MADFORWATER

Ayman Youssef, Ph.D

Associate Professor of Water Quality & Microbiology

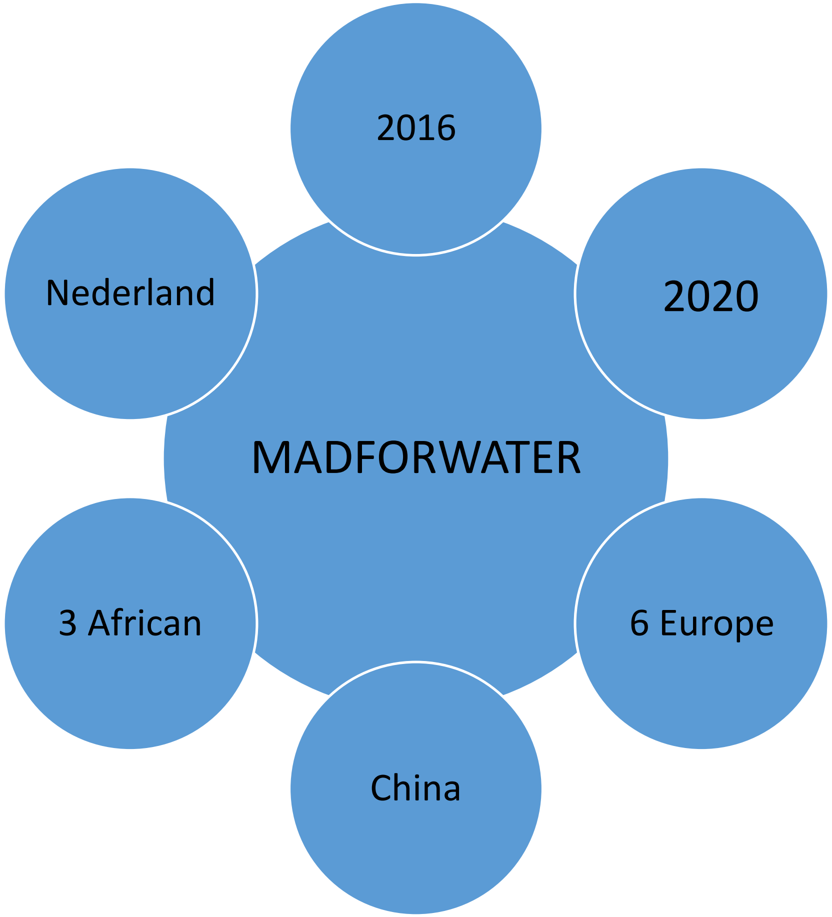
CLEQM, NWRC

DevelopMent AnD application of integrated technological and management solutions FOR wasteWATER treatment and efficient reuse in agriculture tailored to the needs of Mediterranean African Countries (MADFORWATER)

تطبيق الحلول التكنولوجية والإدارية المتكاملة لمعالجة مياه الصرف وإعادة استخدامها بكفاءة في الزراعة مصممة خصيصا لتلبية احتياجات البلدان الأفريقية من دول البحر المتوسط

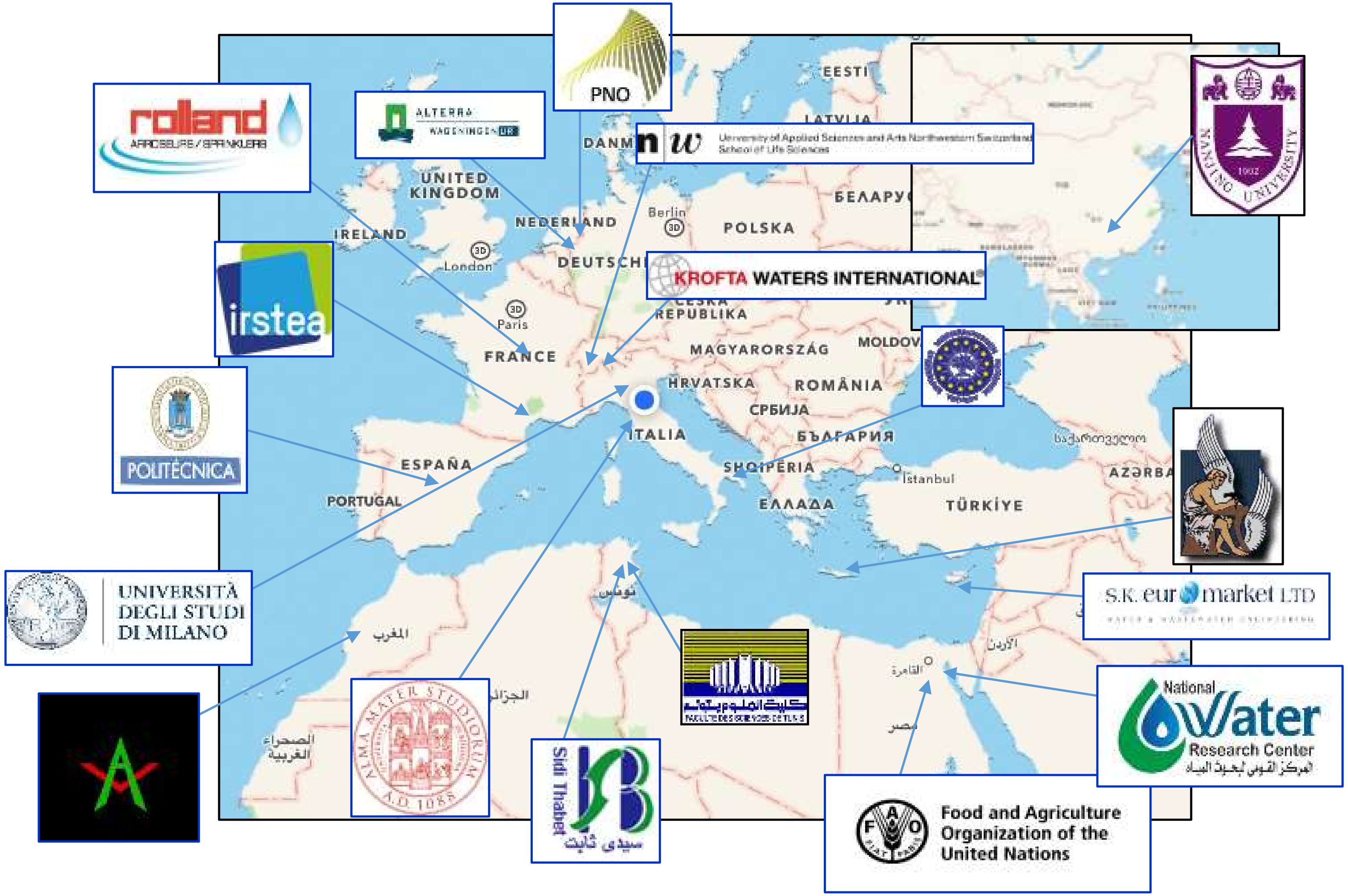
Introduction

- Europe calls
- FP7
- Horizon 2020



The Madforwater Consortium

- 18 partners: 13 research insitutions, 4 SMEs, 1 international organization (FAO)
- 11 countries
- 5 partners from North Africa



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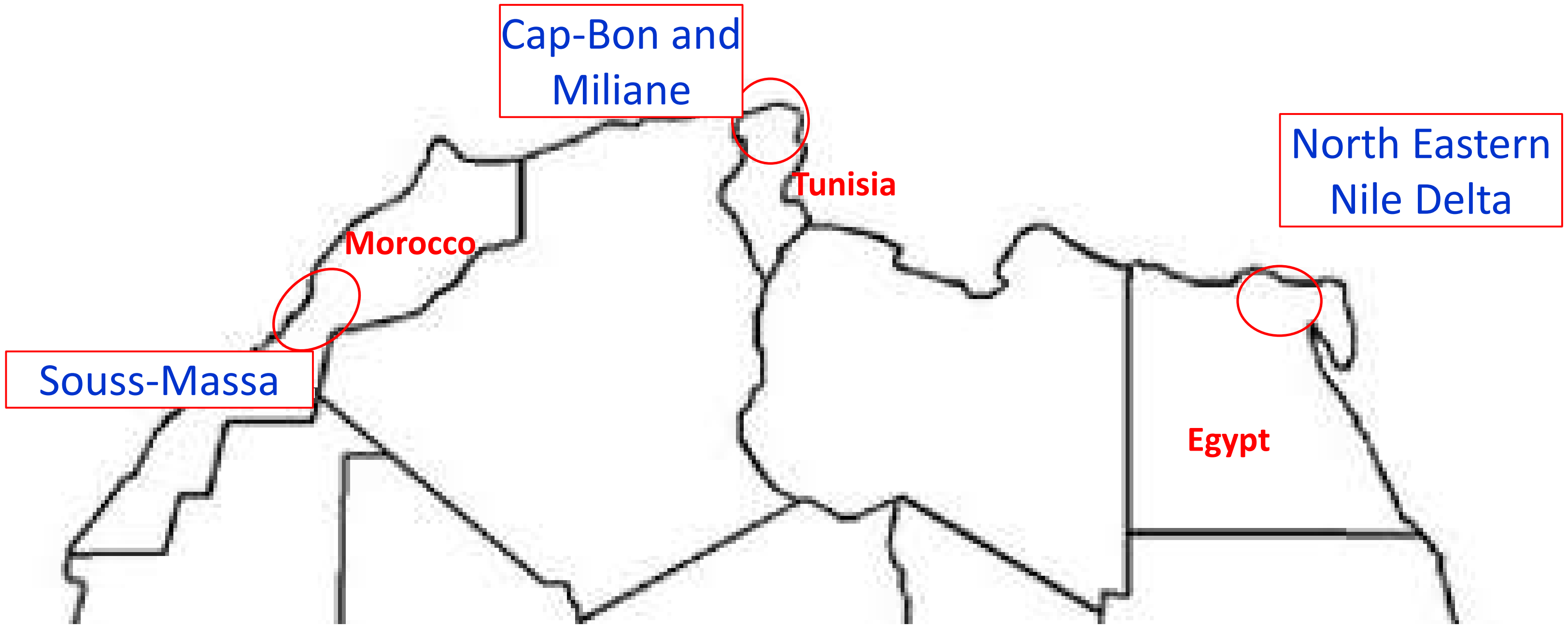
The selected basins



يتطلع مشروع MADFORWATER إلى تحقيق أهداف الدعوة التي وجهها الاتحاد الأوروبي هورايزن ٢٠٢٠ للعمل على موضوع المياه ٥C-2015، من خلال التركيز على تطوير الحلول التكنولوجية وغير التكنولوجية لإدارة الموارد المائية في تونس والمغرب ومصر. على مدى السنوات الأربع المقبلة، سيعمل الشركاء في مشروع MADFORWATER على تطوير الحلول التكنولوجية والإدارية التي تركّز على معالجة مياه الصرف وإعادة استخدامها بكفاءة في الزراعة في شمال أفريقيا، كما وسيعملون على تكييفها بحسب الدول. بذلك، ستتمكن التكنولوجيات الجديدة المتقدمة التي سيتم تكييفها مع السياق الاجتماعي والتقني في الدول الثلاث المعنيّة، من إنتاج مياه صالحة للري إنطلاقًا من مياه الصرف المدنية والصناعية وكذلك من مياه قنوات الصرف. وفي موازاة ذلك، سيطوّر مشروع MADFORWATER تكنولوجيات جديدة تساعد في تحسين إستعمال المياه وإعادة استخدامها في الزراعة. وسيساعد التعاون الوثيق مع الجهات الفاعلة وأصحاب المصالح المحليين في إيجاد وتنسيق الحلول المقترحة آخذين بعين الإعتبار السياق المحلي. ويهدف المشروع إلى التأثير إيجابيًا على المدى الطويل في مصر والمغرب وتونس، على مجال معالجة مياه الصرف وإعادة استخدامها، وبالتالي تحسين الإنتاج الزراعي والحد من استغلال احتياطيات المياه وتلوثها.

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The Madforwater 3-phase strategy:

1) Analytical phase

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Development of tools to enhance the capacity to analyse water stress and vulnerability in Tunisia, Egypt and Morocco, as well as their impact on food security and socio-economic development

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2) Technological phase

a) Lab-scale development of technologies for wastewater treatment and efficient wastewater reuse in agriculture, and technology adaptation to Tunisia, Egypt and Morocco (completed)

b) Scale-up and validation of selected technologies in 4 demonstrator plants to be installed in Tunisia, Egypt and Morocco (plants construction in progress; start up in March-April 2019)

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The Madforwater 3-phase strategy:

3) Implementation phase

a) Development of sustainable water management strategies for 3 hydrological basins in Egypt, Morocco and Tunisia

b) Industrial exploitation activities (business plans for the MADFORWATER SMEs)

c) Capacity building activities

d) Policy recommendations

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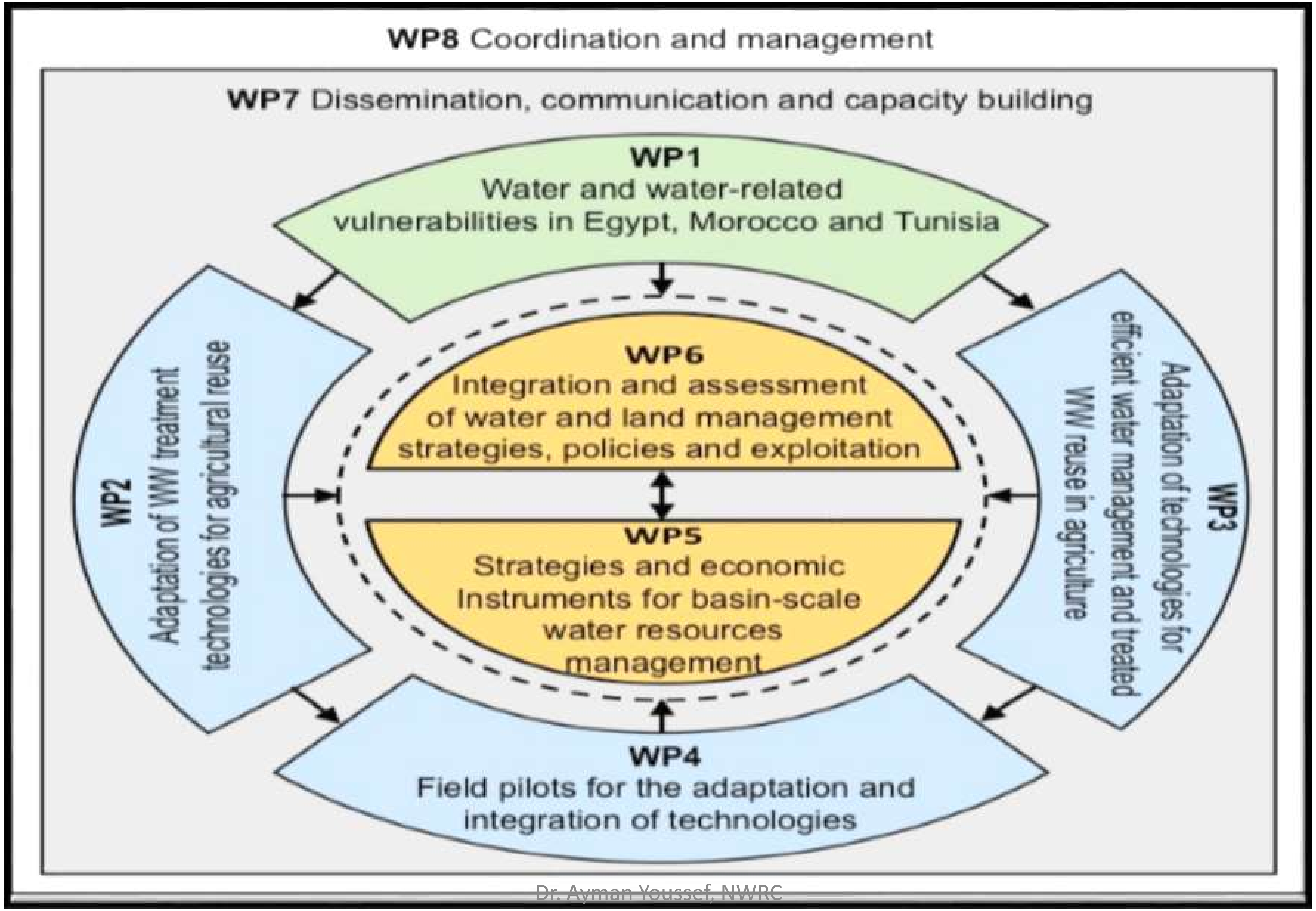
work packages



تقسيم العمل بالمشروع

- **مجموعة العمل ١: المياه ونقاط الضعف المتعلقة بالمياه في مصر والمغرب وتونس**

تحليل وضع المياه ونقاط الضعف المتعلقة بالمياه في البلدان المتوسطية الافريقية على المستوى القطري بطريقة متكاملة من خلال تقييم نوعي وكمي يكون أكثر تعمقًا في الأحواض الثلاثة المعنية.

- **مجموعة العمل ٢: تكيف التكنولوجيات معالجة مياه الصرف لإعادة استخدامها في الزراعة**

تطوير التكنولوجيات وتكيفها على مقياس مختبري لمعالجة مياه الصرف المدينية والزراعية-الصناعية والصناعية. سيتم تكييف أحدى عشرة تكنولوجيا مع الظروف المحلية؛ كما سيتم فحصها وتقييمها من حيث الأداء وتقييم دورة الحياة والتكاليف والفوائد والقبول الاجتماعي في البلدان المستهدفة.

- **مجموعة العمل ٣: تكيف التكنولوجيات لإدارة المياه بكفاءة وإعادة استخدام مياه الصرف المُعالجة في المجال الزراعي**

تطوير التقنيات وتكيفها على مقياس مختبري لإعادة استخدام المياه بكفاءة في الري. سيتم تكييف ست تكنولوجيات مع الظروف المحلية؛ كما سيتم فحصها وتقييمها من حيث الأداء وتقييم دورة الحياة والتكاليف والفوائد والقبول الاجتماعي في البلدان المستهدفة.

تقسيم العمل بالمشروع

- **مجموعة العمل ٥: الاستراتيجيات والأدوات الاقتصادية لإدارة الموارد المائية على نطاق الأحواض**

استعراض وتقييم الاستخدام الحالي للأدوات والسياسات الإقتصادية في مجال إدارة المياه في مصر والمغرب وتونس؛ تطوير أدوات دعم القرار المتاحة للجميع التي ستشمل الأدوات الاقتصادية والتنظيمية لتعزيز طرق تنفيذ التكنولوجيات MADFORWATER؛ تطوير استراتيجيات إدارة مياه الصرف وإعادة استخدام المياه وكذلك، إدارة المياه والأراضي في المجال الزراعي. تم تصميم هذه الاستراتيجيات خصيصًا للأحواض الثلاث المعينة.

- **مجموعة العمل ٦: تكامل استراتيجيات إدارة المياه والأراضي وتقييمها وتوصياتها وسياساتها واستغلالها**

وضع التوصيات المتعلقة بالسياسات لتشجيع اعتماد التكنولوجيات المقترحة والاستراتيجيات المتكاملة في البلدان المستهدفة؛ تطوير مبادئ توجيهية تهدف إلى تمكين تكيف الأدوات وتكنولوجيات المشروع وتنفيذها؛ تطوير خطط الأعمال للاستغلال التجاري في البلدان المتوسطية الافريقية المستهدفة، فضلًا عن استراتيجية استغلال صناعية عامة، تستهدف مجال المياه والري الأوروبي.

- **مجموعة العمل ٧ : النشر والتواصل وبناء القدرات**

وضع وتنفيذ تدابير نشر وتواصل واستغلال ترتكز على بث إمكانات المشروع ورفع مستوى الوعي بين جميع أصحاب المصالح وضمان تأثير المشروع بعد انتهائه، بما في ذلك بناء القدرات وإشراك أصحاب المصالح.

- **مجموعة العمل ٨ : الإدارة والتنسيق**

أنشطة الإدارة والتنسيق، بما في ذلك إدارة الشؤون الإدارية والمالية وإعداد التقارير.

الاجتماع الرابع في يونيو ٢٠١٨ بلاتنيا – كريت - اليونان

الأهداف:

- مراجعة ما تم الاتفاق عليه بالاجتماعات السابقة
- عرض ما توصل اليه كل فريق في الشهور الماضيه
- الاتفاق على ما سيطبق في المغرب وتونس ومصر في التجارب الحقلية
- تحديد الخطوط العريضه للاجتماع القادم

Summary

Wastewater Treatment

- Municipal
- Textile
- Fruit package
- Drainage canal

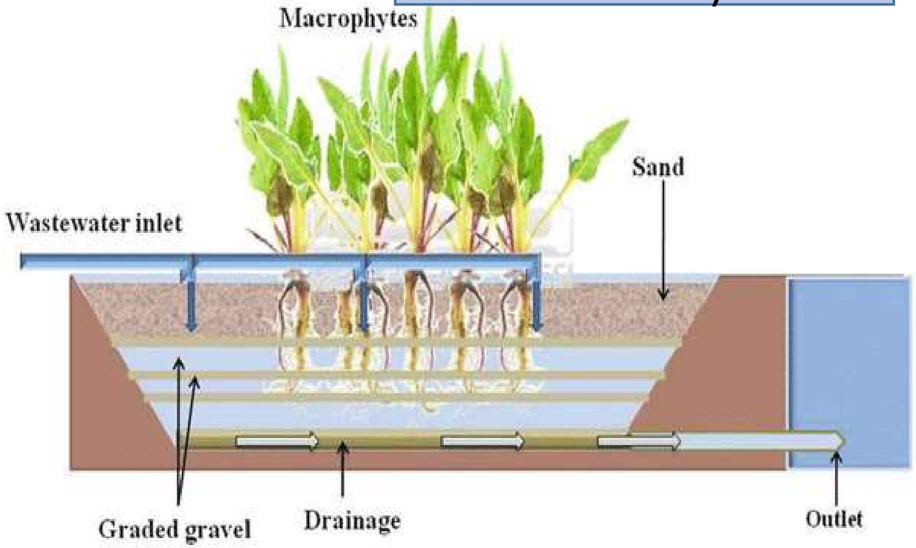
Irrigation Technology

- Mini-sprinkler (droplets)
- Calibrated Nozzles
- Modernization of surface irrigation (OptGate)
- Plant growth promoting Bacteria

Wastewater treatment technologies selected for scale-up:

Municipal wastewater

Innovative nitrifying trickling filters (BOD, N) → Sedimentation → Constructed wetlands (pharmaceuticals, metals)



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- **Demonstrator n. 1: Municipal Waste Water WW treatment section (code: 1-WW)**

Demonstrator n.	1-WW
Type of activity	WW treatment
Type of WW	Municipal
Country	Tunisia
Location	Chotrana 2 WWTP
Selected treatment train	➢ Nitrifying trickling filter ➢ Secondary settler ➢ Constructed wetland (proposed, to be confirmed by SKE) ➢ Chemical disinfection ➢ Final tank to store the treated WW; the irrigation pump will take water from this tank
Roles of partners	SKE: in charge for designing, constructing and installing the plant, including the final tank to store treated WW, and for the required plant maintenance UMA: in charge for the monitoring activity
Timing	March 2019 → equipment delivered to the site and installed April 2019 → plant start-up
Monitored parameters	Flow rate, COD, BOD, NH3, NO3-, Total N, P, TSS, Fecal coliforms, Intestinal nematodes, Metals, Viruses

Wastewater treatment technologies selected for scale-up:

Textile wastewater

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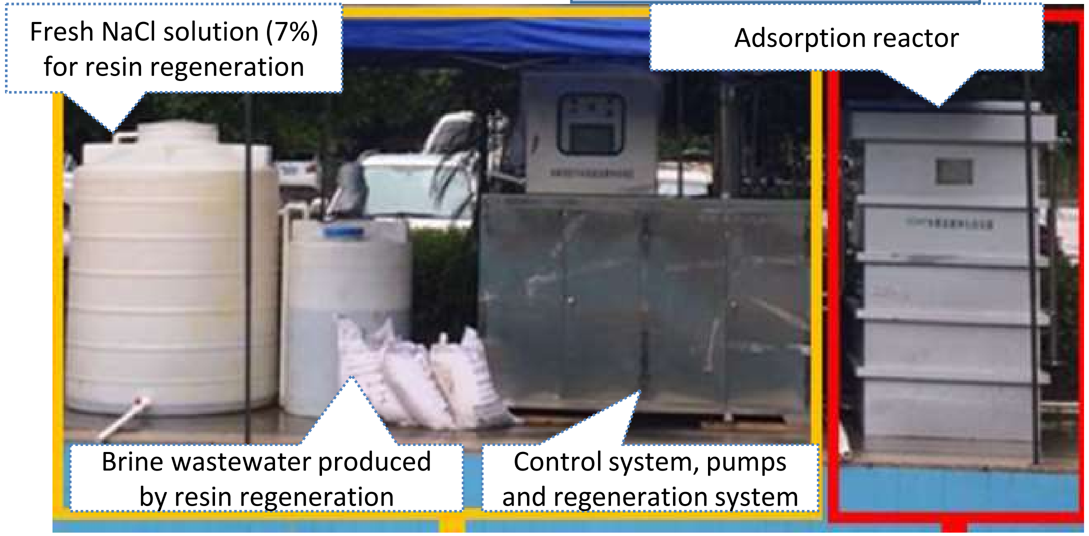
Anaerobic / aerobic moving bed biological reactor (BOD, N, dyes) → Coagulation / sedimentation (dyes) → Adsorption on innovative resins (dyes)



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Demonstrator n. 2: Textile wastewater WW treatment section (code: 2-WW)

Demonstrator n.	2-WW
Type of activity	WW treatment
Type of WW	Textile
Country	Tunisia
Location	Nabeul, G-Tex textile industry, Tunisia
Selected treatment train	➢ Coagulation / flocculation ➢ MBBR ➢ Dye adsorption on non-magnetic resins ➢ Final tank to store the treated WW; the irrigation pump will take water from this tank ➢ Sludge drying beds on gravel The plant will be designed so as to allow the possibility to: a) bypass the coagulation/flocculation unit, b) place the coag/flocculation unit after the MBBR. Since TWW is generally poor in N and P, the plant will also need a dosing system to supply N and P as necessary.
Roles of partners	SKE: in charge for designing, constructing and installing the plant, , including the final tank to store treated WW, and for the required plant maintenance UTM: in charge for the monitoring activity
Timing	March 2019 → equipment delivered to the site and installed April 2019 → plant start-up
Monitored parameters	Flow rate, COD, BOD, NH_3, TSS, Fecal coliforms, Intestinal nematodes, Dyes, Metals

Wastewater treatment technologies selected for scale-up:

Fruit packaging wastewater

Flotation / flocculation (fungicides, suspended solids) → Aerobic moving bed biological reactor → Adsorption on activated carbon (fungicides)

Demonstrator n. 3: fruit and vegetable packaging wastewater
WW treatment section (code: 3-WW)

Demonstrator n.	3-WW
Type of activity	WW treatment
Type of WW	Fruit and vegetable packaging
Country	Morocco
Location	Kabbage company, Taroudant, Morocco
Selected treatment train	➢ MBBR + supply of activated carbon ➢ Coagulation / flotation ➢ Disinfection with UV lamp ➢ Final tank to store the treated WW; the irrigation pump will take water from this tank ➢ Sludge drying beds on gravel
Roles of partners	KWI: in charge for designing, constructing and installing the plant, and for the required plant maintenance IAV: in charge for the monitoring activity
Timing	?? → equipment delivered to the site and installed ?? → plant start-up
Monitored parameters	Flow rate, COD, BOD, NH3, NO3-, TSS, Fecal coliforms, Intestinal nematodes, fungicides

Wastewater treatment technologies selected for scale-up:

Drainage canal water

In the Nile Delta, drainage canals are largely used for irrigation and contain a mixture of:

- drainage water recycled from the irrigated fields
- untreated or partially treated municipal WW
- untreated or partially treated industrial WW

Sedimentation & lagooning (BOD, N, P, suspended solids) → Constructed wetlands (BOD, N, P, pathogens)

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Demonstrator n. 4: drainage canal water Water treatment section (code: 4-WW)

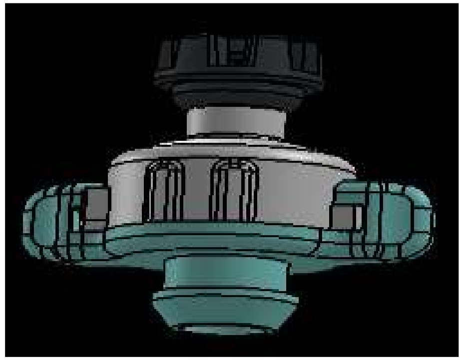
Demonstrator n.	4-WW
Type of activity	Water treatment
Type of WW	Drainage canal water (DCW)
Country	Egypt
Location	Lake Manzala Experimental Station, Egypt
Selected treatment train	The technology that UNIBO is developing for DCW (canalized lagoons) needs to be integrated by other technologies, in order to develop a robust and effective treatment process. Therefore, UNIBO and NWRC agree to integrate the lagooning technology into the DCW treatment pilot plant on which NWRC has been working during the first 2 years of project activity (the Lake Manzala Engineered Wetland Project, or LMEWP). The DCW demonstrator will therefore include a combination of sedimentation, lagooning and wetland. In particular, a portion of the LMEWP will be modified and utilized as MADFORWATER demo. The actual details of the tested treatment train(s) will be defined by UNIBO and NWRC by the end of September 2018 and specified in Deliverable 4.1.
Roles of partners	NWRC & UNIBO: in charge for the joint designs of the demo NWRC → in charge for constructing and installing the plant, for the required plant maintenance and for the monitoring activity
Timing	The timing will be defined by the end of September 2018.
Monitored parameters	Flow rate, COD, BOD, NH_3, total N, TSS, Fecal coliforms, Intestinal nematodes, viruses.

Irrigation technologies (1)

Mini-sprinkler adapted to dry climates and treated wastewater

- **Objective** → to develop a low-cost mini-sprinkler that:
  - thanks to the production of droplets in the 0.5-2.5 mm range, minimizes pathogen dissemination due to aerosols issued from the smaller droplets
  - minimizes water loss by evaporation, thanks to the control of droplet size
  - resists to the potential clogging related to the use of treated wastewater
- The control of the particle size distribution is achieved through the combination of nozzle size, defector's canal shape and rotation velocity.

Irrigation technologies (2)



Calibrated nozzle for localised irrigation, adapted to dry climates and treated wastewater

- **Objective** → to develop an emitter, alternative to drip irrigation emitters, capable to operate with treated wastewater with just a rough filtration at 1 mm size.
- This characteristic is obtained by a high discharge rate (1-4 L/min), that prevents any deposit in the emitter that may lead to clogging and decrease the distribution uniformity and hence the irrigation efficiency.
- The high discharge rate, that may result in runoff, is balanced by the capacity of the emitter to operate for short cycles (typically one-minute frequent pulses), to deliver the required irrigation volume.

Irrigation technologies (3)

Modernisation and increased efficiency of traditional surface irrigation in Egypt

- **Objective** → to convert Mesqas and Marwas (open irrigation channels) into optimized pressurized pipes, equipped with hydrants that supply water to downstream gated pipes, provided with calibrated nozzles and feeding fields furrows.
- This distribution system allows to maintain in the long term water delivery efficiency, to reduce drainage volumes and therefore, to improve water quality in favor of a greater quantity of fresh water available upstream.
- To minimize energy and maintenance cost, the localized system design was adapted to operate at low pressure (around 0.5 bar). The high discharge rate of the proposed nozzles largely reduce emitters fouling and clogging, problems commonly encountered when irrigating with poor water quality.

Irrigation technologies (4)

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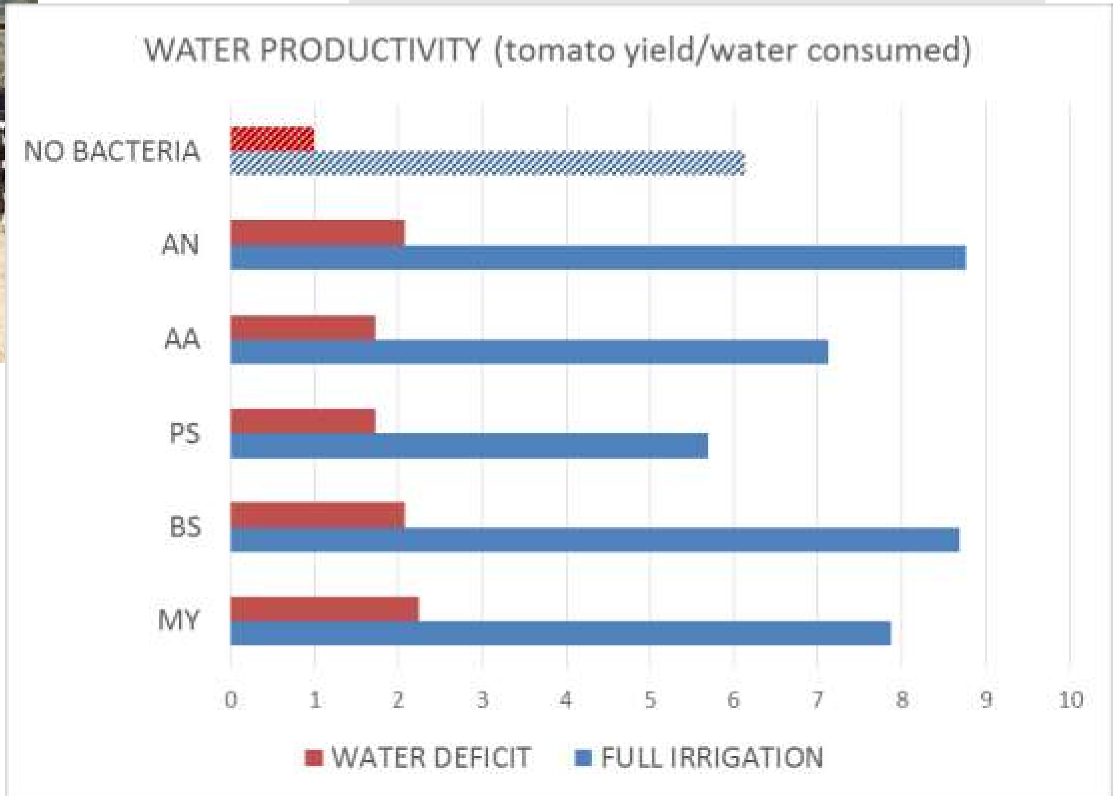
PLANT GROWTH PROMOTING BACTERIA TO ENHANCE CROP RESISTANCE TO WATER SCARCITY

International Centre for Advanced Mediterranean Agronomic Studies (Bari)

- ✓ Tomato (var. Camone)
- ✓ Control plants not bacterised were compared to plants supplied with 5 selected PGP bacterial strains, added to the soil surrounding roots

- ✓ Full irrigation
- ✓ 75% deficit irrigation
- ✓ 50% deficit irrigation



→ 4 strains significantly increased water productivity (kg tomatoes / m^3 water) both in the case of full irrigation and severe deficit irrigation

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Irrigation section (code: 1-IRR)

Demonstrator n.	2-IRR
Type of activity	Irrigation
Type of WW	Textile
Country	Tunisia
Location	G-Tex textile company, Nabeul
Field surface	2500 m2
Selected crop	Corn from April to October Oat from October to May
Irrigation technology 1	Calibrated nozzle. 1 nozzle every 2 corn plants. In the optimistic hypothesis that Rolland will be able to produce a mold by December 2018 / January 2019, the entire field will be irrigated with the innovative nozzle. If the mold will not be available by that time, Rolland will provide 16 innovative nozzles for this irrigation pilot, that will be compared to commercial nozzles in the rest of the field.
Experimental scheme	32 plants (= 16 nozzles) for each experimental condition. Variables: treated TWW / freshwater; innovative nozzle / commercial nozzle → 3 experimental conditions (tTWW + innov. nozzle; tTWW + commercial nozzle; freshwater + commercial nozzle); 32 x 3 = 96 plants; 16 innovative nozzles + 32 commercial nozzles are required.
Roles of partners	Rolland → in charge for designing, constructing and installing the irrigation network, and for the periodic maintenance of such network UTM → in charge for planting the crops, monitoring the irrigation process, evaluating the crop yield and other performance parameters.
Timing	March 2019 → equipment delivered to the site and installed April 2019 → crops planted, start of irrigation & monitoring
Monitoring parameters	Crop parameters: - Crop production yield (kg_{crop}/ha) - Water productivity (kg_{crop}/m3 water supplied) Irrigation parameters: - water volume supplied daily - homogeneity of the flow rate measured at the different nozzles of a same pipe

Irrigation section (code: 3-IRR)

Demonstrator n.	3-IRR
Type of activity	Irrigation
Type of WW	Fruit & vegetable packaging
Country	Morocco
Location	Kabbage company, Taroudant
Field surface	… m2
Selected crop	Citrus trees → which type exactly?
Irrigation technology 1	Mini sprinkler. 1 sprinkler for each tree. In the optimistic hypothesis that Rolland will be able to produce a mold in time, the entire field will be irrigated with the innovative sprinkler. If the mold will not be available, Rolland will provide 16 innovative sprinklers for this irrigation pilot, that will be compared to commercial sprinklers in the rest of the field
Experimental scheme	16 plants (= 16 nozzles) for each experimental condition. Variables: treated FVPWW / freshwater; innovative sprinkler / commercial sprinkler / existing drip irrigation; SIM irrigation / traditional irrigation → the following experimental conditions will be tested: treated WW innovative sprinkler SIM treated WW commercial sprinkler SIM treated WW commercial sprinkler no SIM freshwater commercial sprinkler SIM freshwater commercial sprinkler no SIM freshwater existing drippers no SIM Total: 6 thesis x 16 trees = 96 trees
Roles of partners	Rolland → in charge for designing, constructing and installing the irrigation network, and for the periodic maintenance of such network IAV → in charge for monitoring the irrigation process, evaluating the crop yield and other performance parameters, applying the irrigation modeling software IAMB → in charge for the training on the use of the irrigation modeling software
Timing	?? to be defined after the meeting of July 18 There is a problem relative to the poor overlapping between WW production season (October to April) and irrigation season (February to September?) → it is agreed that irrigation will be performed with the FVPWW when the latter is produced, and with the plant's MWW during the other months
Monitoring parameters	Crop parameters: - Crop production yield (kg_{crop}/ha) - Water productivity (kg_{crop}/m3 water supplied) Irrigation parameters: - water volume supplied daily - homogeneity of the flow rate measured at the different sprinklers of a same pipe

Irrigation section (code: 3-IRR)

Demonstrator n.	**4-IRR**
Type of activity	Irrigation
Type of WW	DCW
Country	Egypt
Location	Lake Manzala NWRC experimental station
Field surface	4-5000 m2
Selected crop	Suger beets (winter) + Cotton (spring)
Irrigation technology 1	Gated pipe
Experimental scheme	About 1000 m2 (20 x 50 m), corresponding to 20 nozzles, will be dedicated to each experimental condition. Variables: treated DCW/ raw DCW; gated pipe/ traditional furrow irrigation. 4 experimental conditions: tDCW, gated pipe tDCW, traditional furrow irrigation raw DCW, gated pipe raw DCW, traditional furrow irrigation IAMB clarifies that the SIM model will not be applied in Egypt. The reason for this is that, according to the current irrigation practice in the Nile Delta, the amount of irrigation water to be supplied to each parcel, and the irrigation schedule, are decided by the irrigation authority. Therefore, the farmer cannot change or optimize the irrigation schedule decided for his parcels.
Roles of partners	Rolland → has already provided to IAMB the required calibrated nozzles IAMB → in charge for designing, constructing and installing the gated pipe, and for the periodic maintenance NWRC → in charge for planting the crops, monitoring the irrigation process, applying the irrigation modeling software and evaluating the crop yield and other performance parameters
Timing	To be evaluated by the end of September.
Monitoring parameters	Crop parameters: - Crop production yield (kg_{crop}/ha) - Water productivity (kg_{crop}/m3 water supplied) Irrigation parameters: - water volume supplied daily - homogeneity of the flow rate measured at the different nozzles of a same pipe - ratio of (drainage water collected) / (irrigation water supplied) for each experimental condition tested


Thank YOU