Sensor-based technologies and integrated assessment models in food production chains - an approach towards enhanced exploration of sustainability potentials

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Technological developments have led to massive changes in the agricultural and food industry. Its sustainable development implies to consider economic, ecological and social aims equally. However, the general accepted formula of these three columns as the basis for sustainability has to be specified with regard to the agricultural and food industry. The following aspects are addressed: responsibility of the agricultural and food industry to guarantee basic nutritional supply and quality assurance for food and feed for the society as a whole; preservation of natural resources; conservation of bio-diversity; socio-economic as well as ethical components and global components of sustainable development. Facing these demands it is indispensable for the agricultural and food industry to implement novel quality management systems in the food production chains to maintain a high quality and safety level in products and processes and to minimize produce losses. Technical solutions for appropriate systems are being developed in the joint research project ProSenso.net2 exemplary for two value-added chains – *cereal grain* and *potatoes, fruit, vegetables*, both of outstanding economic importance in Europe.

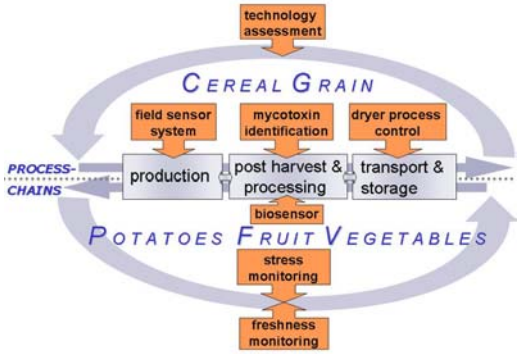

Fig. 1: Research and development tasks of at critical points of the process chains

In ProSenso.net2 existing and new sensor systems are being optimized, developed, and adjusted in order to monitor process and product quality at relevant points of the chains, preferably online. Transfer of the obtained results into agricultural practice is supported by an embedded socio-economic technology-assessment. It aims to quantify the effects of an application of the new sensor-based technologies in agriculture in terms of sustainability. The determination of micro-organisms is of peculiar interest for the inhibition of mycotoxins as well as for the prevention of high decay-induced wastage in the production chain i.e the saving of natural resources. In order to obtain practicable results, different sensors will be combined (sensor fusion), processes exemplarily assessed and evaluated, and research work will be cross-linked beyond the limitations of the product lines. The research and development work is not covering the entire process chains (from soil to food) but will concentrate on the critical points that are particularly relevant for quality and safety matters (fig. 1). Subtasks of the joint project focus the following topics:

In the process chain *cereal grain* research and development aims at the development of
- sensor-based detection methods and device of mycotoxin producing fungi in wheat crops,
- indicators and sensor technology for the identification of mycotoxin producing fungi in the processing of grain
- a microwave-based humidity sensor for process control for enhancing energy efficiency in grain dryers, and
- chain-comprehensive technology assessment.

In the process chain *potatoes, fruit and vegetables* the research aims at the development of
- methods and devices to determine the quality and to evaluate the spoilage risk in horticultural products (fig. 2),
- biosensors for the detection of human- and phytopathogenic micro-organisms in the post-harvest chain of perishable products, and
- a modular system for quality monitoring in the logistic chain of perishable horticultural produce.

Both producers and users of the sensor integrated systems are to benefit from the project outcome. Results will provide planning criteria for the implementation of sensor techniques into production chains and for the necessary adjustment of processes according to the sensor-induced changed conditions. Moreover, it will grant knowledge on sustainability effects of the new technologies.

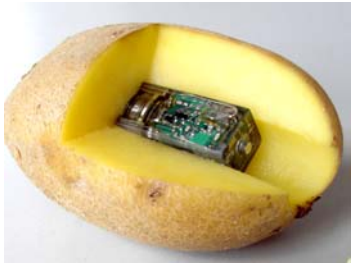

Fig. 2: Sensor implant for measuring mechanical stress in the process chain

At present five research institutions and eight small and medium-sized enterprises (SME) cooperate within the joint research project ProSenso.net2, which is funded by the German Federal Ministry of Education and Research (BMBF).