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# zirkulierBAR

## Nutrient recycling with dry toilets as sustainable solution for communal waste management and regional economies

1 Intro

2 Project & goal

3 zirkulierBAR project: Safe fertilizers with potential

*Linear anthropogenic nutrient flows [1] perturbate natural geochemical cycles [2] and thus entire ecosystems. Globally the impacts can be seen [2] but effects [3] and changes are locally [4]. The interaction and cumulative relevance of Carbon, Nitrogen and Phosphorus is often overlooked [5,4]. A reduction of the regional nutrient throughput through local recycling fertilizers will foster the transition to a sustainable regional circular economy [1].*

The **zirkulierBAR projects** establishes a **circular living-laboratory for the production** of hygienically safe and **quality-assured recycling fertilizers**, namely **compost** from solid matters **and liquid fertilizer** from urine (see fig. 4).

**Practitioners** and **Researchers** together develop **technical elements** and **valorization of recycling fertilizers**, study the **agricultural resource** and **socio-economic impacts**, assess **public acceptance** and engage in the socio-political dialogue.


Figure 5: Infinity loop - nutrient flows through the following processes, the enlarged processes are covered by the zirkulierBAR project (clockwise, starting from the top center-): **Collection**, Transport, **Valorization**, **Legislation & market**, **Fertilization & cultivation**, processing and commerce, consumption, digestion, ...

The marketing-standard **DIN-SPEC 91421:2020-12** is the measure for the hygienic safety and **quality assurance of the recycling fertilizers** produced as well as the baseline development of further development of a quality assurance standard.

A first assessment of the nutrient flows, with material flow analysis (MFA), shows that **almost half of Carbon and Phosphorus** (see fig. 6) input as well as **a quarter of the Nitrogen** input **can be recovered on recycling fertilizers** through the planned living-laboratory.

**Quality-assured recycling fertilizer from source separated human excrements are a crucial resource for the transition to a regional sustainable circular economy.**


Figure 1: Dry toilets - rental toilet cabins for festival


Figure 2: Recycling Fertilizer Product from the living laboratory

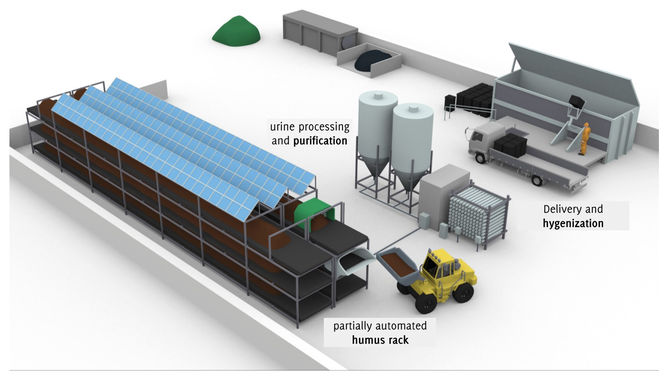


Figure 4: Our living laboratory for the production of quality-assured recycling fertilizer, with delivery and hygienization, partially automated humus rack and urine processing and purification

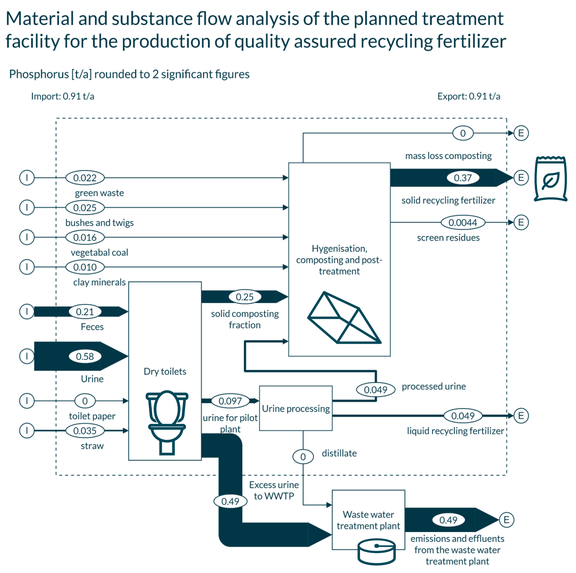


Figure 6: Phosphorus flows in Mg/a (rounded to two significant figures) from the material and substance flow analysis of the living-laboratory. Generated with STAN 2.6.

**Follow Me** for more on material and substance flow analysis (MFA) of the living-laboratory and sustainable regional circular economy


**References:**

[1] Harder R, Giampietro M, Smukler S (2021) Towards a circular nutrient economy. A novel way to analyze the circularity of nutrient flows in food systems. Resources, Conservation and Recycling 172:105693. https://doi.org/10.1016/j.resconrec.2021.105693

[2] Steffen W, Richardson K, Rockström J, Cornell SE, Fetzer I, Bennett EM, Biggs R, Carpenter SR, Vries W de, Wit CA de, Folke C, Gerten D, Heinke J, Mace GM, Persson LM, Ramanathan V, Reyers B, Sörlin S (2015) Sustainability. Planetary boundaries: guiding human development on a changing planet. Science 347:1259855. https://doi.org/10.1126/science.1259855

[3] Vries W de, Kros J, Kroeze C, Seitzinger SP (2013) Assessing planetary and regional nitrogen boundaries related to food security and adverse environmental impacts. Current Opinion in Environmental Sustainability 5:392–402. https://doi.org/10.1016/j.cosust.2013.07.004

[4] van der Wiel BZ, Weijma J, van Middelaar CE, Kleinke M, Buisman CJN, Wichern F (2019) Restoring nutrient circularity: A review of nutrient stock and flow analyses of local agro-food-waste systems. Resources, Conservation & Recycling: X 3:100014. https://doi.org/10.1016/j.rcrx.2019.100014

[5] Harder R, Wielemaker R, Molander S, Öberg G (2020) Reframing human excreta management as part of food and farming systems. Water Res 175:115601. https://doi.org/10.1016/j.watres.2020.115601


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