

## **Developing sustainable, climate-favorable fertilizer technologies for industrial and third world agriculture**

Industrial fertilizer input for agriculture around the globe is absolutely crucial for food security of the growing world population. However, fertilizer use represents a major part of the energy consumption in agriculture and causes large direct and indirect emissions of GHGs (fossil CO<sub>2</sub> from production and N<sub>2</sub>O from field application).

Increased demand for animal products has led to intensification of livestock farming, a trend which is expected to continue in the future. This is leading to large amounts of animal waste, representing both a massive potential pollution source (aquatic, terrestrial, atmospheric) and a valuable resource in terms of nutrients, capable of substituting fossil energy demanding, industrial fertilizers. Developing technologies for production of sustainable, CO<sub>2</sub>-neutral (or even CO<sub>2</sub>-negative) fertilizers from organic waste products has significant potential for greatly reducing GHG emissions from both industrial and third world agricultural production.

The objective of the current Ph.D. is to determine how organic waste products (sludge, household waste, yard waste, animal manures) can be converted efficiently into sustainable fertilizer products by composting, fermentation, carbonisation (producing biochar), combustion (producing ash) and chemical treatments and to optimize these processes in order to improve plant nutritional efficiency, carbon sequestration potential and soil quality effects of the produced fertilizers. This will be done by:

- Developing and optimizing methods for conversion, recycling and utilization of various organic wastes into fertilizer products, including mixing of various products and adding various natural or synthetic inhibitors
- Quantifying the associated direct and indirect emissions of GHG and other environmental contaminants, with the use of isotopic tracing methods
- Employing state-of-the-art tools and methods for characterisation of fertilizer quality and nutrient release properties
- Analyzing the overall climatic impact or “footprint” of new vs. existing fertilizer technologies in scenarios of both industrial and third world agriculture.

It will therefore be an advantage if the applicant has good knowledge about technologies for organic waste utilization and processing, as well as mechanisms and processes controlling environmental gas-emissions (CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, NH<sub>3</sub>) from different systems.

The activities are linked to the research group on Soil biological fertility at Department of Agriculture & Ecology. The group has a major research focus on the influence of manure and organic waste products on soil fertility and the project will be associated with other ongoing projects in the group like CLEANWASTE, PATHOS, FIBCOFERT, SUSANE II.

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