

Using bio-economic farm modelling to assess the economic potential of intercropping in German agriculture

Language: English, German

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Intercropping is a technology which grows two or more crops simultaneously on the same field. Agronomic and environmental benefits of intercropping have been extensively described in the scientific literature, such as lower need of synthetic fertilizers and improved water use (Gaba et al. 2015). However, the uptake of intercropping is relatively low in Germany and mainly mixed cropping is found in the context of organic farming. Existing research on mixed cropping shows that it is currently not economically viable for conventional farming in Germany (Bonke et al. 2021) which is among the crucial barriers for its implementation (Bonke and Musshoff 2020).

This master thesis focuses on the economic potential of intercropping as one important aspect of the relative advantage of the technology and its implementation. The master thesis consists of three parts. First, a selected type of intercropping, e.g. faba beans and oat, should be parameterized for a future model implementation. To do so, bio-physical and economic parameters such as yields, input needs and costs need to be collected based on the literature and, if required, an own survey. The latter can be conducted for example by the Delphi method (see Mack et al. 2023 for application in similar context). Second, intercropping should be implemented as an additional crop into the bio-economic farm model FarmDyn (Britz et al. 2020). Third, the model should be used to simulate policy scenarios to foster intercropping uptake for selected farms, analyzing for example their financial support under the second pillar of the future EU Common Agricultural Policy.

The master thesis is supervised in cooperation with the Agroecology and Organic Farming Group of the INRES (Prof. Döring, Dr. Timaeus). The candidate should have a background in agriculture (e.g. Bachelor of Science Agrarwissenschaften) and an interest in modelling with the programming language GAMS. Depending on the candidate's interests, the focus of the master thesis can be shifted between its three suggested parts. Furthermore, the supervisor will assist the candidate with the modelling tasks.

Reference to start:

Bonke, V., Musshoff, O., 2020. Understanding German farmer's intention to adopt mixed cropping using the theory of planned behavior. *Agron. Sustain. Dev.* 40, 48.

Bonke, V., Siebrecht-Scholl, D., Mußhoff, O., 2021. The profitability of mixed cropping with winter faba bean and winter wheat. *Berichte über Landwirtschaft - Zeitschrift für Agrarpolitik und Landwirtschaft* 99, 1-32.

Britz, W., Ciaian, P., Gocht, A., Kanellopoulos, A., Kremmydas, D., Müller, M., Petsakos, A., Reidsma, P., 2021. A design for a generic and modular bio-economic farm model. *Agric. Syst.* 191, 103133.

Gaba, S., Lescourret, F., Boudsocq, S., Enjalbert, J., Hinsinger, P., Journet, E.-P., Navas, M.-L., Wery, J., Louarn, G., Malézieux, E., Pelzer, E., Prudent, M., Ozier-Lafontaine, H., 2015. Multiple cropping systems as drivers for providing multiple ecosystem services: from concepts to design. *Agron. Sustain. Dev.* 35, 607-623.

Jensen, E.S., Carlsson, G., Hauggaard-Nielsen, H., 2020. Intercropping of grain legumes and cereals improves the use of soil N resources and reduces the requirement for synthetic fertilizer N: A global-scale analysis. *Agron. Sustain. Dev.* 40, 5.

Mack, G., Finger, R., Ammann, J., El Benni, N., 2023. Modelling policies towards pesticide-free agricultural production systems. *Agric. Syst.* 207, 103642.