Renewable Energy for the Sustainable Development of the Agriculture Sector

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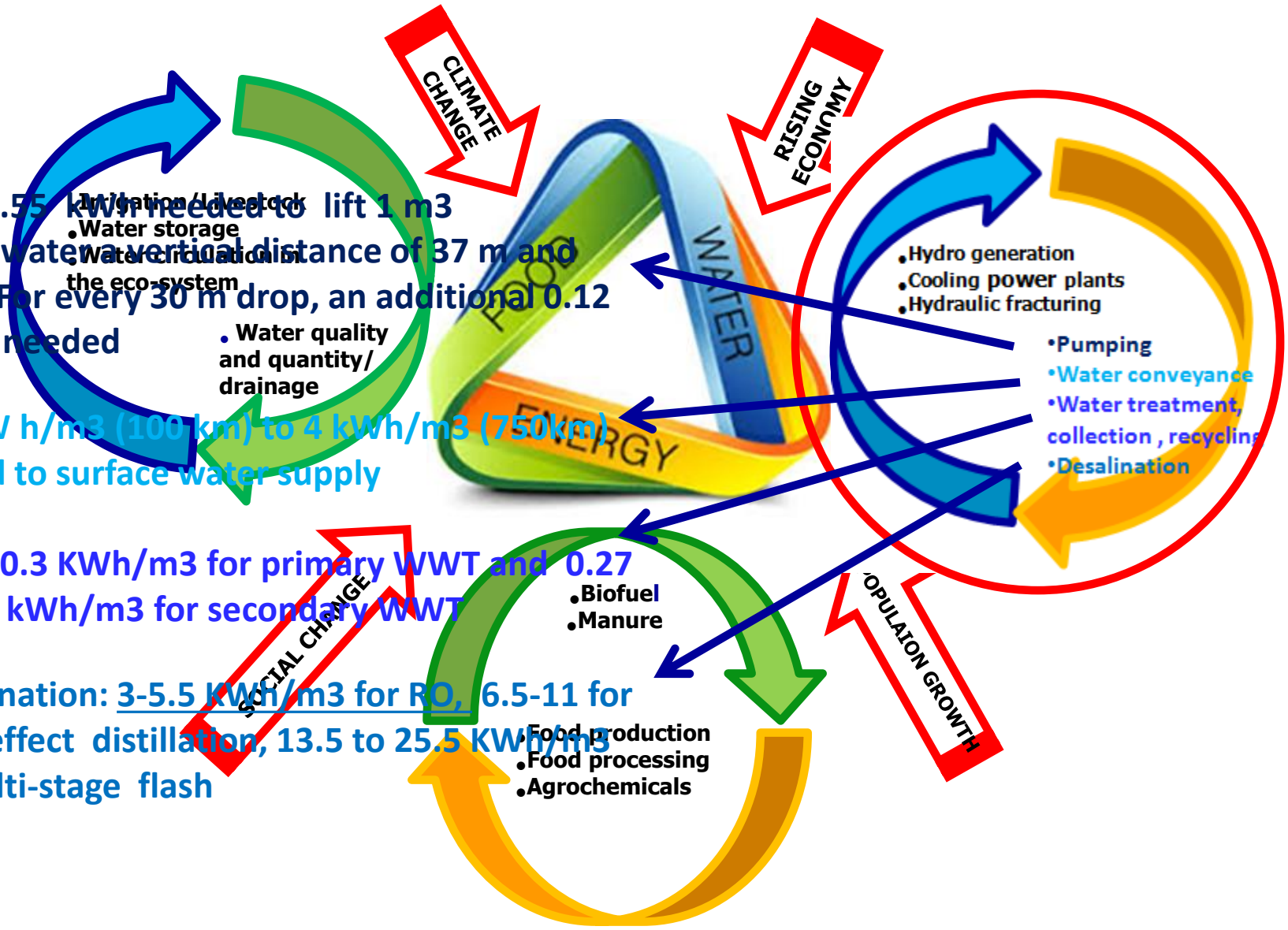
OUTLINE

- **Introduction**
  - …Why RE is important for agriculture sector?
  - New water policy
- **Some examples of solar desalination for irrigation purposes**
- **PV Pumping for agriculture use**
- **Key messages**

……Why RE is important for Agriculture Sector?



- 0.15-1.55 kWh needed to lift 1 m3 groundwater a vertical distance of 37 m and 122m. For every 30 m drop, an additional 0.12 kWh is needed
- 0.2 kW h/m3 (100 km) to 4 kWh/m3 (750km) needed to surface water supply
- 0.1 to 0.3 KWh/m3 for primary WWT and 0.27 to 0.59 kWh/m3 for secondary WWT
- Desalination: 3-5.5 KWh/m3 for RO, 6.5-11 for Multi-effect distillation, 13.5 to 25.5 KWh/m3 for Multi-stage flash

New water policy

- Agriculture is a very important economic sector in Tunisia, consuming about 7% of energy (highly subsidized) – 15% employment and 13% of GDP
- Promote the use of renewable energies in different sectors. This high potential mainly solar energy could be best developed by solar desalination/PV concepts and methods specifically suited to rural areas conditions;
- Introduce desalination to safeguard domestic water supply in such quantities to make up deficits created by climatic change and by demand growth;
- Recycle treated domestic effluents for irrigation purposes

Solar desalination systems concepts for agriculture use

……Why is water desalination for agriculture use based on RE important?

?

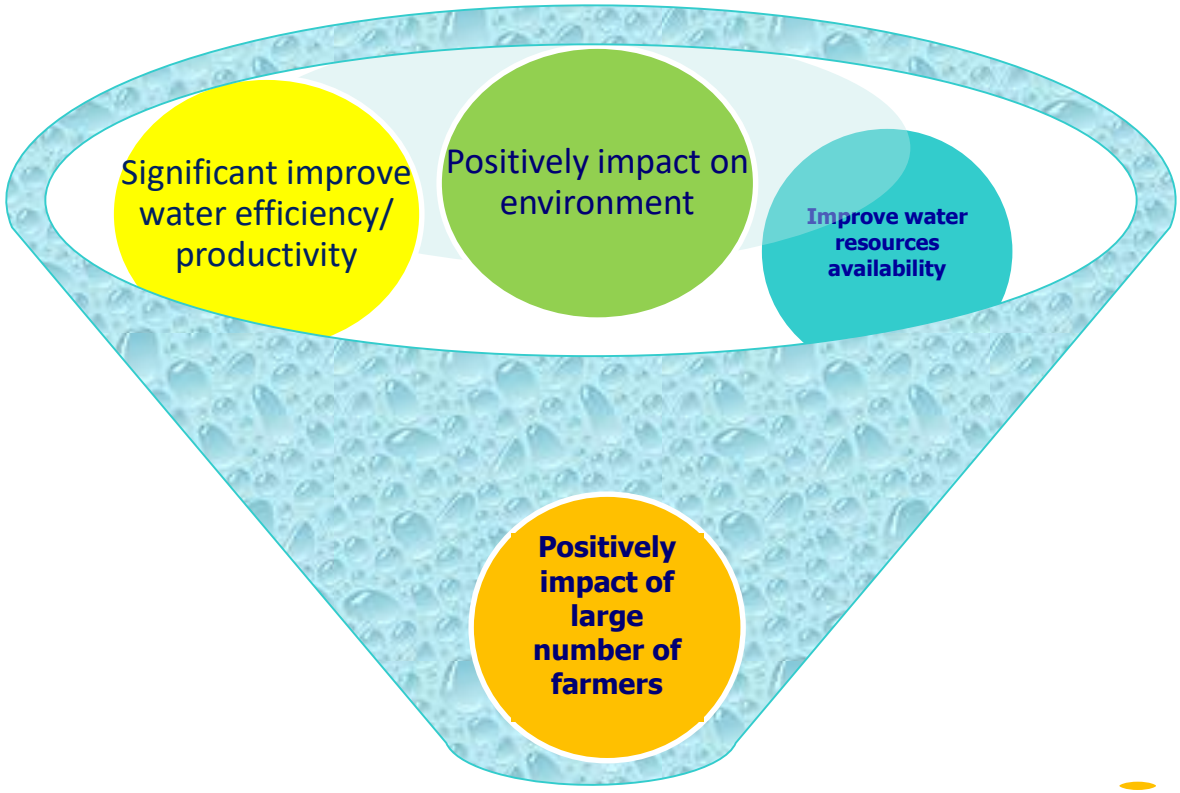
- Most of rural population (1/3 of total population depend significantly on agriculture) and generally settled on the most fragile land with meager and/or highly variable WR
- Arid areas face falling water tables and increasing groundwater salinity.
- Economic, social and environmental negative impacts were becoming serious. In using low-quality irrigation water may reduce crop yields or damage the environment, soils, and aquifers. There can be long-term damage to soils and aquifers that may not be easily recoverable.
- In Agriculture : Significant exploitable RE potential (315 MWC for PV)

Main problems to solve

- Increase the use of non- conventional water resources to guarantee long-term food security and socioeconomic stability
- Increasing water supply reliability in irrigation field.
- Supplying water irrigation with an appropriate quality and independent from climatic deficiencies.

Priorities actions for AWD

CRITERIA



ACTIONS

- **Technically feasible**
- **Economically affordable**
- **Socially acceptable**
- **Environmentally sustainable**

Some examples of solar desalination for irrigation purposes

Solar desalination with aero-evapo-condensation process in Hazeg –Tunisia-

Greenhouse system with integrated water desalination

The fresh water is limited to 5 – 6l/m2. The production have met the crops water needs for two plastic greenhouses of an area of 1200 m2

Source: M.T. Chaibi, 1992

Low production for this costly technology

Water production exceeds the demand by 1.6 to 2.2 times

- The quality of the water is optimal for reuse in irrigation (1g/l)

More research is needed on materials to control light

Some examples of solar desalination for irrigation purposes

Source: M.T. Chaibi, 2003

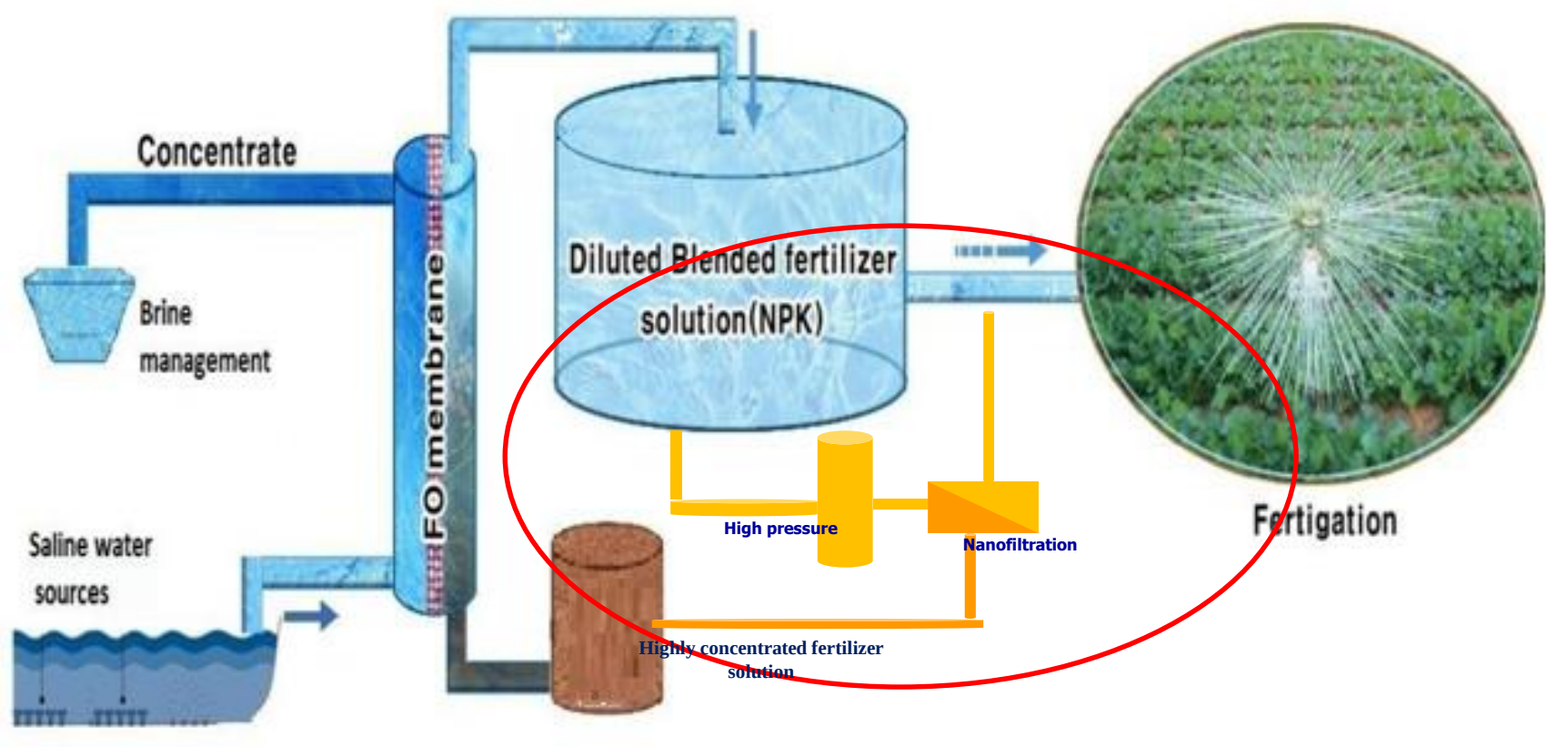
Source: Zaragoza et al. 2007

Relatively costly technology

-Improving irrigation efficiency and reduce water loss by 50%
- Satisfy more than halved the crop water needs

- 75% of the irrigation water is recovered (rain collection could cover the rest).
- 40% increase in crop production
-8 times increase in water productivity

Agriculture Desalination Plant: Promising idea



A novel membrane technology, based on Fertilizer Drawn Forward Osmosis (FDFO) application (Phuntsho et al. 2011)

FDFO requires low energy since it is based on the principle of natural osmotic process driven by concentration gradient and not hydraulic process (RO)

Main challenges:
-Appropriate nutrient concentration
-Integrated NF as post treatment for direct fertigation (**still lower energy consumption comparing to MF-RO and UF-RO by 14 and 20% respectively**

PV pumping for Agriculture Use

Energy status of agriculture sector in Tunisia

Big farms (>20ha, 4%)

- **Electricity by grid (MV) or fuel (Diesel);**
- **Important property assured and stable;**
- **Access to credits without problems**

Small and medium farms (between 1 and 20 ha, 68%)

- **Electricity by grid (MV or LV) or Fuel (Diesel)**

Micro- farms (<1ha, 28%)

- **Diesel fuel;**
- **Low economic productivity**
- **Lack of technical, financial and human capacities**

-Difficulties in accessing credit facilities
-Lack of technical assistance

(Source: GIZ; 2016)

- PV powered irrigation systems is a technically mature option;
- About 13 000 wells widespread in Tunisia with a potential of about 23.3 MWC;
- PVIS is more effective than off grid systems particularly for big and commercial farms and could compete with conventional electric power;
- Strong link with PV systems connected to the grid for other applications (lighting, electrification,….)
- Strong and engaged actors such as ANME, APIA and STEG and more than 200 companies to develop the sector

Finding the right financial mechanisms, business models, institutional arrangements, and best technology options to support PVIS are a major challenge

Integrated approaches such as the water-energy-food nexus and sustainable livelihoods to fill the information gaps regarding PVIS performance and feasibility

Efforts to cooperate and structure the development of competences for professional in the design and the implementation of PVIS

Solar desalination is considered not enough investigated and analyzed to be incorporated in the global scale of water policy

- **Priority is going towards:**

1. Water catchments management
2. Promote water saving
3. Intensify water demand management

Nonetheless, desalination is being increasingly seen as viable water supply option and becoming increasingly cost competitive

THANK YOU!

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