

Additional file 2 Stakeholder survey with summary of responses

This file contains a summary of responses to a survey that aimed at collecting stakeholder input on the scope of the systematic map titled “Technologies for recovery and reuse of plant nutrients from human excreta and domestic wastewater”. The responses were collected over a period of 3 weeks in June 2021.

Table of contents:

INTRODUCTION TO THE SURVEY	2
SURVEY SUMMARY	3
SECTION 1 - BACKGROUND	3
SECTION 2 - REVIEW SCOPE	4
SECTION 3 - SEARCH STRATEGY	6
SECTION 4 - CATEGORISING RELEVANT STUDIES	9
SECTION 5 - ADDITIONAL FEEDBACK	10

Introduction to the Survey



Mapping practices for recovery and reuse of plant nutrients from different waste streams

Research and development of circular nutrient technologies has intensified over the past years, making research output in this field increasingly hard to navigate and keep track of. There is a need for a robust and comprehensive mapping and synthesis of existing relevant research and better brokering of scientific knowledge to policy and practice.

We are a group of Swedish researchers who have set out to:

- Map peer-reviewed English language research on nutrient recovery and reuse.
- Develop an online evidence platform to navigate relevant scientific papers with ease.

We have drafted a protocol that outlines in detail our methodological plan for the systematic map and online evidence platform. To give potential users of the map and platform the opportunity to influence our work at an early stage, we have designed this survey. Your feedback will help us refine the protocol, and it will influence the scope and comprehensiveness of the map and platform. At this stage, we are seeking input regarding:

- What types of scientific research to include?
- What search terms to use to find relevant research?
- How to sort and categorise relevant research?

The protocol can be downloaded at www.endofwastewater.net/content.php?id=codesign. While we encourage you to have a look at the protocol, it is perfectly possible to take the survey without reading the protocol.

This survey form will be open for your feedback until June 15, 2021. Answering our questions will take only about 5-10 minutes. Feel free to share the survey and protocol within your networks.

This survey is part of the project End-of-wastewater which has received financial support from the Kamprad Family Foundation. Please note that we will not collect your personal information. For any questions or concerns, please get in touch with Biljana Macura (biljana.macura@sei.org).

We thank you for your time and valuable feedback!

Additional file 2 Stakeholder survey with summary of responses

Survey summary

Section 1 - Background

Your answers in this section will help us understand differences in knowledge needs across actors.

Q1. What is your role in the transition to a circular nutrient economy?

- ☐ Research
- ☐ Research funder
- ☐ Technology development and commercialization
- ☐ User of fertilizer products
- ☐ Public administration
- ☐ Legislation
- ☐ Advocacy
- ☐ Other (please specify)

NB: For each option, multiple choices were possible.

All 12 respondents answered this question.

Research	8
Knowledge management*	3
Technology development and commercialization	2
User of fertilizer products	2
Public administration	1
Legislation	1
Advocacy	1
Research funder	0

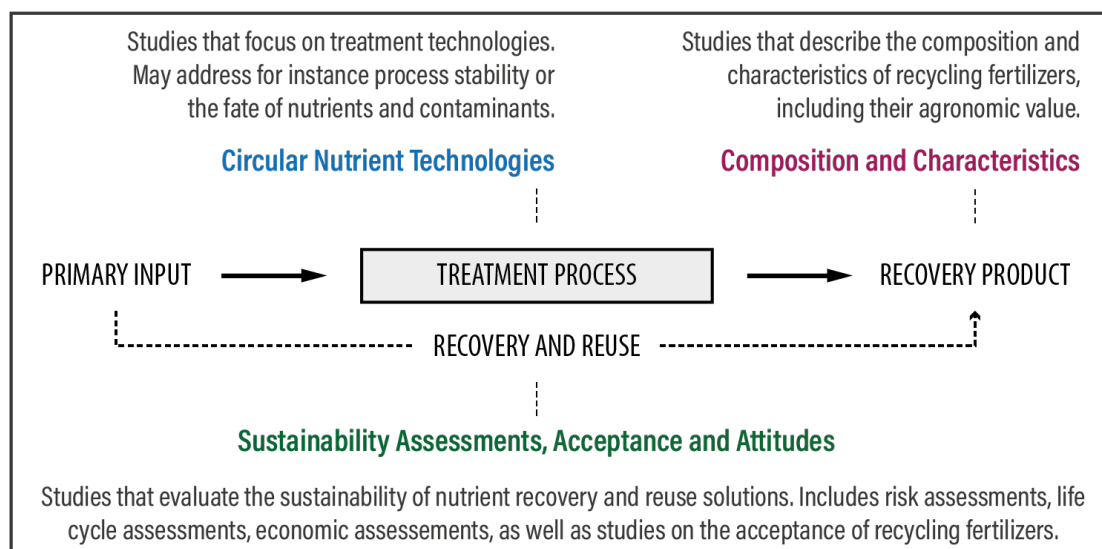
**described by respondents as: 'knowledge management'; 'education, networking, information spreading', and 'dissemination of research'*

Additional file 2 Stakeholder survey with summary of responses

Section 2 - Review Scope

Your answers in this section will inform the eligibility criteria described in section 3.3.3 of the protocol. The eligibility criteria determine the types of studies that will be included in our review.

Our review will focus on the recovery of nutrients from human excreta and municipal wastewater. So far, we have identified several clusters of relevant studies as depicted below:



Q2. Of how much interest are above types of studies to you or your organization?

- **Circular nutrient technologies**
- **Composition and characteristics of recycling fertilizers**
- **Sustainability assessments of circular nutrient solutions**
- **Acceptance of circular nutrient solutions**

NB: For each type of study, respondents had to choose between: 'high', 'medium', 'low' and 'none'.

All 12 respondents answered this question.

	High	Medium	Low	None
Circular Nutrient Technologies	8	4	0	0
Composition and Characteristics of Recycling Fertilizers	6	4	1	1
Sustainability Assessments of Circular Nutrient Solutions	7	4	1	0
Acceptance of Circular Nutrient Solutions	6	6	0	0

Additional file 2 Stakeholder survey with summary of responses

Q3. Are there any other types of studies that would be of interest to you or your organization? Please specify.

Six respondents answered this question.

The answers can be grouped into three themes.

Sustainability of current nutrient supplies

- *Increasing sustainability of current nutrient industry (e.g. ammonia production, wet process for phosphoric acid production)*

Implementation in practice

- Monitoring in-situ of experimental NBS or soil site (in link with sewage sludge products as fertilizer)
- Inventory of successful applications/real examples
- Data of applied (field) research
- Successful deployment of circular sanitation that incorporates dry toilet technologies in public restroom and for farm worker housing

Economic aspects

- Information about costs

Additional file 2 Stakeholder survey with summary of responses

Section 3 - Search Strategy

Your answers in this section will inform the search strategy described in section 3.2 of the protocol. The search strategy affects the comprehensiveness of our review.

So far, we have identified the following search terms to find relevant literature. The idea is to combine search terms as follows: A AND (B OR C) AND D.

A Primary inputs	urine, yellowwater feces, fecal sludge, brownwater, excreta, excrement, blackwater wastewater, sewage, septage, digestate, sludge, biosolid, effluent toilet, latrine, sanitary, sanitation, WASH, watsan
B Treatment processes	membrane filtration, forward/reverse osmosis, nanofiltration, microfiltration, membrane bioreactor bioelectrochemical system, microbial fuel/electrolysis cell, MFC, MEC vermifilter, vermicomposting, composting, black soldier fly, digestion, algal/bacterial treatment hydrothermal, carbonisation, gasification, incineration, combustion, smouldering, pyrolysis, liquefaction, supercritical, low pressure oxidation, LOPROX sorption, stripping, sorbent
C Recovery products	nutrient, nitrogen, ammonia, ammonium, urea, phosphorus, phosphate, potassium, potash fertilizer, soil conditioner, struvite, MAP, ash, compost, algae, biochar, sludge, larvae
D Recovery and reuse	recycle, circular, recirculation recover, return, convert

Q4. Are there other search terms that you think are missing? Please specify.

Eight respondents answered this question.

The answers can be grouped as follows.

A Primary inputs

- manure
- sludge ash
- night soil (old terminology for latrine, bucket sanitation material)
- ecosan
- terra preta sanitation
- productive sanitation
- greywater or graywater
- sewage sludge
- that different spellings are considered e.g. faeces/feces
- In North America, "humanure" - a term coined by Joe Jenkins - continues to be stubbornly popular but is ill-defined as it falls on a continuum from the collection and initial treatment to a recovery product.

B Treatment processes

Additional file 2 Stakeholder survey with summary of responses

- freeze concentration
- pasteurization
- acidification/alkalinization
- charcoal/activated carbon filtration
- anaerobic digestion
- chemical stabilization
- nitrification
- drying
- electrolysis
- bipolar membrane ED
- membrane contactors
- storage
- alkaline
- liming
- autothermal
- aerobic
- anaerobic
- ammonia
- urea
- carboxylic acid
- lactic acid
- fermentation
- crystallization
- precipitation
- microalgal systems
- ion exchange
- wet chemical
- enhanced biological phosphorus removal
- dessication
- There seems to be a need to distinguish between "aerobic composting" and "anaerobic digestion".

C Recovery products

- soil amendments
- phosphoric acid
- CaP minerals
- worms
- plants
- biomass
- irrigation
- effluent
- ashes
- digestate
- biosolids

D Recovery and reuse

Additional file 2 Stakeholder survey with summary of responses

- reduce fertilizer use
- reduce waste in fertilizer industry
- reuse
- application
- uses
- purposes
- destination

Other search terms

- Possibly, you could add an additional letter that refers to the "problem" (eutrophication, food safety, etc.) (example: contaminants (metals, persistent organic compounds, drug residues, etc.)).
- Maybe something about user-attitudes, if that was to be included?

Additional file 2 Stakeholder survey with summary of responses

Section 4 - Categorising Relevant Studies

Your answers in this section will inform the data coding strategy described in section 3.5 of the protocol. The data coding strategy affects the type of information that we will extract from relevant studies.

So far, we have identified the following meta-data domains that we think are meaningful to categorize relevant studies.

Meta-data domain	Example categories
Primary input	e.g. urine, feces, blackwater, sewage, sewage sludge ash, etc.
Treatment process	e.g. crystallization, pyrolysis, sorption, membrane filtration ,etc.
Product	e.g. struvite, ammonium sulfate, algal biomass, biosolids, etc.
Commercial name of process	e.g. NuReSys, DHV Crystallactor, etc.
Commercial name of product	e.g. Aurin, Crystal Green, etc.
Author affiliation location	country and place, including geographic coordinates
Study location	country and place, including geographic coordinates
Study scale	lab, bench, pilot, full
Study type	recovery technology, recovery products, sustainability, acceptance
Research type	primary (experimental or theoretical) or secondary (review)

Q5. Are there any other information (and meta-data domains) we should extract from and use to categorise relevant studies? Please specify.

*Three respondents answered this question.
The answers can be grouped into three themes.*

Studies that fit multiple categories

- How to classify the study type if the study covers more than one category? I suggest to include another category to represent this group of studies that are multi-category / more comprehensive.

Coverage of gray literature

- In the research type, other sources such as technical reports will be consulted? If yes, I suggest to include a new category to this group.

Additional meta-domains

- Also, a new meta-data domain could be "main finding".

Additional file 2 Stakeholder survey with summary of responses

Section 5 - Additional Feedback

Q6. Do you have any other (specific or general) reflections that you would like to share with us? Please specify.

Three respondents answered this question.

The answers can be grouped into four themes.

Research team

- It is not very clear who will be the reviewers and their expertise/background
- Who is funding this?

Target audience

- It is not very clear who is the target audience, users of the platform website

Continuous updating in 'living mode'

- How long would such a website be maintained for?
- About the eligibility criteria- In the protocol it is written that there is no limitation of time, so, I did not understand how it would be done, since everyday new publications are available in the databases. It would require constant updating and repeating the searches.

Other sources of information

- I hope someone on Dr. McConville's team is active in the Gold Ribbon Commission research being carried out by Vermont's Rich Earth Institute and Oregon's Recode. These issues are important to us.