

Systematic recording and analysis of barriers hindering the widespread use of Bio-Based Fertilizers and Nutrient recovery from industrial and municipal wastewater

I.-G. Athanasoulia¹, M. Kyriazi¹, J. Novakovic¹, E. Giannini², K. Moustakas¹, D. Malamis¹, M. Loizidou¹

¹Unit of environmental science and technology, National Technical University of Athens, Department of Chemical Engineering, Zografou, 15772, Greece

²Department of Humanities Social Sciences and Law, School of Applied Mathematical and Physical Sciences, National Technical University of Athens

Keywords: Nutrient Recovery awareness, Bio-based fertilisers, farmers, agricultural associations.

Presenting author email: geoath.labuest@gmail.com

The aim of this work is to support the stable expansion of nutrient recovery (NR) from waste water (WW) and use of recovered nutrients as bio-based fertilisers (BBF). The methodology followed involved two steps:

- i. first, an extended literature review of previous relevant surveys and a specialised web-based research on EU matrix sites (e.g. Fertilisers Europe (Fertilizers Europe, 2022), Registration, Evaluation, Authorisation and restrictions of Chemicals for fertilisers (REACH for fertilizers, 2022)) on the factors driving or hindering the use of NR options in WWT plants (WWTP) and
- ii. second, a survey addressed to all the relevant stakeholders.

The target group is the entire value chain (problem owners, technology providers, intermediate users) who share information on the waste producers; the companies managing WW; the applied treatment methods; the technology providers, as well as the companies that are interested in buying the BBFs in order to sell them to the end users. A unique questionnaire was prepared for each of the following target groups, to facilitate and ensure a response of high value:

- ✓ WW (Urban WW, sewage sludge, food, Industrial WW and brine) producers.
- ✓ WW Treatment plant managers/operators.
- ✓ Bio-based fertilisers Manufacturers (FM).
- ✓ Bio-based fertilisers End-users (Farmers, Agricultural Associations (AA)).
- ✓ Technology providers (TP).
- ✓ Policy makers.

The questionnaire for each stakeholder was divided according to whether they had any previous experience with Nutrient Recovery.

Instead of interpreting bottlenecks as obstacles to the implementation of resource recovery routes, they should be seen as starting points for WWT plants (WWTP) process design and management strategies. Furthermore, the voices of end users will also be heard in this series of interviews. Last but not least, policy makers (national, regional and local authorities) will have the opportunity to explore through this work the potential and the available alternatives for the management of WW streams in the context of circular economy. So far, not all actors in the NR value chain have sufficiently influenced policy makers to address all bottlenecks to the same extent.

The aim is to facilitate or even remove the listed bottlenecks for successful NR implementation through proactive planning resource recovery pathways.

The objectives of the WalNUT stakeholders' survey, data export and the analysis of the interviews are:

- Identify the factors that drive or hinder the adoption of sustainable wastewater (WW) treatment options by producers and facilities.
- to allocate the lock-ins and barriers that hamper the synthesis of BBFs, the use of recovered nutrients as substitutes for fossil-based ones, and the use of BBFs from End-user perspective.
- Engage Policy makers to help close the WW circle.
- Identify the technological barriers that need to be overcome to recover economically important nutrient resources.

The survey responses have been categorized into four groups and processed systematically.

- The first group includes responses from WW producers (urban WW, sewage sludge, food, industrial WW, and brine) and WWT plant managers/operators
- The second group includes responses from BBF manufacturers and BBF end-users such as farmers and agricultural associations
- The third group includes responses from technology providers.
- The fourth group includes responses from policy makers, but none have been received yet.

During the analysis of the survey responses, several challenges were identified, including:

- Lack of a clear definition of bio-based fertilizers, which hinders effective communication and interaction.
- The transition to Regulation (EU) 2019/1009.
- The importance of inclusive content that recognizes the diversity in the needs and abilities of WalNUT stakeholders. For example, in France, certain BBFs such as STRUvite, Biochar, and Incineration ash are not allowed to be used as fertilizers after treatment, despite being commonly used in other countries.
- Identifying the target group that fertiliser manufacturers should focus on, specifically BBF end-users.
- Ensuring the significance of interviewees' responses by carefully evaluating and weighting them.
- Using positive terminology, such as 'not valorized nutrients,' instead of negative terms like 'pollutants,' where appropriate.

Some of the main results of this survey are summarized in Fig. 1. In Figure 1i it is shown that only 22% of interviewees disagreed with the statements 'Uncertain composition, quality and safety (contamination risks due to effluent composition) of BBFs' and 'Spreading of WW-based fertilisers leads to mal odor problems'. 44% of interviewees did not agree with the statements that 'Fertilisation with BBFs is not popular in my area due to utilization of manure from close-by animal husbandries)', 'Lack of follow-on support from consultants on innovative BBF application methods' and 'If a farmer is accustomed to high fertiliser dosages, a small (due to condensation) application dosage, could be perceived as insufficient, leading to overdose.'. Unfortunately, 67% of interviewees agreed upon the statement that they 'Cannot trust certification/authorization of BBFs - Risk of the presence of contaminants (i.e. microplastics, pharmaceutical residuals, etc.)', one interviewee remained neutral and only 22% disagreed.

The level of agreement of the interviewed Technology Providers with the proposed measures to promote the practice of nutrient recovery (NR) has been visualised in the graph presented in Figure 1ii. All interviewees agreed that the economies of scale in the scaling –up from the expanded clientele in the case of NR-law enforcement would be highly beneficial for the development and expansion of nutrient recovery practices. Quite interestingly, all of the interviewees responded on the evaluation of direct help and tax benefits for the application of NR with 75 % agreeing on them.

In Figure 1iii, it is shown that the proposed measure with the most votes (73% agree, 27% neutral) is the 'Obligation in the use of recovered nutrients first instead of mineral'. It is remarkable that while many interviewees did not respond to every field of the survey, all 15 of them responded to this proposal. The measure 'Stricter disposal of WW criteria will increase the number of WWT/NR facilities' is the one with the most 'Strongly agree' votes (53%), 7% 'Agree' vote, 13% neutral votes and 13% 'Disagree' votes. The measure 'Minimum amount of Recovered nutrients (RN) in BBFs and price guarantee' got 42% 'Stongly agree' votes. 17% 'Agree' votes and 41% 'Neutral' votes. The third in line measure with most 'Strongly agree' votes (44%), 33% 'Agree' votes and 23% 'Disagree' votes is 'Obligation of NR practices by WW producers will be a motivating factor to perform NR, reducing access price to technology and reducing the price of recovered nutrients. Circular economy Regulation: Obligation to recover nutrients from WW streams'.

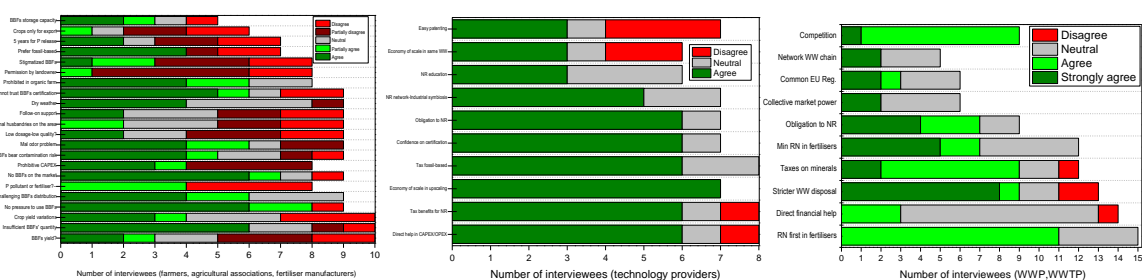


Figure 1: i) Allocation of lock-ins and barriers regarding the utilization of BBFs, ii) Factors that drive the deployment of NR options and iii) Measures to be implemented by WWP and WWTP that would unlock the Nutrient Recovery barriers.

References

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Acknowledgements



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement 101000752 (WalNUT).



