

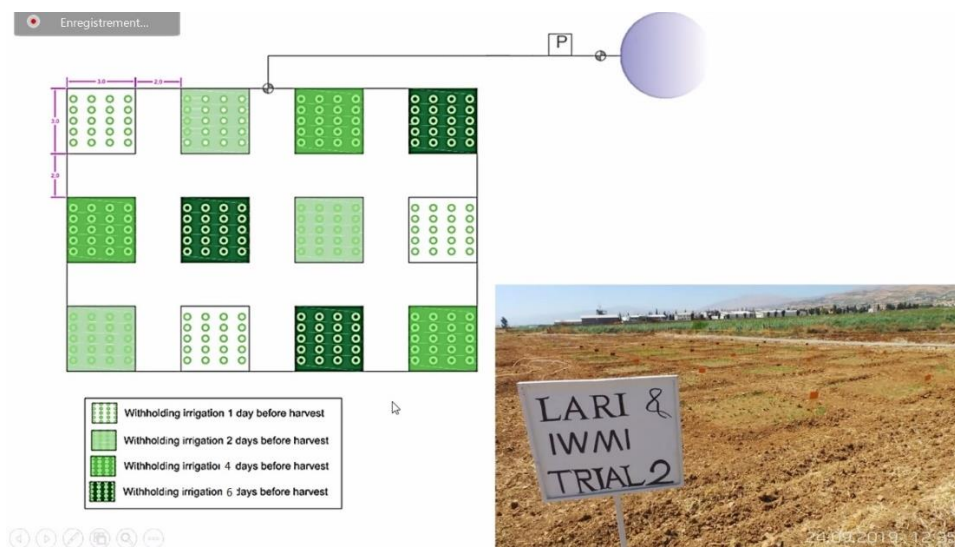


Mardi LEWAP

Which standards for water reuse in Lebanon?

Informing the debate based on international experience and local field experiment

Seminar report – March 15th, 2022



Dr. Marie-Hélène Nassif: IWMI (International Water Management Institute) Consultant, Researcher and Project Coordinator for ReWater MENA in Lebanon

Dr. Marie-Thérèse Abi-Saab: Researcher, Head of the Climate and Water Unit at LARI (Lebanese Agricultural Research Institute)

Mardi LEWAP are seminars that aim at bridging the gap between academics and operational actors. These seminars are open to all members of the LEWAP network.





Introduction

Watch the full event through [this link](#).

Jasmine El Kareh gave a brief introduction about LEWAP; its aim, objectives and activities. LEWAP is a platform that aims at facilitating the exchange of information and experiences among the actors working the water and sanitation sector. In line with one of the objectives of facilitating the exchange of information and bridging the gap between academics and other actors, LEWAP organizes a Mardi LEWAP tackling the latest research in the WASH sector.

The platform also provides tools to share information and publications on the sector: a Facebook page and a [website](#), as well as a database of [actors](#), sectorial [documents](#), and [projects](#).

To join our network and receive information on events and publications, send your name, position, organization and contact information at contact@lewap.org.

Dr. Marie-Helene Nassif, IWMI: Assessing the FAO proposed water reuse guidelines for Lebanon: between international experience and local context

Recording: [00:08:25](#) - Presentation support available through [this link](#)

Dr. Marie-Helene Nassif presents results from a policy analysis of FAO proposed guidelines for water reuse in Lebanon. This research is part of the ReWater MENA project, a 4-years regional project funded by SIDA and implemented by IWMI. The project aims at expanding safe reuse of water in the MENA region – in Lebanon, it translated into supporting LIBNOR committee to formulate official standards for water reuse for irrigation. LIBNOR is the Lebanese standards institution working under the Ministry of Industry, among which a committee was created in 2019 to define official regulations on water reuse.

Dr. Marie-Helene Nassif looks back at the history of guidelines on water reuse, reminding that until now, no official regulation has been adopted for Lebanon. She presents core elements that standards should define including threshold values that take into consideration human health, crop quality and ecosystems; monitoring protocol; recommended irrigation practices; and governance framework. Standards should also be adapted to the local context and the capacities of the country.

Dr. Nassif then presents the three existing approach to water reuse:

- The Californian model, which follows a zero-risk approach;
- The WHO and FAO model which adapts to lower-income countries with higher thresholds and takes into consideration capacities of enforcement;
- The risk management approach, proposed by WHO in 2006 with a shift from fixed standards to multiple-barrier approach with different control points along the sanitation-food chain; this approach proposes safety thresholds adapted to the country but requires a strong institutional coordination.



By analyzing the FAO proposed standards in comparison to existing approaches and international regulations, it resulted that these guidelines are relatively strict and hard to enforce in practice. They fall under the second regulatory approach, with low pathogen thresholds and no possibility of water reuse for raw crops, which is stricter than WHO guidelines. Moreover, they do not define any governance framework for management and monitoring.

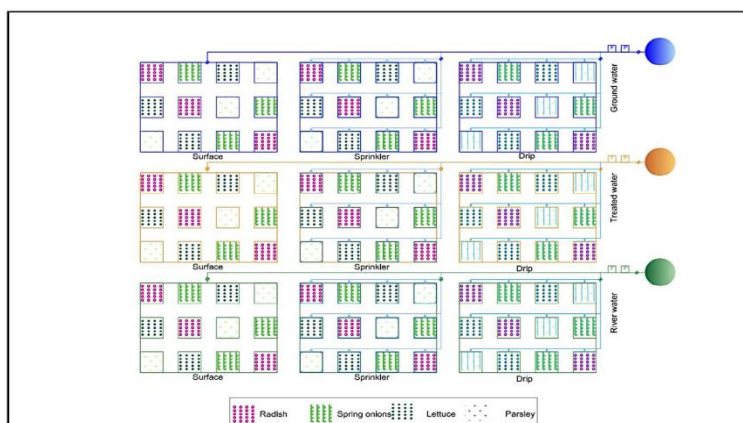
IWMI recommends shifting towards the risk management approach, which requires lower investment cost on treatment technologies and addresses informal reuse, thus reducing risks. However, enforcing this needs to define a governance framework to ensure safe management and control.

Dr. Marie-Therese Abi Saab, LARI: Presentation of Local evidence on the impact of irrigating vegetables crops from Ablah WWTP (Bekaa region)

Recording: [00:45:08](#) - Presentation support available through [this link](#)

Dr. Marie-Therese Abi Saab presents a second research implemented as part of the ReWater MENA project to inform the formulation of reuse standards, and to evaluate the risks of irrigating crops through treated water. She underlines the need to consider water reuse as an alternative source in the context of the Litani river basin where freshwater is more and more polluted. The experiment studies the impact of using different sources of water on crops of vegetables eaten raw, to assess if the restrictiveness of FAO guidelines, which don't allow reuse of water to irrigate vegetables eaten raw, is relevant in the context of Lebanon.

Two trials were conducted; the first experiment was looking at the productivity, quality and risks on health, crops and environment, of treated water compared to groundwater and Litani river water, when using different irrigation methods. The second trial was focusing on the effect of irrigation withholding before harvest as a simple method to minimize health risks.



Zoning of water sources, irrigation methods, and crops in the trial 1 field, D. Marie Therese Abi Saab (extract from the presentation)

In the first trial, soils, water and crops were analyzed to assess the quality of water, nutritional value of crops, health risk, and environmental risk. The experiment shown that nutritional quality of crops irrigated with treated water was good. Metal was detected regardless of the water sources but stayed



within the safe limits of both FAO and WHO. Regarding parasite contamination, the results proved that several factors have to be considered:

- The quality of water: under 2 log E. Coli CFU/100ml, there was no contamination of crops regardless of irrigation methods; between 2 and 3 log, there was a difference between irrigation methods and type of crops.
Water quality depends on the source (for example, Litani river water was proven unsafe for irrigation, contrarily to groundwater which stays under 2 log of E.Coli CFU/100ml), but also on treatment efficiency. The quality of treated water varied between 2019 and 2020, with the 2020 effluent quality exceeding ground water quality.
- The irrigation method: between 2 and 3 log E. Coli CFU/100ml, with drip irrigation, parasites were present only in crops grown underground, while with sprinkler and surface irrigation all crops were contaminated.
- Local environment conditions and time of harvest: decrease in temperature can kill E. Coli, which can explain the difference in parasite presence between crops grown underground and other crops.

The second trial added another factor as it explored way to reduce contamination with a simple farming practice consisting of withholding irrigation before harvest. The trial compared result when stopping irrigation 1, 2, 4 and 6 days before harvesting. It resulted in a diminution of parasite level but also a loss of up to 5% of yield per day. The recommendation from this experiment is thus to withhold irrigation 2 to 4 days before harvesting to reduce contamination with little loss of yield.

This experiment, strengthened by international evidence collected through literature, shows that the currently applied FAO guidelines are stringent for the context. Dr. Abi Saab concludes that irrigation water quality standards and water reuse standards should focus on promoting health protection and food safety at affordable costs. Based on the results, standards could adopt drip irrigation with water of less than 3 log E. Coli CFU/100ml for vegetables consumed raw with the exception of underground crops which should not be irrigated with water having more than 2 log E. coli.

The full results will be published soon and shared through LEWAP platform. In the meantime, the following papers are available:

- M. T. Abi Saab, C. Daou, I. Bashour, A. Maacaron, S. Fahed, D. Romanos, Y. Khairallah, N. Lebbous, C. Hajjar, R. Abi Saad, C. Ojeil, M. H. Sellami, S. Roukoz, M. Salman (2021). *Treated municipal wastewater reuse for eggplant irrigation*. Australian Journal of Crop Science AJCS 15 (08):1095-1101. doi: 10.21475/ajcs.21.15.08. p2711.
- M. T. Abi Saab, H. Makhlof, J. Zaghrini, S. Fahed, D. Romanos, Y. Khairallah, C. Hajjar, R. Abi Saad, M. H. Sellami, M. Todorovic (2020). *Table grapes irrigation with treated municipal wastewater in a Mediterranean environment*. Water and Environment 35 (Issue 2), 617-627. <https://doi.org/10.1111/wej.12656>.
- M. T. Abi Saab, D. Jammoul, H. Makhlof, S. Fahed, N. Lebbous, C. Hajjar, R. Abi Saad, M. Younes, M. Hajj, M. Todorovic (2018). *Assessing the performance of constructed wetland for water quality management of a Southern Mediterranean river*. Water and Environment Journal, 508-518. Print ISSN 1747-6585.



Questions and Answers

Recording: [01:37:25](#)

Is there any timeline regarding the elaboration of standards through LIBNOR?

Initially, the process was expected to finish with the project in September 2022 but some delays were faced and it is not sure a final draft will be ready on time. If the process isn't finalized by then, another expert organization would be needed to ensure the continuation and follow-up with all institutions. IWMI is ready to discuss this with those interested to support.

Which crops can currently be irrigated with treated water?

According to currently applied FAO guidelines, if the water quality is within category I (see presentations), vegetables eaten raw aren't allowed but vegetables eaten cooked, fruit trees, cereal crops, industrial crops, and gardens can be irrigated; if water quality falls under category II, vegetables eaten cooked aren't allowed either; with water quality in category III, only fruit trees, cereal crops and industrial crops are allowed.

What improved the quality of treated water between 2019 and 2020?

Ablah treatment plant was probably functioning better with continuous chlorination and disinfection process, resulting in treated effluent constantly falling under category I in 2020. It shows the importance of having well-functioning WWTP to ensure a good level of safety on the final produce.

What was duration between last irrigation and testing of pathogen?

For the second trial, the number of days was defined to assess its impact – testing was done after 1, 2, 4 and 6 days. For the first trial, crops were tested after 1 day.

Was water quality tested at the dripper or at the outlet of the treatment station?

Tests were conducted directly at the water emittance to measure real irrigation conditions; analysis from WWTP inlets and outlets were also available.

What was the impact of using treated water on soil salinity?

There was no high level of salt in the soil layers; salinity was higher with the drip irrigation method but it remained within safe limits. Similarly, metal levels remained within the FAO limits. All the tables will be available in the upcoming paper.

Do category II and III limits bypass the surface water discharge thresholds set by the MoE?

According to comparisons conducted by IWMI, MoE guidelines aren't more stringent. More broadly, it raises the question of coordination between regulatory instances. Currently, treatment plant operators don't have clear standards to follow and environmental limit values are not always monitored. It highlights the need for a governance framework to unify regulation and specify the responsibilities of each administration in regard to monitoring.



Is chlorination allowed considering that plants can't tolerate chlorinated water?

The regulation for residual chlorine is the same for category I, II and III (it shouldn't exceed 0.5 to 2 mg/l). The treated effluent was within this limit, and can thus be used for crop irrigation.

Was there any trial on fodder crop?

There was no trial on fodder crop until now, but LARI is interested to work on this if funds are available.

Did you use the same amount of fertilizers on comparative plots?

No fertilizer was used during the trial to focus on the effect of water source on the crops.

Do you have data on yields?

Yields levels were higher for river and treated water which contain more nutrient than groundwater. All these results will be published in the coming paper.

Through your coordination with LIBNOR, do you see institutional coordination as attainable in Lebanon to ensure good management and monitoring

Existing practices show an issue in monitoring, and in sharing the results of monitoring done at the level of treatment plants. The lack of coordination between administrations in Lebanon is a problem to be seriously considered in order to apply aspects of the risk management approach. Efforts are needed at the level of the regulation and the enforcement, including through agreements on responsibilities and accountability mechanisms. The LIBNOR committee enabled to gather different stakeholders: Ministries (MoEW, MoA, MoE), treatment plants operators, and representatives from Water Establishments, who shared the challenges they face to obtain good level of water quality. This participatory process is needed to design appropriate regulations taking in consideration many aspects. Management of WWTP and reuse systems requires efforts, including in terms of governance and funds, but they are worth it as high cost technologies and strict standards didn't lead to more safety, on the contrary.

Can you provide recommendations on the best way forward? Which ministry should take the lead?

The process is led by LIBNOR, a public institution working under the ministry of industry. The ReWater MENA project supported LIBNOR in gathering important decision-makers which are still involved in this process. The Ministry of Energy and Water has an important leadership in supporting LIBNOR and coordinating with other ministries such as the Ministry of Agriculture and the Ministry of Environment who also have mandates when it comes to water reuse. If the ReWater MENA project doesn't continue, support to LIBNOR will be needed.

The ongoing administrative procedure consists in finalizing a draft which will be submitted to LIBNOR board; after signature, it can be released as guidelines first, and then proposed as an official regulation at the council of the ministries.