INNOVATIVE APPROACHES TO OPTIMIZE GENETIC DIVERSITY FOR SUSTAINABLE FARMING SYSTEMS OF THE FUTURE (INSUSFAR): PROJECT OVERVIEW

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Introduction

In order to cope with the increasing yield instability caused by changing agricultural ecosystems due to climate change, future agriculture will need to achieve a high level of self-regulation. Furthermore, future crops will have to maintain or increase yield levels and socio-ecological services while being less dependent on fossil fuel based inputs. One of the main factors in meeting these requirements is the functional diversity on inter- and intra-species levels. The exact mechanisms of the interaction between functional diversity and yield stability, ecosystem services and dependence on external inputs, as well as the extent of their interaction, are not yet completely understood.

Hence, the INSUSFAR project aims to contribute to the knowledge of the impact and optimization potential of genetic diversity in self-pollinating crops regarding external inputs, agricultural and economic outputs and ecological services using wheat as a model species. Among others, these questions will be addressed:
(1) To what extent has plant breeding contributed to the adaption of varieties to more sustainable farming systems so far? (2) How do varying degrees of inter- and intra-crop diversity affect the adaptability of different agricultural systems? (3) How does diversity develop over time in systems of varying intensity and which selection and maintenance methods are needed for the improvement of diversity benefits? (4) What is the socio-economic and ecological impact of more diverse crops in future agricultural systems?

Materials and Methods

In order to answer these questions, (1) data from variety testing in Germany will be analyzed regarding the effect of plant breeding progress on the adaption to different input levels in agricultural systems, and a meta-analysis of peer reviewed studies on breeding progress will be conducted. (2) The performance of differently adapted populations and genotypes of different morphological types will be investigated in farming systems with different levels of input, diversity and tillage systems. Experiments will be carried out as medium-term field trials on experimental farms and on selected farms in established

cropping systems. (3) The genetic changes of genetically diverse populations will be investigated. (4) Energy and material flows and their socio-economic and ecological impact will be analyzed with respect to indicators for sustainability in the form of a process analysis based on trial data from experimental stations and on-farm. In addition, scenarios will be calculated on crop rotation, farm and regional levels.

The results will be relevant for their potential applications to agricultural practices, as well as within a political and administrative framework that might be necessary to support sustainable agricultural development. As breeding is a long-term process, the data generated during the course of the project will be available for future research as a public resource through a specifically developed database.

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