Regional Workshop

Use of Brackish Water for Agricultural Production in the Near East and North Africa:

Status, Good Agricultural Practices and New Developments

Cairo – Egypt / June 10-12, 2013

Case study of Yemen

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Plan

- Introduction
- Status on the use of brackish water for agricultural production
- Policies, regulations and institutions
- Good Agricultural Practices
- Impacts, opportunities and constraints
- New developments
- Recommendations

Introduction

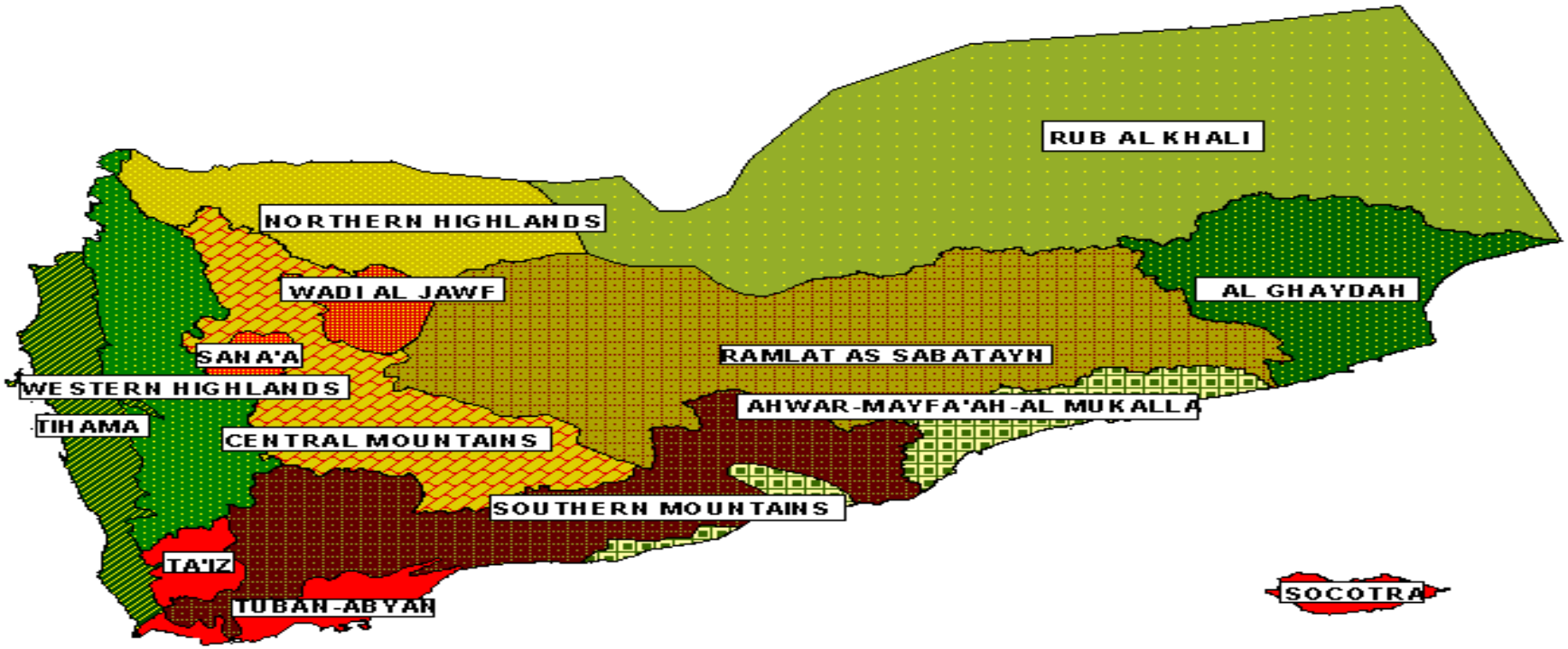
- Yemen has 527,968 sq km **area with** population of about **24 million** (likely to be doubled after 20-25 years);
- Yemen depends on two main sources of water: rainfall and groundwater;
- Diverse physical and topographical features:
  - Mountain chains, inter- mountain plains and wadis, coastal plains and desert areas;
  - Varied climate and variable annual rainfall (less than 50 to near 800 mm).

Introduction .....Continue

- Groundwater depletion has become a critical issue since 1980s;
- The per capita share of water resources, that is, 135 m3 per annum is very low comparing world average of 7,500 m3 per capita per year, even that of MENA region average of 1200 m3 per capita per year;
- Total water use is about 3.5 BCM, while annual renewable resources were 2.5 BCM, annual water deficit is about **one** BCM (a water deficit which continues to grow annually, is met by Groundwater over-exploitation (> 90% is used for irrigation);
- Water scarcity is more critical in the western part of the country, where more than 90% of the population live.

Introduction .....Continue

Location of Brackish water: In many places in the country, brackish water appears naturally either in surface water or in groundwater. However, the extensive withdrawal of groundwater caused to increase the salinity in many basins particularly in the coastal areas.



Status on the use of brackish water for agricultural production

- Brackish water is mainly used for rock cutting industry in highlands, as well as for irrigating some tolerant crops mainly in coastal plains. However, brackish water with high salinity is used for water supply in Taiz city by mixing with freshwater for domestic use without any desalination
- The usable brackish water for agriculture in Yemen is about 300 MCM/year, mostly in the coastal areas particularly in Tehama region. The total irrigated area by brackish water is about **38,500 ha.**

Brackish water use in Tehama area

Crop	Salinity Tolerance Rate	Treatment (A)		Treatment (B)	
		Applied water including leaching water requirement (m^3/ha)	Yield (ton/ ha)	Applied water without leaching water requirement (m^3/ha)	Yield (ton/ ha)
Sorghum (grain)	Moderate salinity tolerance	7500	1.22	6323	0.52
Sorghum dry matter			8.52		5.21
Cotton	High salinity tolerance	12950	1.8	9713	1.11
Okra	low salinity tolerance	10237	0.75	8148	0.73

About 40% of the yield decreased.
Salinity ranged between 5000 - 6000 *micromhos/cm* for both treatments

Policies and regulations

- **Preparation of the National Agricultural Sector Strategy (NASS) (2012 – 2016);**

- Strengthen the relationship with other related Water Institutions particularly MWE including NWRA and GARWPS as well as Water supply and Sanitation Corporations, and SFD.
- Participated in the preparation of **NWSSIP** and **NWSSIP update.**
- **Establishment of Environmental Protection Authority EPA**
- Establishment of National Irrigation Program (NIP) as implementation entity for the irrigation activities.

- Working with NWRA under the IWRM approach.
- Establishment of Water Sector data base.
- Establishment of Water Law and water By-law.
- **Environmental Protection Law in 1995**

Institutions

Ministry of Agriculture and Irrigation (MAI)

- Irrigation Sector
- Agricultural Research Authority
- TDA
- ACU

Ministry of Water and Environment (MWE)

- NWRA
- GARWSSP's
- Local Water Supply and Sanitation Corporation

SFD – WEC

Good Agricultural Practices

- Yield reductions often occur when the salts accumulate in the root zone to such an extent that the crop is no longer able to extract sufficient water from the salty soil solution, resulting in water stress for a significant period of time.
- To avoid problems of using the Brackish water supplies, there must be a sound water management system to ensure that the quality of water available is put to the best use. In addition, there is a need to improve the plant-soil-water availability by maintaining a low salinity in the root zone through frequent irrigation and leaching requirement applications.
- Water saving technologies must be applied in order to save water and increase irrigation efficiency

Major impacts of brackish water use on agricultural production

The use of high salinity water for irrigation has negative environmental, economic and social impacts

Environmental impacts:

- the continuous use of saline water increased the salinity in the soil leading to decreased soil fertility and crop productivity

Economic impacts

The change in cropping patterns in the coastal areas includes the shift from cultivation of fruits (mango, banana) to cultivation of field crops (sorghum - millet - cotton) and limited types of vegetables

The use of brackish water is accompanied by low crop productivity and low income level

There is a significant decline in the prices of agricultural lands where salinity is high with a possibility of salinity increase in future

Social impacts:

local migration of population to the cities

the migration of labor

Opportunities for brackish water use in Yemen

- Due to water scarcity problems, there is a need to use brackish water in agriculture and water supply purposes as follows:
- Agriculture is the major potential sector to use brackish water in Yemen. Most of the crops have a high resistance to salinity particularly cereals as well as the fodder crops, which are the milestone of food security
- Brackish water could be used to solve the problems of seawater intrusion.
- brackish water could be a practical solution all over the coastal areas, as well as in the highland areas. Moreover, brackish water could be used to irrigate different crops without any desalination, particularly in areas that have a low rate of salinity.
- Law cost reverse osmosis (RO) desalination compact units could be use to desalinate the brackish water for the agriculture purposes.

Constraints affecting the scaling-up of brackish water use

The constraints can be summarized as follows:

- Increase in soil salinity.
- Yield reductions due to salt accumulation in the root zone to such an extent that the crop is no longer able to extract sufficient water from the salty soil solutions resulting in water stress for a significant period of time.
- High cost of agricultural inputs due to the need for deeper plowing and more pumping costs to cover the additional water requirement for leaching.

New developments

- There are no actions have been taken concern the Brackish water use in Agricultural purposes
- The NASS and NWSSIP mentioned for the used of Nun-Conventional water use particularly the use of treated wastewater and Grey-Water.

Recommendations

Prepared a National non-conventional Water Resources Strategy.

Prepared a specific policy for brackish water use in agricultural purposes. Hence, brackish water would be recognized as a suitable and acceptable alternative to use in agricultural purposes.

Prepared brackish water assessment studies for all basins.

Establish brackish water research programs with the aim of increasing crop yield and identifying the leaching water requirements.

Recommendations …….Continue

Introduce modern irrigation systems to the farmers who irrigate by brackish water, with a suitable subsidy for the poor farmers, and provide them with Irrigation Advisory Services (IAS)

Provide farmers with the multiplication seeds recommended by the research authority, with comprehensive agricultural extension services to increase yield of the crops irrigated by brackish water

Encourage the farmers to have more than one main crop in each farm and gradually replace the salt-sensitive crops with more tolerant once

Recommendations …….Continue

Produce brackish water use guidelines including Crop Patterns and Crop Rotations.

Develop a water quality monitoring program including a regular basis monitoring activity for groundwater pollution in the main recharge zones


Thank you for your attention