Environmental impact assessment of biobased fertilizer

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Introduction

The ReJuice Project aims to valorize the liquid fraction that is originated from the pressing of agriculture residues. Five value chains are being assessed, and this research contemplates the organic fertilizer one.

Thinking of circular economy, it becomes necessary to substitute mineral fertilizers, since those come from a finite resource. For example, the production of ammonia comes partly from natural gas, and potassium chloride is obtained through shaft mining.

Varta Valorisatielab runs experiments with chrysanthemum residues juice, a largely cultivated flower in The Netherlands, which its juice presents a high nutrient content and can substitute up to 20% of the fertilizer requirement of the flower. This research aims to answer the question:

- What is the environmental value of a biobased fertilizer from flower juice?

Materials & Methods

The four steps for a life cycle analysis were conducted:

- *Goal and scope definition:* The functional unit was settled in 1 liter of chrysanthemum juice. The boundary is a gate-to-gate approach, i.e, from the pressed juice to the biofertilizer, the processes were assessed.
- *Life Cycle Inventory:* The data was collected via interview with the partner and a visit to their facilities. A process flow diagram was drawn.

A model in the software *LCA for Experts* was built.

Based on a chemical analysis provided by the partner, a crediting NPK was added to the model, representing the nutrient content existent in the biofertilizer.

3) Life Cycle Impact Assessment:

The methodology used was ReCiPe 2016, which links 17 impact midpoints to 3 endpoint areas of protection, incl. human health, ecosystems and resource availability, as shown in the picture on the right.

Source: https://www.rivm.nl/en/life-cycle-assessment-lca/recipe

4) Interpretation of results:

It was made from the avoided burden perspective.

Limitations

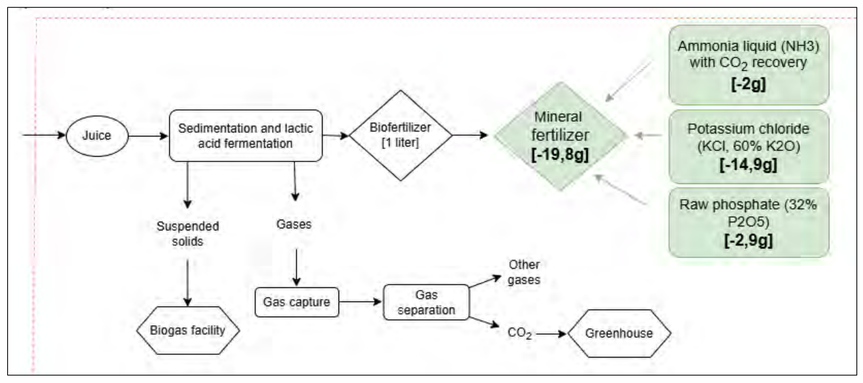
Even that the biofertilizer conteined many other nutrients, only the three most essential nutrients currently comercialized in mineral fertilizers were assessed: nitrogen (N), phosphorus (P) and potassium (K), due to limitations in the software.

Conversions were necessary from the data provided in the chemical analysis (NH4 in mmol/L for example) and the processes available in the software (NH3 in kg for example).

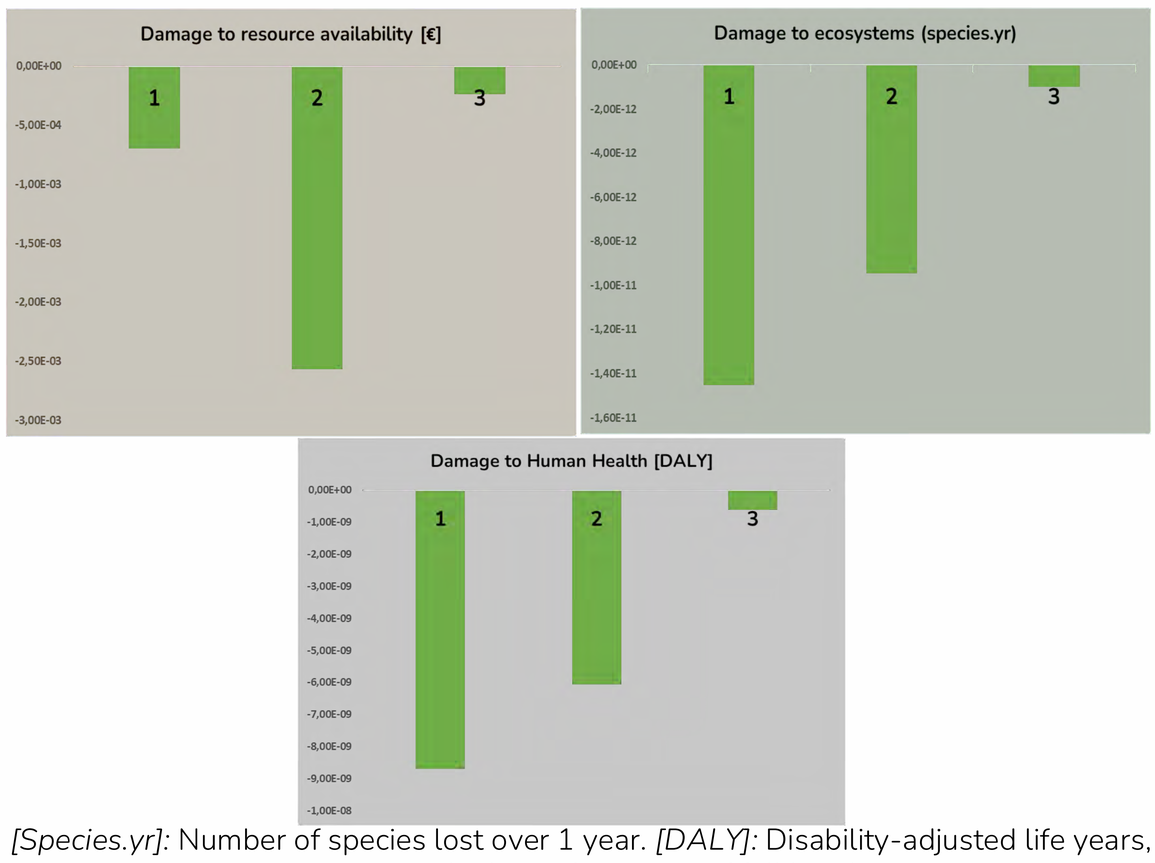
The processes included were:

Potassium chloride (KCl/MOP, 60% K2O)	Raw phosphate (32% P2O5)	Ammonia liquid (NH3) with CO2 recovery

Results



Process flow diagram of biofertilizer production and crediting.



[Species.yr]: Number of species lost over 1 year. *[DALY]:* Disability-adjusted life years, represents the loss of one year of full heath.

1: Ammonia liquid (NH3), **2:** Potassium chloride (KCl, 60% K2O) and **3:** Raw Phosphate (32% P2O5). Negative results mean benefit on the environment.The highest avoided impact for human health and ecosystems was ammonia extraction, and for resource availability was potassium. Phosphorus extraction had the lowest avoided impact in the 3 categories.

Discussion

Potash extraction evolves incoming waste that is treated as inert material on a landfill site. That means land use is required for depositing the waste, gases are emitted and it can contaminate underground water. Despite that, ammonia production is more chemically intensive and emits 30% more CO2 eq. than potassium chloride, which is directly linked to climate change, a challenge for wild and human life.

When it comes to resource availability, ammonia extraction comes from the conversion of natural gas in hydrogen and carbon monoxide, and then mixture of nitrogen and hydrogen. Beside natural gas being finite, nitrogen is abundant. In the other hand, the potash salt deposits are non-renewable mineral resources

The three nutrients showed considerable avoided damage per liter of biofertilizer, given their concentrations. That is why it is important to find a circular source for these nutrients that are so fundamental for plants growth and reproduction. For accuracy of the environmental value of the biobased fertilizer, the whole value chain of its production has to be further assessed.

References

1. ISO 14040:2006, Environmental management — Life cycle assessment — Principles and framework.
2. ISO 14044:2006, Environmental management — Life cycle assessment — Requirements and guidelines.
3. ReCiPe 2016 v1.1 A harmonized life cycle impact assessment method at midpoint and endpoint level; Report I: Characterization.