



Institute for Water
and Energy Sciences
(Including Climate Change)

Water Reuse for agricultural purposes: The Algerian Experience

Dr. Chérifa Abdelbaki (a) & Rachid YAHIAOUI (b)

(a) Pan African University, Institute for Water and Energy Sciences (PAUWES), Tlemcen, Algeria

(b) National Office of Irrigation and drainage, Algeria

Contact: cherifa.abdelbaki@pauwes.dz

Tél: +213 552 833 383



- 1. PAUWES Presentation**
- 2. Water REUSE: Technical aspects and main Experiences**
- 3. Water REUSE: Law and Standards**
- 4. REUSE: Ongoing Projects**



PAU Pan African University

The Pan African University (PAU) is the flagship programme of AU and pan-African internationally acknowledged network university that was launched by Heads of States to contribute to the development of higher education and applied research in order to ensure the sustainable socio-economic advancement in Africa.



Agenda
2063
The Africa we Want



PAU Pan African University

PAU is a response to :

- ▶ The need to revitalize higher education and research as major tools for ensuring high level of intellectual capital for Africa's development,
- ▶ To promote world class and yet locally relevant research,
- ▶ Invigorate dynamic and productive partnership with public and private sectors.
- ▶ To provide an exemplar for excellence in African HE and research.



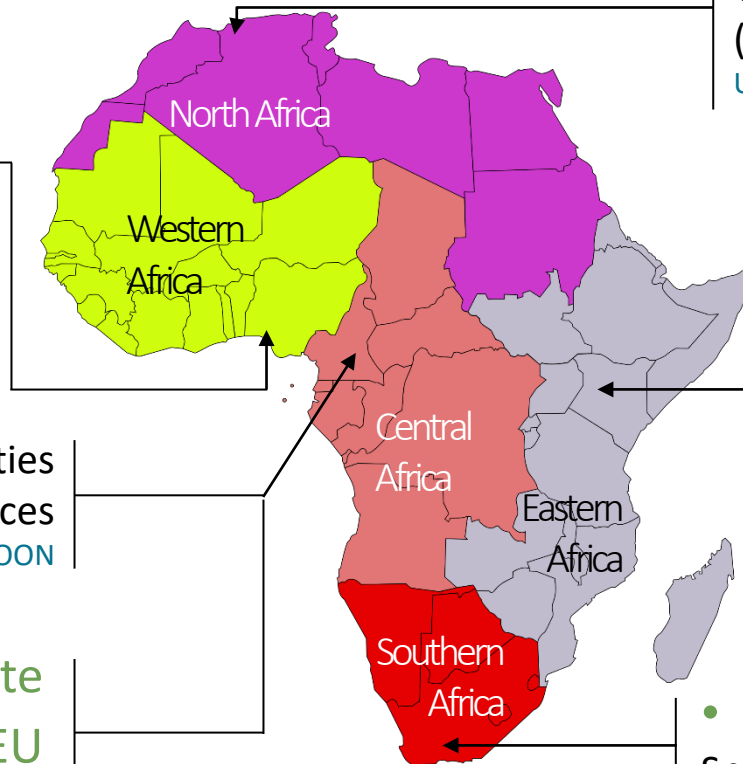


PAU Pan African University

- **PAULESI**
Life & Earth Sciences
University of Ibadan, Ibadan, NIGERIA

- **PAUGHSS**
Governance, Humanities
and Social Sciences
University of Yaounde, Yaoundé, CAMEROON

- **PAU Rectorate**
 - **PAVEU**
Pan-African Virtual e-University
Yaoundé, CAMEROON



- **PAUWES**
Water & Energy Sciences
(including Climate Change)
University of Tlemcen, Tlemcen, ALGERIA

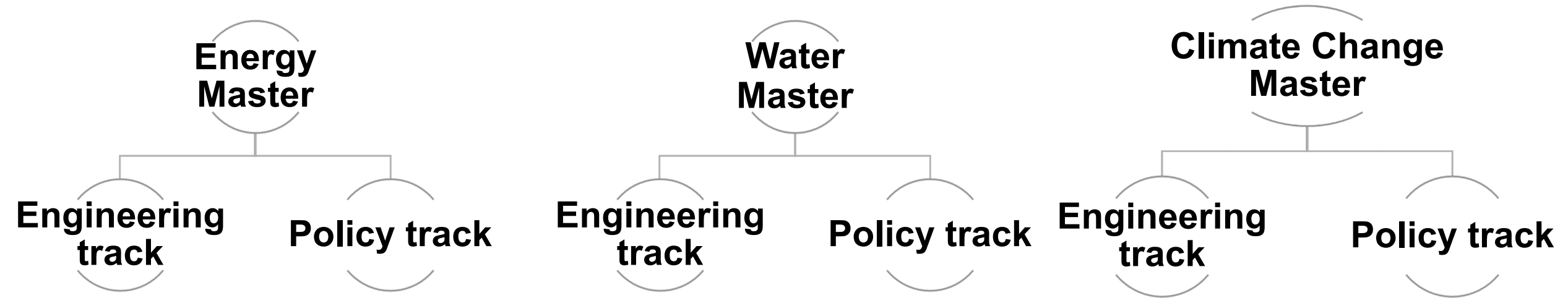
- **PAUSTI**
Basic Sciences,
Technology & Innovation
Jomo Kenyatta University of Agriculture
& Technology, Nairobi, KENYA

- **PAUSS**
Space Sciences
Cape Peninsula University of Technology,
Cape Town, SOUTH AFRICA



Institute for Water and Energy Sciences (incl. Climate Change)

PAUWES offering MSc



Bologna standards, Joint Degree PAU and University of Tlemcen

- 4 Semester, 120 credits
- 30 credits / semester
- 30 credits / thesis



PAUWES Student statistics

Since its inception in 2014



Institute for Water
and Energy Sciences
(incl. Climate Change)

09

cohorts
Recruited

576

Students

338

Graduates

34%

of
Females

44

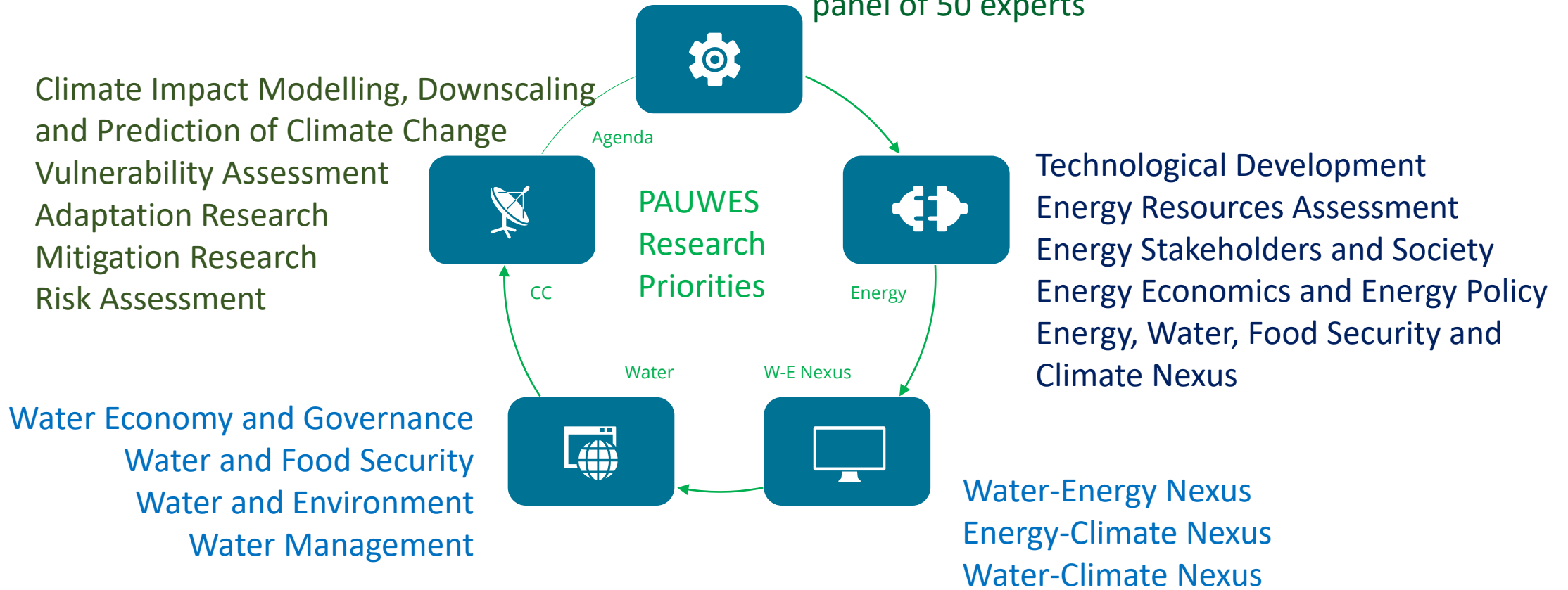
AU
State Members



PAUWES Research Agenda

Development Process

The agenda was developed through 3 workshops with a panel of 50 experts



PAUWES 1 & 2

Higher Education
Cooperation with
tPAUWES



RARSUS & RARSUS - SEMALI

Risk Assessment and Reduction
Strategies for Sustainable Urban
Resource Supply in Sub-Saharan
Africa

Mikrokli ma

(Central Asia
and West Africa)



WESA

Water and Energy
Security in Africa

WASCAL

West African Science
Center on Climate Change
and Adapted Land Use



TEA-LP (PAUWES-MDE)

Transforming Energy
Access – Leadership
Programme



Institute for Water
and Energy Sciences
(incl. Climate Change)

Research and Cooperation

Ongoing projects

Long-term EU-AU Partnership on Renewable Energies projects



LEAP-RE

The Sustainable Energy Transition and Digitalization of Smart Mini-grids for Africa (SETADISMA)

The project aims at studying brown and green-field mini-grid together with the inclusion of digital technologies and fully integrated socio-economic models in different case studies in Africa.

Period: Jun. 2021 – June 2024

Budget: 1.9 Million Euros

PAUWES budget: 115,000 Euros





Institute for Water
and Energy Sciences
(incl. Climate Change)

Research and Cooperation

Ongoing projects



Transforming Energy Access LEARNING PARTNERSHIP

PAUWES Mini Grid, Digitalization and Entrepreneurship programme (PAUWES-MDE)

is an Online Postgraduate programme developed by the Pan African University Institute for Water and Energy Sciences (including Climate Change) (PAUWES) with the support of the Global e-Schools and Communities Initiative (GESCI), the PAU-MDE aims to strengthen youth's capacity on the continent with innovative business ideas in the mini-grid sector with technical and entrepreneurial skills for the creation of smart microgrid businesses and start-ups in Africa.



The African School of Regulation (ASR) Initiative (Phase 1)

- The initiative aims to **build knowledge among governments, regulators, utilities and other stakeholders in the regulation of the energy sector in Africa** in support of social and economic development within the bounds of environmental sustainability with focus on the energy regulation sector.
- This phase will enable the development of a **Virtual Knowledge Hub** with an inventory of all capacity building activities and institutions in the energy regulation sector in Africa and a repository of openly accessible materials

PAUWES Role

- Develop the Virtual Knowledge Hub
- Contribute to Policy Dialogue related activities
- Offer relevant online training material
- Contribute to research activities

Period: 3 years (Phase 1: 2 years)

Start: TBD

Budget: 2 Million Euros (1st phase)

Location: Africa



UNIVERSITY OF CAPE TOWN





Institute for Water
and Energy Sciences
(incl. Climate Change)

Research and Cooperation

Ongoing projects

Groupement de recherche international-Sud (GDRI-Sud) : Risques Hydrologiques au Maghreb (RHYMA)



Core-to-Core Program



JAPAN SOCIETY FOR THE PROMOTION OF SCIENCE

日本学術振興会



Institute for Water
and Energy Sciences
(Including Climate Change)

Partners

جامعة أبو بكر بلقايد
UNIVERSITÉ DE TLEMCEM



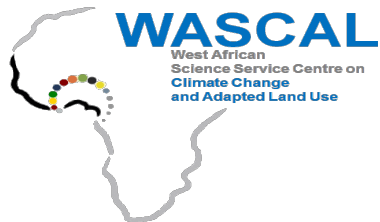
Institute for Water and Energy Sciences (Including Climate Change)



African Union Commission

ITT

Institute for Technology and Resources Management in the Tropics and Subtropics



GLOBELEQ
POWERING AFRICA'S GROWTH



CONOSCOPE
RESULTING GROUP



gesci
Founded by UN ICT Task Force



UNITED NATIONS UNIVERSITY
UNU-EHS
Institute for Environment and Human Security



Center for Development Research
Zentrum für Entwicklungsforschung
University of Bonn



2iE Institut International d'Ingénierie de l'Eau et de l'Environnement



MICRO ENERGY
INTERNATIONAL



giz



Technische Universität Berlin



KFW
Bank aus Verantwortung



Schneider Electric

ATKINS

Member of the SNC-Lavalin Group



KAOSPILOT

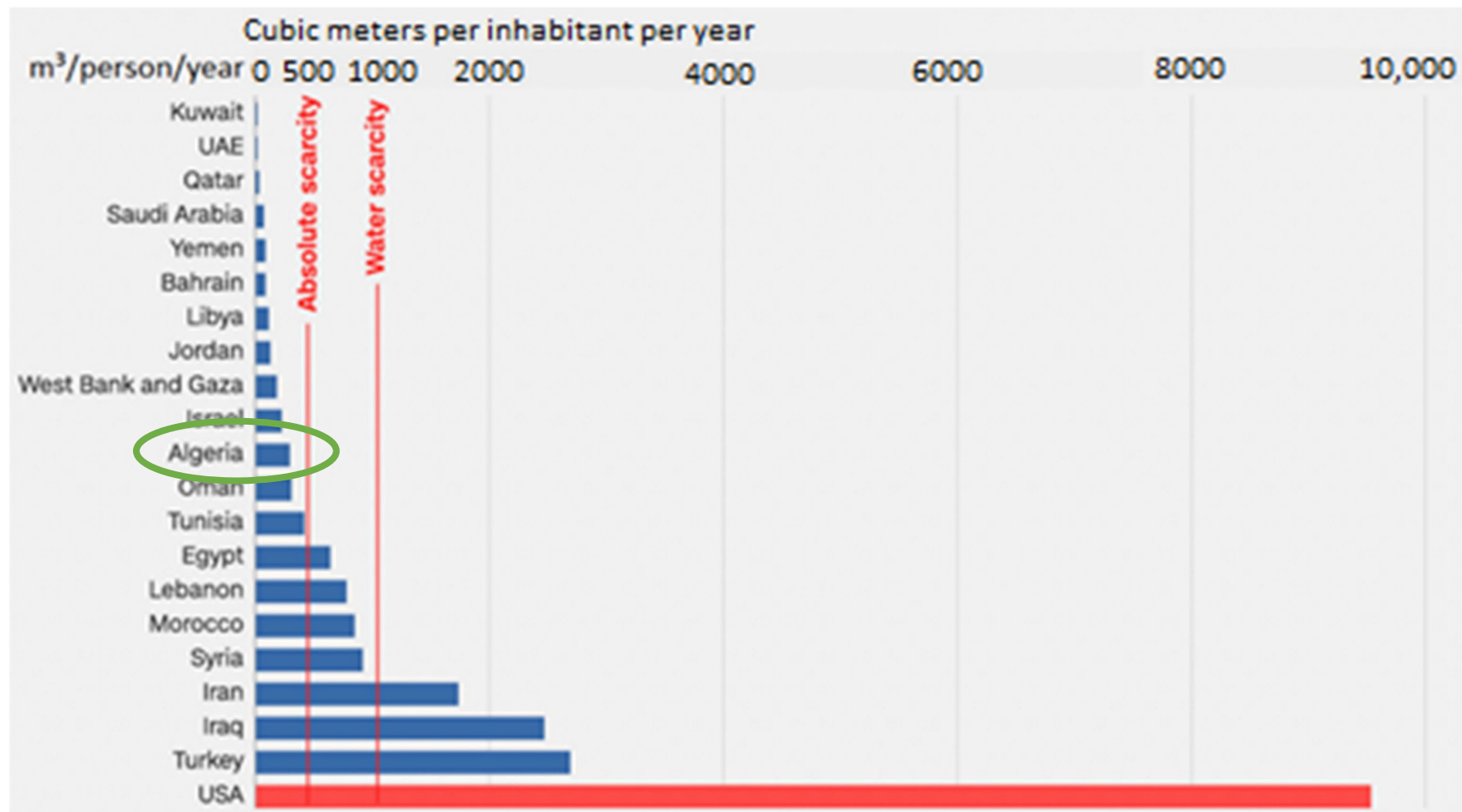




Institute for Water
and Energy Sciences
(Including Climate Change)

Water Reuse for agricultural purposes: The Algerian Experience

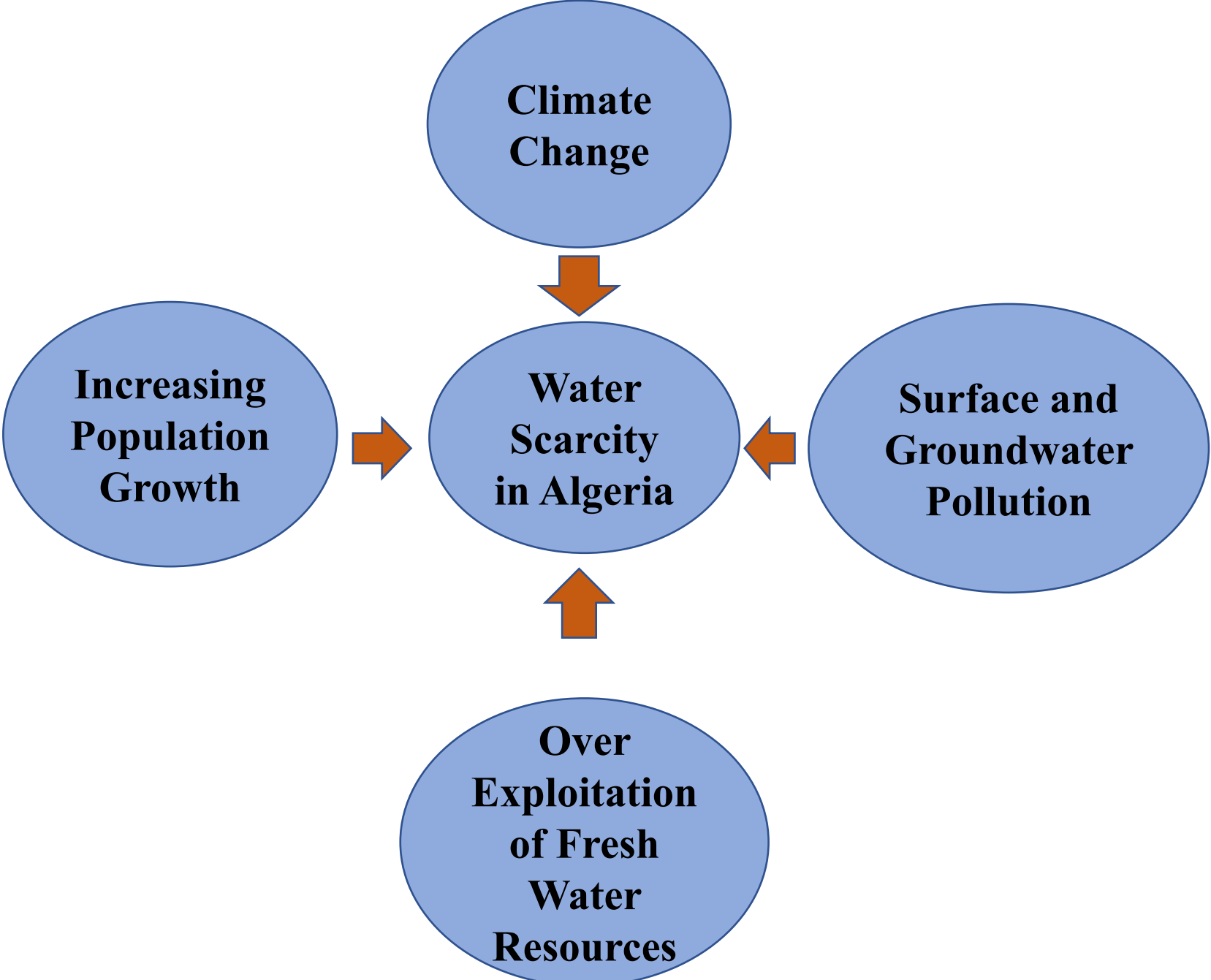
Water availability dropped to **under 447 cubic meter/cap/yr** in 2012, which is significantly **below** the “**scarcity threshold**” of **1,000 cubic meter/cap/ yr** set by the United Nation Development Programme .

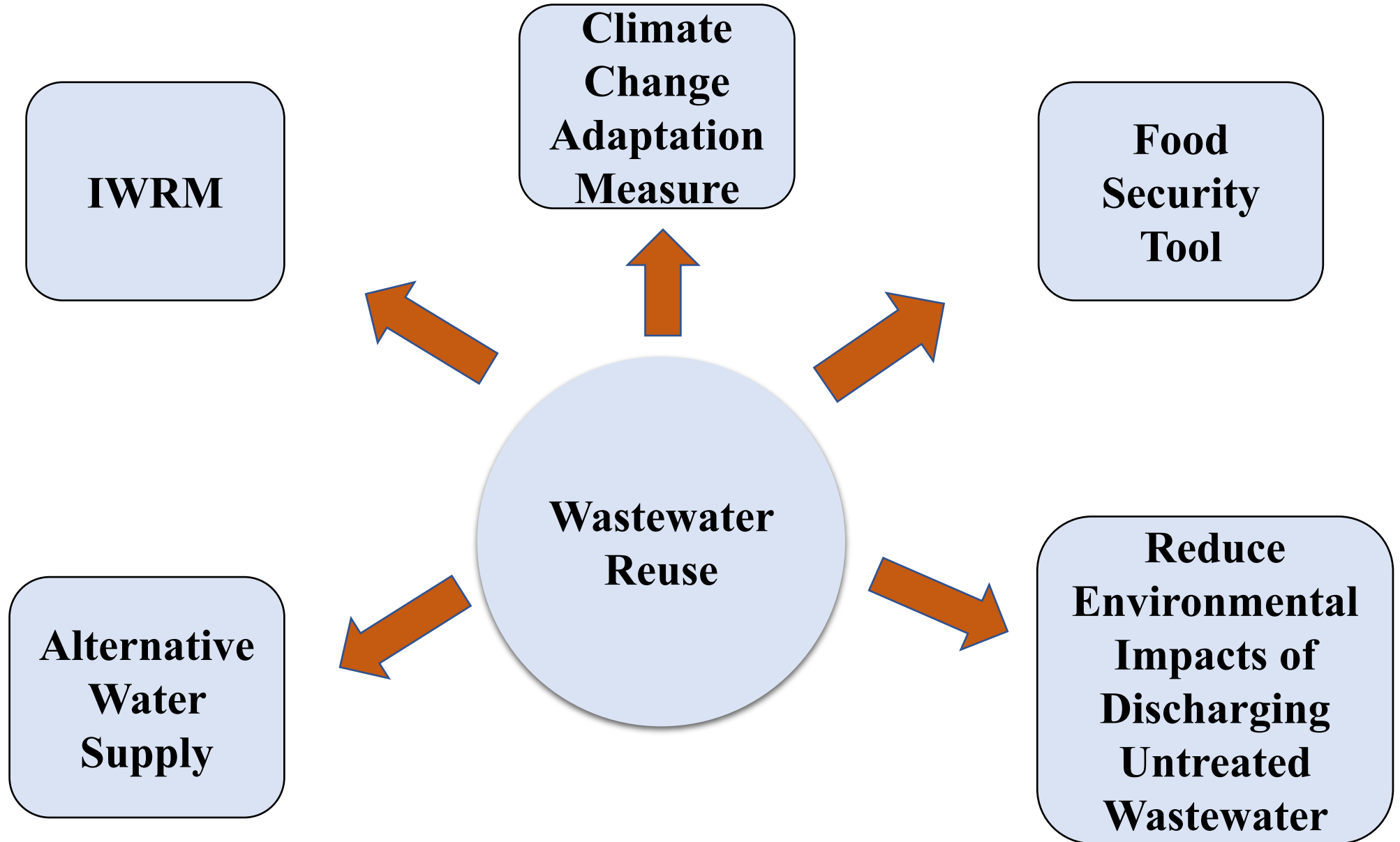


Naturally available freshwater resources in various countries in the Middle East and North Africa

<http://www.fao.org/ag/agl/aglw/aquastat/dbase/index.stm>

- During the **last 25 years**, Algeria has experienced a **severe drought**, which has affected the country's rainfall by causing **important deficit**. In the whole of the country, the pluviometric deficit have been evaluated to **nearly 30%**.
- **Models for climate change** indicate that rainfall could **decrease** by more than 20% by **2050**, which would result in greater **worsening water shortages** in different basins of Algeria.
- **Agricultural irrigation** is the **primary water-consuming sector** followed by the domestic and industrial sectors.
- Agriculture is facing more and more serious **problems** in **irrigation**. Water intended for this purpose is almost **rare** and the application of adequate **solution** is essential to adapt to **climate change**.
- IPCC (**Intergovernmental Panel on Climate Change**) defines **climate change adaptation** as “an adjustment in natural or human systems in **response to actual** or **expected climatic stimuli** or their effects, which moderates harm or **exploits beneficial opportunities**”.





Water Resources in Algeria

Conventional resources

Renewable resources: 14.4 B m³
(Underground resources: 3 B m³)

Surface Water Resources :
11.4 B m³

Unconventional resources

Desalination : 1 B m³ /Y

Treated wastewater: 400 M m³ /Y





الديوان الوطني للتطهير
•⊙⊕⊙• •Ψ⊕⊕⊙⊕ | :⊙⊕⊙⊕⊕⊕
Office National de l'Assainissement

154 WasteWater treatment Plants (75 lagoons, 76 activated sludge WWTP and 03 planted filters) with a nominal flow of 1 575 925 m³/d

The processes used are activated sludge and natural lagoon.

17 WWTPs ----- Reuse of treated wastewater in agriculture.

The volume reused at the end of August 2022 is 14.6 million m³ to irrigate more than 11 076 ha (ONA, 2022)

The volume of treated wastewater exceeds 20 million cubic meters, i.e. an average daily flow of 668,396 m³/d

The potential of this resource in Algeria is estimated at 700 - 750 million m³ and will reach the volume of 1.5 billion m³ in 2040 (ONIDE, 2022)



Potential of Water REUSE for agricultural purposes in Algeria

<i>Periods</i>	<i>2020</i>	<i>2024</i>	<i>2030</i>
<i>Reuse Projects</i>	<i>16</i>	<i>42</i>	<i>176</i>
<i>Volume (Mm³/y)</i>	<i>34</i>	<i>112</i>	<i>712</i>
<i>Surface (ha)</i>	<i>3 500</i>	<i>22 500</i>	<i>105 000</i>



REUSE Projects in Algeria (ONID, Novembre 2021)

- Irrigation of the Hennaya perimeter (W-Tlemcen) over 912 ha, which has been in operation since 2012 and supplied from treated wastewater from the Ain El Houtz WWTP in Tlemcen
- Irrigation of the Mléta perimeter (W-Oran) over 6286 ha, supplied from the KERMA WWTP, operated during the 2018 irrigation campaign.
- Irrigation of the perimeter of Témacine (Ouargla): Témacine lagoon; Total area: 780 ha.
- Irrigation of the perimeter of Bordj Bou Arreridj: WWTP Bordj Bou Arreridj; Area: 250 ha.

Water REUSE in Algeria: Some Experiences

- Irrigation of the perimeter of Sétif: WWTP of Sétif ; Area: 800 ha .
- Irrigation of the perimeter of Hamma Bouziane (Constantine): WWTP of Constantine. Area: 400ha.
- Irrigation of the Mascara perimeter:
- Mascara WWTP, Area: 600 ha
- Ghris Lagoon, Area: 150 ha
- Lagoon: El Hashem. Area: 150 ha

12 000 ha



- 28 collective and individual farms and specializing in citrus fruits, olive trees, various fruit trees, etc.
- Irrigation methods practiced: Gravity mode, with conversion to drip, since 2013.
- Irrigation of the perimeter using purified water from the WWTP began in 2012.
- The perimeter saw an increase in irrigated areas, 360 ha in 2012 and 695 ha in 2018.



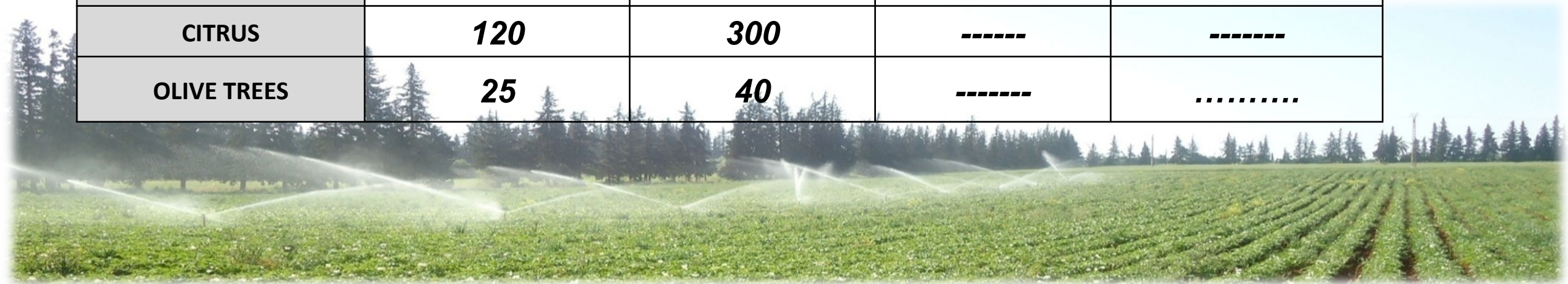
Evolution of the Irrigated Area using treated Wastewater

<i>Irrigated area</i>	<i>WWTP</i>	
	<i>EL KERMA - ORAN: Capacity :270 000 m³ /d Perimeter of M'leta: 6286 ha</i>	<i>AIN EL HOUTZ - TLEMCEN : Capacity: 30 000 m³ /d Perimeter of Hennaya: 912 ha</i>
<i>2018</i>	<i>248</i>	<i>695</i>
<i>2019</i>	<i>493</i>	<i>800</i>
<i>2020</i>	<i>1331</i>	<i>800</i>
<i>2021</i>	<i>2513</i>	<i>800</i>



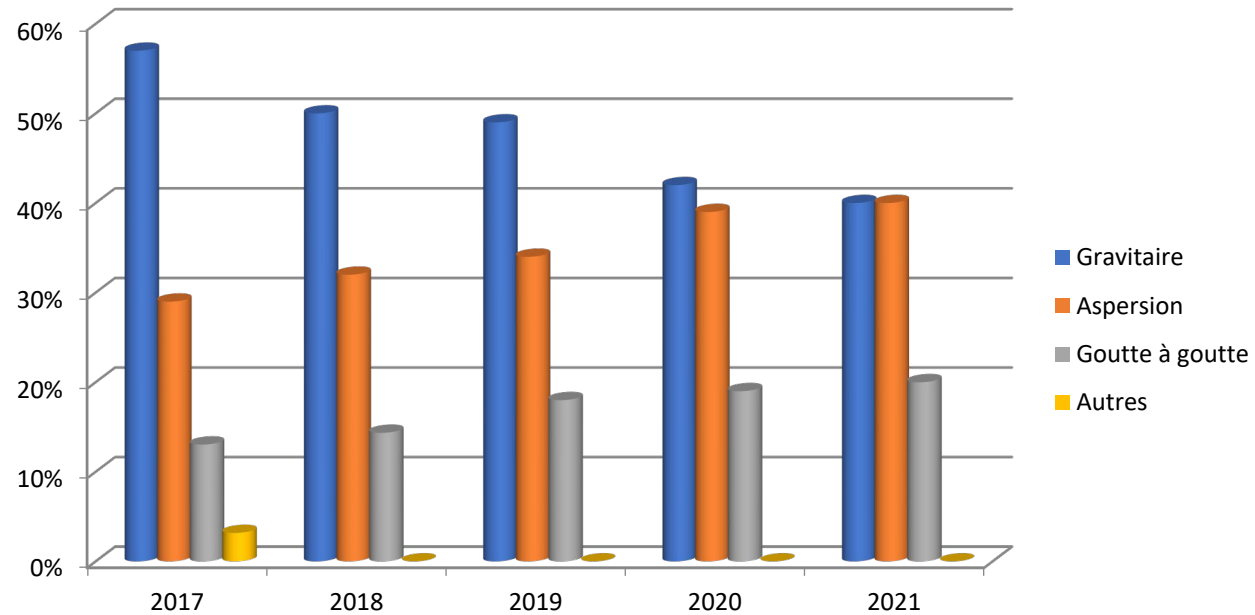
CROP YIELDS IN BOTH PERIMETERS (HENNAYA AND M'LETA)

	HENNAYA IRRIGATION PERIMETER		M'LETA IRRIGATION PERIMETER	
	<i>Rd (qtx/ha) Before REUSE</i>	<i>Rd (qtx/ha) With REUSE</i>	<i>Rd (qtx/ha) Before REUSE</i>	<i>Rd (qtx/b/ha) With REUSE</i>
CEREALS	15	35	12	25
MAIZE	-----	-----	35	70
ALFALFA	-----	-----	70	120
SORGHUM			600	1400
CITRUS	120	300	-----	-----
OLIVE TREES	25	40	-----



Irrigation Methods

<i>Irrigation modes</i>	2017	2018	2019	2020	2021
<i>Gravity</i>	57%	50%	49%	42%	40%
<i>Sprinkler</i>	29%	32%	34%	39%	40%
<i>Drip system</i>	13%	14%	18%	19%	20%
<i>Others</i>	3%	0%	0%	0%	0%



Water Quality _ WWTPS: AIN EL HOUTZ & EL KERMA

WWTP	Samples	Parameters								Performances		
		BOD (mg/l)	COD (mg/l)	TSM (mg/l)	NH4 (mg/l)	N-NO2 (mg/l)	N-NO3 (mg/l)	PO4 (mg/l)	O2 (mg/l)	BOD(mg /l)	COD (mg/l)	TSM (mg/l)
AIN EL HOUT TELEMCEN	Input	216	480	239	37.4	1.6	2	8	0.8	92	92	91
	Output	15	39	20	11.2	0.8	1.7	5	4.81			
EL KARMA ORAN	Input	360	590.78	515	38	1.8	2.5	10	0.9	98.30	94.10	97.50
	Output	18	98.75	53	13.5	0.9	1.9	6	5			

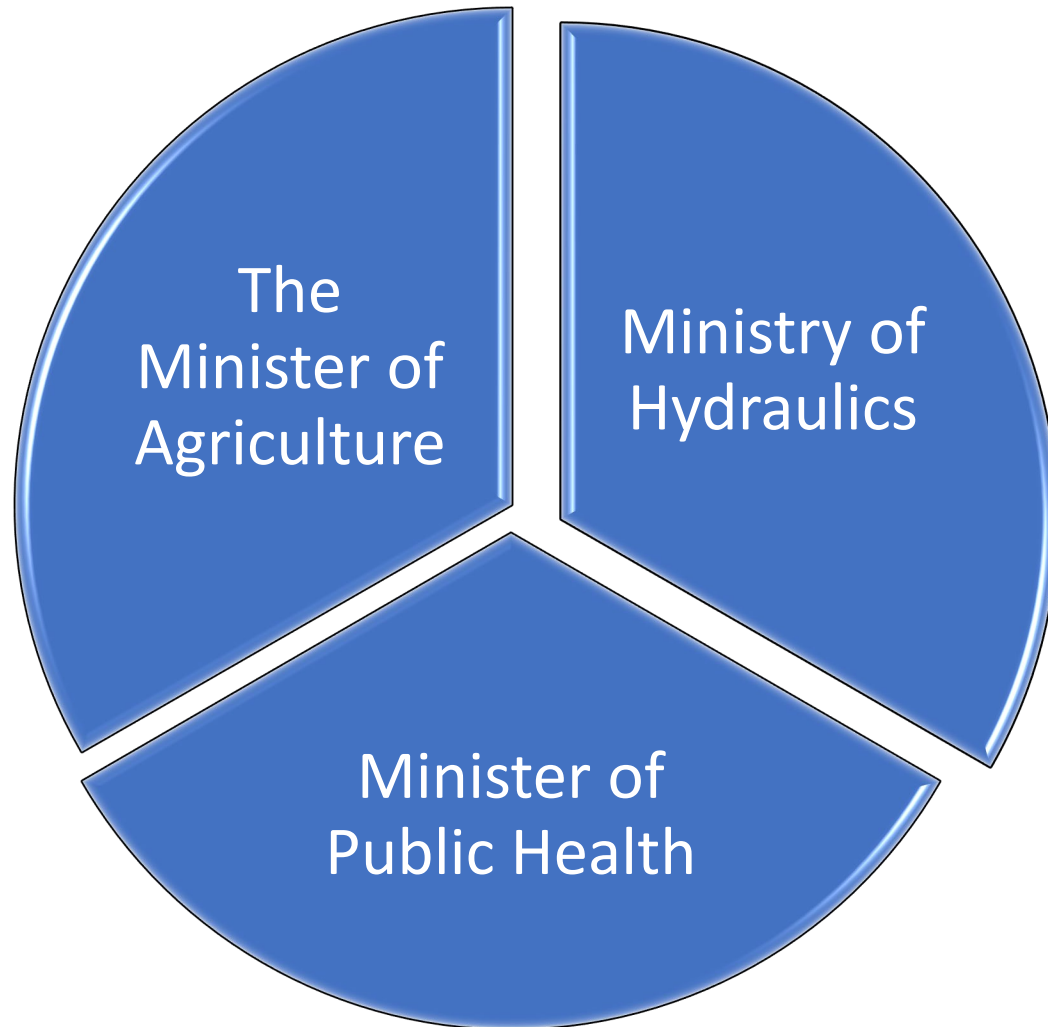


EXTENSION OF THE IRRIGATED AREA _ REUSE

<i>Perimeters</i>	<i>localisation</i>	<i>Surface (ha)</i>	<i>Needs (Mm³/en)</i>
<i>WWTP M'sila</i>	<i>M'sila</i>	<i>800</i>	<i>11.5</i>
<i>WWTP Boussaâda</i>	<i>Boussaâda</i>	<i>800</i>	<i>11.5</i>
<i>WWTP Sidi Aissa</i>	<i>Sidi Aissa</i>	<i>500</i>	<i>06</i>
<i>WWTP de Boufarik</i>	<i>Boufarik</i>	<i>3000</i>	<i>18</i>
<i>Total</i>		<i>5100</i>	<i>47</i>



Interministerial consultation framework



**Creation of a
coordination and
monitoring committee**



- Rationalization of water resources management in agriculture
- Valorization of conventional and unconventional water resources

LEGAL AND REGULATORY FRAMEWORK

To ensure better protection of users and consumers, studies have been launched by MH(Ministry of Hydraulics) to strengthen the legislation.

- **2006 -2010 SINBAD - UNESCO Project:** The implementation of the feasibility study on the integrated management of treated water in agriculture,
- **TECSULT 2008 Project:** Four missions were developed by this project
 - - Recognition and collection of all basic data
 - - Study of a master plan for the reuse of treated wastewater
 - - Development of a pilot study for reuse
 - - Reuse of treated wastewater for agricultural with definition of the types of crops, and for industrial or other purposes (refilling groundwater, municipal needs, watering, etc.)

LEGAL AND REGULATORY FRAMEWORK

- **Law n°05-12 du 04 Août 2005**: related to water, instituted the concession of the use of treated wastewater for irrigation purposes (JO n°60-year 2005)
- **Decree No. 07-149 of May 20, 2007** : lays down the terms and conditions for the concession of the use of treated wastewater for irrigation purposes as well as the standard specifications.
- **The inter-ministerial decrees of January 2, 2012** which implement the provisions of **article 2 of executive decree n°07-149**, published in January 2012 by the Ministry of Water Resources (JO No. 41)
- **These decrees establish:**

LEGAL AND REGULATORY FRAMEWORK

- The specifications of treated wastewater used for irrigation purposes and in particular with regard to microbiological parameters and physico-chemical parameters
- The list of crops that can be irrigated with treated wastewater.
- The Algerian standard No. 17683: "Reuse of treated wastewater for agricultural, municipal and industrial purposes - Physico-chemical and biological specifications" is available at the Algerian Institute of Standardization IANOR;

1

- **Impact of treated wastewater irrigation on soil properties and groundwater quality**


2

- **Water reuse for Agriculture as an Adaptation Measure to Climate Change**

What should be done to reuse without major risks?

- Raising farmers' awareness of the benefits of reusing treated wastewater in irrigation.
- Application of the regulatory framework, the crops to be grown and the recommended irrigation systems.
- Establishment of a training, supervision and extension program.
- Strengthening intersectoral coordination



A conceptual illustration where a hand from the top right pours water from a photograph of a lush waterfall into a photograph of a dry desert. The water flows from the waterfall photo into the desert photo, creating a stream in the desert. The text 'Thank you for your attention' is overlaid in the center.

Thank you for your attention



Institute for Water and Energy Sciences (incl. Climate Change)





Institute for Water
and Energy Sciences
(Including Climate Change)

Water Reuse for agricultural purposes: The Algerian Experience

Dr. Chérifa Abdelbaki (a) & Rachid YAHIAOUI (b)

(a) Pan African University, Institute for Water and Energy Sciences (PAUWES), Tlemcen, Algeria

(b) National Office of Irrigation and drainage, Algeria

Contact: cherifa.abdelbaki@pauwes.dz

Tél: +213 552 833 383