**Thesis Project Offer**

**Joint Research and Education Programme “Palestinian-German Science Bridge PGSB”**

**Forschungszentrum Jülich GmbH & Palestine Academy for Science and Technology**

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**Thesis type**

- [ ] BSc
- [ ] MSc
- [x] PhD

**Intended starting date (approx.):** June-August 2020

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**Contact details of supervisor/responsible host at Forschungszentrum Jülich**

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<tr>
<td>Mr.</td>
<td>Dr.</td>
<td>Arnd</td>
<td>Kuhn</td>
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**Phone**

+492461614386

**E-mail**

a.kuhn@fz-juelich.de

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**Function**

Senior Scientist

**Institute and homepage of institute**

IBG-2 http://www.fz-juelich.de/ibg/ibg-2/EN/Home/home_node.html

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**University affiliation in Germany**

- tentative: University of Bonn

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**Co-Supervisor at Palestinian university (if applicable)**

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**E-mail**

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**University/institution Department/faculty/institute**

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**Project description**

**Title:** "Use of biochar and algal biomass for sustainable crop production."

A low and decreasing carbon content in agricultural soils worldwide and an insufficient supply of mineral nutrients are an increasing obstacle to sustainable plant production. In addition, the increasing demand for food makes it necessary to develop marginal soils that are not yet suitable for plant cultivation through measures to improve soil quality for plant production. The carbon content is crucial for soil fertility as it is an essential factor for water retention, soil ion exchange capacity, soil structure and microbial activity. Further, a sufficient supply of mineral nutrients to crop plants is decisive for the level of crop yield. To prevent nutrient losses from agricultural waste streams and to close nutrient cycles locally available nutrient sources should be captured.

This is where the proposed PhD project comes in. Local resources will be used to sustainably increase the carbon content of agricultural soils and ensure the supply of mineral elements for crop cultivation. Crop plants may be for human consumption, for animal feed and forage as well as for energy production or material utilisation depending on local and regional conditions. In addition to field investigations, experiments will be carried out under controlled conditions in the research greenhouse in Jülich to elucidate the basic mechanisms of plant biomass production and soil improvement. In addition, the influence of soil temperature on the growth and quality of crops will be considered.
Following the model of "Terra Preta - Soils", biochar is introduced into the soil. The targeted administration of biochar from crop residues or other woody biomass has ecological (increased soil fertility, sustainable land use, carbon sequestration in the soil, reduction of greenhouse gas emissions and nutrient losses, use of marginal areas for plant production) and economic effects, like increase in crop productivity, reduction of the necessary irrigation and fertilisation, increase in the value of the areas.

The local nutrient fluxes must be used for the mineral nutrient element supply of the crop plants. In particular, urban wastewater and wastewater from agricultural production can contain high levels of plant nutrients. The task is to extract these mineral nutrients from the wastewater and to make them available again for plant production, thus largely closing the nutrient cycle. One method that has been tried and tested in Jülich is to use microalgae or benthic algae communities that obtain their nutrients from the wastewater, e.g. via the "Algal Turf Scrubber" method (ATS). The dried algae biomass can be easily distributed over the soil and worked in. During microbiological degradation of algae in the soil, the absorbed nutrients, such as phosphorus, are released again and are available to the crop plants.

The supervisory committee on FZJ side (Silvia Schrey & Arnd Kuhn, both IBG-2; Roland Bol, IBG-3) combines expertise in the effects and usage of biochar in agricultural systems, application of algae biomass as organic fertilizer, and organic matter and nutrient (e.g. N, P, K, S) cycles of soils thus providing the complementary proficiency to scientifically support field investigations carried on site in Palestine.

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