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Establishing an economic farm model to simulate, compare, and rank winter wheat production risks when switching from pure line varieties to composite cross populations

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The overall goal of the economic risk assessment in the INSUSFAR project is to draw conclusions on and give recommendations for optimum (site-specific) degrees of diversity in order to balance the trade-off between a potential short-term yield decrease and long-term yield stability when changing from homogeneous winter wheat varieties (pure lines) to genetically diverse composite cross populations (CCPs).

In order to build a simulation model a comprehensive system analysis was conducted to identify the main drivers for and influences on the economic performance of winter wheat production systems. Net return of winter wheat production was chosen as target indicator to be modelled. The economic performance of the winter wheat production system is a combined result of multiple internal effects and various external stochastic elements of the agro-ecosystem. The key domains of management were identified and comprise the internal effects most relevant for the project scope: “variety selection”, “plant protection”, “cultivation”, and “fertilization”. Stochastic effects are represented by the natural conditions and external events: “landscape characteristics”, “weather”, “soil”, and “extreme climatic events”.

Net return of winter wheat production is an indicator of economic performance based on cost-benefit analysis. Main influences are the sales revenues from and the costs of winter wheat production. Costs as a key influence on net return are largely dependent on management decisions, but rely on external effects too, e.g. fuel prices, field size, and the soil type. Market prices in general are a stochastic element irrespective of the farm and agro-ecosystem characteristics. However, specific sales revenues are largely dependent on the quality and the amount of winter wheat produced. Both yield and quality are the results of complex interrelations involving internal and external effects. The variety selected and cultivation measures are direct internal influences while climatic events are direct external influences on winter wheat yield and quality. Indirect management impacts result from regulation of pathogens and pests and nutrient availability. Landscape characteristics (e.g. field size, natural habitats), weather patterns (e.g. precipitation, temperatures), and soils (e.g. type and condition of soil) have an indirect external effect on winter wheat yield and quality through their influence on pathogens, pests, and nutrient availability. Extreme climatic events (e.g. drought, frost) represent direct external impacts on yield and quality. Feedback loops exist concerning management impacts on landscape characteristics and soil, which ultimately influence the management measures again.

The empirical data available at the end of the first trial season have been screened and structured for the economic analysis. Yield parameters have been prepared to enter the model calculations, so that first simulations could be conducted and the general functionality of the model could be evaluated. At this point, results for quality parameters (protein content) in the experiments have not been obtained. Their impact on market price and sales revenues is already implemented in the model, but actual calculations are still missing. However, the simulations conducted so far show that the model results are reflecting the system changes as hypothesized. Therefore, the constructed interactions and functionalities within the model are fit for the analysis of the different scenarios and the evaluation and ranking of the different influences on economic performance.

Textbaustein WP 5.2 für den Abstract zu Marias Präsentation:

"A comprehensive system analysis was conducted to identify the main drivers for and influences on the economic performance of winter wheat production systems. Based on the system analysis a basic farm budget model was designed to calculate costs and benefits. With this full cost accounting approach systematic differences and the general effects of composite cross populations can be evaluated in financial terms. Based on the software package *@Risk* the cost-benefit analysis was enhanced to a risk modelling tool (*FarmRisk 1.0*). The simulations conducted so far show that the model results are reflecting the system changes as hypothesized. Therefore, the constructed interactions and functionalities within the model are fit for the analysis of the different scenarios and the evaluation and ranking of the different influences on economic performance."