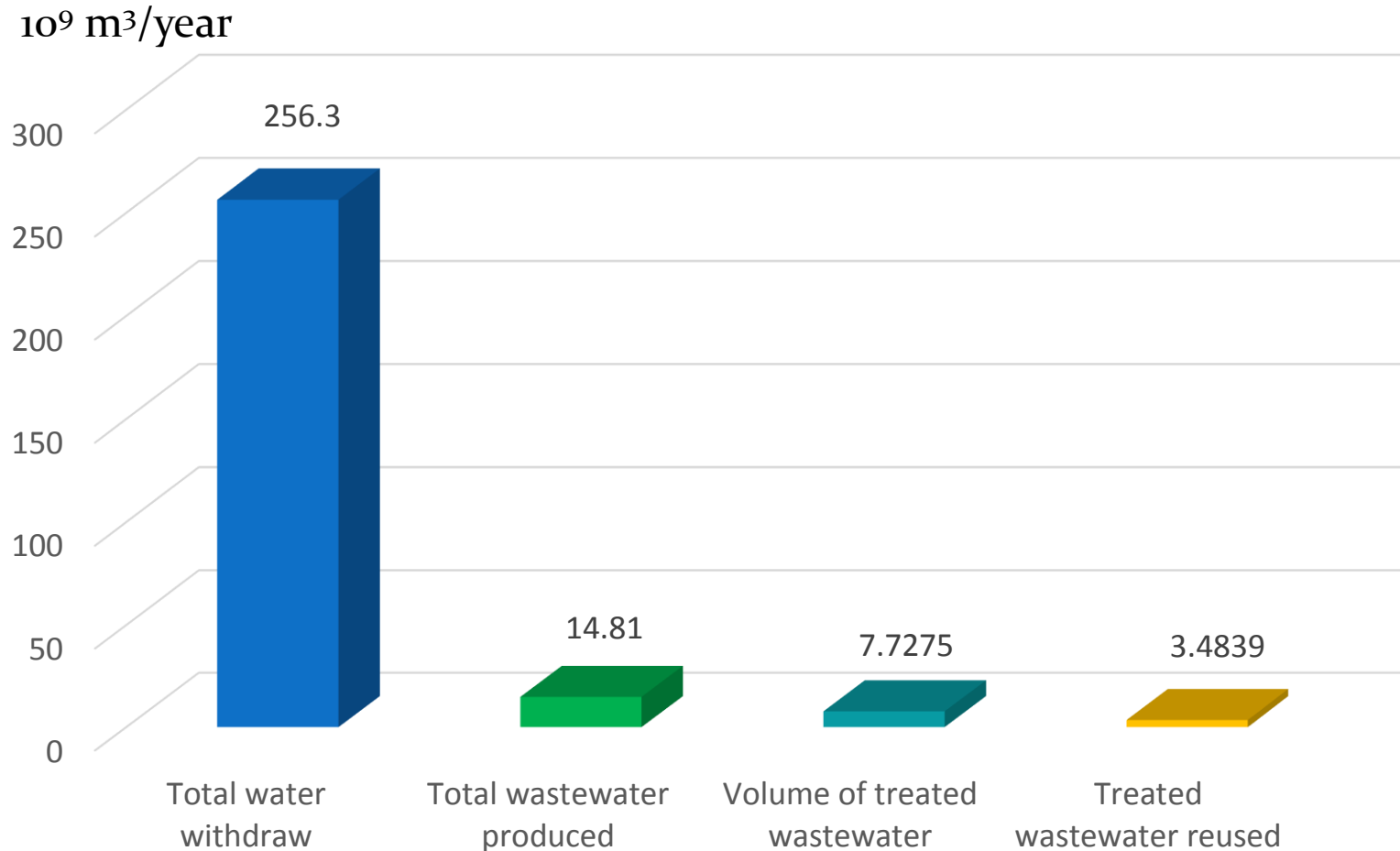


**How to make wastewater recycling  
sustainable?**

# Water issues in the Arab countries

- All Arab countries are below the level of severe water scarcity since 2015 with fragile ecosystems under multiple stress
- 40 percent of the Arab population is already living in conditions of absolute water scarcity
- Agriculture water Share 85% of available water resources
- There is a need for the mobilization of non conventionnel water, particularly wastewater resources

# Wastewater Reuse in Arab Countries



**Total water withdrawal , raw wastewater treated wastewater and reused treated wastewater in the Arab countries in 10<sup>9</sup> m<sup>3</sup>/year (FAO-AQUASTAT 2014)**

# WASTEWATER REUSE IN THE ARAB REGION

Total use estimated at 3.4839 km<sup>3</sup> per year

Egypt, by far, largest user with over 70% of region

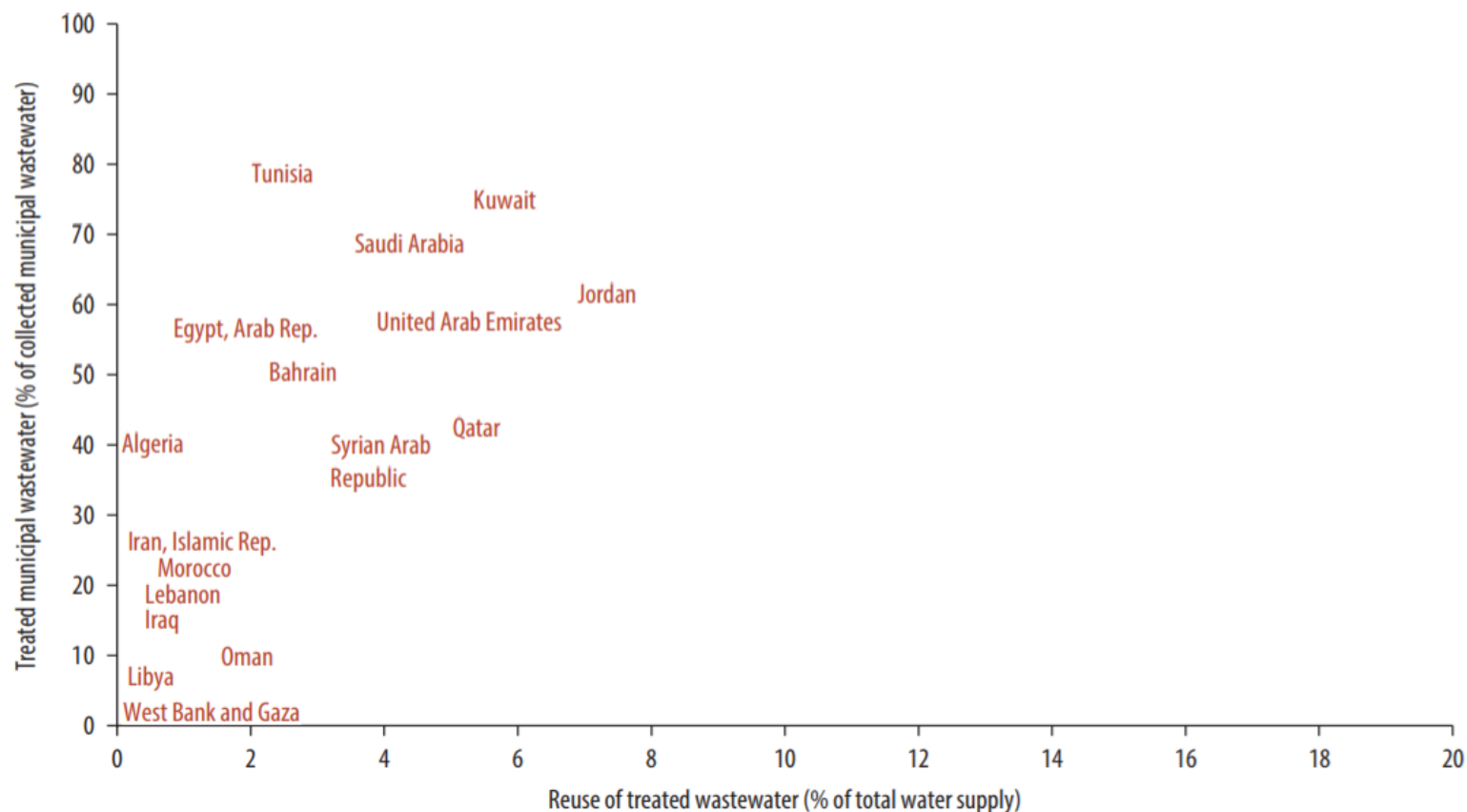
Direct reuse being introduced at Aqaba, Wadi Musa, Irbid in Jordan

Syria, Tunisia, are other top users



# Wastewater Reuse in Arab Countries

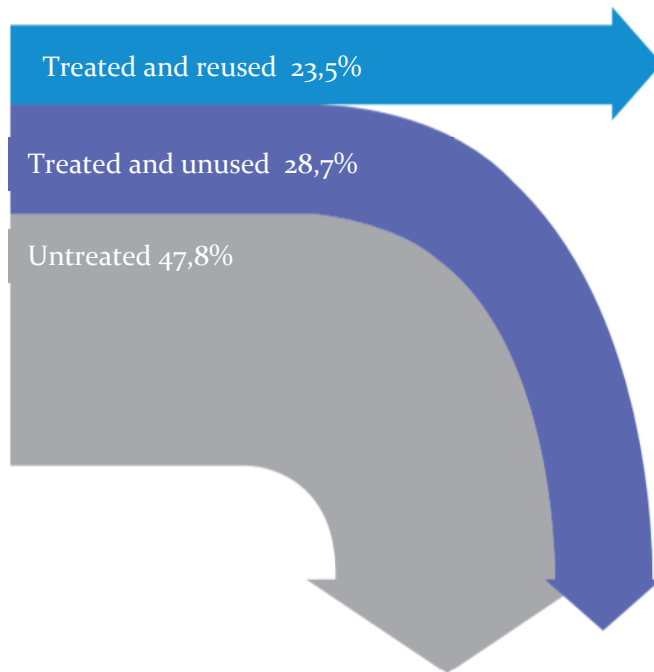
Share of Wastewater That Is Reused versus Share That Is Treated



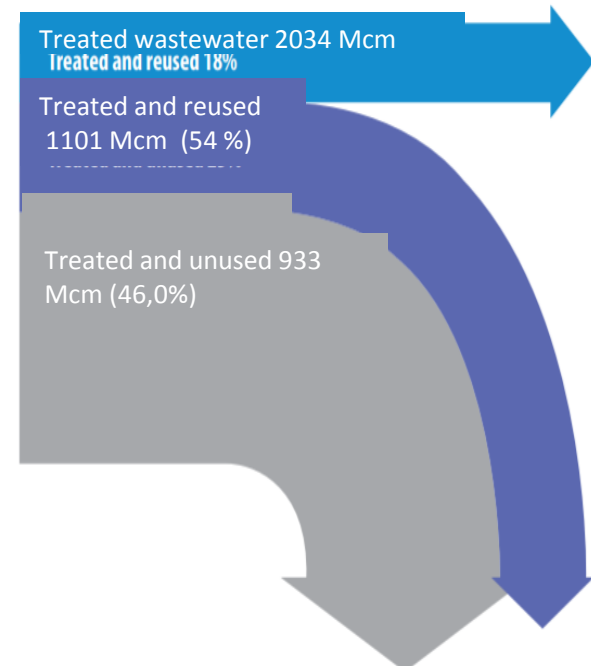
Source: World Bank, using data from FAO AQUASTAT (database).

# Wastewater Reuse in Arab Countries

Share of Collected Wastewater That Is Untreated, Treated, and Reused in Irrigation



Share of Collected Wastewater That Is Untreated, Treated, and Reused in Irrigation



Source: World Bank, using data from FAO AQUASTAT (database).

Arab World 2014

GCC Countries 2015

# Why Treated Urban Wastewater

Compared to desalination, it is a cost-effective and energy saving to increase water supply and mitigate the impact of climate variability and climate change

Reuse of treated wastewater means making a productive asset out of a waste production from which it is possible to recover heat, energy, nutrients and clean water ( aqua environment

Different reuse opportunities with social, economic and environmental values



# Why is Wastewater Reuse Important for Arab Countries?

| Country<br>Refer: adapted from 4,5 | Type of Reuse  |
|------------------------------------|--|
| Egypt                              | Agriculture (direct forage and trees, indirect vegetables) |
| Jordn                              | Agriculture (direct forage and trees, indirect vegetables) |
| Lebanon                            | Agriculture Forages  |
| Morocco                            | Golf courses and Phosphate Industry                        |
| West bank                          | Agriculture  |
| Syria                              | Agriculture  |
| Tunisia                            | Irrigation of green areas, Agriculture, Wetlands           |
| Yemen                              | Agriculture  |
| UEA                                | Green space irrigation                                     |

# Reuse of wastewater in the Arab region

- Reuse options are manifold and strongly depend on a country's economic structure.
- Agriculture plays a major role for reuse in Jordan, Egypt,
- Green space irrigation in urban centers and tourist facilities is the focus of United Arab Emirates, Tunisia and Morocco.
- wastewater is “lost” as outfall to the sea. Particularly Morocco (60%), Lebanon (80%)
- Increased acceptance and reliance on reclaimed water will play a key role in mitigating the impacts of global climate change

# Wastewater Technologies used in Arab Countries

| Country<br>Ref; 1-13 | Degree of<br>Treatment | Treatment Techniques Employed                                 |
|----------------------|------------------------|---|
| Egypt                | P, S                   | AS, OD, TF, and WSP   |
| Jordan               | S, T                   | AS, TF, WSP, EA, and anaerobic sludge digesters               |
| Morocco              | P,S,T                  | Natural lagoons, AL, TF, AS, and WSP                          |
| Lebanon              | P,S                    | Settling tanks and AS   |
| Syria                | S                      | AS, Wet Land, Oxidation ponds, and AL                         |
| Tunisia              | S, T                   | AS, OD, WSP, AL, and TF                                       |
| Yemen                | S                      | WSP, settling/Imhoff tanks (predominant), AS, TF, and EA      |
| UEA                  | S,T                    | AS and SF   |
| Kuwait               | T, A                   | AS, OD, SF, DF, UF, and RO                                    |
| Algeria              | S                      | AS, WSP, AL, SF, reed bed sewage treatment, and garden filter |
| Bahrain              | S,T                    | AS, SF, RBC, AL   |
| Oman                 | S, T                   | AS, WSP, RBC  |
| KSA                  | S, T                   | AS, WSP, T,F  |
| Sudan                | P,S                    | WSP, AS   |

P: Primary, S: Secondary, T: Tertiary, A: Advanced

AL: Aerated Lagoons, WSP: Waste Stabilization Ponds, TF: Trickling Filters, SF: Sand Filtration, AS: Activated Sludge, OD: Oxidation Ditches, UF: Ultra Filtration, RO: Reverse Osmosis, DF: Disc Filtration, RBC: Rotating Biological Contactors, EA: Extended Aeration

# TYPE OF TECHNOLOGIES IN ARAB REGION



# TYPE OF TECHNOLOGIES IN ARAB REGION

Riqqa Activated sludge



Sulaibiya Advanced



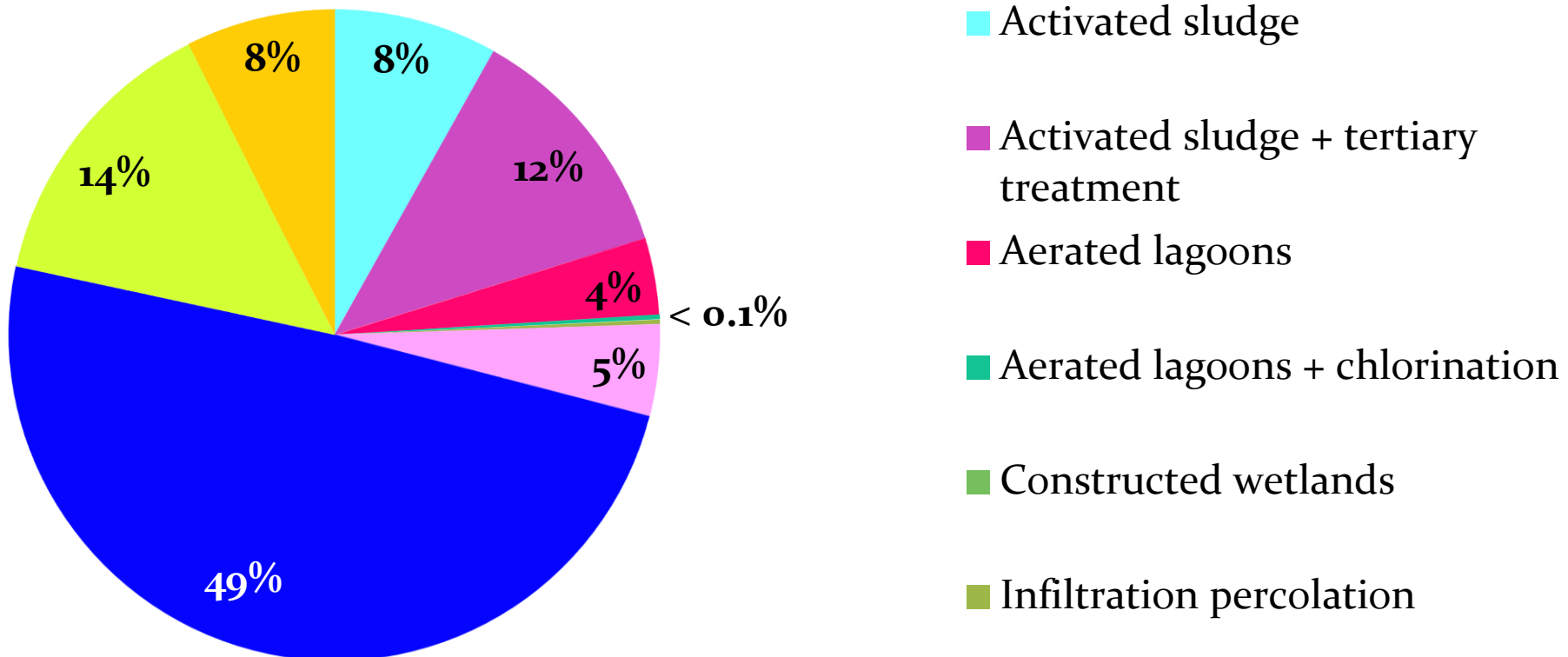
Al Khiran STP



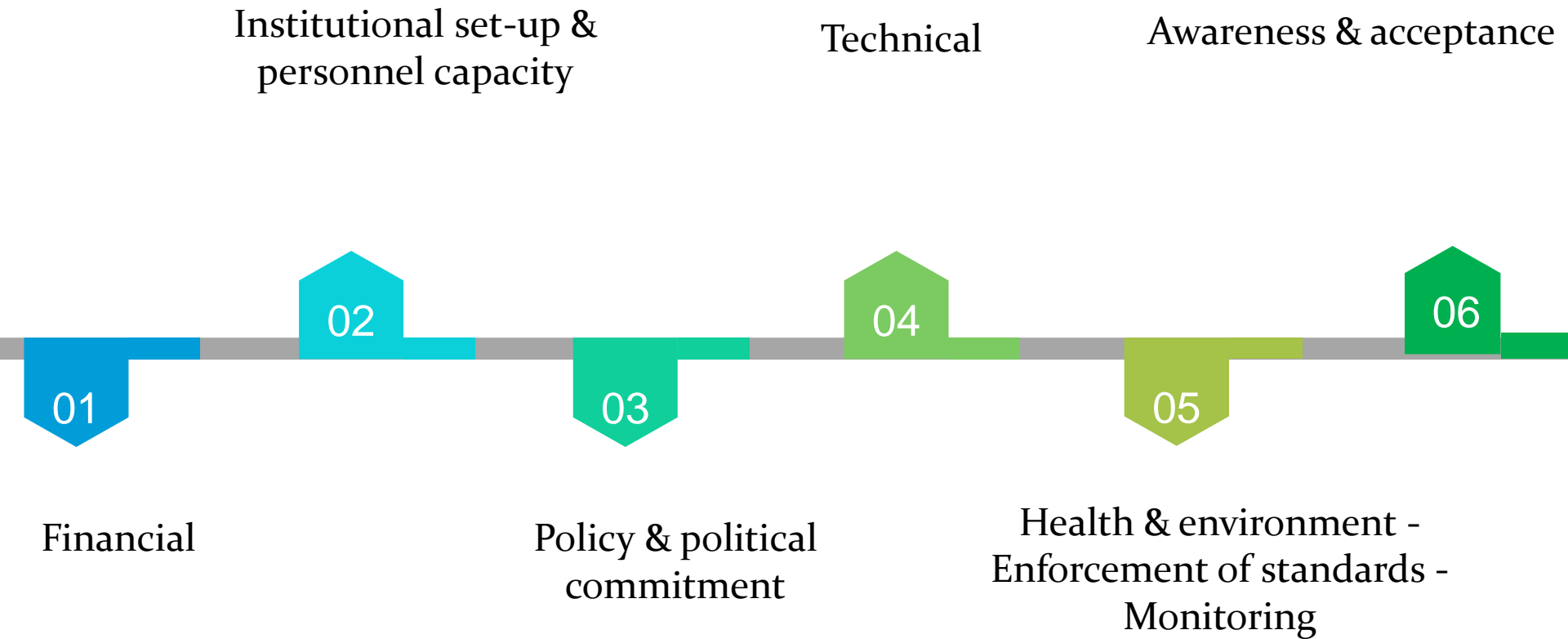
Jahra STP



# VOLUMES OF TREATED WASTEWATER BASED ON THE TYPE OF TECHNOLOGY IN MOROCCO



# Main constraints of Reclaimed Wastewater Reuse



# Safety Control & Risk Management

- Unfortunately, in many Arab countries that are already using or start using treated wastewater, the monitoring and evaluation programs are not well developed
- Poor monitoring of performing parameters serious negative impacts on health, water quality and environmental and ecological sustainability



# Wastewater Quality

- Quality parameters are set in most of the Arab countries, however only few have the capacity and means to meet these standards.
- Jordan implemented a safety control system for agricultural produce grown on a mix of treated wastewater and freshwater
- Salt content of industrial effluents jeopardizes and efficient reuse in irrigation water

# Clogging of sprinklers in the Golf of Agadir



# WASTEWATER REUSE GUIDELINES

TABLE 2

WASTEWATER REUSE GUIDELINES FOR SOME ARAB COUNTRIES

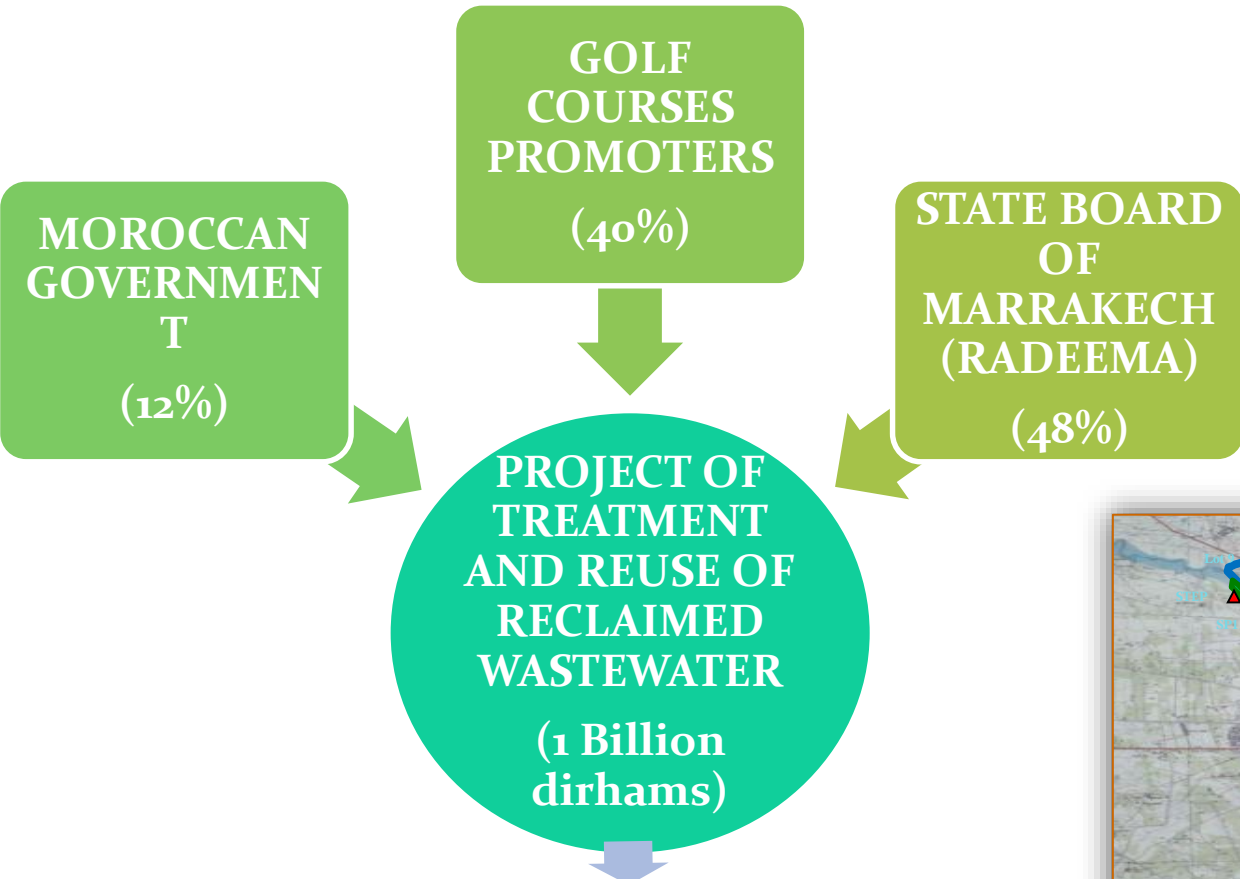
|                     | E. Coli Or Fecal Coli<br>/100ml             | Nematode<br>eggs/l | Other <sup>1</sup><br>parameters | Crops eaten<br>uncooked is<br>allowed | Code of<br>practice |
|---------------------|---|--------------------|----------------------------------|---------------------------------------|---------------------|
| <b>WHO</b>          | 1000  | <1                 | No                               | Yes                                   | Yes                 |
| <b>Jordan</b>       | 100   | <=1                | Yes                              | No                                    | Yes                 |
| <b>Morocco</b>      | 1000  | Absence            | Yes                              | Yes                                   | No                  |
| <b>Palestine</b>    | 1000  | <1                 | Yes                              | No                                    | Yes                 |
| <b>Syria</b>        | 1000  | <1                 | Yes                              | No                                    | Yes                 |
| <b>Tunisia</b>      | -   | <1                 | Yes                              | No                                    | Yes                 |
| <b>Kuwait</b>       | 20  | <1                 | Yes                              | No                                    | Yes                 |
| <b>Oman</b>         | 200   | <1                 | Yes                              | Yes                                   |                     |
| <b>Saudi Arabia</b> | 2.2   | <1                 | Yes                              | No                                    | Yes                 |
| <b>Yemen</b>        | No specific standard                        |                    |                                  |                                       |                     |
| <b>Egypt</b>        | Decree 44/2000, but no specific<br>standard |                    |                                  |                                       |                     |

1. BOD<sub>5</sub>, COD, NO<sub>3</sub>, TSS, EC  
Source: Xanthoulis, 2010



# **SUCCESSFUL STORIES FOR THE REUSE**

# Case of Reclaimed Wastewater Reuse in Marrakech



- Construction of a wastewater treatment plant (33 million m<sup>3</sup>/year)
- Construction of a distribution network (80 km).



# Use of treated wastewater for Forest development in Egypt El-alaky, Aswan (*Castor*, *Khaya*, *Jatropha*, *Gogopa*)



Jatropha: haute rendement par l'utilisation des eaux usées



Ca. 12 tonnes de noix par hectare =  
à 4.000 litres d'huile et 8 t de  
matière résiduel



# WATER REUSE IN KUWAIT





Golf Courses





Golf course/Race track

# *Golf de Hammamet 600 ha*





# GROUDWATER RECHARGE



# Planning for Wastewater Reuse

- The formulation of realistic, economically feasible, safe and socially acceptable set of standards and regulations is very essential
- Codes of practices for sustainable use are also crucial
- Policies accompanied by national strategies for wastewater reuse are preconditions to success
- Many different stakeholders are involved and it is very crucial to allocate responsibilities in both treatment and reuse stages
- The choice of an adequate technology should be based on an integrated assessment of the local technical, environmental and social aspects

# Lessons learned and recommendations



➤ Need to integrate water quality in wastewater reuse

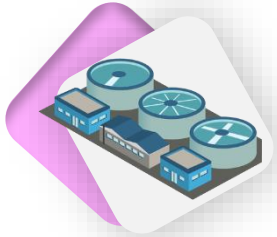


- 
- Strengthen existing networks and institutions
  - Implementation of strategy and policy to promote reuse



- 
- Strengthening Public Private Partnership

# Lessons learned and recommendations



Selection of treatment system based on the type possible reuse  
Emerging contaminants, are becoming a concern for environment protection and health



Need to diversify different reuses



Cost-benefit analysis should include socio-economic and environmental aspects



- Constant dialogue between all relevant partners
- Capacity-building and sharing knowledge



*Thank You*

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