Work Package 2: Peer To Peer for Experience Sharing

P2P No.10: Focus Group on Treated Waste Water Reuse (TWWR)

Report on the "Standards for TWWR in Jordan, including golf courses, groundwater recharge and industrial use"

SWIM–Horizon 2020 Support Mechanism

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Version	Document Title	Author	Review and Clearance
V3	Report on the "Standards for TWWR in Jordan	Rifaat Abdel Wahaab (Non-key expert)	Suzan TAHA (Key Water Expert)

THE SWIM AND H2020 SUPPORT MECHANISM PROJECT (2016-2019)

The SWIM-H2020 SM is a Regional Technical Support Program that is funded by the European Neighbourhood Instrument (ENI) South/Environment. It ensures the continuation of EU's regional support to ENP South countries in the fields of water management, marine pollution prevention and adds value to other important EU-funded regional programs in related fields, in particular the SWITCH-Med program, and the Clima South program, as well as to projects under the EU bilateral programming, where environment and water are identified as priority sectors for the EU co-operation. It complements and provides operational partnerships and links with the projects labelled by the Union for the Mediterranean, project preparation facilities in particular MESHIP phase II and with the next phase of the ENPI-SEIS project on environmental information systems, whereas its work plan will be coherent with, and supportive of, the Barcelona Convention and its Mediterranean Action Plan.

The overall objective of the Program is to contribute to reduced marine pollution and a more sustainable use of scarce water resources. The Technical Assistance services are grouped in 6 work packages: WP1. Expert facility, WP2. Peer-to-peer experience sharing and dialogue, WP3. Training activities, WP4. Communication and visibility, WP5. Capitalizing the lessons learnt, good practices and success stories and WP6. Support activities.

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1 CONTEXT

As part of its overall workplan - under work package (WP2), the EU-funded "Sustainable Water Integrated Management & Horizon 2020 - Support Mechanism (SWIM-H2020 SM)" project implemented a Peer to Peer activity on one of its Priority Themes: "Treated Wastewater Reuse". The objectives of the Peer to Peer (P2P) activity, which involves direct exchange of experience between peers from relevant institutions in the beneficiary countries, are: The Coach/Peer also include references such as papers, report and web-links published at the national levels.

- Sharing expertise and guidance among Peers on a specific issue/ topic
- Boosting south-to-south (also north-to-south) cooperation
- Build the cornerstones for long-lasting relations and exchanges, as opposed to one time ad-hoc exchange.

The exchange within the P2P activity is normally focused around pressing/emerging issues of the beneficiary countries, which drove the identification of the focus group under the above mentioned priority theme following a matchmaking process between those countries requesting the expertise and those offering it. In this regard the following focus group has been identified as part of Treated Wastewater Reuse (TWWR) theme, together with the coach and the peers receiving the expertise and those offering it as per the following table:

Table 1. P2P-10 Focus Group: Sharing Experience in Treated Waste Water Reuse (TWWR)

Country Offering Expertise	Countries Receiving Expertise			Coach Information
Jordan	Egypt	Morocco	Algeria	
Eng. Mohammed al Kouz E-mail: Mohammed_alkoua@mwi.gov.jo Tel: +962798503408	**Eng. Dina M. Ali** Technical Office of East Delta Region (EPADP) Ministry of Water Resources & Irrigation (MWRI) E-mail: E.dinaali99@gmail.com Tel : +2-01016122817	**Mme. Jaouhar Touria** Chef de la Division Préservation de la Qualité de l'Eau et Lutte contre la Pollution à la Direction de la Recherche et la Planification de l'Eau, Email: jaouhar@water.gov.ma Tel.+212661-759741	**Mr. SIDHOUM Mohamed** Sous-Directeur du dessalement d'eau de mer Direction du dessalement de l'eau Ministère des Ressources en Eau et de l'Environnement E-mail: sidhoum.med@gmail.com Tél.: +213 663759618	**Dr. Rifaat Abdel- Wahaab** Sector Head (R & D), Holding Co. for Water & Wastewater E-mail: rawahaab@yahoo.com Tel:+2-012 70000585

2 PREVAILING ISSUES WITHIN THE FOCUS GROUP

Peers from both Egypt, Morocco and Algeria were asked to identify the imminent issues/questions pertaining to the focus group. A set of questions were submitted per each peer via email (beginning July 2018) and are summarised below. These questions were also discussed during the Peer-to-Peer session at the regional training workshop on Technical, Regulatory, Legal, and Cultural Aspects of Treated Wastewater Reuse (REG-8) that was held in Athens (23-24 July 2018)

Table 2. Issues Raised Per each Recipient Peer

Algeria (DZ)	Morocco (MO)	Egypt (EG)
The practice of treated wastewater reuse (TWWR) in agriculture wells is developed & regulated by laws & standards to produce suitable water for irrigation and to reduce pollution and the negative impacts of the discharge of untreated wastewater to the Mediterranean Sea. **DZ-1**: Regulations governing the use of treated wastewater for uses other than agriculture are not yet developed. **DZ-2:** The success of wastewater reuse projects are very much linked to the reduction of environmental & health risk	**MO-1:** Non-definition of a clear and precise responsibilities of government departments, agencies concerned and users in terms of mobilization, management of costs and monitoring the quality of treated wastewater; **MO-2:** Existing **restrictive wastewater reuse standards** in irrigation (of 2002), compared with WHO guidelines; **MO-3:** Lack of standards for the reuse of wastewater for certain uses, in particular the watering of golf courses, groundwater recharge and industrial re-use.	**EG-1:** Decentralized approaches to wastewater treatment and management: applicability in developing countries **EG-2:** Groundwater recharge with reclaimed municipal wastewater: health and regulatory considerations **EG-3:** Standards regarding biological and chemical loads of wastewater & salinity **EG-4:** Regulations for best practices for wastewater treatment and Irrigation techniques as well as regarding crops and areas to be irrigated. **EG-5:** High salinity concentration in wastewater. The most important criteria for evaluation of suitability of treated wastewater for irrigation use.

Based on the discussion during the workshop, the specific topics were grouped jointly with the participants as indicated in the following table:

Table 3. Proposed themes and grouping of specific topics

Proposed Theme	Applicable for	Priority
1. Jordan's experience in standards & Regulation focusing on crops irrigated with TWW.	MO-2	
2. Appropriate WWT technologies for reuse that removes physico-chemical & biological Parameters (including standards)	DZ-2, EG-3 & EG-4	Not applicable
3. The institutional framework/set-up for	MO-1	3[1]

[1]Request has been dealt within one of the SWIM-H2020 SM Expert Facility Activities: Activity number: EFS-MO-2 titled «Support the promotion of wastewater reuse by strengthening institutional, regulatory and financial aspects, as well as participatory approaches, incentives and awareness (In French: Appui

Proposed Theme	Applicable for	Priority
wastewater reuse.		
4. Standards for TWWR in Jordan, for other purposes especially for -golf courses, -groundwater recharge -industrial use	 DZ-1 MO-3 DZ-1, EG-2 MO-3 DZ-1, MO-3	 2 1 2
5. Criteria for evaluation of suitability of treated wastewater for irrigation use	EG-5	See FAO Reference[2]
6. Applicability of decentralized approaches to wastewater treatment and management in developing countries	EG-1	Not applicable

3 SCOPE AND OBJECTIVE:

Based on the issues that have been identified (see table 3), and considering the available resources and time, it was agreed during the regional meeting (see section 2 above) to focus on theme No.4 as it is of priority for the three countries (Algeria, Morocco & Egypt). As for theme No.5 concerning the criteria for evaluation of suitability of treated wastewater for irrigation use, the participants were referred to the following:

1) Food and Agriculture Organization, (2003). Users' Manual for Irrigation with Treated Wastewater available on http://www.fao.org/tempref/GI/Reserved/FTP_FaoRne/morelinks/Publications/English/Usersmanual-en.pdf;
2) FAO, (1985). Water Quality for Irrigation. FAO Irrigation and Drainage Paper No. 29, FAO 1985 reprinted in 1989 and 1994. Available on http://www.fao.org/docrep/003/T0234E/T0234E00.htm
3) An updated reference "Irrigation Water Quality Standards for Indirect Wastewater Reuse in Agriculture: A Contribution toward Sustainable Wastewater Reuse in South Korea" (Water 2016, 8, 169; doi:10.3390/w8040169, http://www.mdpi.com/journal/water) was also provided that concerns not only the criteria but comparison of wastewater reuse issues and standard worldwide. Noting that theme no. 5 is closely related to theme no. 4 but with a view to international standards.

à la promotion de la réutilisation des eaux usées par le renforcement des aspects institutionnels, réglementaires et financières, ainsi que des démarches participatives, des mesures incitatives et la sensibilisation». See https://www.swim-h2020.eu/wp-content/uploads/2018/09/SWIM-H2020-EFS-MO-2-Global-Report.pdf

[2] See http://www.fao.org/tempref/GI/Reserved/FTP_FaoRne/morelinks/Publications/English/Usersmanual-en.pdf, and http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.470.8910&rep=rep1&type=pdf

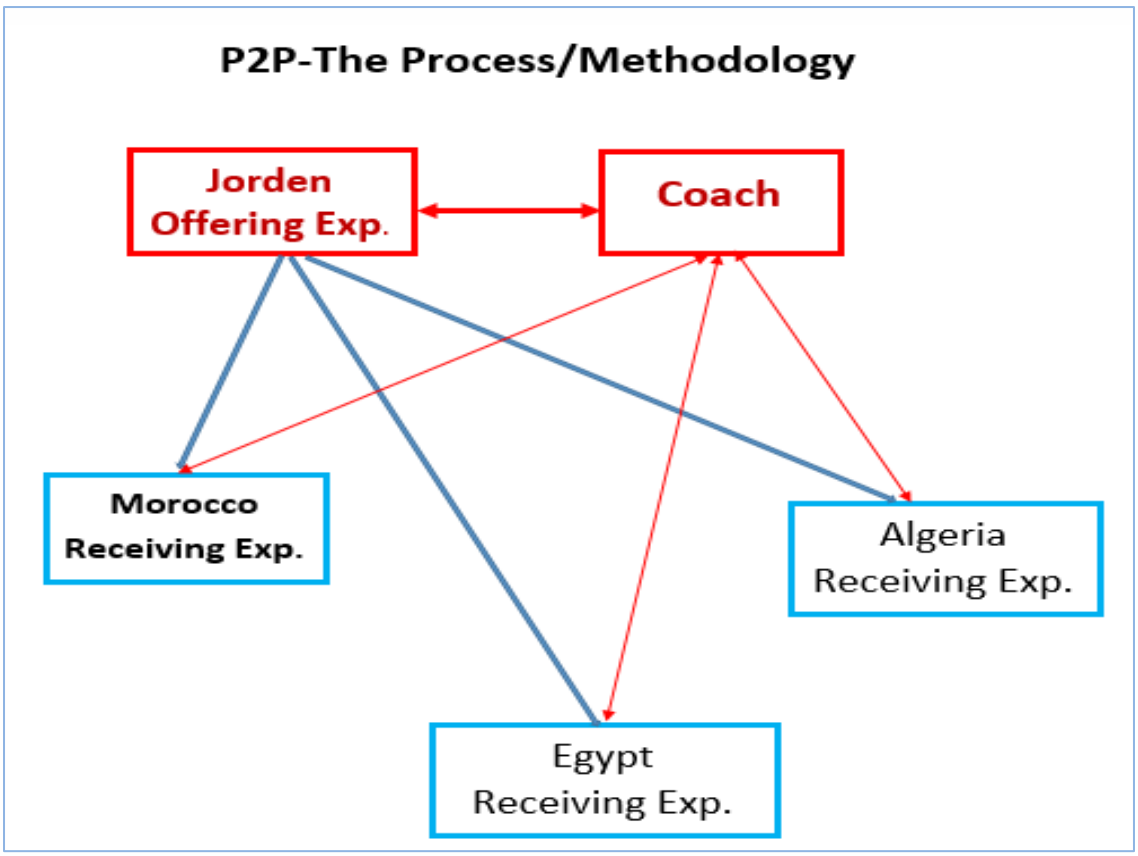
Accordingly, a document titled "Standards for TWWR in Jordan, including golf courses, groundwater recharge and industrial use" was prepared that responded to the questions asked by the recipient peers as per theme 4 of the above table.

4 METHODOLOGY

Based on the experience made in the home institution of the Jordanian peer (the Water Authority of Jordan), a document containing the relevant background information about Jordan, the status of treated wastewater in the country, and an overview of the applicable standards was prepared and sent out to the peers from Algeria, Egypt, and Morocco together with the supporting materials on the standards for TWWR in Jordan, including golf courses, groundwater recharge and industrial use".

Figure 1 depicts the communication channels established between both the countries receiving expertise, the country offering the expertise together with the P2P coach.

Figure 1. Proposed communication between parties



The output of the peer to peer session is presented in the following sections of this report, which depicts the standards applicable in Jordan provided by the Jordanian peer(s) in response to the issues raised by the recipient peers. Whenever needed, the coach complimented the material provided by the Jordanian peer with further information namely related to the use of reclaimed water in Golf courses, to compensate for lack of full coverage of respective standards in Jordan.

5 OUTCOMES OF THE PEER TO PEER SESSION

This section addresses the request raised **by** Algeria, Morocco & Egypt about specific guidance documents for "Standards for TWWR in Jordan, including Golf courses, Groundwater recharge and Industrial use" around the following three subheadings.

- Reclaimed Water Reuse Standards in the Kingdom of Jordan
- Jordanian Standard 202/1991Requirements for Discharges of Industrial Effluents
- Jordanian Standard for Golf courses

5.1 RECLAIMED WATER REUSE STANDARDS IN THE KINGDOM OF JORDAN

Continuous population growth increases the demand for water and forces water agencies to look for alternative water sources. Especially in arid and semi-arid areas such as Jordan, the future demands for water cannot be met with traditional water resources such as surface and ground water. In order to address increasing water demands, reuse of treated effluent from municipal wastewater treatment plants and on-site treatment have to be developed.

Since public health is of importance in wastewater reuse, the quality for reused water must be addressed.

5.1.1 Background of Jordan

Jordan has a surface area of (89.544) square kilometres with population of about (9.5) million in 2015, and a population growth rate of (3.1%). Jordan's water resources are scare and are directly depending on rainfall, which varies from year to year and according to the location (from (50) mm in the eastern part to (600) mm in the northern and western mountains).

Jordan is characterized by a pronounced scarcity of renewable fresh water resources Due to the population growth, the annual renewable fresh water resources per capita is less than (60) m^3/cap/year, thus making Jordan a country with absolute water scarcity (shortage). The water resources of Jordan consist of surface and ground water resources and treated wastewater used in irrigation.

5.1.2 .Current situation of TWW Reuse in Jordan

One of the key objectives of Jordan's water reuse management plan is to use reclaimed water, where practical, in exchange for present and future use of fresh water and to maximize the returns from reclaimed water resources. Accordingly, the Ministry of Water and Irrigation (MWI), together with the Water Authority of Jordan (WAJ) require that all new wastewater treatment projects must include feasibility aspects for treated wastewater reuse and have set standards for treating

wastewater based on the intended reuse (in case of irrigation depending on the type of crops and other intended aspects (Example-South Amman WWTP)). Below is a quick overview of the current situation of TWW Reuse in Jordan

- There are 32 public Wastewater Treatment Plants (WWTPs) in Jordan.
- Total amount of reclaimed water generated from the WWTPs is 164 million cubic meters, of which 146 million cubic meters is reused.
- The percentage for reuse of reclaimed water in Jordan is about 90% for the year 2017.
- Regulations of reclaimed water are mainly based on use restrictions and must be authorized and monitored by WAJ with a signed agreement between the two parties.
- Most of reclaimed water is used for:
  1. **Irrigation as follows**:
     - Direct reuse for irrigating fodders in the surrounding areas of the treatment plants (about 25 MCM in the year 2017)
     - Indirect reuse: reclaimed water discharged to wadis (such as the case of the treated effluent discharged from As-Samra WWTP to Zarqa River reaching King Talal Dam (KTD) after getting blended with flood and base flow to be used further downstream for irrigation in the Jordan valley). In 2017 about 115.644[3] Million Cubic Meters of As-Samra treated wastewater was reused for irrigation (i.e. 100% of reclaimed wastewater is reused)
  2. **Industrial activities**: mainly for cooling as is the case in Aqaba & south Amman WWTPs

5.1.3 CURRENT NATIONAL WASTEWATER STANDARDS

Today there are several sets of standards and criteria for wastewater and sludge that were derived from the work of the Water Authority of Jordan and the Ministry of Water and Irrigation. The existing standards and instructions that directly apply to wastewater reuse are:

- The Water Authority of Jordan (instructions to control industrial discharges to public sewers.) for the year 2017
- Jordanian Standard No. 202/2007 for Industrial Reclaimed Wastewater
- Jordanian Standard No. 893/2006 for Reclaimed Domestic Wastewater
- Jordanian Standard No. 1766/2014 – Irrigation Water Quality Guideline

5.1.3.1 The Water Authority of Jordan (instructions to control industrial discharges to public sewers) for the year 2017

In 1988, the Water Authority of Jordan developed comprehensive instructions to control industrial discharges to public sewers. The current "Instructions for Commercial and Industrial Wastewater" provides the legal foundation for preventing the entry of toxic and damaging substances and liquids to Jordan's public sewer. The act provided specific prohibitions on toxic chemicals, petroleum products, dense slurries, and excessive hot, alkaline or acidic discharges.

[3] http://www.mwi.gov.jo/sites/ar-jo/DocLib2/%D8%A7%D9%84%D8%AA%D9%82%D8%B1%D9%8A%D8%B1%20%D8%A7%D9%84%D8%B3%D9%86%D9%88%D9%8A%202017.pdf

Because of the necessity of agricultural reuse of treated wastewater, a list of the maximum concentrations of heavy metals that could be disposed of was included in the rules. Recommendations for the maximum salinity, measured as TDS, of discharges to sewers were also included in the 1988 version of the instructions.

By 2017, it was clear that some updates and revisions on the 1988 instructions concerning industrial and commercial discharges to sewers were needed. The Water Authority of Jordan called for revision of the rules and several other government offices were invited to attend deliberations on the subject. Several improvements to the instructions resulted from the discussion. **These included the refinement of the list of heavy metal concentrations allowed in industrial discharges to sewers and specific limitations to concentrations of pollutants and toxins based on the experience in Jordan**. **The new instructions also included a practical provision allowing industries with waste liquids with high COD to make discharges to the sewer. The revised rules allowed these materials to be discharged to the sewer under a calculated fee that included a surcharge for the high content of organic materials**.

The 2017 revision to the rules makes it possible for any industry to obtain a connection to the sewer for that portion of their wastewater that meets the quality requirements of the revised discharge standards.

See Annex 8.1

5.1.3.2 Jordan Standard 202/2007 for Industrial Reclaimed Wastewater

In 1991, Jordan's Institution for Standards and Metrology (JISM) - being the national entity responsible for Issuing standards in Jordan - published a standard for discharge of industrial wastewater after extensive discussion with the Water Authority of Jordan, the Ministry of Health, the Ministry of Planning, the ministry of environment and many others. This was superseded later by 2004 standards and then by 2007 standards (3rd edition) on industrial wastewater discharges.

The standards define wastewater generated from industries as that water which is discharged or produced from the use of water in some or all the phases of production processes, cleaning, cooling, or others; whether treated or untreated. They include a set of criteria for the quality and treatment necessary for industrial wastewater discharged to various receiving waters, for irrigation or for groundwater recharge. Standard 202/2007 incorporated the World Health Guidelines for the reuse of industrial wastewater that included three categories:

- Reuse for Irrigation
- Recycle for industry
- Discharge to Wadis, Rivers and Water Bodies

The irrigation reuse standard specify limitations on BOD & COD and limited E.coli to 1000 MPN/ 100 ml of treated wastewater. Boron, a heavy metal that limits plant growth, was limited to concentrations of one part per million (1 mg/L.).

Standard 202/2007 recognized the problem of salt in reclaimed wastewater to be used in agriculture -- a limit of 2000 mg/l of total dissolved solids was specified and remains in force for industrial effluents.

See Annex 8.2

5.1.3.3 Standard 893/2006 – Reclaimed Domestic Wastewater

Prior to 1995, professionals in the Water Authority of Jordan relied on World Health Organization standards for wastewater treatment plant design and effluent control. By 1995, it was recognized that a comprehensive national standard was needed. Thus, in 1995, the first edition of a **comprehensive reuse standard for treated domestic wastewater** was principally developed by the Water Authority of Jordan and all relative parties, and was **amended twice till it reached the last edition in 2006**. Thus a permanent technical committee for water and wastewater has amended the Jordanian Standard No. 893 for year 1995 & 2002dealing with "Water-Reclaimed Domestic Wastewater" and recommended its approval as a Jordanian Technical base No. 893/2006 (third edition).

Scope:

- The **893/2006** standard is purposely set to specify the conditions that the reclaimed domestic wastewater discharged from wastewater treatment plants should meet in order to be discharged or used in the various fields mentioned in this standard . The Reclaimed Domestic Wastewater standard has two primary components:
  a. Reclaimed water discharged to streams, wadis or water bodies.
  b. Reclaimed water for reuse (Direct Reuse).
- Reclaimed water must comply with the conditions stated in this standard for each of its planned end uses (**Irrigation or Artificial recharge**).
- It is not permitted to dilute by mixing reclaimed water before being discharged from wastewater treatment plants with pure water intentionally to comply with the requirements set in this standard.
- The item concerned with reclaimed water reuse for irrigation purposes consists of two main groups; standards group and guidelines group:
  - Standards group: is the group of properties and standards that operating parties must produce water complying to and according to the usages mentioned in this standard.
  - Guidelines group: The guidelines group is considered for guidance only and in case of exceeding its values, the end user must carry out scientific studies to verify the effect of that water on public health and the environment and suggest ways and means to prevent damage to either.
- The 839/2006 Standard includes the following categories of wastewater reuse specifications depending on the type of plant (See Table 4):

See also Annex 8.3

Table 4. Water Reuse Standards in the Kingdom of Jordan

parameter	unit	Maximum allowable limits for reuse purpose 893/2006			
		Cooked vegetables, parks, play grounds and sides of roads within city limit	Fruit trees , sides road outside city and landscape	Field crops ,industrial crops, and forest trees	Cut flowers
		A	B	C	D
Biological oxygen demand (BOD)	mg/l	30	200	300	
Chemical oxygen demand (COD)	mg/l	100	500	500	
Dissolve oxygen (DO)	mg/l	>2	-	-	> 2
Total suspended solid (TSS)	mg/l	50	200	300	15
pH	unit	6-9	6-9	6-9	6-9
Turbidity	NTU	10	-	-	5
Nitrate	mg/l	30	45	70	45
Total nitrogen	mg/l	45	70	100	70
Escherichia coli	MPN or CFU/100ml	100	1000	-	<1.1
Intestinal helminthes eggs	Egg/l	≤1	≤1	≤1	≤1
Fat &oil &grease (FOG)	mg/l	8	8	8	2

5.2 STANDARDS FOR IRRIGATION OF GOLF COURSES WITH RECLAIMED WATER

There is no Standard related to the irrigation of Golf Courses with Reclaimed Water in Jordan, however, the maximum allowable limits specified under Standard 893/2006 for the use of reclaimed Domestic Wastewater in parks, play grounds and the sides of roads within the city limits can also be applied for golf courses. There are also some experience from EU countries such as Portugal and Spain and also from the Arab countries such as Egypt.

Treated wastewater can be used for Golf courses in a controlled environment. Golf courses irrigated with reclaimed water require:

- Differentiated management of the golf course ecosystem;
- The carrying out of a risk assessment of the use of the resource;

- Managers and staff with specific formation on the use of reclaimed water and good knowledge of rules and regulations on reuse;
- Professional superintendents with specific knowledge on wastewater reclamation and reuse;
- A good communication policy.

Likewise, the use of chemicals must be dissociated from the use of reclaimed water on the golf courses, especially in facilities managed according to American protocols, which are slightly different from European management systems that are based on more natural premises and criteria. Certainly in the reuse of reclaimed water on golf courses, management should be adapted to minimize the specific problems associated with reuse. This, in fact can generate certain benefits, including the improvement of integrated management of water resources in the region or basin in question.

Information on the type of water resource used to irrigate golf courses in the Mediterranean is not readily available in some countries. On the contrary, information on courses using reclaimed water in the USA is plentiful, since it is considered an added value in the image of the facility. Certainly, given the increasing availability of treated and reclaimed water and the water needs of golf courses, the future development of the sport in areas without surplus water resources will predictably depend upon the use of reclaimed water. Its use for irrigation is essential, not only because of the lack of water resources, but also due to the increasing criticism of the use of conventional water resources and the improvement of the tools that guarantee the safe use of reclaimed water. This source must then become one of the basic resources of the Mediterranean golf courses.

Egyptian code (501/2015) developed Standard for Irrigation of Golf Course and classifies treated wastewater to 4 grades according to the degree of treatment: A, B, C & D. These grades to be specified based on the effectiveness of the treatment process made to raw wastewater until reaching the minimum level corresponding to a number of physical, chemical and biological standards. However, annex 8.4 .shows compiled guidelines and standards existing worldwide and regionally for Wastewater Reuse.

See annex 8.4 (a & b)

Table (5) shows a summary of treated wastewater standards allowed for reuse for agricultural purposes according to this code.

Table 5. Standards for Wastewater Reuse in Agricultural Use

Requirements & Limitations		Degree of Treatment			
		Grade A	Grade B	Grade C	Grade D
Physical & Chemical Standards	TSS	10 ≤	30 ≤	50 ≤	300 ≤
	Turbidity, (NTU)	5	Undefined	Undefined	Undefined
	BODs	10 ≤	30 ≤	60 ≤	350 ≤
Pathogens Standards	Fecal Coli-forms /100 ml	100	1000	5000	Undefined
	Intestinal nematodes/liter	1 ≤	1 ≤	1 ≤	Undefined

The code allows using treated effluent Grade (A) for Golf courses and allows to produce this grade by:

- Treating raw wastewater on the treatment plant site only, or through doing additional treatment on the agriculture site.
- Mixing fresh water of suitable quality – in case it is available – with treated wastewater in secondary treatment plants. It is stipulated in all cases to obtain the approval of Ministry of Water Resources and Irrigation for the permanent use of fresh water for this purpose.

Reclaimed water quality regulations for golf course irrigation in Portugal and Spain

Table 6 lists the quality limits for the use of treated wastewater recommended in Portugal and Spain, respectively.

Table 6. Reclaimed water quality regulations for golf course irrigation in Portugal and Spain

Constituent	Portuguese regulation NP 4434/2005[4]		Spanish regulation RD 1620/2007[5]
	Recommended Limit (mg/L)	Maximum limit (mg/L)	Maximum limit (mg/L)
pH	6.5–8.4	-	-
Conductivity	1 dS/m	-	3.0 dS/m
Suspended solids	60 mg/L	-	20 mg/L
Turbidity	-	-	10 NTU
SAR	8	-	6
Intestinal nematode eggs	1 egg/ 1 L	-	1 egg/ 10 L
Coliform	Fecal coliforms200 CFU/100 mL	-	E. coli200 CFU/100 mL
Aluminum	5.0	20	-
Arsenic	0.10	10	0.1
Barium	1.0	*	-
Berylium	0.5	1.0	0.1
Boron	0.3	3.75	0.5
Cadmium	0.01	0.05	0.01
Ion Chlorine	70	-	-
Chromium	0.10	20	0.1
Cobalt	0.05	10	0.05
Copper	0.20	5.0	0.2
Fluoride	1.0	15	-

[4] Norma Portuguesa (NP). Reuse of Reclaimed Urban Wastewater for Irrigation; Portuguese Institute for Quality: Caparica, Portugal, 2005; No. 4434/2005.
[5] Real Decreto (RD1620/2007). Régimen Jurídico de la Reutilización de las Aguas Depuradas (Legislation on reuse of treated waters) BOE núm, 294; Ministry of the Presidence, Spanish Government: Madrid, Spain, 8 December 2007.

Iron	5.0	*	-
Lead	5.0	20	-
Lithium	2.5	5.8	-
Manganese	0.20	10	0.2
Molybdenum	0.005	0.05	0.01
Nickel	0.5	2.0	0.2
Nitrate	50	*	-
Selenium	0.02	0.05	0.02
Sulphate	575	*	-
Tin, Tungsten, & Titanium	-	-	-
Vanadium	0.10	1.0	0.1
Zinc	2.0	10	-

For further information on the wide range of issues involved in the use of reclaimed water in golf courses, the peers are invited to consult the following reference: "Golf Course Irrigation with Reclaimed Water in the Mediterranean: A Risk Management Matter" (See https://www.mdpi.com/2073-4441/4/2/389/htm).

The said reference discusses the related hazards—due to the presence of microorganisms and pollutants—and the corresponding risks that can appear. It also analyses the resulting biological, chemical and physical water quality concerns, discusses legal aspects related to the use of reclaimed water and suggests good reuse practices, including a detailed examination of risk assessment procedures and tools through observation or chemical, physical and microbiological analysis. In order to detect health problems on a golf course, the Hazard Analysis and Critical Control Points (HACCP) system—which focuses on quality determination in water samples from relevant control points—is described in detail.

Further information on the reuse aspects in the Mediterranean Region can be consulted in the following document: "Guidelines for Municipal Water Reuse in the Mediterranean Region", which can be searched on the internet.

5.3 COMPLEMENTARY INFORMATION REQUESTED BY THE ALGERIA PEER

Further information was requested by the Algerian peer regarding the standards used for indirect reuse of treated wastewater. This is particularly applicable to the Irrigation Water Quality Guidelines issued in 2014 by JISM; namely the "Jordanian Standard No. 1766/2014 – for the use of water for irrigation regardless of the source of water (fresh or reclaimed wastewater, Mixed Water). Being a guideline, its application is not mandatory.

See annex 8.5.

More information about the authorizations issued by the WAJ was also requested by the Algerian peer to draw a parallel with the Algerian concession model for the use of treated wastewater. A sample reuse contract was therefore provided, which is normally signed between WAJ Environment and Reuse department and the farmers willing to reuse treated wastewater in restricted irrigation (See Annex 8.5 Sample TWW reuse contract with Farmers.pdf)

See Annex 8.6

6 PEER TO PEER ASSESSMENT

A set of indicators was used to evaluate the peer to peer exchange i) evaluation indicators, reflecting the quality of the organizational, administrative and planning aspects activity's (See section A below), (ii) indicators to assess the technical quality of the activity(See section B below), and (iii) indicators for an overall assessment of the activity as indicated in section C below.

A set of criteria in each category was developed & assessed by the participants, using a qualitative description ranging between "Excellent" to "Poor", with an opportunity to provide suggestions for improvement. For the sake of comparison, the qualitative descriptions are given assigned numbers as follows: Excellent = 4 Good = 3 Average = 2 Poor = 1

The evaluation questionnaire for each pear country is shown in annex 8.7

A. Organizational, administrative and planning issues before and during the activity

Criteria (A1-A3) were developed to evaluate the organization, administrative and planning issues. Table 7 below presents the feedback received from the participants on these

Table 7: Results of the evaluation of the organization, administrative and planning issues

A. ORGANISATIONAL, ADMINISTRATIVE AND PLANNING ISSUES BEFORE AND DURING THE EVENT (3 forms were filled)		*Peer Country*				Average Score (max = 4)
		Algeria	**Morocco**	**Egypt**	**Jordan**	
A1	Planning of the P2P session : efficient and effective communication of objectives	3	4	3	4	3.5
A2	Clarity, coverage and sufficiency of concepts, objectives, anticipated outputs and outcomes	3	3	3	3	3
A3	Efficient and Effective Facilitation of the P2P process	3	3	3	4	3.25

The overall rating of 3.25 out of four indicates that the activity was well appreciated

B. FEEDBACK ON TECHNICAL ASPECTS/CONTENT

A set of five criteria; B1-B5 (See table 8) were used hereby to evaluate the technical aspects/content of the activity.

Table 8. Results of the evaluation of the technical aspects/content

B.FEEDBAACK ON TECHNICAL ASPECTS/CONTENTS (5 forms were filled)		*Peer Country*				Average Score (max = 4)
		Algeria	**Morocco**	**Egypt**	**Jordan**	
B1	Efficient and effective performance and interaction with the other	2	3	2	4	2.75
B2	Clarity, coverage and sufficiency of concepts, objectives, anticipated outputs and outcomes	3	3	3	4	3.25
B3	Length of the process :In your view the duration of the peer to peer process (from conception to the delivery of the output)	Sufficient	Sufficient	Sufficient	Sufficient	-
B4	What did you like most about this P2P process and what was the benefit for you to participate?	Exchanges Experiences	Communication in French Lang	Exchanges Experiences	Exchanges Experiences	-
B5	What needs to be improved or could be done differently?	-	Communication in French Lang.	Exchanges Information	Exchange visits	-

C. OVERALL ASSESMENT

Two criteria; C1-C2 (See table 9) were used hereby to provide an overall assessment of the activity.

Table 9. Results of the overall assessment

C.OVERALL ASSESSMENT		*Peer Country*				Average Score (max = 4)
		Algeria	**Morocco**	**Egypt**	**Jordan**	
C1	Do you see the peer-to-peer processes a suitable tool for knowledge transfer?	3	Very Suitable	3	3	3+
C2	Overall rating of the P2P process	3	3	3	3	3

It is worth to highlight that the overall assessment of P2P activity is good and was highly acknowledged by the peers. A Significant recommendation was given to continue cooperation & exchange knowledge and experience between peers' countries.

7 LITERATURE:

1. Egyptian Code Wastewater reuse in agriculture (501/2015), Ministry of Housing, Utilities & Urban Development (UHUUD), Egypt. http://www.swim-sustain-water.net/fileadmin/resources/regional_training-Tunis/Egypt.Reuse_Code_Presentation.Djerba..pdf .
2. Golf Course Irrigation with Reclaimed Water in the Mediterranean: A Risk Management Matter https://www.mdpi.com/2073-4441/4/2/389/htm
3. Guidelines for Municipal Water Reuse in the Mediterranean Region (See https://wedocs.unep.org/rest/bitstreams/7336/retrieve)
4. Reuse of reclaimed wastewater for golf course irrigation in Tunisia (Water Sci Technol. 2001;43(10):117-24.)

8 ANNEXES

8.1 WAJ INSTRUCTIONS TO CONTROL INDUSTRIAL DISCHARGES TO PUBLIC SEWERS FOR YEAR 2017

See “Annex 8.1 WAJ Instructions 4 Industrial Discharges to Public Sewers (Year 2017).pdf”

Annex 8.1-.Jordanian Stand

8.2 JORDANIAN STANDARDS NO. 202/2007 FOR INDUSTRIAL RECLAIMED WASTEWATER

See “Annex 8.2 JS 202-2007 4 Industrial Reclaimed WW.pdf”

Annex 8.2.Jordanian Standard for Industri

8.3 JORDANIAN STANDARDS NO. 893/2006 FOR RECLAIMED DOMESTIC WASTEWATER.

See “Annex 8.3 JS 893-2007 4 Reclaimed Domestic Wastewater.pdf”

Annex 8.3-Jordanian Standard Reclaimed-\

8.4 (A & B): COMPILED GUIDELINES AND STANDARDS EXISTING WORLDWIDE AND REGIONALLY FOR WASTEWATER REUSE

See “Annex 8.4-Compiled guidelines and standards (worldwide regionally)4WWR.pdf”

Annex 8.4a-Compiled guideli

Annex 8.4b-Egypt WW Reuse Code 201

8.5 JORDANIAN STANDARD NO. 1766/2014 – IRRIGATION WATER QUALITY GUIDELINE.

See “Annex 8.5 JS 1766-2014 – Irrigation Water Quality Guideline.pdf”

Annex 8.5-Jordanian Standard No. 176620

8.6 . SAMPLE TREATED WASTE WATER REUSE CONTRACT WITH FARMERS.

See “Annex 8.6 Sample TWW reuse contract with Farmers.pdf”

Annex 8.6-Sample Reuse Contract.pdf

8.7 EVALUATIONS BY THE PEERS

8.7.1 ALGERIA

Algeria-P2P Evaluation questionn

8.7.2 EGYPT

Egypt-P2P Evaluation questionn

8.7.3 JORDAN

Jordan-P2P Evaluation questionn

8.7.4 MOROCCO

Morocco-P2P Evatuation questionn