المعمل المتقدم للتحاليل
الكيميائية

Water resources and desalination: The Libyan perspective: a review

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Introduction

- Libya is located in a dry and semi-arid region of Africa with no perennial rivers or real freshwater lakes and an average yearly rainfall of less than 100 mm.
- The limited access to surface water resources has resulted in heavy dependence on groundwater.
- Extensively use of conventional water resources like groundwater, poor awareness of how to optimally use and save water and seawater intrusion into the coastal water aquifers, all contributed to a sever water crisis in Libya.
- There is an urgent need to look for alternative water sources to meet people needs and compensate the reduction in groundwater.

- Desalination is one of such alternative water sources that can solve water shortage problem in Libya.
- The objective of this paper is:

✓ to highlight the conventional and non conventional water resources in Libya.

✓ to present an overview on seawater desalination technology in Libya and why it should be accommodated as a strategic and ultimate solution for water shortage.

The water shortage problem in Libya

- Libya is considered to be one of the top 36 countries in the world facing water stress.
- The following reasons are believed to be the main causes of water problems in Libya:
  - Excessive groundwater exploitation
  - Decreased annual average of rainfall
  - Intensive agricultural activities in the coastal plains
  - Seawater intrusion
  - Low water tariffs
  - Lack of clear strategy related to the local water sector
  - Poor management in the General Water Authority (GWA)

Water resources in Libya

- There are two types of water resources in Libya; conventional water resources represent about (97.3%) of the nation's water resources, and non-conventional water resources accounting for (2.7%).

- **Conventional water resources**

  1- Surface water

  Libya has very limited surface water resources. Its contribution to the current water resources in use is less than 3%.

Figure 1:Tawargha's spring

Table 1. Constructed dams in Libya

No	Water basin	Number of dams	Total capacity (Mm^3)	Average annual storage (Mm^3)
1	Al Jabal Al Akhdar	5	160.6	15.95
2	Kufra and Sarir	4	8.14	1.8
3	Jiffarah plain	3	96.6	25.5
4	Al Hamada	4	119.4	17.4
Total			384.74	60.65

2- Groundwater

Groundwater is the main water source in Libya. It accounts for more than 98% of the total water consumption.

Table 2. The characteristics of the main five basins

Basin name	Area (km^2)	Basin type	Estimated groundwater capacity (km^3)
Jiffarah plain	18,000	Renewable	-
Al Hamada	215,000	Renewable	4,000
Al Jabal Al Akhdar	145,000	Renewable	-
Murzuq	350,000	Non-renewable	4,800
Kufra and Sarir	700,000	Non-renewable	-

Figure 2: Libya groundwater basins

Non conventional water resources

The non conventional water resources in Libya include mainly the man-made river, wastewater treatment and desalination technology.

1. The Man-made river project (MMRP)

- This project is considered to be the largest and most expensive groundwater pumping and conveyance project.
- The construction work on this project began its first stage in the mid of 1980s.
- The first stage of the project was partially operated in 28th of August 1993, while the second staged was partially operated in 28th August 1996.

- Despite the fact that some coastal cities was supplied with water from MMRP, people feel skeptical about the quality of the water.
- Recently and due to violence and conflicts over some areas in the Southern part of Libya, citizens of Tripoli have experienced difficulties getting access to water from MMRP. Water supply was deliberately cut off by some rebels and protesters.
- Based on the abovementioned information concerning the quality of water and due to the current situation of MMRP, water shortage is still a continuing problem in most of the Libyan land.

2. Desalination technology

- Desalination is considered to be the second non-conventional water resource adapted in Libya.
- Desalination technology have been used in Libya since the early 1960s, although few desalination plants have been established since then.
- There are currently about 21 operating desalination plants, with a total capacity of 525,680 m^3/d.
- The overall contribution of desalination in the overall local water supply represent 1.4% in the year 2002.

Table 3. The existing operating desalination plants in Libya

Location	Desalination type	Design capacity m^3/d	No of units	Operation year
Tubrok	MED*-TVC	40,000	-	1977-2002
Bomba	MSF	30,000	3	1988
Darna	MED-TVC	40,000		-
Sussa	MED-TVC	10,000		2000
Sussa ext.	MED-TVC	40,000	-	-
Abou Traba	MED-TVC	40,000	-	2006
Zliten	MSF	30,000	3	1992
Azawia	MED-TVC	80,000	-	-
Zwara	MED	40,000	-	2006
Zwara ext.	MED-TVC	40,000	-	-
Tubrok	MSF	24,000	4	1977
Tajoura	RO	10,000	2	1984
Misrata	MSF	30,000	3	1987
Sirt	MSF	10,000	1	1986
Azawia double	MED	2,500 x 2	2	2006
Tripoli west	MED-TVC	5,000 x 2	2	-
Homes	MSF	10,560 x 3	4	2
Benghazi North	MED-TVC	4,800 x 1	1	2005
Benghazi North double	MED-TVC	2,500 x 2	2	2007
Darna	MED-TVC	4,700 x 1	1	1998
Hrawa	MSF	500 x 1	1	1989
Total design capacity		525,680		

- **Desalination is the solution for the water scarcity problem**

The following reasons are believed to make desalination the first and best solution for water crisis in Libya.

- Over-exploitation of groundwater
- The increasing demand of water
- The current unstable conditions of the MMRP make it unreliable water source in the future.
- The availability of seawater in high quantities and relatively free of industrial pollutants
- The biggest and the most populated Libyan cities are located along the coast
- Desalination costs are falling worldwide

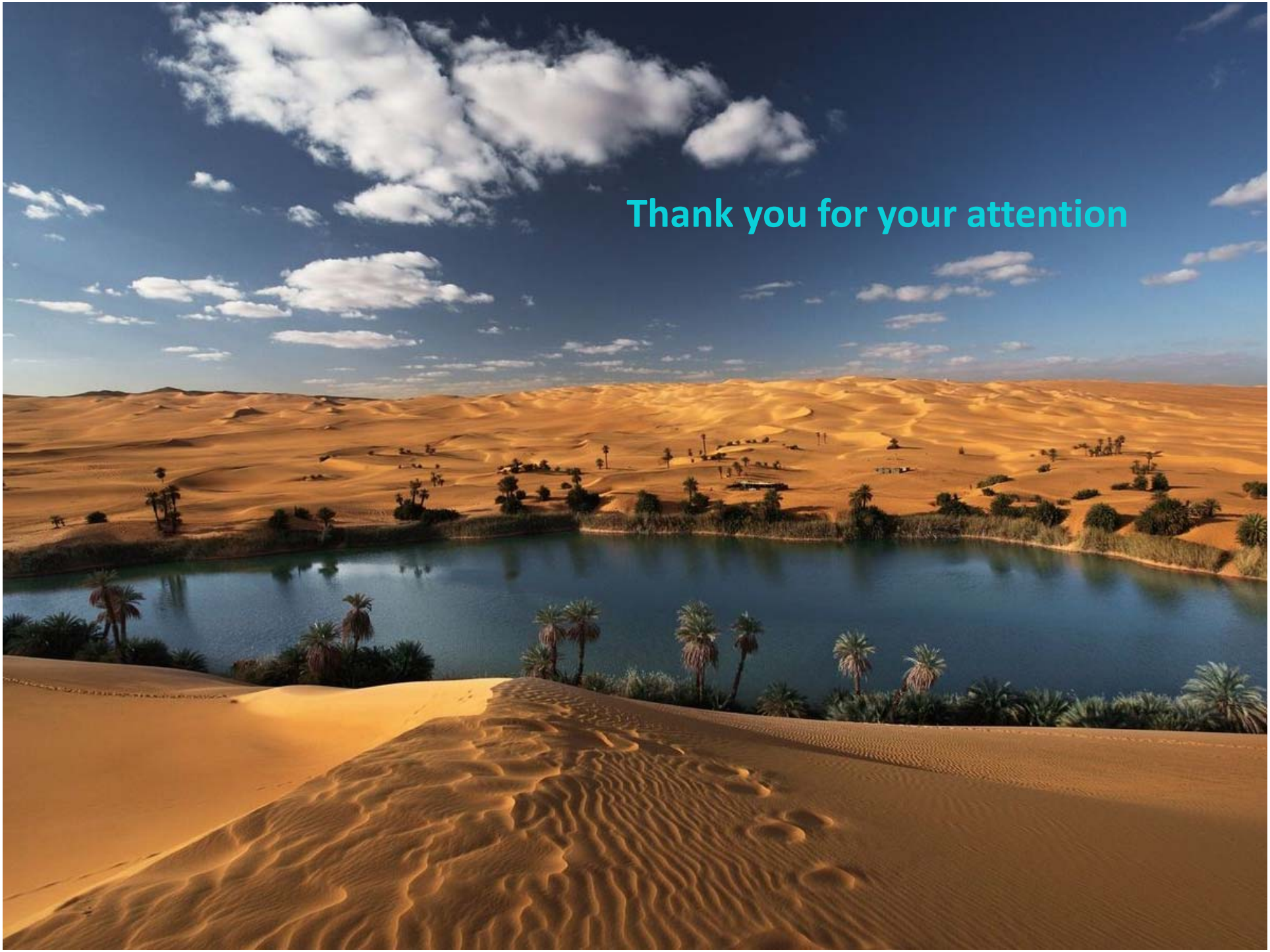
❑ Conclusions & Recommendations

- Agricultural sector is the biggest consumer of water (80%) and has a very low contribution in the country's economy. Therefore proper irrigation technologies should be implemented.
- The absence of good management in all water authorities caused many problems regarding documentation whatsoever. Therefore there must be a cooperation between the national authorities to solve the water shortage problem.
- Despite the fact that the manmade river has partly solved the water crisis in the northern parts of the country, yet it can not be reliable for all situations.

- Desalination of seawater should be strongly adopted in all coastal Libyan cities, while desalination of brackish water plants should be installed throughout the country.
- Manmade river project recommended to continue to be as a second water supply source to compensate the loses of water when it is needed.
- The government should take initiative in the direction of water reuse and recycling by encouraging research in water reuse field, this can be conducted by research centers and universities.

Acknowledgment

- Special thanks to Water Science & Technology Association
- Sincere appreciation to Prof Waleed Zubari, Eng Ali Redha for their valuable support
- Special thanks to everyone who contributed scientifically and financially in this work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