

# **Wastewater Reuse in Morocco Status, challenges and business opportunities**

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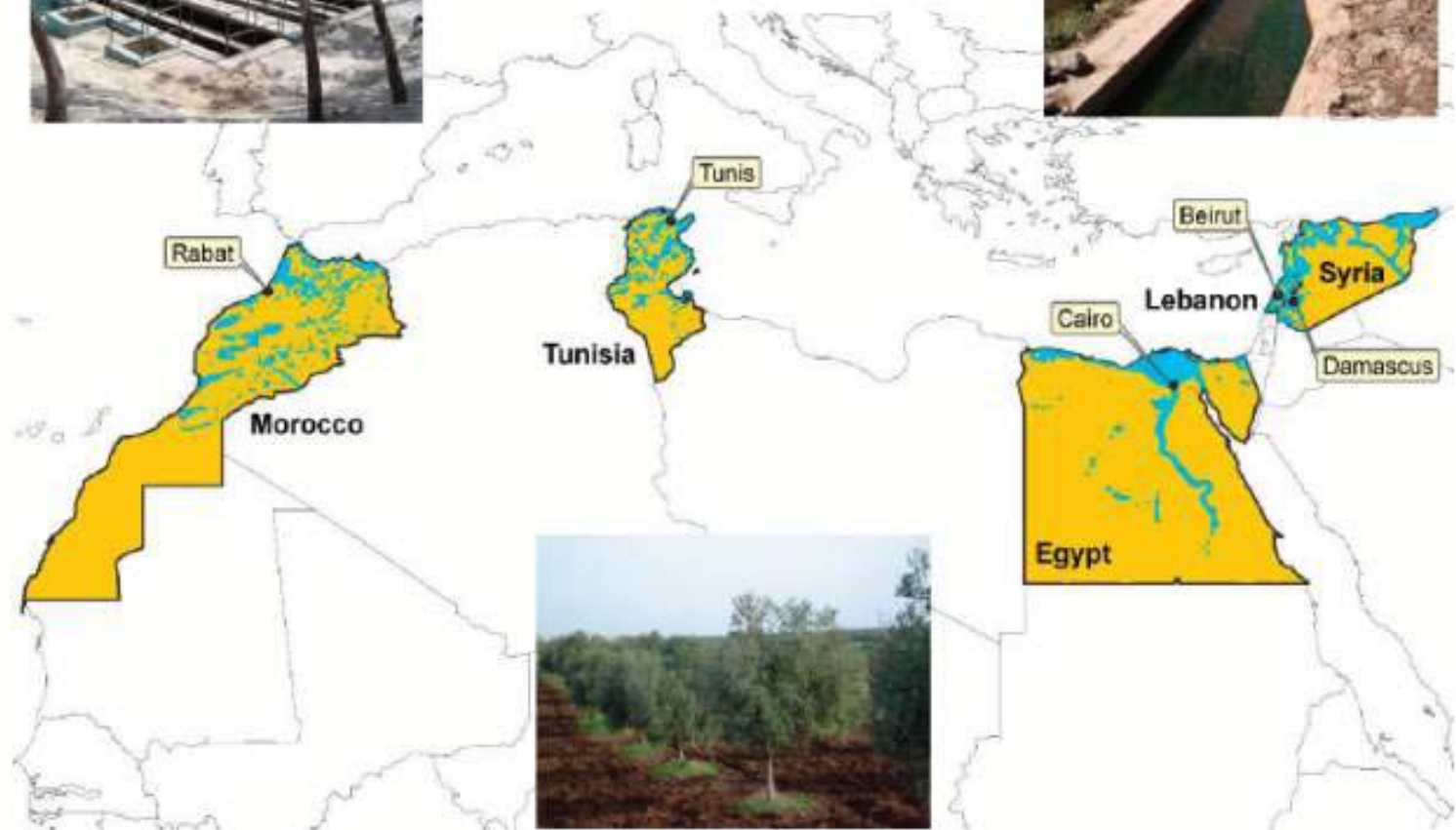
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# OVERVIEW

- Current status of Wastewater Treatment and Reuse in Morocco
- Business Challenges and opportunities
- Prospects
- Concluding remarks

# Current status of Wastewater Treatment and Reuse in Morocco



# PHOENICIAN

4th and 3rd centuries BC



## Full sized bathtubs



(Bahri A. 2010)

# Morocco is not an exception in MENA

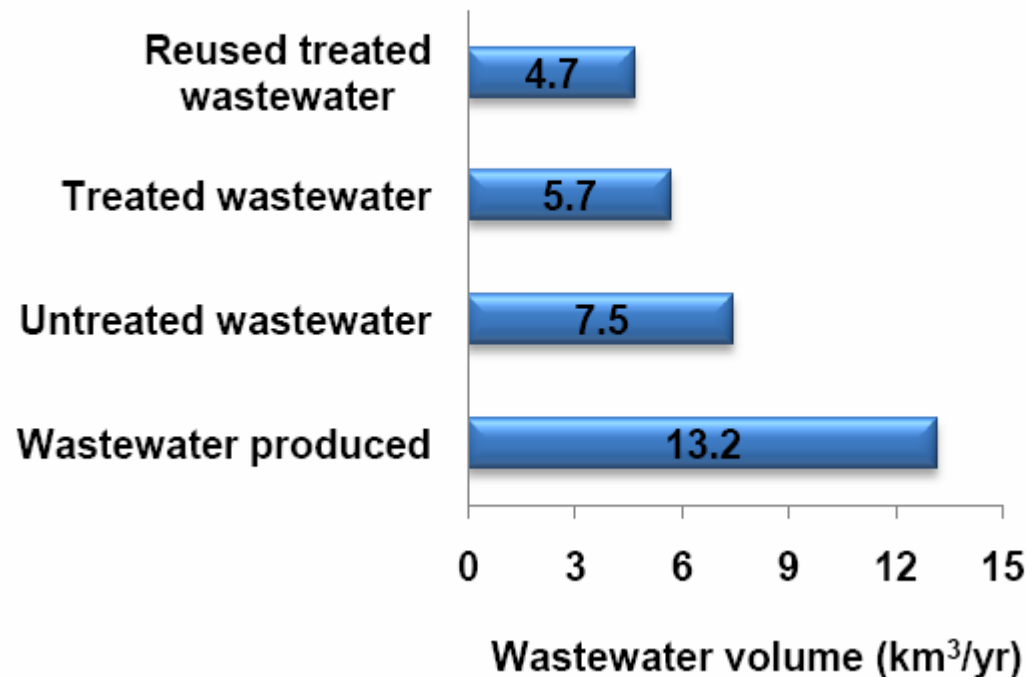
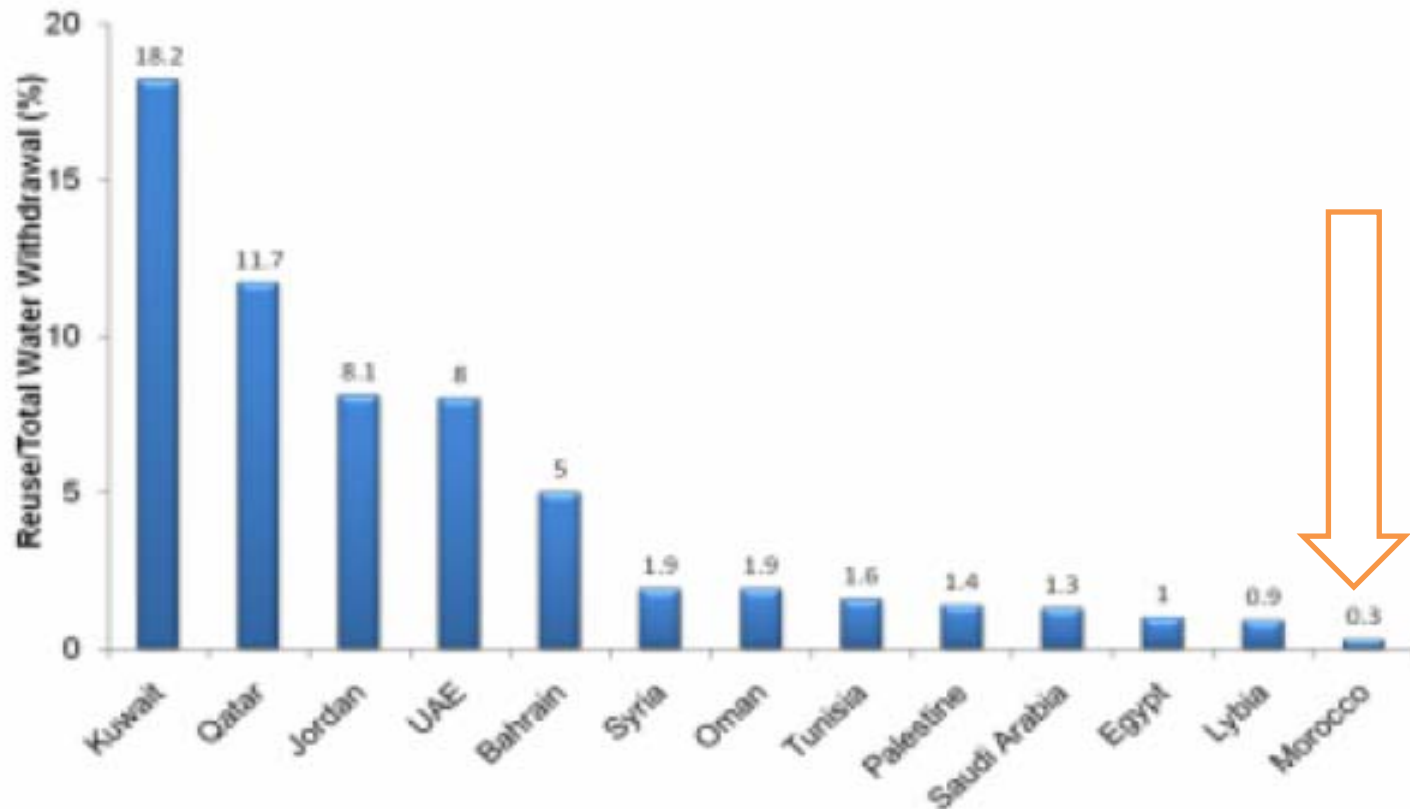


Figure 1. Volume of wastewater produced, treated, disposed of or reused for irrigation in the MENA region (Qadir *et al.*, under press)

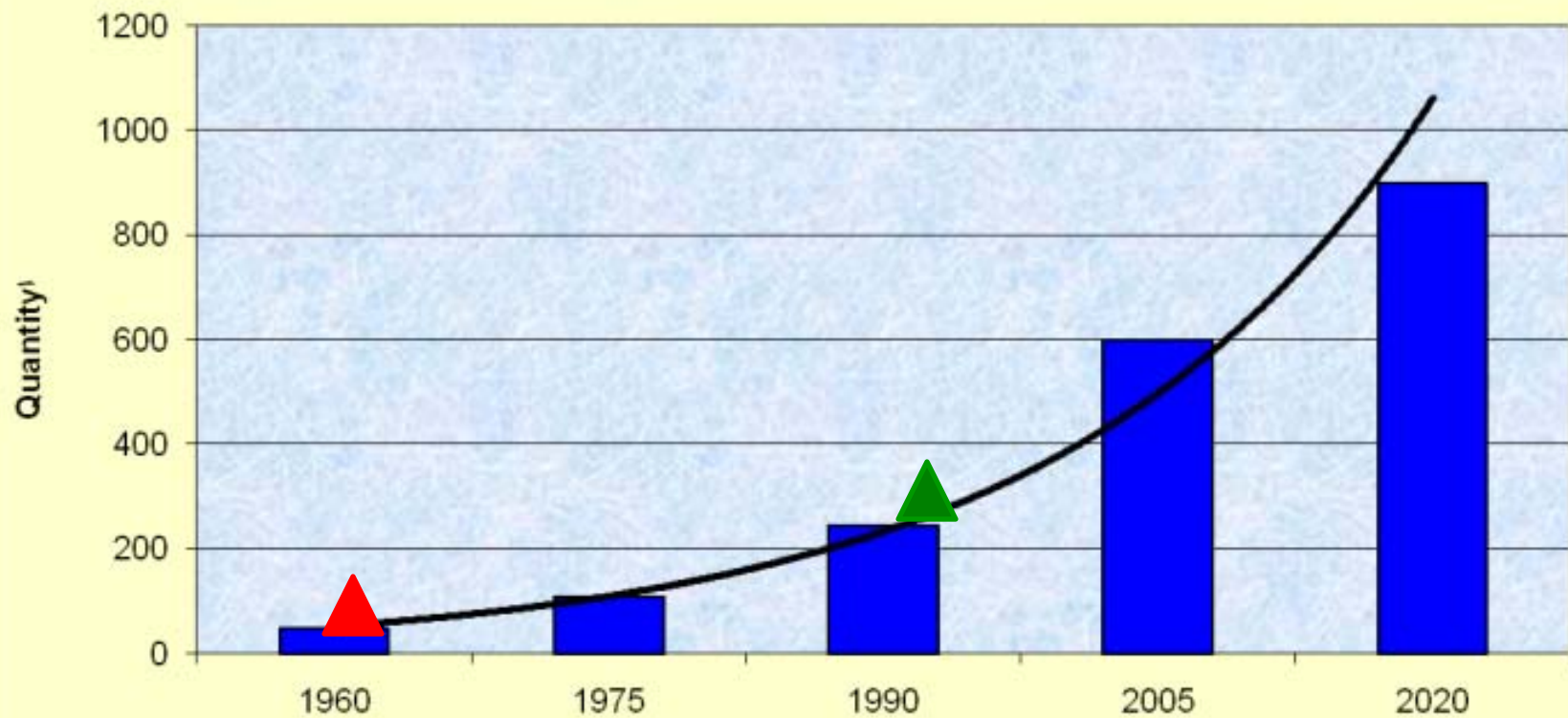
And was even lagging behind in reuse of the small proportion treated till the recent years



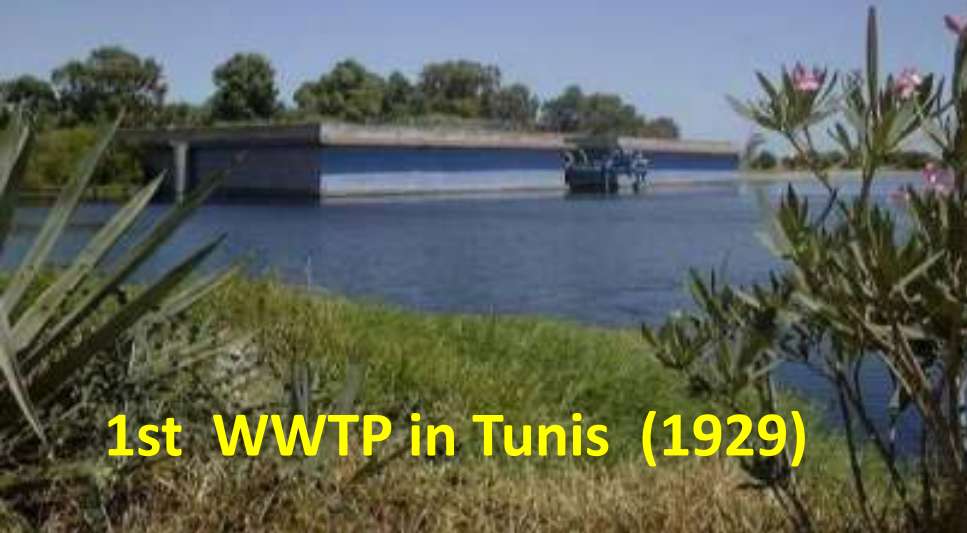
- Morocco wastewater volume today is estimated to next to 600 Million m<sup>3</sup>: enough to continuously irrigate a scheme of 30,000 ha with high nutrient content water

Fast growing with urbanization and progress in water supply

### Evolution of Wastewater Generated (Mm<sup>3</sup>/year)



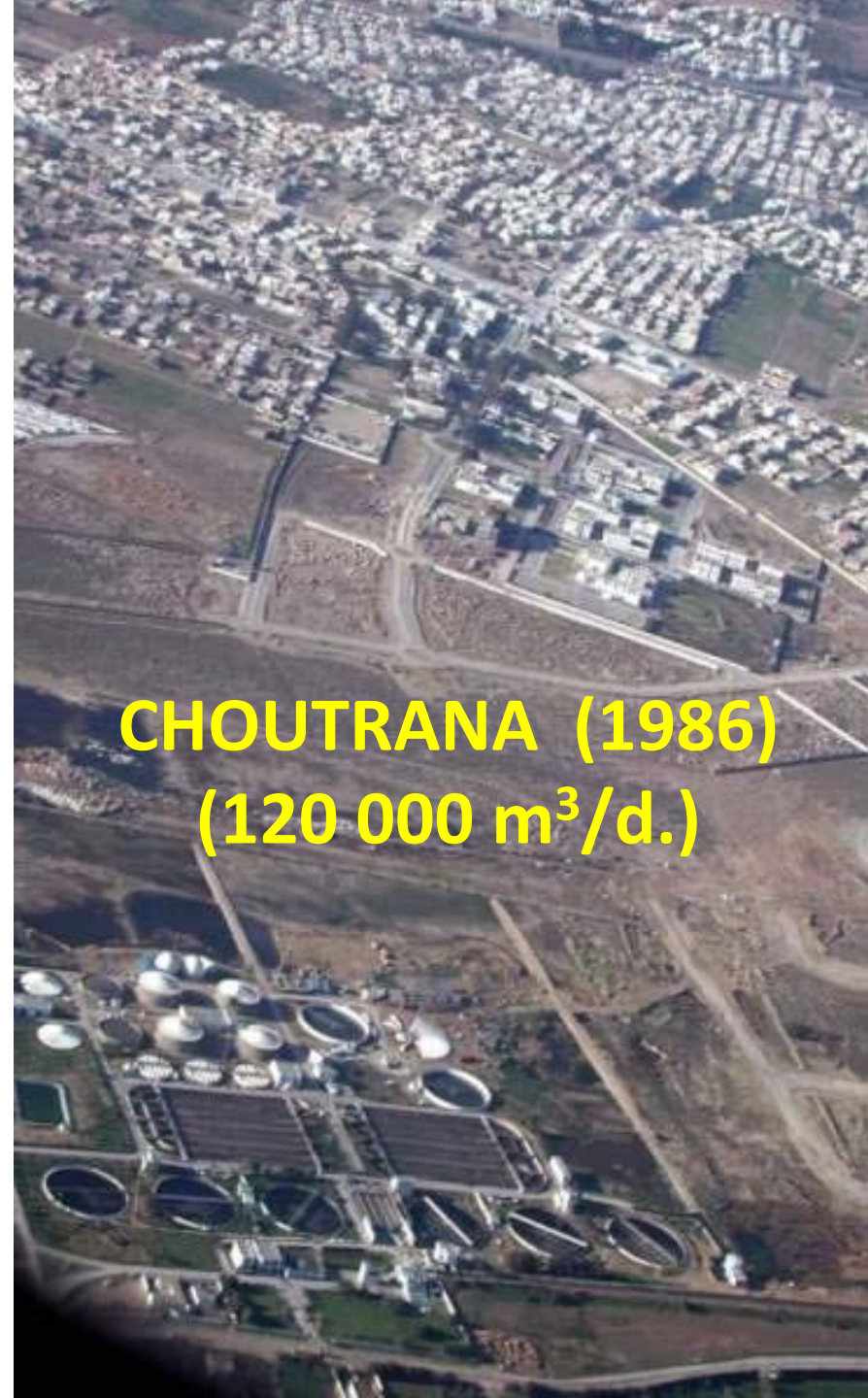
**MOROCCO IS NOT COMPARABLE  
TO TUNISIA FOR INSTANCE**



**1st WWTP in Tunis (1929)**



**LA CHERGUIA A.S. WWTP (1958)**  
**60 000 m<sup>3</sup>/d**

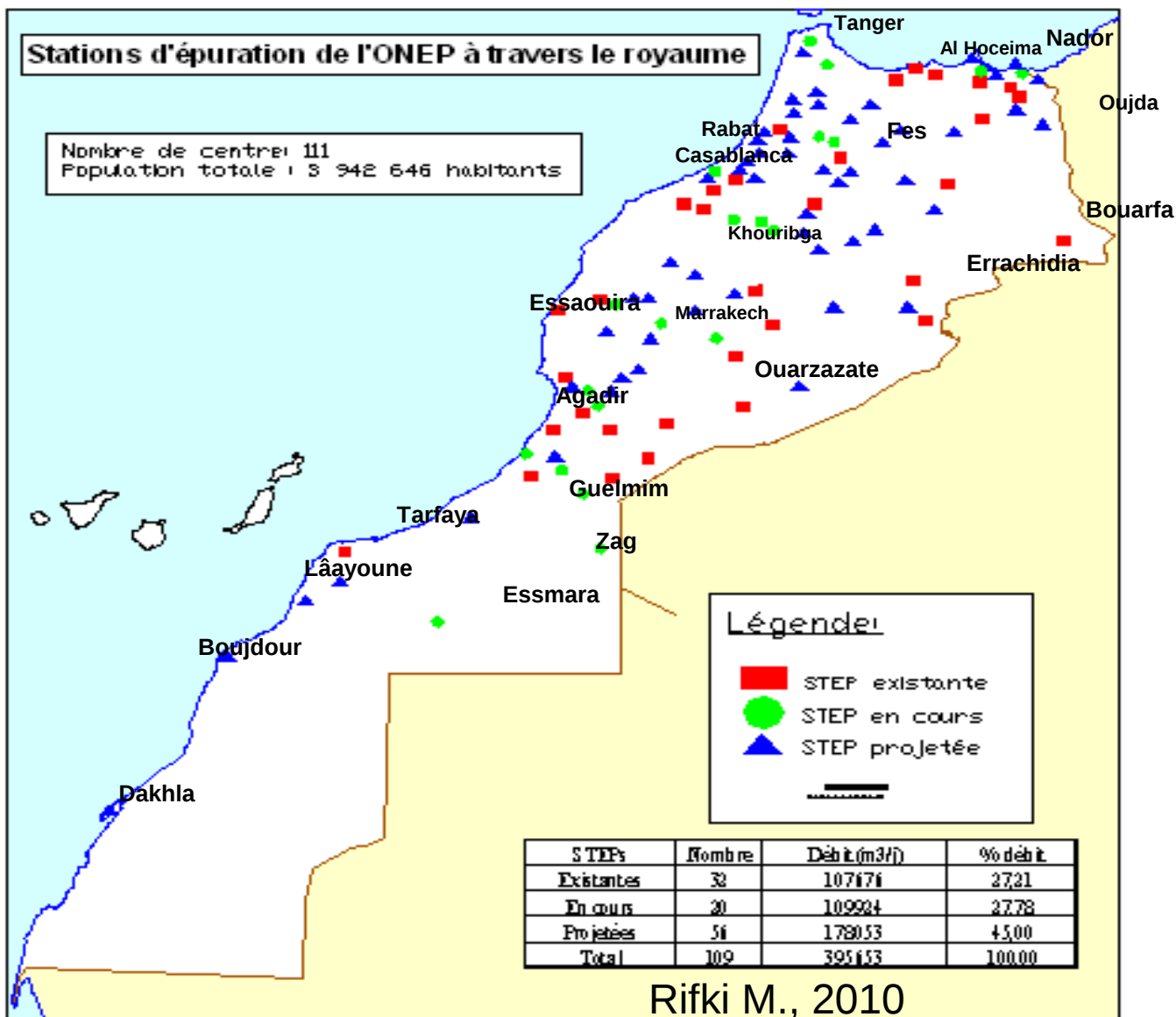


**CHOUTRANA (1986)**  
**(120 000 m<sup>3</sup>/d.)**

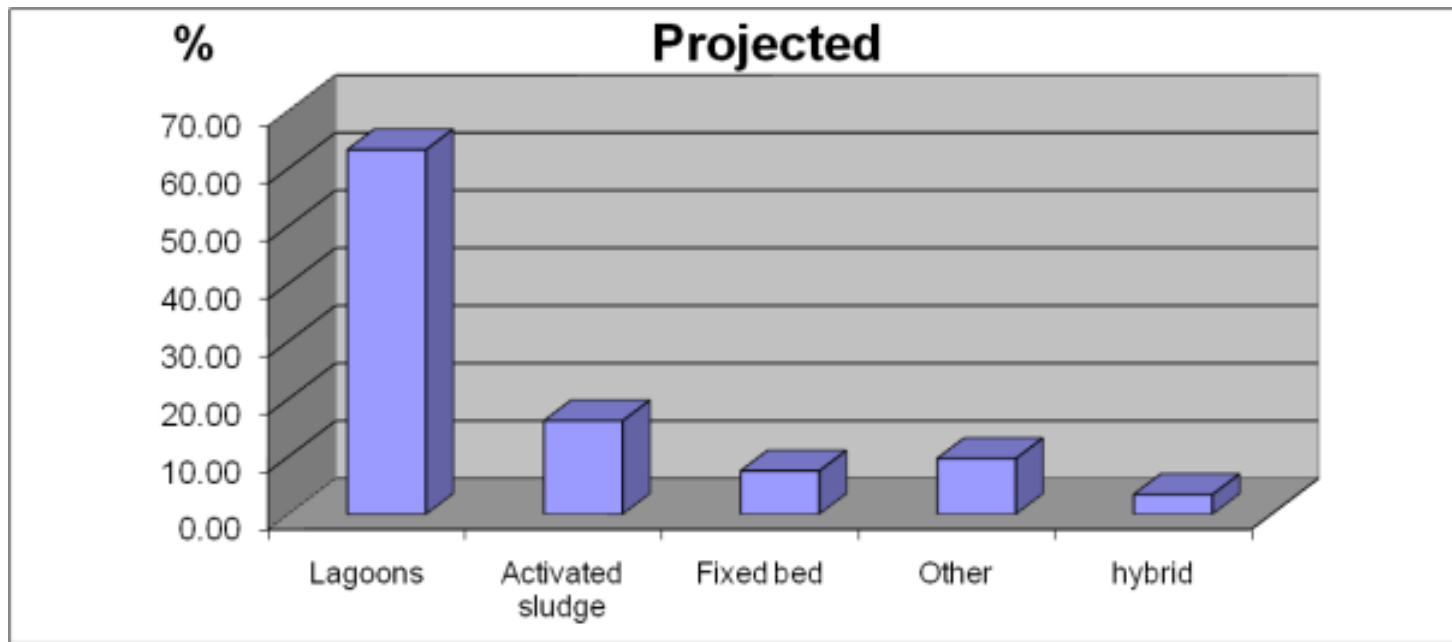
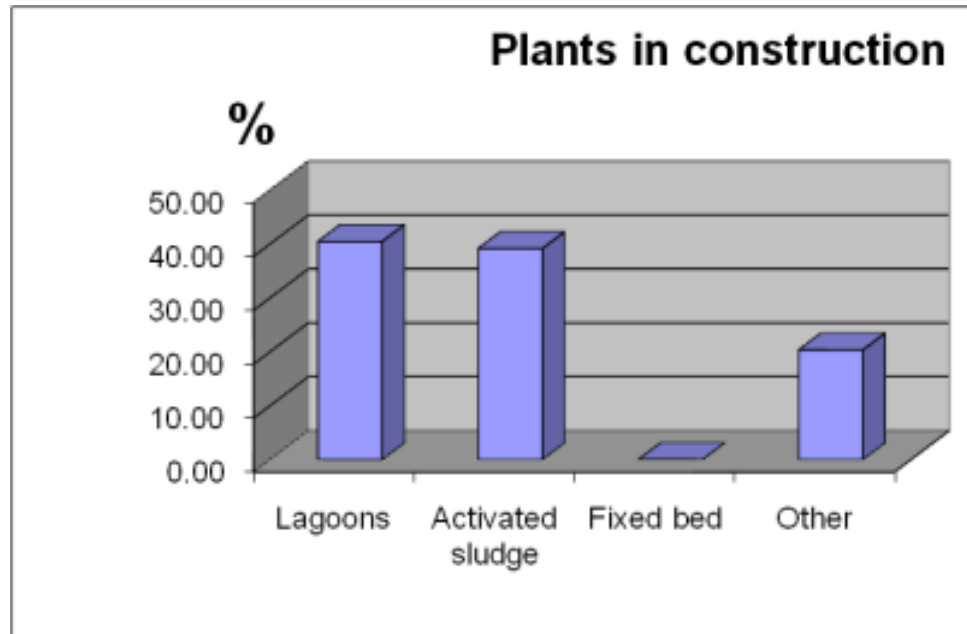
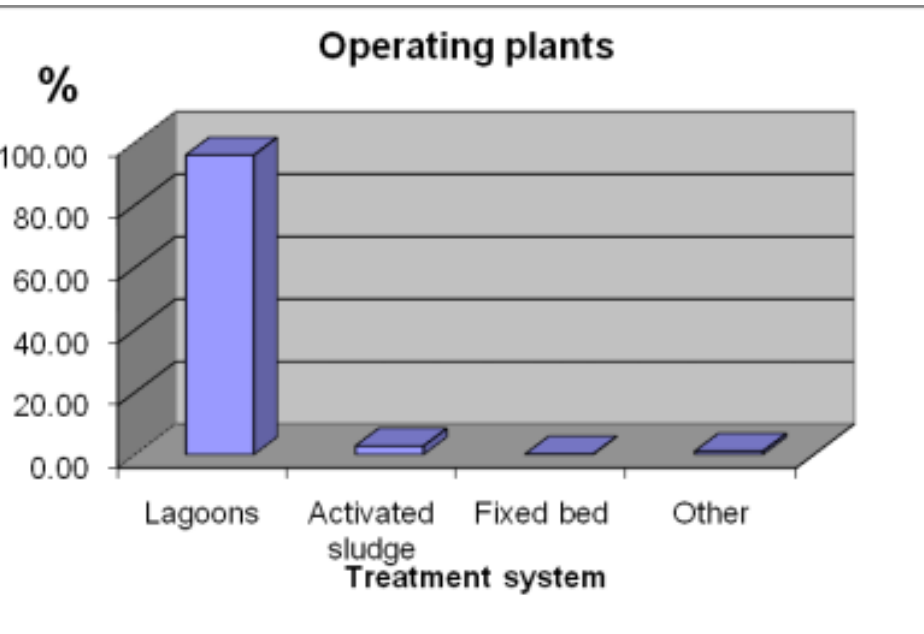
## Fast growing coverage, number of plants and Discharge

| <b>Treat. plants</b>   | <b>Number</b> | <b>Discharge (m<sup>3</sup>/d)</b> |
|------------------------|---------------|------------------------------------|
| <b>Existing</b>        | 32            | 107676                             |
| <b>In construction</b> | 20            | 109924                             |
| <b>Projected</b>       | 56            | 178053                             |
| <b>Total</b>           | 109           | 395653                             |

# Treatment plants distribution across the country



# TREATMENT SYSTEMS



- Mostly mechanical treatment plants with sludge recycling. Sludge management is another challenge
- Stabilization ponds and aerated lagoons
- However, there is a clear trend to intensive technologies in the integrated national plan for sanitation
- Efforts in water supply went faster than sanitation and WW treatment and not paralleled with plans for reuse, sustainable cost recovery and financial viability of the treatment plants beyond O & M

- Population covered : 12 Millions
- Users : 2.6 Millions
- Network length : 15,000 km
- Volume: 500 Millions m<sup>3</sup>/year
- Discharged in Atlantic Ocean and Mediterranean : **92 %**
- Treated : **7 %**
- TrT plants : **6**
- Connection to sanitation network : 70% to 95%



| <b>Operator</b>                                        | <b>RAMSA</b>                        | <b>RADEET</b>               | <b>RADEEC</b>                                           | <b>RADEEMA</b>              |
|--------------------------------------------------------|-------------------------------------|-----------------------------|---------------------------------------------------------|-----------------------------|
| <b>Citiy</b>                                           | <b>Agadir<br/>+ Ben Sergao</b>      | <b>Béni-Mellal</b>          | <b>Settat<br/>+ Soualem<br/>Sahel + Oulad<br/>Abbou</b> | <b>Marrakech</b>            |
| <b>Treatment<br/>system</b>                            | <b>Infiltration<br/>percolation</b> | <b>Activated<br/>sludge</b> | <b>Lagoon<br/>ponds</b>                                 | <b>Activated<br/>sludge</b> |
| <b>Treatment<br/>level</b>                             | <b>Secondary</b>                    | <b>Secondary</b>            | <b>Tertiary</b>                                         | <b>Primary</b>              |
| <b>Capacity<br/>(m3/d)</b>                             | <b>51.000</b>                       | <b>11.000</b>               | <b>17.000</b>                                           | <b>118.000</b>              |
| <b>Coût<br/>(Million<br/>MAD) (1 USD<br/>=8.3 MAD)</b> | <b>97</b>                           | <b>60</b>                   | <b>76</b>                                               | <b>167</b>                  |

# **INFILTRATION-PERCOLATION - BEN SERGAO'S WWTP MOROCCO**



**Pre-treatment: anaerobic pond  
5 infiltration-percolation basins  
under operation since 02/1993  
Treatment capacity : 750 m<sup>3</sup>/d.  
( 1 m<sup>2</sup>/ eq-inhabitant ) – 0.8-1.5 m/d.**



(Choukrallah 2010)

# INFILTRATION- PERCOLATION - BEN SERGAO'S WWTP

- Performances: 99.6% SS, 96% COD, 53% N, 3-4 log. units FC
- No clogging problems
- O&M costs: 1.12 Dh/m<sup>3</sup>



**Inlet**



**Outlet**



**Drip-irrigated  
tomatoes**

# Differential progress and Tourism could be a key driver to leverage progress

- Daily discharge of **236,682 m<sup>3</sup>**
- Marrakech golf courses + landscaping 20,000 m<sup>3</sup>/d
- Agadir, Watering lawns and golf courses  
10,000 m<sup>3</sup>/j in 2012 et 20,000 m<sup>3</sup>/d in 2015
- Tiznit Agriculture demand for treated WW,  
4,900 m<sup>3</sup>/j

# Ownership

- State owned and run (ONEP), Private companies/Concession (REDAL, VEOLIA, LYDEC) and local communes and council.
- A comparative analysis of the performance of the state owned, communal council owned and private wastewater treatment plants shows a good quality/cost of service among the three clusters.

# Huge potential, yet untapped

- Today total production of WW is sufficient to irrigate 30,000 ha
- At least 7,000 ha are illegal irrigation in peri-urban agric in large cities
- Saving in water, nutrients and environments are not often computed in the cost-benefit equation
- The country is energy import dependant

## **CURRENT USES**

**Irrigated agriculture**

**Landscaping**

**Very limited reuse in industry, sugar, beverage, cement**

## **POTENTIAL USES**

**Aquaculture**

**Recreation and Environment rehabilitation**

**Industrial reuse**

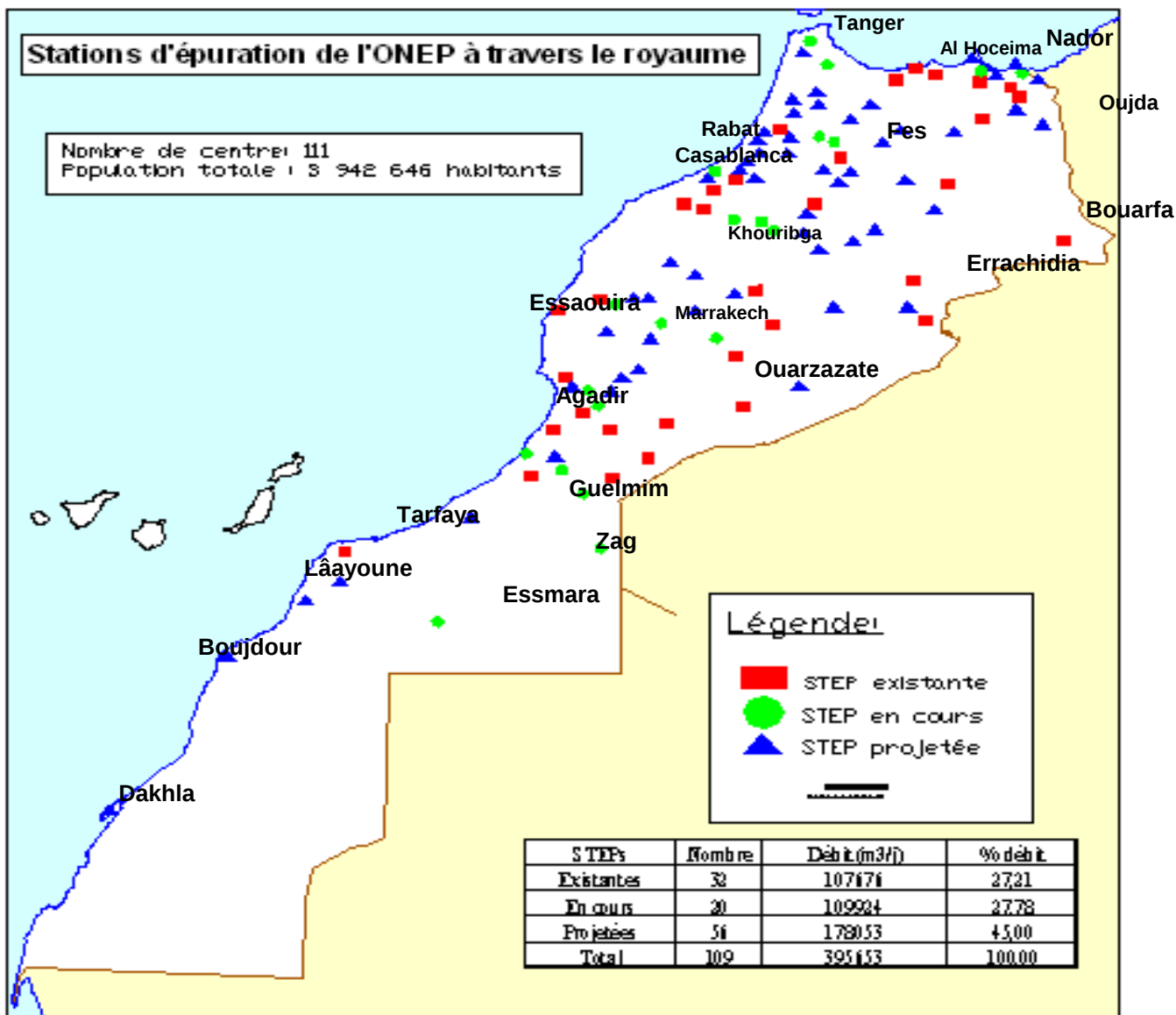
**Agro-forestry**

# Business Challenges and opportunities

# Challenges

- Related to regulation, reuse policy
- Public stigma on health risks and cultural barriers
- Lack of demand for treated wastewater by farmers as far as conventional water is heavily subsidized
- Problems related to transportation of the treated wastewater to the point of use
- Limited technologies uptake (Targeted subsidies)

## A major opportunity: Growing demand for treatment



## Small scale decentralized units increasingly adopted

- Growing use by small communities and hotels in tourist areas along the coastal zones and beach areas
- Often highly compact facilities run by private owners
- Small scale units using trickling filters, duckweed based ponds, infiltration percolation systems
- Capacity range from 8 to 15000 m<sup>3</sup>/d

# Political backup to an ambitious national program

- A national program of wastewater treatment and reuse is launched in 2009 with investments that amount to more than USD 7 billions to which another 3 billion dollar operation is estimated for the coming two decades (EBI, WB, Gov.)

# Economic instruments

- The average charge for wastewater is not sufficient to ensure sustainable cost-recovery. However, the tariff is yet among the highest in the MENA region (USD 0.20/m<sup>3</sup>).

# Health risks mitigation

## Quality versus costs

- Public perception of risk
- Cultural barriers
- Sensitive issue with regard to the agricultural crops export to EU, GCC and US
- Tertiary treatment has a cost that cannot be totally subsidized from the public treasury

# Consequence

- Mix of situations with:
  - Man power and qualified staff operating TP and effluent complying with existing regulations
  - Poorly maintained and often out of service and effluents quality below the standards
- Lack of multiple uses according to differential quality of effluent

- Capacities (technical as well as managerial competencies) in operation, maintenance and service delivery and water supply, sanitation, treatment and reuse are not equally available/distributed
- Clear deficit in TTT and R-use vision and policy

# Reuse challenges

- Agriculture is the main user
  - Incentive for use (let alone for fees and charges)
  - Seasonality : need for storage facilities that keep quality
  - Quality sufficiently good to be used with no restriction
  - Availability / location: need for long distance transportation
- Very little but increasing “on the spot” treatment and reuse in industrial unit, yet the enforcement of PPP has a way to go

# Institutional fragmentation and regulatory deficits

- ✓ Ministries of Interior, State Secretariat Water, ministry of Agriculture and Rural development, Ministry of Health, Local elected Communes and Municipalities, ONEP, WUA, NGO, Micro and small-entreprises
- ✓ New norms and standards that make this a high institutional risk
- ✓ Wastewater reuse stipulated in the new water Strategy and national water law 10-95
- ✓ Enforcing (incentives disincentives) mechanisms reviewed and improved

# Explore new avenues for investment in restricted use



**Mulberry leaves and silkworm culture**

# REUSE OF RECLAIMED WATER IN TUNISIA

**OLIVE TREES**



**PEACHES**



**ORANGE TREES**



# Prospects

# From wastewater disposal to reuse

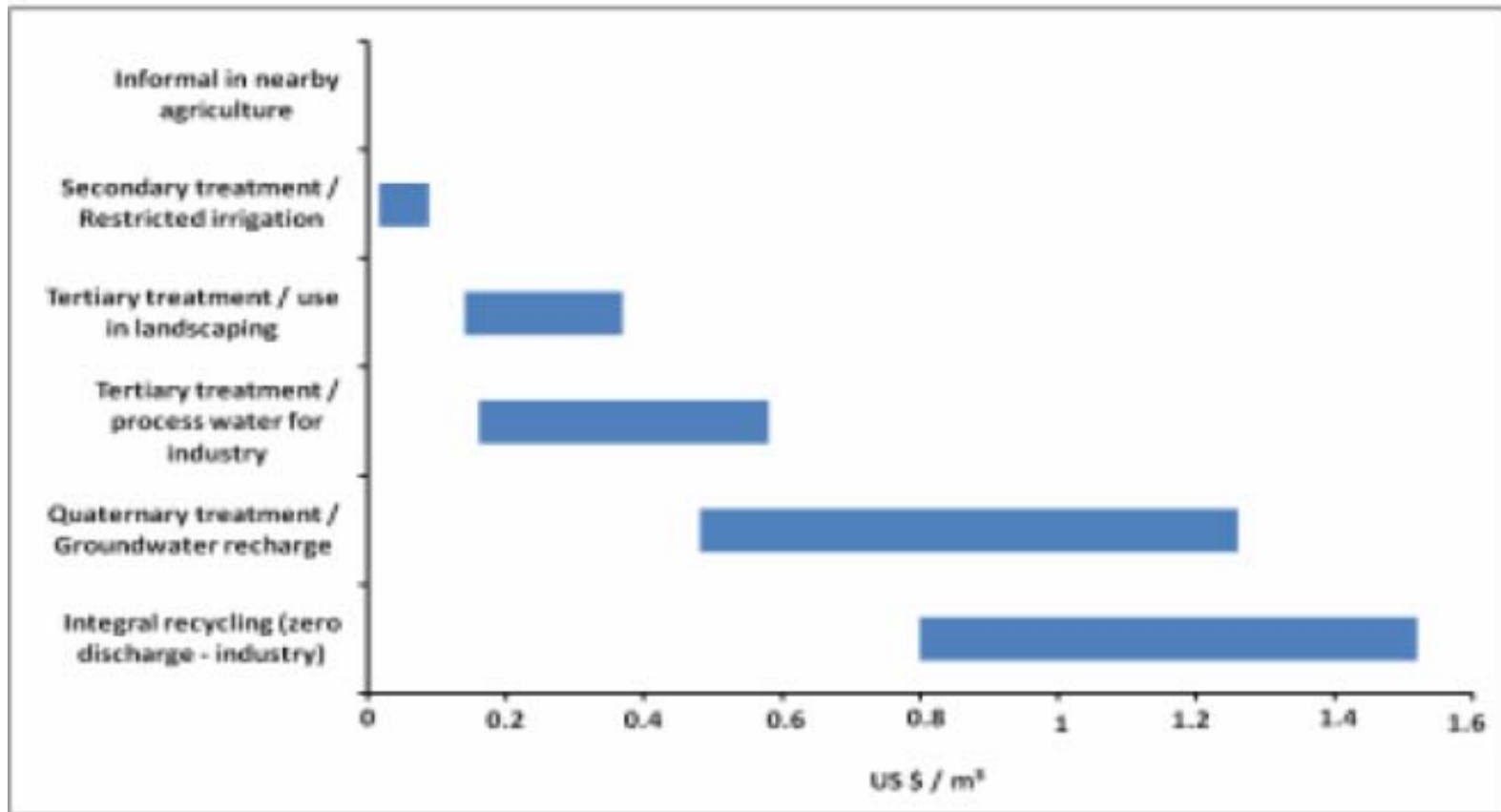
## Informal Peri-Urban Agriculture

- ✓ Disposal of domestic and industrial wastewater in drains or natural waterways
- ✓ No treatment
- ✓ Use of wastewater and nutrients: Reliable water supply and reduction in fertilizer need  $\Rightarrow$  increases crop yields
- ✓ Unregulated, unrestricted irrigation of all types of crops, and mainly vegetables
- ✓ Traditional water rights
- ✓ Improved livelihoods (Net revenue: US\$ 500-8,000/ha/yr)
- ✓ Little or no management of health or environmental risks

## Planned Agricultural Reuse

- ✓ Source / collection system
- ✓ Treatment
- ✓ Reduction of pollution of surface water bodies
- ✓ Distribution system to users
- ✓ Optional blending
- ✓ Storage
- ✓ Crop restrictions re. irrig. of vegetables  $\Rightarrow$  unrestricted irrigation
- ✓ Use of treated effluent and nutrients
- ✓ Specific water quality standards  $\Rightarrow$  Stringent water quality standards for different reuse options: Ag., Ind., Recr., Env., GWR, etc.
- ✓ Protection of farm workers
- ✓ No public health and environmental impacts
- ✓ Monitoring, enforcement

# Differential cost-Multiple safe uses



# Way forward:

- ✓ Regulate the sector and enforce laws to minimize the cost of treatment and invest both upstream and downstream in decentralized treatment and reuse
- ✓ Provide more incentives to Private sector inject capital in construction and innovate in cost recovery mechanisms
- ✓ Research has provided evidence, Time to move up with further with sufficient water quality generated and safe reuse of wastewater to bridge the growing gap between water demand and supply and Growing food demand and food security and other national challenges

Concluding remarks

- ✓ The regulatory and institutional bottlenecks in the sector are gradually removed
- ✓ Creating incentives for business in WW treatment and reuse has become a clear national policy with strong political will and budget.
- ✓ Clear backup from lending agencies and ODA
- ✓ Support to Applied research and innovation in the context of matching treatment to reuse
- ✓ Public awareness while ensuring proper health risks mitigation

THANK YOU FOR YOUR  
ATTENTION  
CHUKRAN

| <b>System</b>                                       | <b>Land requirements<br/>(m<sup>2</sup>/inhabitant)</b> | <b>Construction Costs<br/>(€<sup>4</sup>/inhabitant)</b> | <b>O&amp;M Costs<br/>(€/inhabitant*year)</b> |
|-----------------------------------------------------|---------------------------------------------------------|----------------------------------------------------------|----------------------------------------------|
| Conventional primary treatment                      | 0.02 - 0.04                                             | 9 - 15                                                   | 0.4 - 0.8                                    |
| Facultative pond                                    | 2.0 - 4.0                                               | 11 - 23                                                  | 0.6 - 1.2                                    |
| Anaerobic pond + facultative pond                   | 1.2 - 3.0                                               | 9 - 23                                                   | 0.6 - 1.2                                    |
| Anaerobic pond + facultative pond + maturation pond | 3.0 - 5.0                                               | 15 - 30                                                  | 0.8 - 1.5                                    |
| Facultative aerated lagoon                          | 0.25 - 0.5                                              | 15 - 27                                                  | 1.5 - 2.7                                    |
| Constructed wetlands                                | 3.0 - 5.0                                               | 15 - 23                                                  | 0.8 - 1.2                                    |
| Rapid infiltration                                  | 1.0 - 6.0                                               | 9 - 23                                                   | 0.4 - 1.2                                    |
| Overland flow                                       | 2.0 - 3.5                                               | 12 - 23                                                  | 0.6 - 1.2                                    |
| Conventional activated sludge                       | 0.12 - 0.25                                             | 31 - 50                                                  | 3,0 - 6.1                                    |
| Activated sludge + extended aeration                | 0.12 - 0.25                                             | 27 - 38                                                  | 3,0 - 6.1                                    |
| Conventional activated sludge + tertiary filtration | 0.15 - 0.30                                             | 38 - 58                                                  | 4.6 - 7.7                                    |
| Trickling filter                                    | 0.12 - 0.3                                              | 38 - 46                                                  | 3,0 - 4.6                                    |

Source: Adapted from WHO Guidelines for the Safe use of Wastewater, Excreta and Greywater (2006) – Volume 2

## Comparison of Wastewater Treatment Costs and Reuse Fees

The costs for wastewater treatment and reuse as well as for conventional irrigation water - as by far the major reuse option in the target countries are summarised and compared - as dynamic water production costs (DWPC) in m<sup>3</sup> - in the following table:

Table 1: Comparison of wastewater treatment costs and user fees

| Polluter countries<br>= freshwater consumer          |                        | User countries<br>= e.g. farmer                                              |                              | User countries<br>= farmer                           |                              |
|------------------------------------------------------|------------------------|------------------------------------------------------------------------------|------------------------------|------------------------------------------------------|------------------------------|
| Wastewater Treatment Costs                           |                        | Water Reuse Costs                                                            |                              | Irrigation Water Fees                                |                              |
| Ordinary concrete pipelines + ww stabilisation ponds | ~0.8 €/m <sup>3</sup>  | Real costs in Morocco (only O&M)*                                            | ~0.11 €/m <sup>3</sup>       | Real costs for water provision from dams in Morocco* | 0.25 - 0.64 €/m <sup>3</sup> |
| Good quality sewers + advanced treatment processes   | 3 - 5 €/m <sup>3</sup> | Real costs in Tunisia (only O&M)*                                            | 0.06 - 0.11 €/m <sup>3</sup> | charged in Morocco                                   | 0.09 - 0.14 €/m <sup>3</sup> |
| Collection and secondary treatment in Tunisia        | ~2.7 €/m <sup>3</sup>  | Irrigation fees for treated ww in France, Spain, Jordan, Morocco and Tunisia | 0.02 - 0.08 €/m <sup>3</sup> | charged in Tunisia                                   | ~0.077 €/m <sup>3</sup>      |

\* Numbers taken from current feasibility studies in the countries