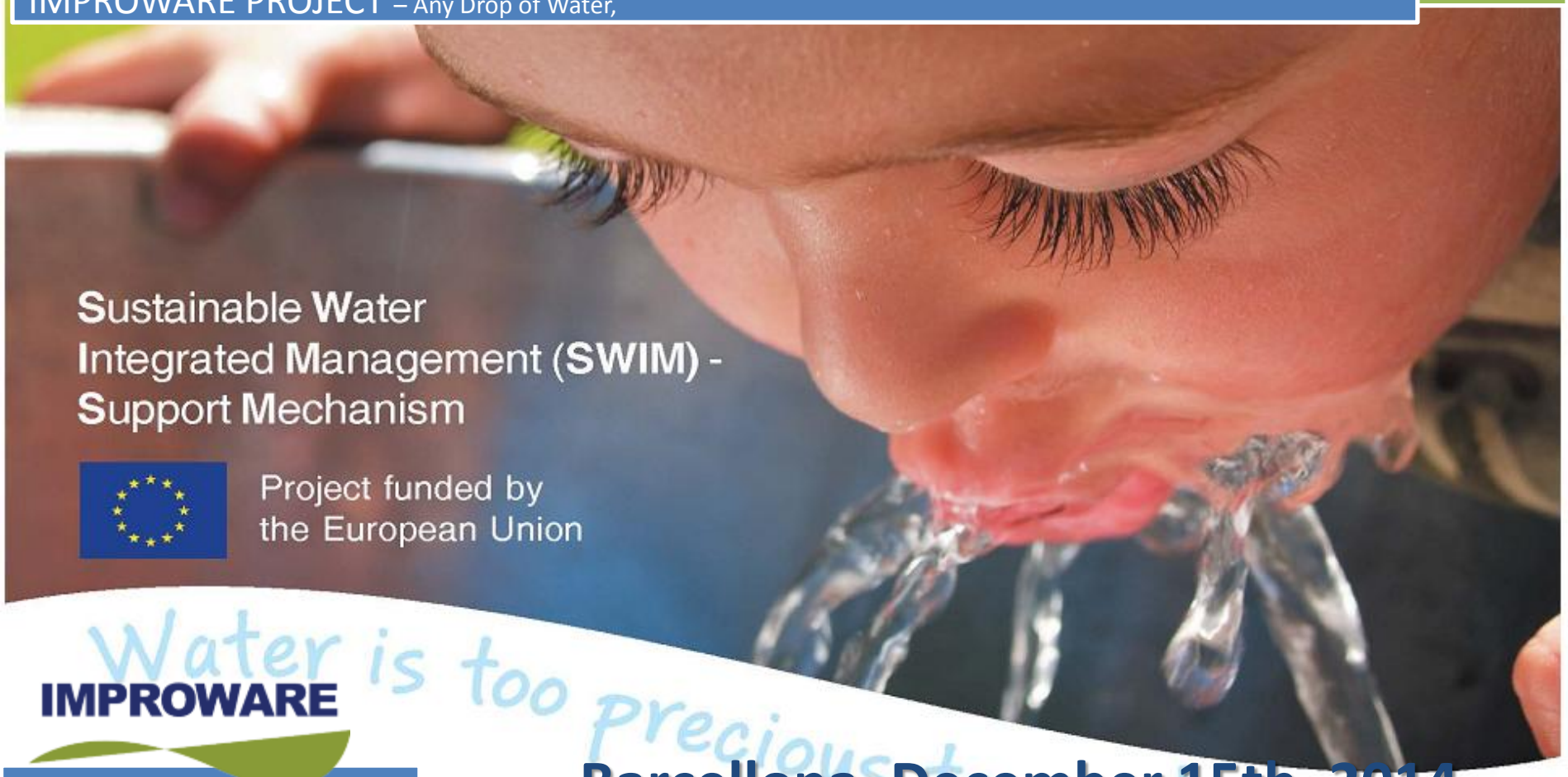


IMPROWARE

PROJECT

AARHUS UNIVERSITY

CONSORZIO UNIVERSITARIO DI ECONOMIA INDUSTRIALE E MANAGERIALE

CUEIM

CURSA

MINISTERO DELL'AMBIENTE

Barcellona, December 15th, 2014 IMPROWARE DEMO projects' achievements and way forward

Andrea De Angelis

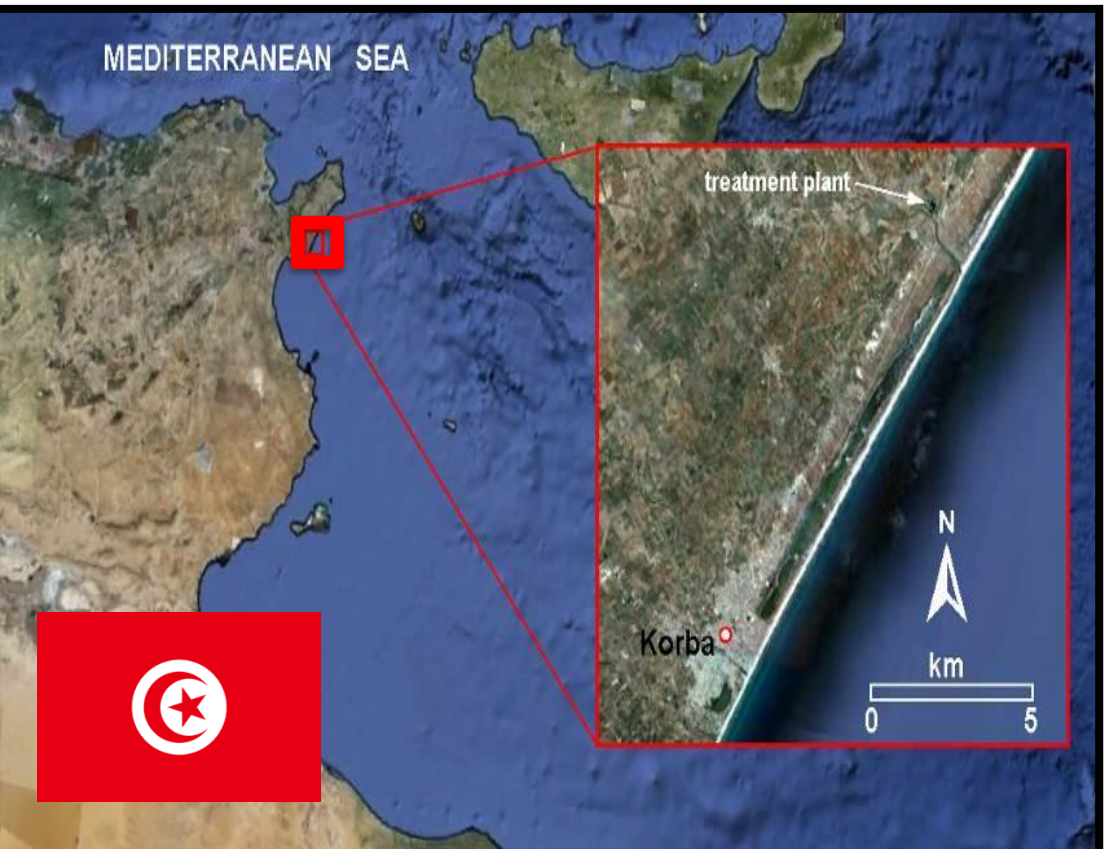
Introduction

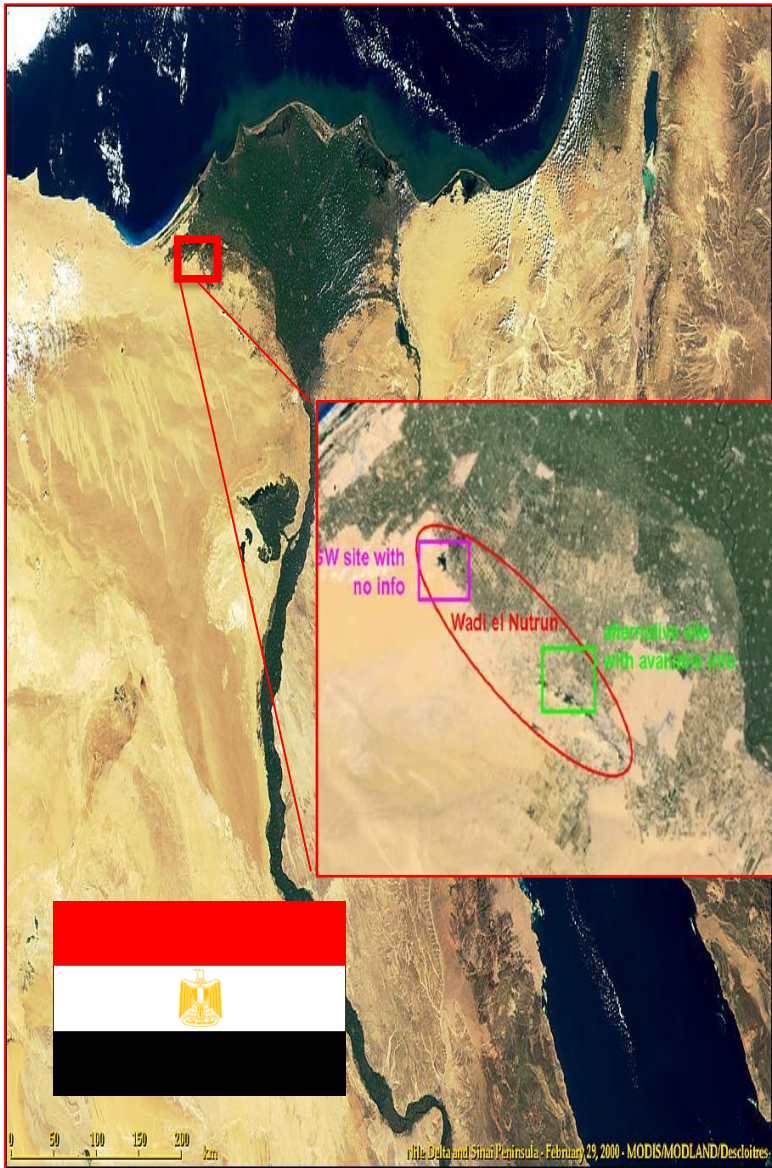
INNOVATIVE MEANS TO PROTECT WATER RESOURCES IN THE MEDITERRANEAN COASTAL ARE AS THROUGH RE-INJECTION OF TREATED WATER

Project sites

Egypt: Nobariya

Tunisia: Korba





General Data

Priority addressed	Promoting Water Demand Management and Efficiency, including Non-Conventional Water Resources
Locations of the Project	Nobariya Wadi El-Natrun (Egypt) Korba (Tunisia)
Duration of the project	30 months originally – Deadline August 2014 (achieved an extension to February 2015 and requested another one to June 30 2015) Real Implementation (Feb 2013-June 2015) 28 Months

Partnership

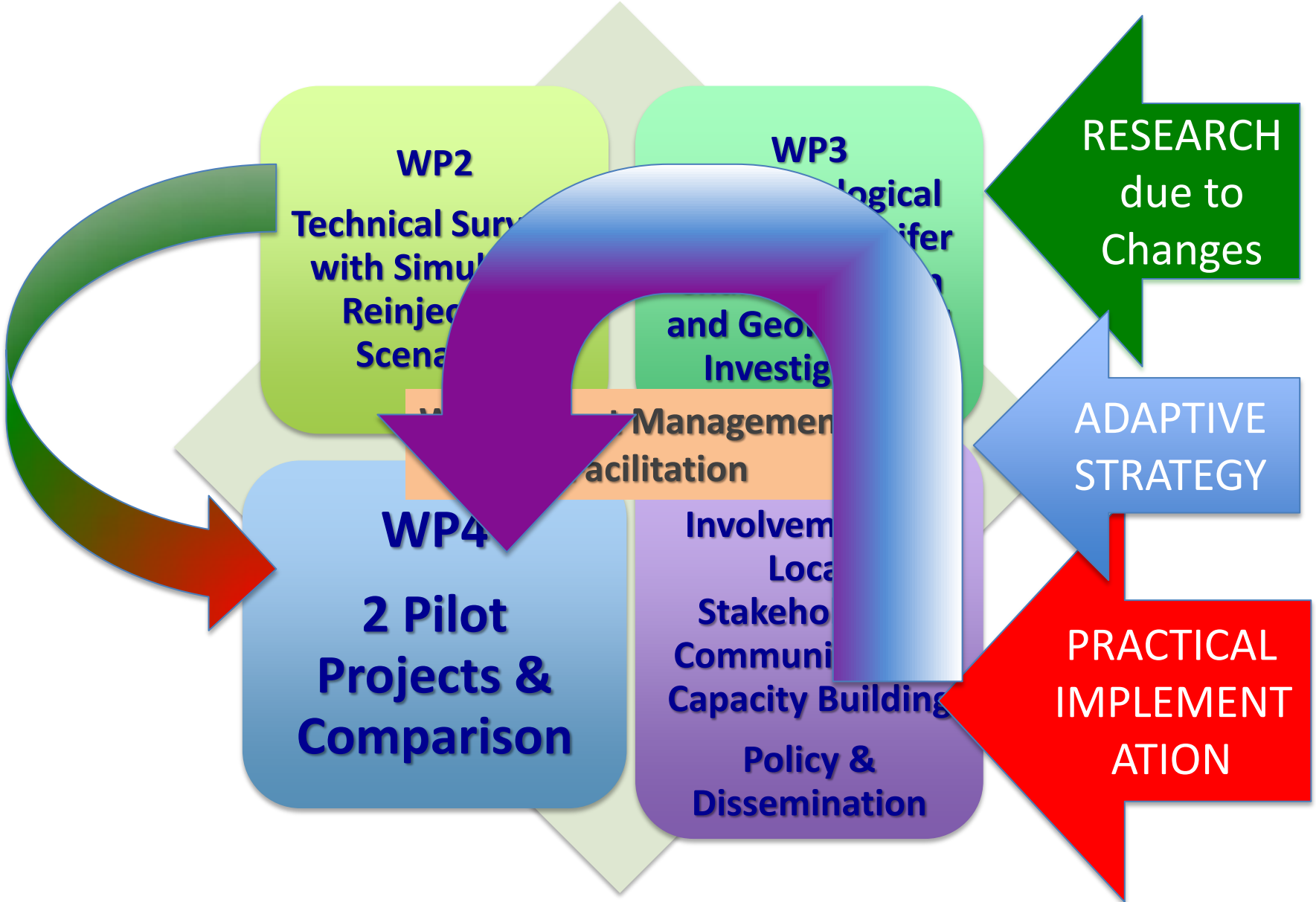
	EEAA - Egyptian Environmental Affairs Agency (*Egypt*)
	ONAS - Office National de l'Assainissement National Sanitation Utility (*Tunisia*)
	IMELS (*Applicant and Leader*) **Italian Ministry of the Environment, Land, and Sea (*Italy*)**
	CUEIM - University Consortium for Industrial and Managerial Economics (*Italy*)
	CURSA - University Consortium for Environmental and Socio-economic Research (*Italy*)
	AU- Aarhus University (*Denmark*)

Specific Objectives and its Updates - THROUGH AN ADAPTIVE STRATEGY

- **SUSTAINABLE DEVELOPMENT:** To improve the economic development prospects of rural by **increasing water availability for agricultural activities**, consequently reducing the current over-exploitation of drinking groundwater.
- **TECHNOLOGY - and KNOW HOW - TRANSFER:** To facilitate in building-up & improving planning and management skills at sub-regional and regional level. **IMPROVING TECHNICAL DIALOGUE – 1) WWTP, 2) CW 3) INSIGHTS FROM THE RESEARCH SIDE and FROM POPULATION and COMMUNICATORS – TOTALLY INTEGRATED APPROACH**
- **REGIONAL COOPERATION: To encourage regional co-operation** in the area of sustainable and integrated water management through capacity building, institutional strengthening and public participation.
- **POLICY MAKING:** To draw the attention of **policy makers** on the existence of solutions and innovative methodologies to tackle water scarcity problems.

Rationale of the Implementation

Management: Work Packages



WP2
Technical Surveys

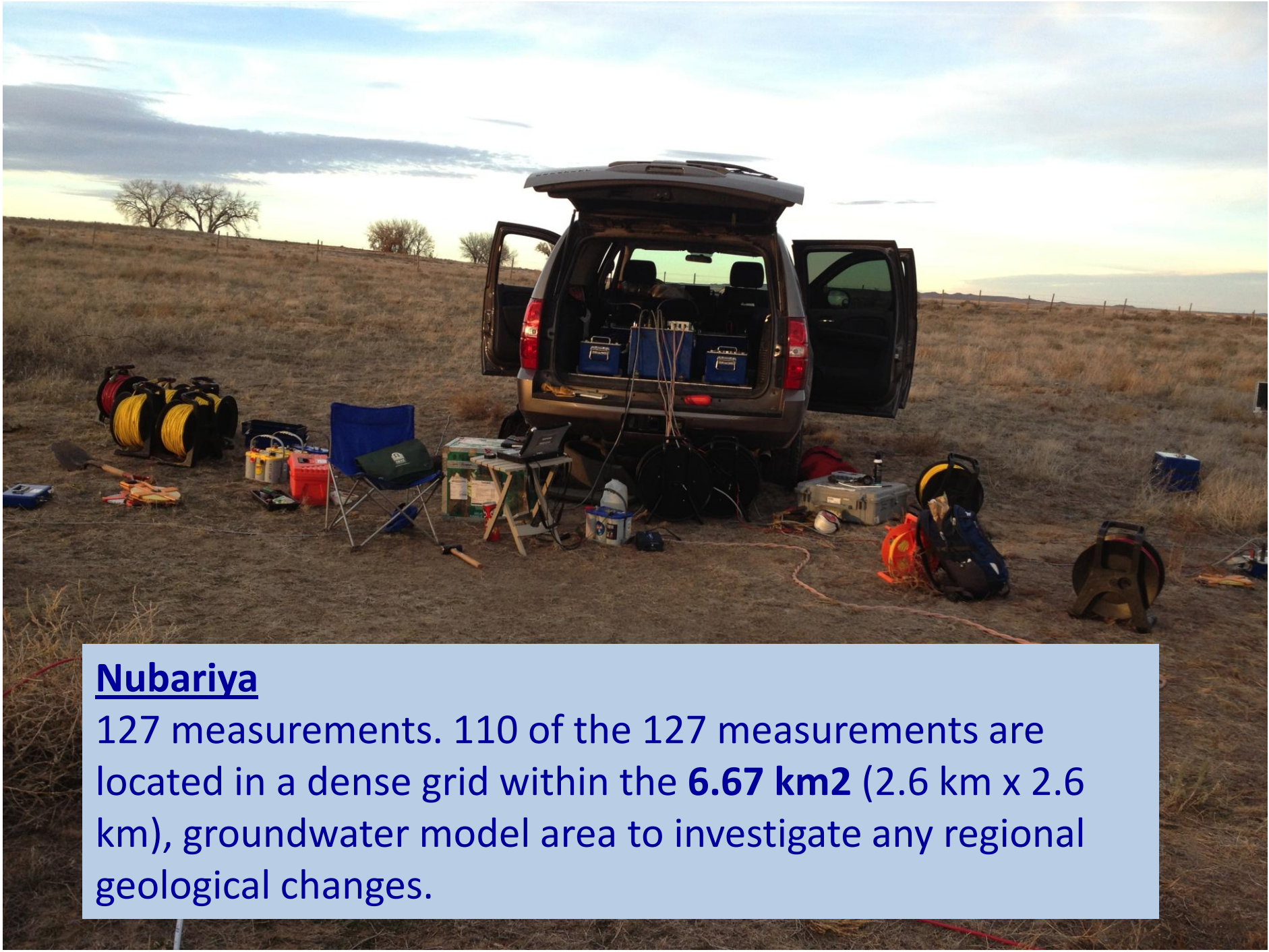
WP3
Hydrogeological Surveys

Implementation Processes - Research

Method a: <u>**Aquifer characterization by geophysical investigation**</u>

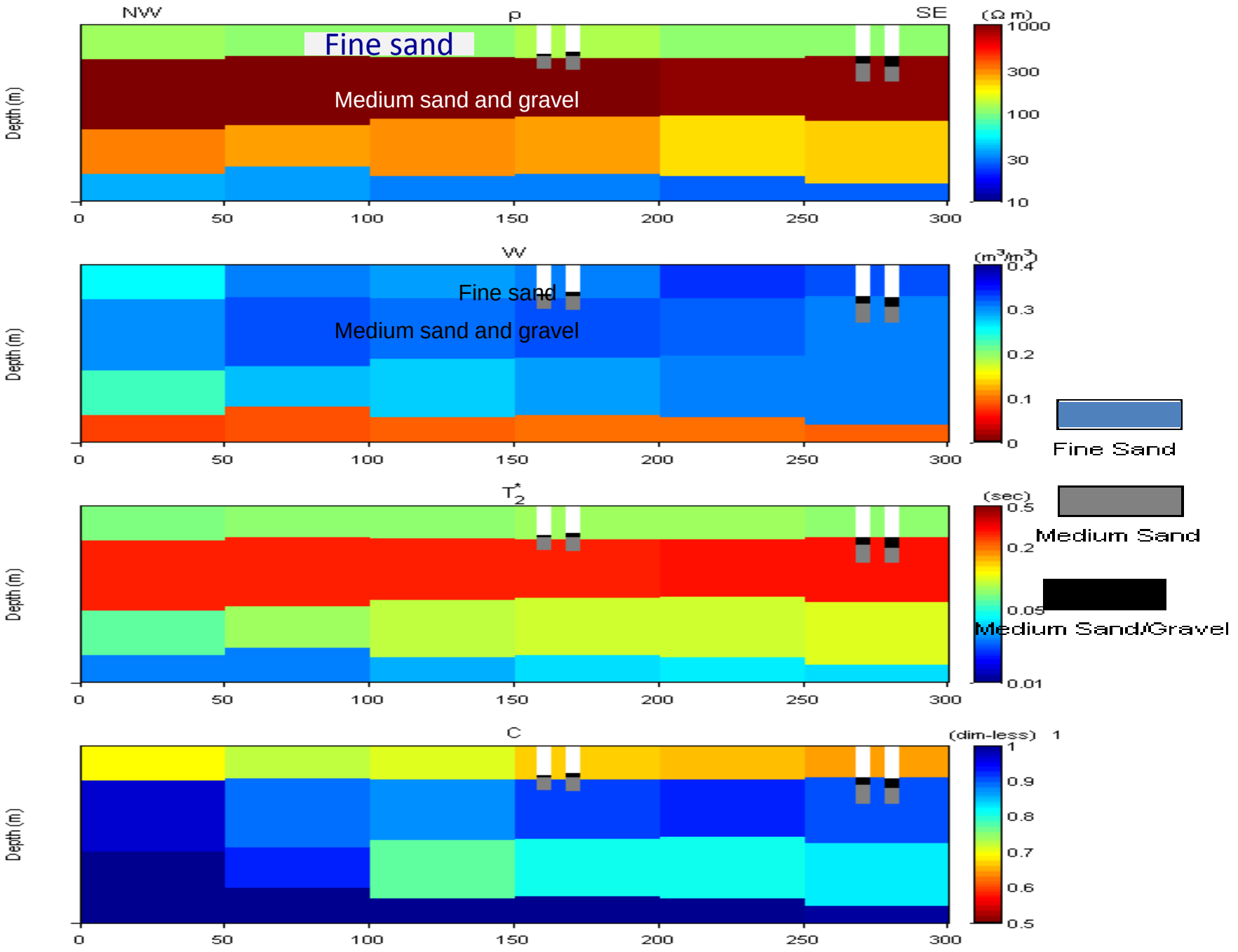
By Ground electromagnetics (TEM) for both near surface and deeper penetration, and b) Magnetic Resonance Sounding (MRS)

WP3 Hydrogeological Surveys – Aquifer Characterization and GeoPhysiscal Investigation



Nubariya

127 measurements. 110 of the 127 measurements are located in a dense grid within the **6.67 km2** (2.6 km x 2.6 km), groundwater model area to investigate any regional geological changes.


NW
ρ
SE
(Ω m)
1000
300
100
30
10
Fine sand
Medium sand and gravel
Depth (m)
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100
150
200
250
300
VV
(m³/m³)
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0.3
0.2
0.1
0
Fine sand
Medium sand and gravel
T*2
(sec)
0.5
0.2
0.05
0.01
C
(dim-less)
1
0.9
0.8
0.7
0.6
0.5
Fine Sand
Medium Sand
Medium Sand/Gravel

WP3 Hydrogeological Surveys – Aquifer Characterization and GeoPhysiscal Investigation

WP3 Hydrogeological Surveys – Aquifer Characterization and GeoPhysiscal Investigation

Korba

The full survey, after processing, 116 measurements. 81 of the 127 measurements are located in a dense grid within the 1.44 km2 (1.8 km x 0.8 km) groundwater model area, to investigate any regional geological changes (total area **5,6 km2 (2.8 km x 1.8 km)**.

WP2
Technical Surveys

WP3
Hydrogeological Surveys

Implementation Processes - Research

Method b: 1 productive drilled Well and 4 drilled piezometers.

- Continuous core sample from main well and sample from 4 piezometers.

This provides a local lithological description.

- Aquifer test : pumping test and analysis with Jacob method.
- Chemical analysis and water quality indications

WP2

Technical Surveys with Simulated Reinjection Scenarios

SWIM

WP2

Technical Surveys with Simulated Reinjection Scenarios

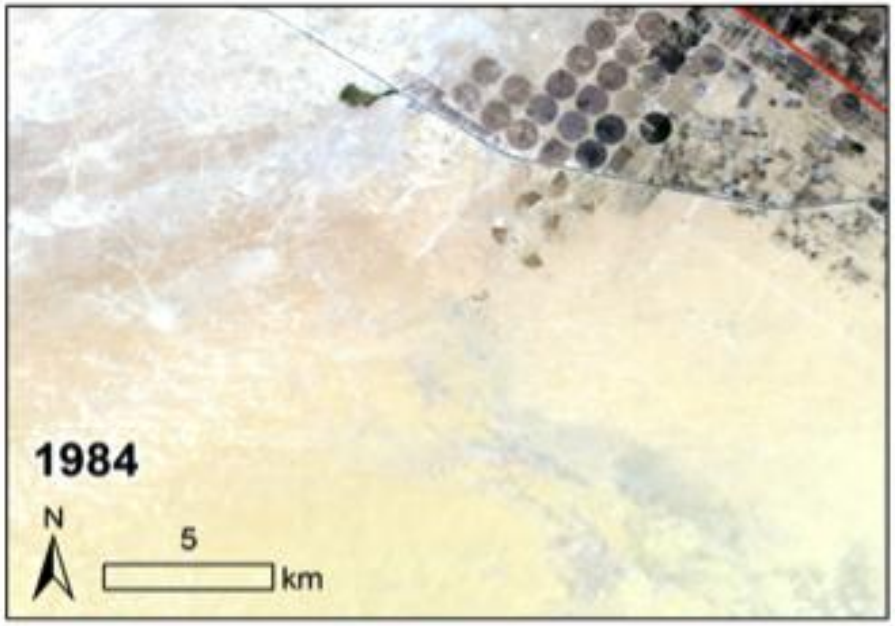
Implementation processes

WP2
Technical Surveys

WP3
Hydrogeological Surveys

Implementation Processes - Research

SIMULATED REINJECTION: Modelling to support aquifer recharge
(starting from the use of CATHY, UNIPD,and CODESA) studying specific methodologies for reusing wastewaters to recharge coastal aquifers in arid regions suffering from saltwater intrusion


1984
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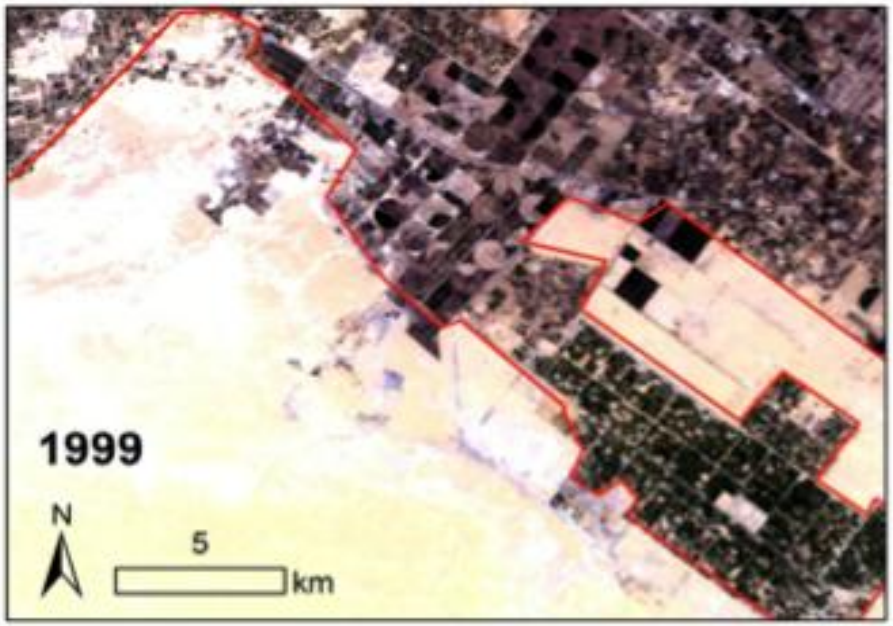
km


1999
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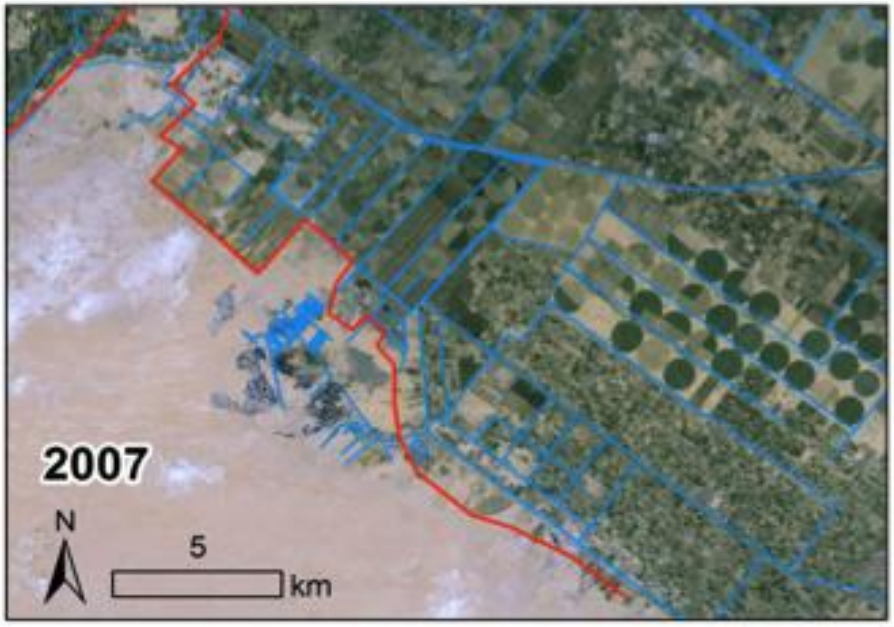

2007
N
5
km


2014
N
5
km

WP2
Technical Surveys

Where are we in Research?
90% is done

WP3
Hydrogeological Surveys

MAIN ACTIVITY	%
WP2 - TECHNICAL SURVEY	90
1. Tunisia Data collection	100
2. Egypt Data collection	100
3. GIS database implementation	80
WP3 - HYDROGEOLOGICAL SETTINGS	90
1.1. Egypt – Field Investigations	100
1.2. Egypt – Data Processing and interpretation	90
2.1 Tunisia – Field Investigations	100
2.2. Tunisia – Data Processing and interpretation	100
Modelling	60

WP4

2 Pilot Projects & Comparisons

Implementation Processes – Hard Activities

WP4 ACTIVITIES

WP4

Pilot Projects

Pilot Activities in two Sites

- **Nobariya:**
  - Upgrade of Waste Water Treatment Plant
  - Building and connecting to the WWTP a Constructed Wetland aimed at making Tertiary Water Treatment
  - Irrigation Field
- **Korba:**
  - Improvement of the existing Waste Water Treatment Plant for better water quality of the aquifer recharge

To **increase**
targeted reg
drinking gro

Constructed
effluent qua

With the
dimension
one, even
(Adaptive Strategy).

WP4 2 Pilot Projects & Comparison

Nobariya Model of WWTP Upgrade

1 Pumping station

2 Oxidation tank

Sedimentation tank **4**

5 Chlorination tank

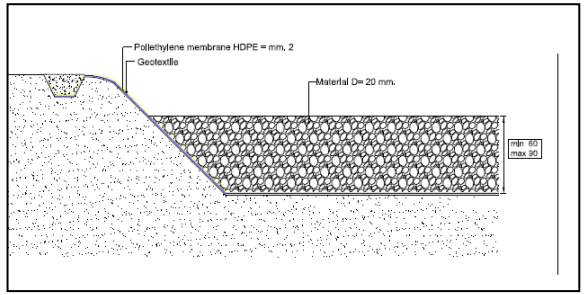
3

Constructed wetland

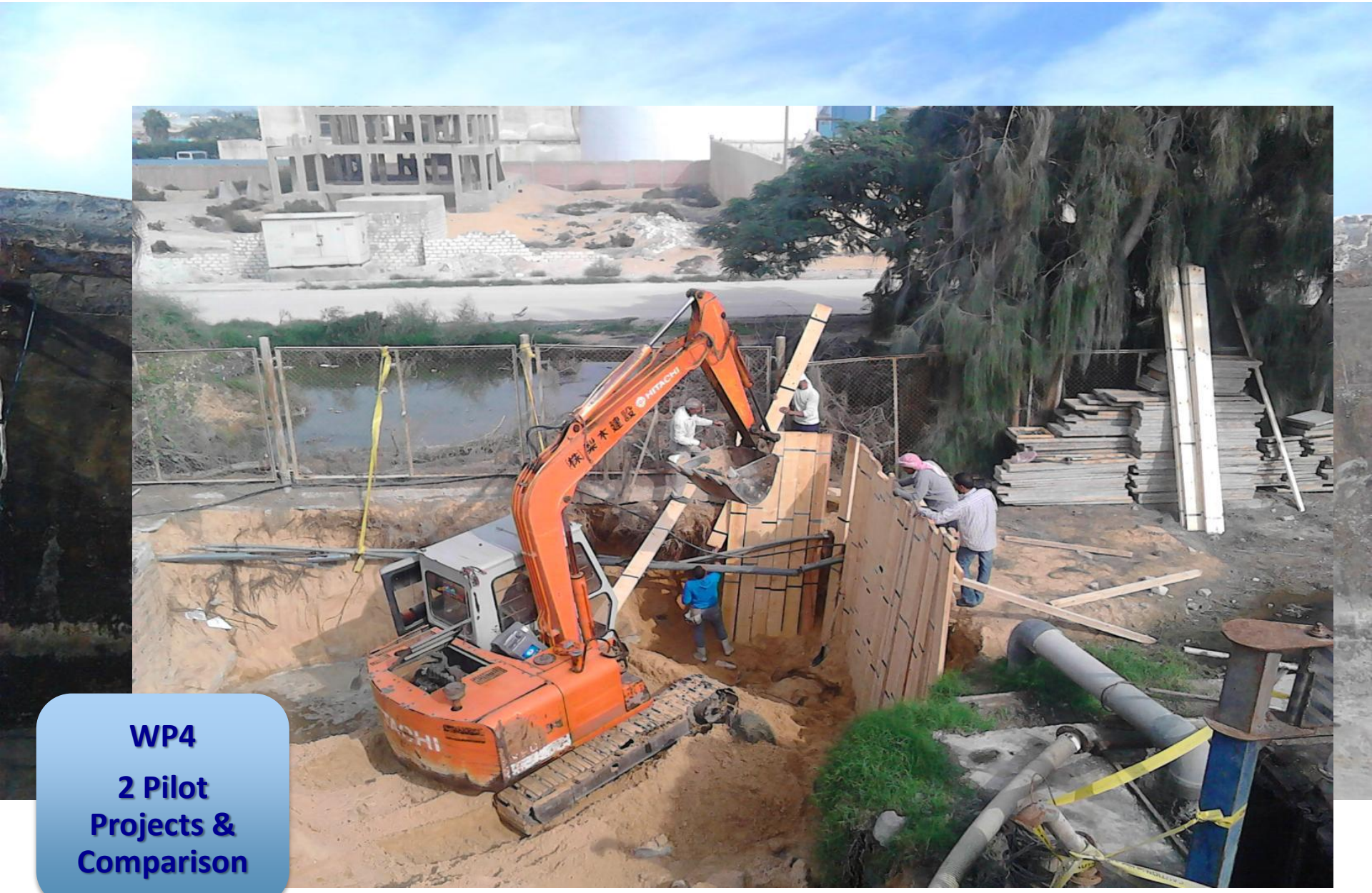
Civil and industrial wastewaters
(on average about 6000 m^3/d)
30.000 inhabitants

- New pumping station
- Pretratment section
- Sludge recirculation system
- Sludge scraper bridges
- Monitoring System
- Constructed wetland

6



Irrigation



WP4

2 Pilot Projects & Comparison

Excavation supports work for Discharge trap.

WP4

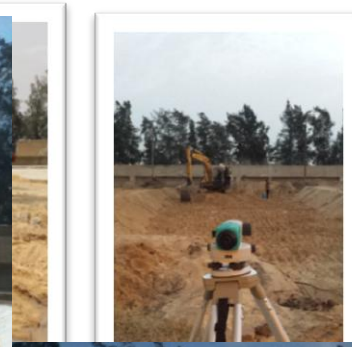
2 Pilot Projects & Comparison

WP4

2 Pilot Projects & Comparison

Cleaning and Preparing Settling tank

Nobariya: Constructed wetland



Korba Model

Pumping station

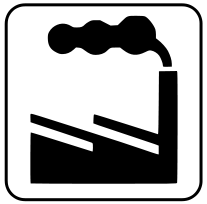
Screen
Sand trap

Aeration tank

Decanter

1

Maturation ponds



Civil and industrial wastewaters
(on average about 4500 m^3/d)

Thickening

Drying beds

3

Infiltration basins

1) Realization of sand filter treatment for effluent refinement upstream maturation ponds
2) Installation of baffles in the maturation ponds
3) Realization of a samplig point between the maturation ponds and the recharge system
4) Disinfection (<u>at lab scale</u>)

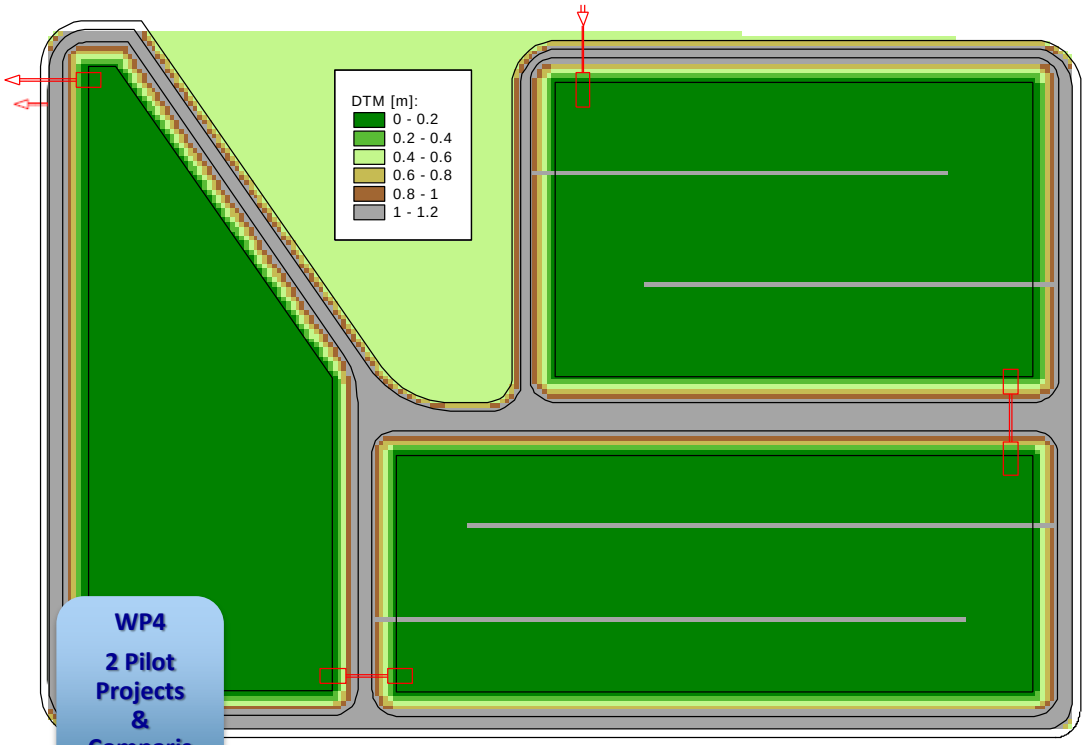
WP4
2 Pilot Projects & Compariso n

Korba: upgrade of the WWTP – Tender Process (it is in its Evaluation Phase)

Numerical study for the evaluation of the ponding system's effluent quality of the Korba WWTP

Evaluate the effect of the baffles and of the sand filtration on the quality (physical-chemical and microbiological) of the effluent from the ponding system of the Korba (Tunisia) wastewater treatment plant (WWTP).

At present the secondary effluent of the WWTP is sent directly to the ponding system



WP4

2 Pilot Projects & Comparison

	V1	V2
Capacity [m^3]	8116	8675
Water height [m]	1	1
Total area [m^2]	8400	9000
Lenght [m]	114	148
Height [m]	74	61
Digital model's cell	1080	1122

WP5

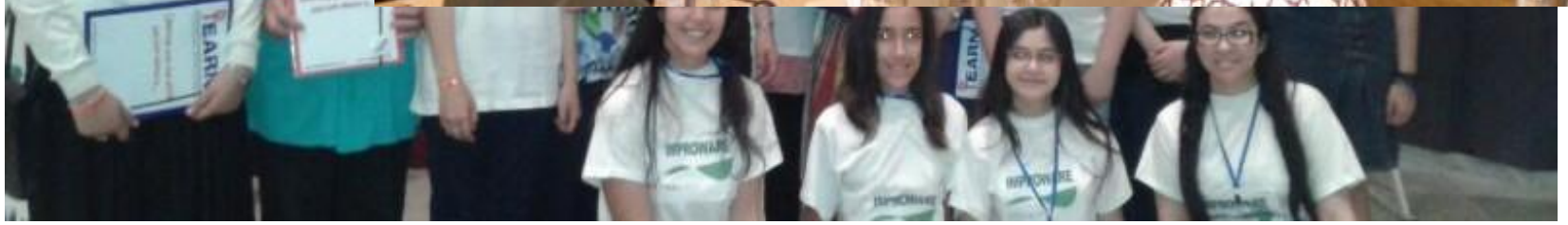
Involvement of Local Stakeholders, Communication, Capacity Building

Policy & Dissemination

Implementation Processes – Soft Activities

Any Drop of Water

WP5



WP5

Involvement of Local Stakeholders, Communication, Capacity Building

Policy & Dissemination

Implementation Processes – Soft Activities Any Drop of Water

30 Public Participation events

3 Main Appointments

- 2 held in Tunisia, (april & october 2014)
- 1 (to be held in Egypt first February 2015)

2 20days learning by doing in-field on TEM systems

2 Technical Seminars held on Geophysical Investigations

2 E-learning Courses held

1 E-Learning (to be held)

3 Policy Briefs (in preparation)

WP5

Involvement of Local Stakeholders, Communication, Capacity Building

Policy & Dissemination

Egypt

Stakeholders directly involved in WP5 Activity in Egypt (up to October 2014): 200

Participatory Communication Strategy: 90

- High Level Stakeholders meeting: 25
- Policy Makers: 20
- Local NGOs: 25
- Local industries: 20

Capacity Building

- School Students: 60 directly involved in the activity;
- Local-based training: 25
- EEAA: 20
- Local women: activity ongoing

Workshops and communication events in Egypt (done and planned): 15

High level Working Group sessions in Cairo: 5

Steering Committee in Nobariya (EEAA and Authority): ongoing

WP5

Involvement of Local Stakeholders, Communication, Capacity Building

Policy & Dissemination

TUNISIA

Stakeholders directly involved in WP5 Activity in Tunisia (up to December 2014): **1.500**

Participatory Communication Strategy:

-Institutional: 80

-Local Farmers: 150/170

-Local NGOs involved: 2

-Local citizens involved in WSs: 750

Capacity Building

-School Students: 500/600 directly involved in the activity;

Up to December 2014 Numbers of:

Workshops in Tunisia: 9

Awareness Campaign: 6

Dissemination

Dissemination, Replication & Sustainability

1) MODELLING Cost-effective, environmental-friendly, easily-replicable methodologies to treat waste waters and to use these to recharge aquifers developed as "pilot" models

IMPROWARE aims to **highlight practices and replicable models**, by the realization of **optimal "low cost technologies and techniques**", availing of:

- Construction of **two technical models** as **best practices** of **tertiary** treatment;
- Definition of an **operational model**, identifying the factors that need to be integrated.

2) Planning and management skills improved at sub-regional and regional level; (in connection with the policy briefs)

3) Know-how transferred

- Technical Guidelines on the adopted operative model:
  - Maintanence of the plants
  - Comparison between the two realized technical models (Korba a Nobariya)
  - Comparison between inlet and outlet plants data.

Dissemination

WP4

Comparison of the 2 sites

Also through South – South Dialogue

Any Drop of Water (Treat it, save it!) Policies and Techniques for A Sustainable Present

International Symposium Tunis (1-3 October 2014)

Results and Lessons

Sustainability of the outcomes

Our answers to the issues of future sustainability have been:

Egypt

- A high Level working group organized in Cairo (a sort of Egyptian steering Committee)
- A permanent Steering Committee that will be started in Nobariya
- Leverage effect: done by the Ministry of Housing and he Authority of Nobariya: light figures but showing proactiveness.

Tunisia

- We are still to find a way to cope with the needed coordination between ONAS and DGRE of the Ministry of Agriculture to cooperate for the sake of the project and the future of Korba site.
- ONAS is still positive in leaving a third party to organize and indipendent sampling on the water quality.
- Leverage effect: 275.000 Eur of unexpected co-financing from ONAS that will remain out of the scope of IMPROWARE.

Results and Lessons

Results and Lessons

Developed Model for increase the water availability for agricultural activities

In Egypt:

- Identification of the water demand, irrigation system and type of plants to be sown;
- Irrigated area divided in three parts for comparison:
  1) Cultivation with tertiary treated water
  2) Cultivation with well water
  3) Cultivation with secondary treated water
- Economic analysis of operative and investment costs for the three assumptions and analysis of the results;
- Sustainability Assessment
- Comparison with existing legislation.

Results and Lessons

Results and Lessons

Developed models to increase Water availability for agricultural activities

In Tunisia:

- Cost Analysis for treatments implemented (baffles and sand filtration);
- Monitoring analysis before and after the upgrade;
- Assessment of increasing of the available treated water and study the effect of treated water reused for groundwater reinjection;
- Restoration of the infiltration ponds in Korba.

Results and Lessons

Developed Soft & Adaptive STRATEGIES

IMPROWARE has adopted an **Adaptive Strategy Approach**. The methodological points provided and programmed by the IMPROWARE partners was to leave an adequate space for a possible re-programming, considering the countries situation, and in particular considering the inputs that **participatory approach** would have carried out**.**

It was successful.

IMPROWARE - Added Values Achieved: Participatory Approach

Results and Lessons

Methodological Added Values

- One of the core IMPROWARE objectives has been to involve in an extensive **Participatory Approach** affected communities and stakeholders in the decision-making process on the main issue of water treatment and possible use of non-conventional water, in order to actually shift the Project "ownership" to the Local community.
- This model has been tested in several ways in Egypt and Tunisia, and - with regard to Korba and Nobariya - it has been an unprecedented experience. This allowed several bottom-up actions directly inspired to the principles of the **Aarhus Convention**.

- It was successful.

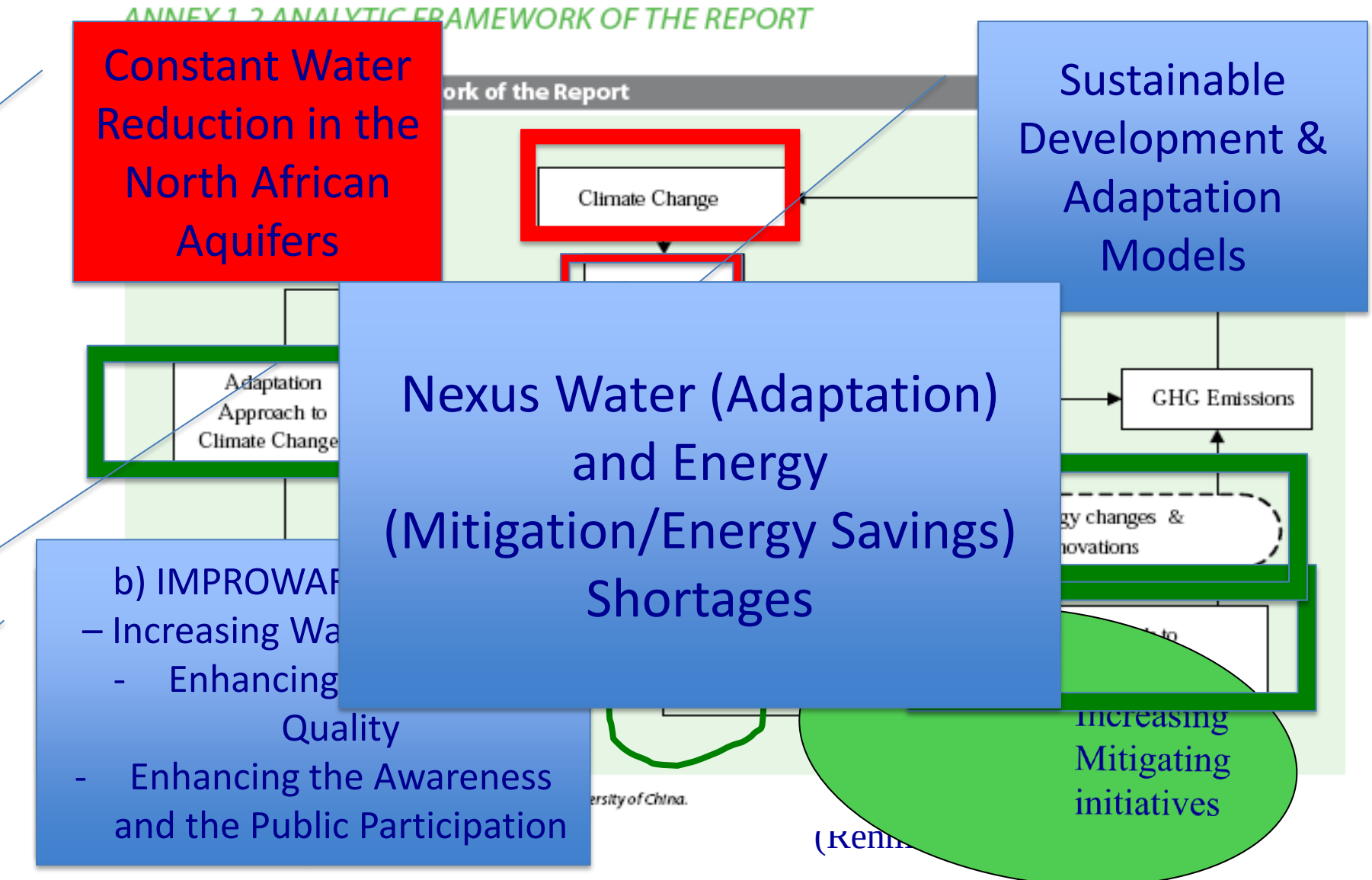
Adaptive Strategy Outcome

Results and Lessons

A sampling point (indipendent) in Korba aimed to test the Water Quyality

Between Korba WWTP and the recharge system will set-up a sampling point in the pipe which transports water from the WWTP to the recharge system. The sampling point will be used for monitoring activities (e.g. with automatic sampler for monitoring physical chemical parameters and a sampling point suitable for monitoring microbiological quality). The monitoring point will be available to third parties that will be identified accordingly between ONAS and DGRE (e.g. a local NGO or an third authority).

MODELS DEVELOPED: Human Development and Adaptation also as NEXUS Water-Energy on the TWW - Analytical Model



Constant Water Reduction in the North African Aquifers

Sustainable Development & Adaptation Models

Nexus Water (Adaptation) and Energy (Mitigation/Energy Savings) Shortages

b) IMPROWAR
– Increasing Wa
- Enhancing
Quality
- Enhancing the Awareness and the Public Participation

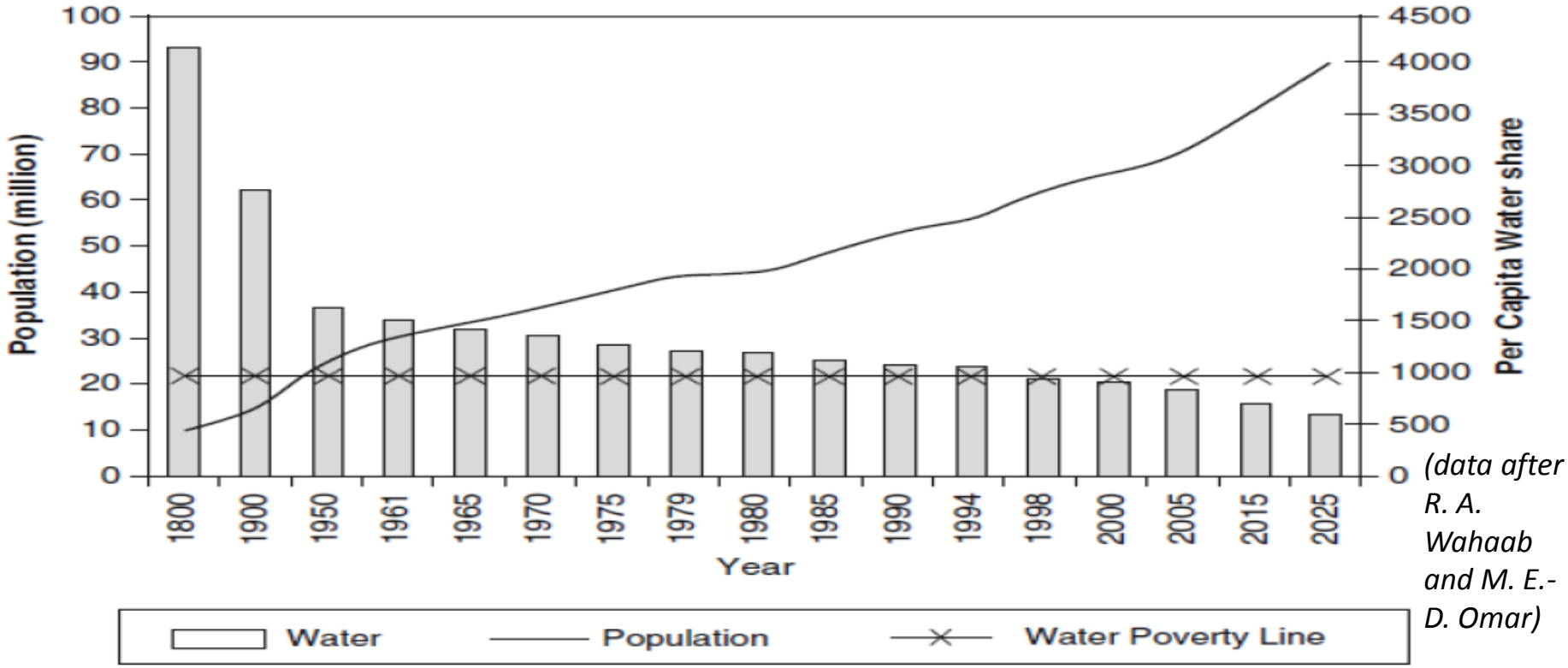
Conclusions and the way Forward

Conclusions & the Way Forward Of IMPROWARE

Water availability in North Africa

- North Africa assists to the continuous decrease of water availability, due to a reduction of the natural recharge of aquifers as a consequence of climate change and the growth of population (and hence water need).

Population growth and per-capita water share in Egypt in m3/yr.



(data after R. A. Wahaab and M. E.-D. Omar)

1) Main Insights in Research

Conclusions and the way Forward

In order to enhance the Decision Making regarding TWW we need:

- the definition of a **technical protocol** for the Environmental Impact Assessment on the use of TWW for aquifer recharge (e.g., hydrogeological characterization of the site by direct tests and geophysical surveys, in-situ water and TWW characterization, predicting the TWW fate into the subsurface by modelling, monitoring network, etc).
- definition of proper **indices** for the TWW in order to define the methodology (e.g., farmland irrigation, surficial infiltration by ponds, subsurface recharge by wells) more suitable for its reuse in the context of natural fresh-water saving.

2) Main Insights in Practices

Conclusions and the way Forward

In the future we would intend **utilizing all the IMPROWARE operational models** for:

- development of **innovative constructed wetlands** to couple secondary effluent refining and commercial plant production;
- development of suitable advanced treatments trains for secondary effluent refining and reuse for **reinjection** in safe conditions.
- **introducing the spread of the Energy Efficiency** element in the Egyptian WWTP plants**.**

Wherever there are no WWT Plants also we think to:

- development of suitable treatments for wastewater treatment and reuse for **small rural communities**.

We think to deepen water-energy nexus in Egypt, Tunisia (and/or other med countries) for:

- potential **energy savings** in different parts of water cycle (water abstraction, water treatment and supply, wastewater treatment) and potential water savings (e.g. due to water loss or in agriculture).

3) Main Insights from general point of view

- Set-up of treatment suitable for obtaining reclaimed wastewater at a required quality level and at sustainable costs for end-users.
- Fate of contaminants contained in RECLAIMED WW (Nobariya and the yeast);
- Long-term effect of RECLAIMED WW

Approach to SWIM and Wastewater treatment and reuse must take into account a number of **barriers on the way, such as**:

- Existing infrastructures
- Strengthening the coordination between different competent authorities
- Land availability
- Social acceptance
- Regulatory barriers
- Financial barriers and Tariffs

Conclusions and the way Forward

4) Main Insights on Artificial Recharge

The long-term objective of providing North Africa with Artificial Aquifer Recharge systems depends on internal political choices and also on EU (and other international players) options.

Currently Artifical Recharge could remain **as a substantial reminder** of the necessity of the susbstantial effort of constant and gradual **Removal of the Barriers to the Sustainable Integrated Water management models** that should be secured by all the local water stakeholders working in-the-field, public, private, scientific community, civil society.

At least the AAR should be considered **a long-term objective** that establishes an optimistic horizon: it is to be considered the ultimate goal of the entire Water Cycle.

Barriers should be removed to make the reclaimed wastewater reuse be part of the **adaptation strategy** to cope with climate change and increase resilience.


Ciao!

IMPROWARE's Consortium

Consor

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CUEIM

CURSA
Consorzio Universitario per la Ricerca Socioeconomica e per l'Ambiente

Sustainable Water Integrated Management (SWIM) - Support Mechanism

Project funded by the European Union

Water is too precious to waste

IMPROWARE

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