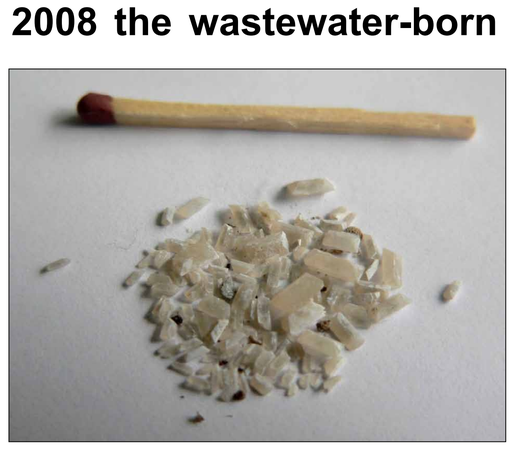
# The Role of Struvite from Sewage Sludge in regional Phosphorus Flows

**Tim Theobald, Jürgen Kern**

Leibniz Institute for Agricultural Engineering Potsdam-Bornim,14469 Potsdam, Max-Eyth-Allee100

**Enhanced biological P removal in combination with a crystallization stage allows controlled production of struvite ($NH_4MgPO_4$ • 6 $H_2O$) from an enriched phosphorus (P) wastewater stream as realized by Berliner Wasserbetriebe. The P availability and plant uptake has been proved in pot and field experiments and since 2008 the wastewater-born struvite can be applied as a legal fertilizer.**

**In order to evaluate the potential of recycled P, we employed a material flow analysis monitoring the P flows through society. With its aid pathways of losses, recycling potentials and hidden pools can be identified and quantified. Based on information gained by such analyses, the efficiency, productivity, resilience and sustainability of a system may be improved. The objective was to demonstrate the current role of struvite and other residual products as P fertilizer within the boundary of Berlin-Brandenburg and to show their potential to replace mineral P fertilizer in future.**



Struvite crystals

## Site description

The area of research consists of the two German federal states Berlin and Brandenburg with a population size of 6 million people in total and an area of 30,377 km². The system boundary was the outer limit of State Brandenburg (Fig. 1). Within this region the P flows were calculated for the three main sectors (Fig.2):

- Agriculture
- Waste management
- Wastewater management.

The calculation period was the year 2011.


**Figure 1:**
**S**ystem boundary

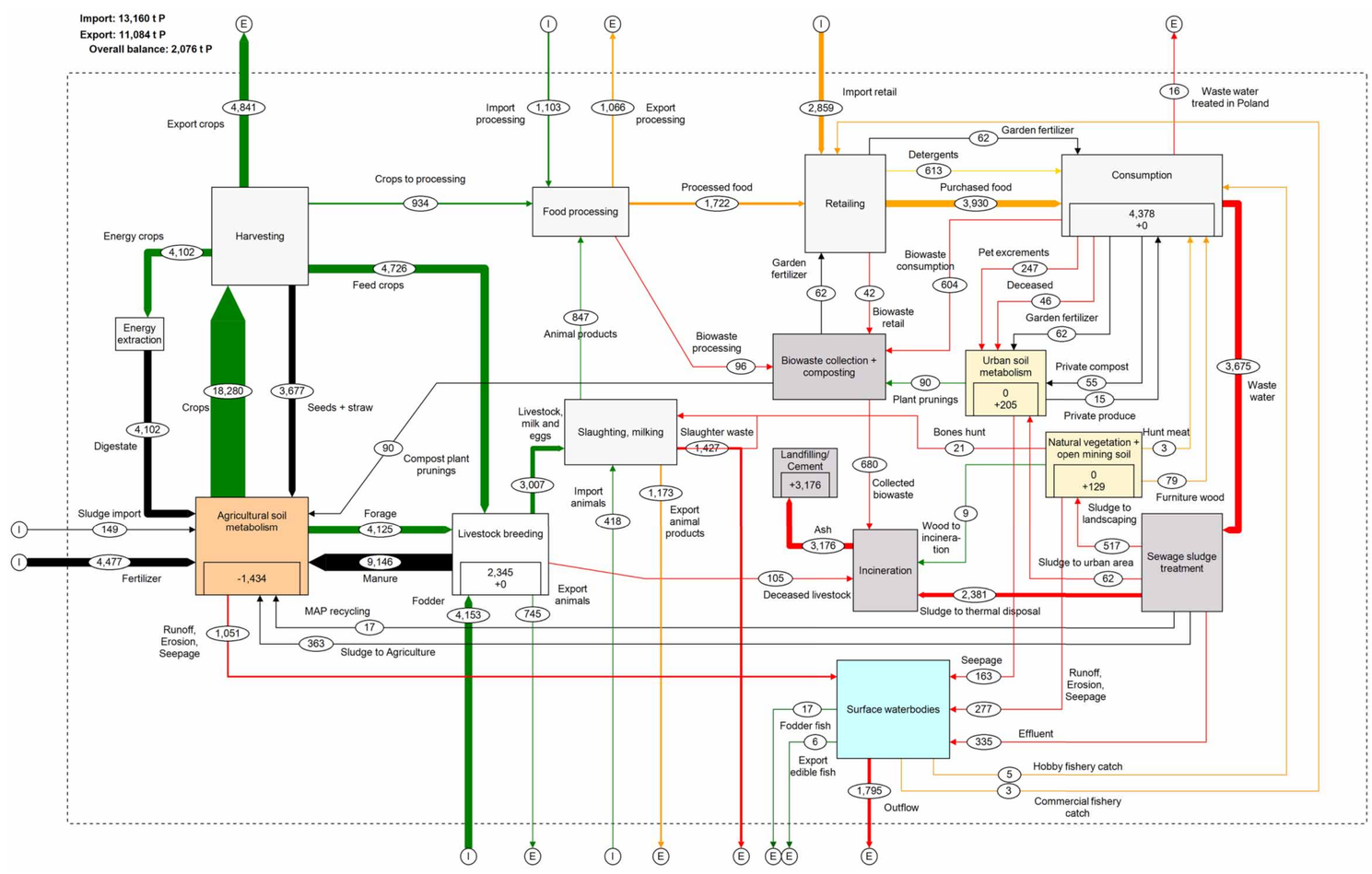



**Figure 2:** Sankey diagram showing the P flows within the region of the two German Federal states Berlin and Brandenburg in 2011. The thickness of the arrows corresponds with the size of the flow. Calculated figures are indicated along with the arrows. E and I stand for export and import flows, respectively.

Color code for boxes: dark and light brown = soil processes, light grey = processing and consumption processes, dark grey = waste processes, light blue = water process.

Color code for arrows: black = inputs to plant production, green = primary produces, orange = flows to consumption, red = waste flows and losses. Data was visualized using the software STAN.

## Results

### Overall P balance in the year 2011

- The overall import into the region Berlin-Brandenburg was 13,160 t P and the overall export was 11,084 t P.

→ Net balance within the system boundary was **+ 2,076 t P**.

**P balance for agricultural soil in 2011:**

- In total 22,021 t P were applied to soil by organic residues such as manure, digestate and others (77%) and by urban residues and mineral fertilizers (23%).

→ The balance for agricultural soils was **- 1,434 t P**.

**P resources from the wastewater stream in 2011:**

- The overall P recovery efficiency of treatment plants was 91%. This amounts to a total of 3,340 t P being recovered from wastewater.
- Only 11% (= 380 t P) were recycled to agriculture, with 0.5% in form of struvite.
- 71% (= 2,381 t P) of the recovered P was landfilled due to high heavy metal contents.

## Outlook

The recycling of the hitherto great proportion of P in wastewater currently not considered for agricultural use may compensate the negative balance of agricultural soils. Here, the development and implementation of new economically sound technologies are needed.

**Leibniz-Institut für Agrartechnik Potsdam-Bornim e.V. (ATB)**

Max-Eyth-Allee 100 | 14469 Potsdam | Germany | atb@atb-potsdam.de | www.atb-potsdam.de

Leibniz-Gemeinschaft