Wastewater treatment and reuse best practices in Morocco: Targeting circular economy

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**Introduction**

*Mediterranean basin* is considered the most scarce region in the world (Ezbakhe et al., 2019).

*Morocco*, known by rapid population growth, urbanization and increase of economic growth, is suffering from deficit and pressure on water resources.

One of the best alternatives to deal with this problem is wastewater reuse especially in agriculture.
Wastewater contains some macro and micronutrients in different quantities, but cannot cover all plant needs. Wastewater reuse has been practical approach in the last 30 years in the large urban areas and cities (Casablanca, Rabat, Fez...), because of the arid climate of Morocco.
Population growth in Morocco results in pressure on freshwater, on agricultural production and wastewater quantity will rise.
According to the environment ministry, in Morocco, the annual volumes of wastewater discharge have risen sharply over the last three decades.
Governemental strategies

The National Liquid Sanitation and Wastewater Treatment Program (PNA 2005 – 2030) is targeting general access to the sanitation and wastewater treatment network.

1) implementing and promoting the circular economy concept in Morocco that could enhance the sustainable development rate by protecting natural resources.

2) identifying best management of wastewater, which is available in large quantities.

3) capacity state improvement of basins, dams and water preservation systems.
The Green Morocco Plan was launched in 2008 by the Moroccan government. It aims to face the environmental challenges, especially water scarcity which a serious threat to Mediterranean countries.

The priority of the Green Morocco Plan is to manage water resources, to reduce pressure on freshwater and to conduct new strategies in wastewater reuse in agriculture.
Figure 6-3 Distribution of different kinds of wastewater treatment technologies existing in Morocco (Source: AZIZ & Farissi, 2014)
Wastewater reuse is not a new strategy, but generally, a lack of data, interference of several factors, differences in the nature and composition of wastewater make the understanding and elaboration of a typical and unified prototype for treating wastewater very difficult. It has been reported that 7% of agricultural lands are irrigated with untreated water and 10% used treated wastewater.
Wastewater reuse in agriculture and acceptance from Moroccan society

Comparison of the yield obtained by irrigation using treated wastewater and that obtained by using fresh water

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Crop</th>
<th>Chrysanthemum</th>
<th>Melon</th>
<th>Zucchini</th>
<th>Eggplant</th>
<th>Maize</th>
<th>Bread wheat</th>
<th>Durum Wheat</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Flower/plant</td>
<td>T/ha</td>
<td>Kg/plant</td>
<td>Kg/m²</td>
<td>Qx/ha</td>
<td>Qx/ha</td>
<td>Qx/ha</td>
</tr>
<tr>
<td>Fresh water</td>
<td></td>
<td>69</td>
<td>26.2</td>
<td>1.29</td>
<td>3.17</td>
<td>12.43</td>
<td>5.11</td>
<td>0</td>
</tr>
<tr>
<td>Treated wastewater</td>
<td></td>
<td>80</td>
<td>34.6</td>
<td>2.18</td>
<td>3.41</td>
<td>12.62</td>
<td>48.69</td>
<td>31.83</td>
</tr>
</tbody>
</table>
Wastewater reuse in agriculture and acceptance from Moroccan society

The implementation of wastewater treatment plants should also take into consideration economic and social aspects. For example, the location, proximity to population habitations, roads and natural resources, agricultural lands and agroforestry are very important to reduce the impact of wastewater. These factors could increase the cost of wastewater valorization in agriculture and the quality can be evaluated easily and the persisting risks can be avoided.
Wastewater reuse in agriculture and acceptance from Moroccan society

The Center for International Cooperation on Agronomic Research for Development (CIRAD), financed the Massire Project, which is a project for supporting farmers and new solutions and ideas in agriculture. The project funding is 1.7 million € financed by the UN International Fund for Agricultural Development (IFAD).

PREM (Sustainability of Water Resources in Morocco) Global Project funded by USAID in partnership with the Secretariat State in Charge of Water and Environment in Morocco.

Wastewater treatment plants funded by OCP Group for phosphate extraction (Khouribga, Benguerir and Youssoufia cities) in Morocco are using microfiltration and disinfection of tertiary treatment and they are also using biogas technology to produce electricity from wastewater treatment.

Biofertilizers projects
Wastewater Reuse Policy in Morocco

National data for Morocco reports the presence of 17 wastewater offices and services (public and private) in all municipalities. Generally, these specialist services manage 112 networks in both large cities and small ones. The population that benefit from these facilities is estimated to reach 20 million and will continue to increase due to the development of the country.
## Wastewater Reuse Policy in Morocco

<table>
<thead>
<tr>
<th>Authorities managing water sector</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>River Basins Agencies</td>
<td>9 agencies are managing the main hydraulic basins of Morocco.</td>
</tr>
<tr>
<td>ONEP (national office of drinkable water)</td>
<td>Principal producer of potable water in Morocco.</td>
</tr>
<tr>
<td>Distribution offices</td>
<td>Private organizations responsible for drinkable water distribution in some big cities in the country.</td>
</tr>
<tr>
<td>Municipalities</td>
<td>Responsible for irrigation of gardens and green spaces.</td>
</tr>
<tr>
<td>Rural Towns</td>
<td>Providing drinkable water to rural populations.</td>
</tr>
<tr>
<td>ORMVA (agricultural offices)</td>
<td>Responsible for the management of the big irrigated perimeters in the country.</td>
</tr>
<tr>
<td>DPA (provincial delegations of agriculture)</td>
<td>Management of the small hydraulic resources.</td>
</tr>
<tr>
<td>ONEE (national office of electricity)</td>
<td>Principal producer of electric energy including energy of hydraulic origin (merged with ONEP).</td>
</tr>
<tr>
<td>Waters and forests administration</td>
<td>Responsible for water resources management.</td>
</tr>
</tbody>
</table>
The communal charter of 1976 in Morocco gives the municipalities responsibility of managing and distributing freshwater and sanitation network. The main legislative framework and articles that manage and organize working in the water and wastewater sector are:

- **Article (84):** It is prohibited to reuse wastewater in agriculture if not treated and in accordance with international standards and limits for nutrient and heavy metals composition.

- **Article (57):** Good and precise conditions of wastewater reuse are imposed. Authorization to treat and reuse wastewater can be supported financially and technically from the government and national administration to preserve water resources against environmental challenges and pollution.
Conclusion

In this world, water is extremely important for our life, but that precious resource is very limited in terms of availability.

Water is used in agriculture to produce food, where 70% of the available water and 30% of energy are used in agriculture. In addition, the global population is increasing (9 billion estimated in 2050), which implies continued pressure and high demand for water, energy and food.
Thank You for your Attention