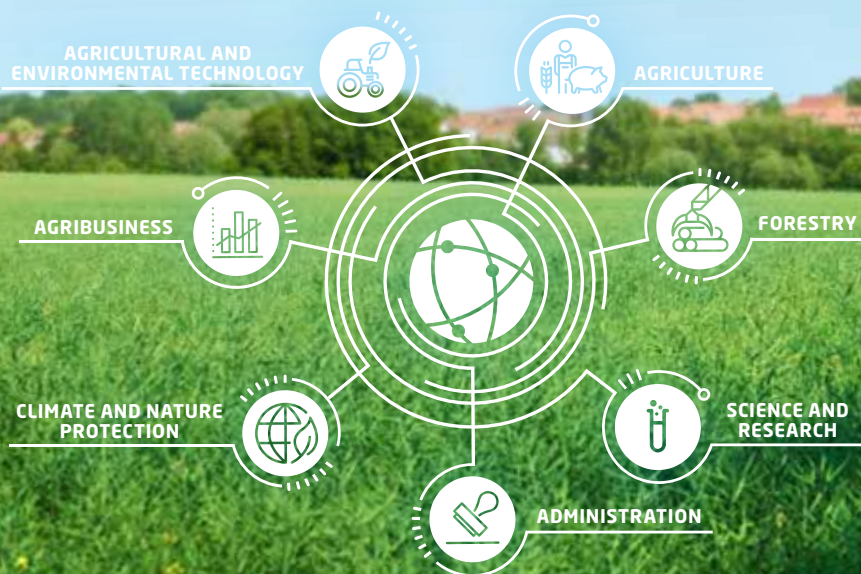


# simul<sup>+</sup> InnovationHub

## Projects

Status: 06.12.2018





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Projects

Status: 06.12.2018

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## Subject area

# EXPERIMENTAL FIELD 5G IN AGRICULTURE AND FORESTRY

## 1. Communication infrastructure in rural areas (rural network)

PROJECT BEING PLANNED

### Objective

The goal of the project is to create a digital experimental field with a focus on the necessary communication and cloud infrastructures. The experimental field serves to investigate and test technologies for blanket wireless data transmission with the help of 5G in rural areas to network agricultural enterprises and utilise data hubs. The test field is a platform and shop window with non-discriminatory access to test and demonstrate new and future digitisation applications for agricultural purposes and for innovations in rural areas.

### Project content

- ⚡ Analysis of digitisation applications and their technical requirements
- ⚡ Design, planning, realisation and operation of a 5G-based experimental field
- ⚡ Testing and demonstration of digital technologies and applications
- ⚡ Development of strategies to integrate local stakeholders, user groups as well as external stakeholders, technologies and applications
- ⚡ Development of operator and business models for new value-added chains
- ⚡ Elaboration of digitisation guidelines

## 2. Test and demonstration field: digitisation in plant cultivation/field swarm technology

PROJECT BEING PLANNED

### Objective

The goal of the project is to highlight the potentials of digitisation in plant cultivation with respect to conserving and utilising resources, environmental protection as well as the performance and facilitation of work (exploitation of the possibilities offered by "Agriculture 4.0"). Furthermore, a contribution is to be made to eliminating reservations about digitisation in agriculture and its introduction into practical farming is to be promoted.

### Project content

- ∴ Partial digitisation of workflows and digitisation of complete workflows
- ∴ The use and comparison of remote sensing data in agriculture
- ∴ Testing existing possibilities for autonomous work in plant cultivation
- ∴ Preparation of education and training programmes

## 3. Test and demonstration field: digitisation in animal husbandry

PROJECT BEING PLANNED

### Objective

The goal of the project is to develop and test new methods to control biological processes based on reliable forecasts. This goal will be achieved by an all-embracing digitisation of those stages of production that have already been mechanised and automated. The focus here will be on questions related to animal welfare, transparency and consumer protection.

### Project content

- ∴ Further development of a systemic approach to the digital networking of animal identification, animal localisation and wireless data transmission
- ∴ Development of optical identification methods by means of automatic image analysis
- ∴ Testing and evaluation of indoor and/or outdoor animal localisation systems
- ∴ Electrification for the operation of sensors, data storage, pre-processing and aggregation as well as for radio-based data transmission
- ∴ Evaluation of data transmission technologies in livestock farming
- ∴ Evaluation of the key technologies and preparation of offers for know-how transfer

## 4. Test and demonstration field: sensors in plant cultivation

PROJECT BEING PLANNED

### Objective

The goal of the project is to identify and test the latest sensor technology available to record soil, plant and stock parameters in plant cultivation and to evaluate this in terms of the technical, ecological, economic and environmental value added. Farming and plant cultivation decisions call for a sound information base. Sensors are a key technology in the collection of data as a basis for decisions.

### Project content

Testing and demonstration of various sensors and sensor-based navigation methods in plant populations

- Testing airborne and satellite-based methods to plan the application of fertiliser, analyse growth, soil moisture, to forecast harvest and detect plant diseases
- Testing and demonstration of plant cultivation sensors on ground-based vehicles and machines
- Testing stationary sensor stations on plant phenology, micro-climate, soil moisture, ground cover as well as pest infestation in the field
- Testing and demonstration of sensor-based methods to identify and protect wild animals when mowing grasslands and using plant protection products

## 5. Test and demonstration field: sensors and robotics in animal husbandry

PROJECT BEING PLANNED

### Objective

The goal is the development and expansion of a test field to try out sensor and robotics solutions as well as assistance systems to support autonomous animal husbandry. A number of automated solutions already exist for individual stages of the process, particularly in dairy farming. However, these have often only gained a foothold as isolated solutions. There is a need to develop a better networking of the robotics solutions that are in use and an ontology based on this for the complete milk production process chain.

### Project content

- Testing and evaluation of 3D image sensors and automatic 3D image analysis methods to gather information for animal and process monitoring
- Testing and evaluation of systems to monitor the quality of water troughs and water outdoors and indoors
- Testing and evaluation of procedures to monitor health
- Testing and evaluation of traffic guidance systems for animals, e.g. gate and feed fence control



- ⚡ Testing and evaluation of robotics solutions for cleaning and care equipment
- ⚡ Development of an evaluation system as well as educational and training programs

## 6. Test and demonstration field: business data management and Farm Management and Information Systems (FMIS)

PROJECT BEING PLANNED

### Objective

The goal of the project is to highlight possibilities and recommendations for safe and self-determined data management. FMIS play a key role as user interfaces and tie points for all smart farming applications and as decision supports in agricultural enterprises. However, the data produced by agricultural enterprises is often located on third-party servers. Wherever cloud solutions are used, the rights of data usage are usually transferred to other economic operators. This situation is unsatisfactory and a hindrance to the further expansion of digitisation.

### Project content

- ⚡ Testing of various FMIS in a test and demonstration field and evaluation of the software with development recommendations
- ⚡ Testing of data hub systems in a test field, evaluation of the software and submission of development recommendations
- ⚡ Testing of an FMIS in practice with subsequent evaluation of the solution and submission of suggestions for improvement
- ⚡ Preparation of education and training programmes

## 7. Test and demonstration field: IT solutions to evaluate animal husbandry systems

PROJECT BEING PLANNED

### Objective

The goal of the project is to develop and test an IT-based solution for an inventory management system for dairy farms based on animal welfare. IT-based instruments to analyse, manage and control the operational processes are hereby created to improve the quality of life of the livestock. These instruments are provided for self-monitoring and a continuous self-improvement of animal husbandry. Methods are therefore developed in the project to improve inventory management in the sense of animal welfare, hygiene and health.

### Project content

- ∴ The content of the process management system focuses on animal hygiene, welfare and health
- ∴ Development of IT solutions for an animal welfare-based process management system with the named main foci
- ∴ Testing and validation of the animal-welfare-based IT solutions in pilot plants
- ∴ Comprehensive evaluation of the methods and solutions that were implemented as well as the drawing of conclusions and recommendations for further use

## 8. Development and implementation of educational, transfer and communication offers within the test and demonstration field for smart farming

PROJECT BEING PLANNED

### Objective

The educational and experimental station Köllitsch (LVG) is a working farm to implement the test and demonstration field for smart farming. It offers optimum implementation structures based on many years of experience in the field of precision farming. The knowledge gained so far has already been integrated in numerous vocational training programs. The implementation of the future test and demonstration field opens up further possibilities to extend these experience and knowledge within the scope of basic and advanced training.

### Project content

- ∴ Preparation of a training program for courses within the scope of inter-company training
- ∴ Development and implementation of special advanced training modules on digitisation for university and technical college students as well as grammar school pupils
- ∴ Development and implementation of training programs within the scope of advanced training
- ∴ Organisation of various events, e.g. light-house events, user seminars, practitioner's seminars, field days

- Dissemination of the results through extensive PR work

## 9. Agriculture online – portrayal of a modern and sustainable farm using new media taking the LVG (educational and experimental station) as an example

PROJECT BEING IMPLEMENTED

### Objective

Portrayal of a modern and sustainable farm by means of new media taking the educational and experimental station Köllitsch (LVG) as an example. Communication of modern, sustainable ways of doing business in primary agricultural production incl. information on vocational training. Pilot development of principles for specific communication. Testing of various cam sensor and tracking systems for information transfer. Development of recommendations for action for the sector.

### Project content

- Combined use of interactive presentation methods, for example using sensors or cameras, to communicate the content areas online to the general public

- Short video sequences, the use of trackers for dairy cows in the barn, the use of herd management systems for cows or live sequences on the computer monitor on a tractor with precision farming technology, for example, are planned
- Static and dynamic content complement each other in the presentation
- The new presentation media have a pilot character and can be used as an example by agricultural enterprises to present themselves
- Deduction of recommendations for other agricultural enterprises in terms of the effort, benefits, practicality, risks and costs

## 10. Planning and implementing solutions for digital plant cultivation in the LVG Köllitsch

PROJECT BEING PLANNED

### Objective

The goal is to plan and implement solutions for digital plant cultivation in the educational and experimental station (LVG) Köllitsch and to establish a smart farming architecture in tillage farming at the LVG and for the vocational training at the site. The four levels of smart farming in plant cultivation, field, machine, control/planning as well as the management level, are integrated in the concept.

### Project content

- ⚡ Geo-referenced soil inventory
- ⚡ Extension of the precision farming applications (e.g. plant protection, sowing, soil cultivation)
- ⚡ Networking (machine – machine, man – machine)
- ⚡ Data transfer, retention, security
- ⚡ Data processing, process control and decision support (farm management and information system)
- ⚡ Knowledge transfer

## Subject area

# SMART FARMING AND FORESTRY TECHNOLOGY

## 1. Field swarm technology soil cultivation and plant protection

### PROJECT BEING PLANNED

#### Objective

The goal is the further development of the field swarm approach that was developed within the scope of the "Regional growth cores" funding programme. In addition, this makes a significant contribution to sustainable agricultural engineering and resource-saving farming.

#### Project content

- ::: Development of autonomous driving on the field
- ::: Development of a mechanical weed control system with a sensor system to detect areas of weeds and site-specific, ultra-flat, exact tillage
- ::: Development of an intelligent plant protection module with weed detection and needs-based substance application
- ::: Demonstration and practical trials of the overall system in the test and demonstration field
- ::: Design of a concept for the further development of the field swarm unit
- ::: Development of a consistently electric field swarm unit with quick-charge unit and rechargeable battery

## 2. Cognitive robotics 2.0 in horticulture, fruit and wine growing (autonomous wine and fruit growing) – including practical tests

PROJECT BEING PLANNED

### Objective

Further development of the ELWOBOT to automate fruit and wine growing, i.e. an autonomous vehicle platform with modules for mowing/mulching, for plant protection and for contour cutting; independent navigation of the vehicle in the plantation, automatic process documentation and integration of the machines in an FMIS; storage and processing of the sensor and operational data, transmission of process data to the machine, human-machine-interface with decision support.

### Project content

- ∴ The existing vehicle will be completely re-engineered with respect to the electric drives, vehicle management, navigation sensors and plant protection equipment.
- ∴ Preparation, performance of field tests in various weather conditions and at various times of the day and night with subsequent evaluation of the test
- ∴ Revision of the navigation and environment recognition, new vehicle platform as well as conversion of the electric drive system to converter technology suitable for outdoor use.
- ∴ Development of a pre-series vehicle, generation of all production documents and preparation of the market launch

## 3. Sensor system/IoT nutrient supply soils/plants (N+P), soil moisture, soil density, soil function

PROJECT BEING PLANNED

### Objective

Development of stand-alone sensor units suitable for long-term use that can remain in the ground permanently and send information on the supply of nutrients in the soil. Furthermore, information on the soil temperature, soil hydrology and soil density are to be integrated in a second group of sensors. The sensors communicate with stationary or mobile communication units by wireless

technology. These communication units serve as a gateway to transmit the sensor data to the cloud and/or the user's farm management system.

### Project content

- ∴ Development of the sensor unit: nutrient detection unit, power supply module, communication module, overall unit

- ::: Development of stationary and mobile communication units to network various sensor units, for the data rate and data transfer
- ::: Adaptation of the communication interface to the test field infrastructure
- ::: Manufacture and test of the sensor units in the laboratory under controlled conditions
- ::: Production and field tests of the sensor and communication units in real conditions with a weak point analysis

## 4. Sensor system/IoT plant condition, plant health

PROJECT BEING PLANNED

### Objective

The integration and further development of intelligent, networked soil and plant sensor systems to record agricultural production and process data as a basis to control the production processes through a farm management and information system (FMIS). Investigation of the potential offered by existing data and new sources of information; development of analysis strategies for the different data bases; linking of data from various sources.

### Project content

- ::: Investigation and collection of data sources in the agricultural sector
- ::: Evaluation and assessment of existing data sources, assess the plausibility of the data and investigate additional ways to record live data
- ::: Integration of various FMISs in the test field
- ::: Development of data analysis strategies and decision support
- ::: Involvement of model farms and the test and demonstration field for a qualified assessment of the decision support

## 5. Integration of data hubs for the inclusion of FMIS and machines/sensors

PROJECT BEING PLANNED

### Objective

Establishment of a "data hub" as an important basis for digitisation to ensure the data sovereignty of farmers, legal security and the non-discriminatory provision of data; solution of compatibility problems between various data providers and receivers, if and as

long as there is no standardisation; integration of heterogeneous machinery in the test field by means of the data hub; demonstration of the manufacturer-neutral networking of machines.

**Project content**

- ::: Selection and assessment of an existing "data hub"
- ::: Integration of selected data hubs in the 5G test field
- ::: Development of a networking architecture for heterogeneous machinery
- ::: Integration of the heterogeneous machinery in the test field by means of the data hub
- ::: Demonstration of the manufacturer-neutral networking of machines

## 6. Use of an all-In-One CMOS image sensor with an OLED micro-display to determine plant substances for the purpose of fertilisation optimisation taking ornamental plants as an example

PROJECT BEING PLANNED

**Objective**

Development of cutting-edge technology to assess the nutritional status of plants for an optimum fertilisation; improvement of cultivation safety, product quality and profitability as well as environmental friendliness in the production of ornamental and other plants; use of statistical learning methods and computational intelligence for the management and evaluation of the new, complex measurement procedure.

**Project content**

- ::: Development, manufacture and conditioning of the all-in-one CMOS image sensor (light detection) with OLED micro-display (light emission)
- ::: Generation of measurement data for plant material
- ::: Development and verification of intelligent evaluation models: with the help of new methods of statistical learning and computational intelligence
- ::: Development and conditioning of the 2<sup>nd</sup> generation of sensors: taking previous results into account as well as the requirements on handling that are expected from practical trials
- ::: Calibration based on extensive plant data
- ::: Testing in working farms with respect to the handling, safety, acceptance etc.
- ::: Dissemination of the results in trade media as well as in basic and advanced training



## 7. Development of a soil-preserving, high-performance and ergonomic winching system to haul timber from windthrow and bark beetle nests

PROJECT BEING PLANNED

### Objective

The project has set itself the goal of developing a technical solution by which raw wood can be transported in small amounts (distributed felled timber) at economically reasonable costs and in an ergonomically feasible manner on surfaced and machine roads without machinery having to drive over sensitive ground.

### Project content

- ::: Development of the method, narrowing down of the general conditions, compilation of technical specifications

- ::: Conversion of the vehicle-mounted winch by a manufacturer of forest machinery according to the technical specifications
- ::: Test of the winch system under real operating conditions to collect distributed felled timber at level, impassable locations
- ::: Test of the winch system under real operating conditions to collect distributed felled timber on short, steep slopes
- ::: Conversion of the vehicle-mounted winch according to the second technical specifications
- ::: Final test of the winch system under real operating conditions

## 8. Procedure to assess digitisation methods and technological implications

PROJECT BEING PLANNED

### Objective

Analysis of the effects of individual digitisation elements and the increasing digitisation in farming on agricultural enterprises, the agricultural sector, society and natural resources. Of particular interest are the consequences of networking on agricultural enterprises of all sizes, on the one hand, and the contribution that can be made by digitisation to socially and ecologically compatible as well as economically successful farming on the other.

### Project content

- ::: Investigation into how the networking of agricultural machinery into overall production systems affects resource efficiency and sustainability
- ::: Investigation of approaches for the partial digitisation of small agricultural enterprises
- ::: Investigation of the issue as to how far efficiency can be improved through digitisation

::: Investigation of the effects of a shift from the farmers' practical knowledge and experience towards assistance and management systems as well as external system providers

::: Investigation of the question of whether important knowledge is lost by Agriculture 4.0 and the extent to which operational decisions by farmers could be predetermined

## 9. Further development of integrated plant protection and the introduction of new plant protection methods (dropleg method) into practice for sustainable plant production

PROJECT BEING PLANNED

### Objective

Integrated plant protection should be developed further to reduce the burden on the ecosystem through plant protection products. With this in mind, the practicality of the eco-friendly dropleg method will be tested in various field crops in Saxony with a view to the targeted application of plant protection products, the avoidance of inputs into the ecosystem and the production-related practicability.

### Project content

Testing of the dropleg technology with the following main foci:

- ::: Rape/flowering treatment, maize/weed control, snout moth control, cereals/disease control, sugar beet/control of late weed infestation
- ::: Comparison with conventional nozzle technology on working farms
- ::: Accompanying analysis of residues in the plants and crops
- ::: Comparative evaluation of harvest parameters and quality as well as an economic evaluation
- ::: Preparation of recommendations for action

## 10. CowBodyScan – automatic 3D-image analysis system

PROJECT BEING IMPLEMENTED

### Objective

Further development of the high-resolution IR sensor 'optiCOW' into a stand-alone, marketable product for the automatic, non-contact determination of the condition of cattle. The function of the 3D sensor has been enhanced to include the simultaneous recording of real physical dimensions and the identification of pathological motor functions. Information on the animal's physiology will be generated from the sensor data and shown to the stockman as decision support.

### Project content

- :: Automatic recording and evaluation of various parameters for moving dairy cattle (e.g. daily, non-contact appraisal of the physical condition; daily, non-contact recording of the gait for the early detection of lameness; biometric body measurements to assess growth)
- :: Storage of this huge amount of data from the 3D sensors in a specially developed database
- :: Compression and plausibility check of the data

## 11. Testing various cultivation and production systems

PROJECT BEING IMPLEMENTED

### Objective

Investigation of crop rotations for renewable raw materials on light, warm soils in northern and eastern Saxony. Concrete statements should be able to be made on the yield and profitability of production of the raw materials as well as the ecological impact of these farming systems on dry class D locations.

### Project content

- :: Investigation of ten crop rotations at locations seriously affected by climate change

- :: Testing of various intense crop rotations with a high share of catch crops, a maize-maize crop rotation and a cultivation system with reduced N fertilisation and two perennial types of crop
- :: With the help of data from previous crop rotation tests, conclusions will be drawn on the effects of climate change (consequences for harvests depending on the vegetation start, weather and time of maturity)

## 12. StaPlaRes – N-stabilisation and rhizospheric fertiliser application

### PROJECT BEING IMPLEMENTED

#### Objective

Reduce N-losses during urea fertilisation in typical crop rotations and increase the nutrient efficiency. The beneficial effects of double-stabilised urea will be quantified. We will also look at how an economic and ecological optimisation of N-fertilisation measures can be achieved and which adjustments have to be made to the method of cultivation with respect to the climatic development.

- :: Significant reduction of N-losses through a combined N-stabilisation with urease and nitrification inhibitors
- :: Reduction of NH<sub>3</sub>-losses through a special side-dressing in which urea can also be applied to standing crops
- :: Investigation of the method in field tests and supplementary analyses through laboratory, greenhouse and lysimeter tests
- :: Additional evaluation through life cycle assessments and eco-efficiency analyses

#### Project content

- :: Development of novel technologies within the scope of urea fertilisation to the greatest possible resource efficiency and environmental protection

## 13. 'Precision Farming' in forage production

### PROJECT BEING IMPLEMENTED

#### Objective

Various precision farming methods and technologies for efficient and eco-friendly nutrient management will be evaluated on grassland and in arable feed crop production. The subplot-related nutrient supply for the growing feed crops will be recorded and controlled so as to achieve well-adjusted plant nutrient balances and the minimum plant nutrient leaching potential that can be achieved is presented.

#### Project content

- :: Performance of a soil inventory as well as a coordinate-based biomass and yield measurement
- :: Partitioning of the area into management zones (subplots) that are primarily geared to optimum soil nutrient contents (with a focus on phosphate)
- :: Evaluation on the basis of soil and plant samples in conjunction with various methods of soil and yield mapping including satellite-based measurements

## 14. SpaceDataMilking – a system to automate operational procedures

PROJECT BEING IMPLEMENTED

### Objective

The goal of the project is to develop a farm management system for decision support and the automation of operational procedures using customised, building-referenced space-time data taking milk production as an example. The multitude of process data generated during production will be combined with the master data for the dairy cows together with the space-time coordinates for the individual animals. Specific behavioural characteristics and animal-physiology conditions will be derived from this data that can help the herd manager reach his decisions and promote a transparent digitisation of the milk production process.

### Project content

- ∴ Definition of an integrative layer model for the envisaged farm management system and drafting of a catalogue of requirements for its use
- ∴ Analysis and elaboration of the requirements on a database in the layer model
- ∴ Extensive field tests following the integration of the overall system in a pilot plant
- ∴ Performance of investigations and development of methods for space-time coordinates of individual animals and analysis of the resulting behavioural pattern
- ∴ Evaluation of the detected deviations from the normal behaviour of individual animals in an assistance system and visualisation for the herd manager as a decision-making tool

Subject area

## ENVIRONMENTAL TECHNOLOGIES AND SUSTAINABILITY

### 1. Low-cost production of fibrous plant components and residues as well as their processing into structural elements based on non-woven fabrics

PROJECT BEING PLANNED

#### Objective

The demand for sustainable raw materials from agriculture such as natural fibres for use in technical applications has grown steadily. The goal of the project is to manufacture domestic, semi-finished textile products in the desired qualities using new technological developments as cheaply as goods from abroad. Questions related to increasing efficiency through the coupled and cascade use of nutrient plants as well as new developments in process and production technology through a change in processing steps play a key role here.

#### Project content

- ✚ Choice of raw materials and test of their suitability as base materials for processing
- ✚ Modification of the harvesting techniques aimed at a partial processing and compacting to a form that is suitable for transport
- ✚ Modification of the processing technologies for the raw materials through upstream treatment and cleaning technology for pre-cleaning, dust extraction, the isolation of foreign bodies or drying
- ✚ Generation and development of finished products and components

## 2. Local energy supply for agriculture

PROJECT BEING PLANNED

### Objective

Development of concepts for optimum energy supply strategies for agricultural production and rural areas using existing resources such as the sun, wind and bio-mass. Testing low-cost and robust storage systems for local energy supplies. Combination of various systems to generate and use renewable energies for use in agriculture.

### Project content

- ✚ Development of a simulation model for different kinds of energy supply and storage
- ✚ Elaboration of concepts for an optimum supply strategy and simulation of the scenarios to identify the best alternative
- ✚ Design of an energy storage device for applications in agriculture
- ✚ Design and development of the charging infrastructure for electrified agricultural equipment
- ✚ Comparison of technologies for energy generation, conversion and storage
- ✚ Demonstration of a "power to X" application

## 3. Further development and demonstration of methods to process fermentation products into fertiliser products and water and to cultivate microalgae as well as their integration in a digitally-supported operational nutrient management system

PROJECT BEING PLANNED

### Objective

Development and optimisation of methods to produce concentrated solid and liquid fertilisers from agricultural residues (specifically fermentation products from biogas systems and liquid manure) aimed at producing fertilisers with defined and constant product properties. Furthermore a central unit is to be built to provide microalgae inoculant (similar to "seeds") so that microalgae biomass can be produced. The use of microalgae as a fodder supplement improves sustainability in agricultural production by reducing the demand for conventional fodder.

### Project content

- ✚ Evaluation of the process chain to treat liquid manure and fermentation products
- ✚ Procedural and sensory-analytical further development of measurement technology to record and draw up a balance of constituents that are relevant for fertiliser values and material flows
- ✚ Planning and construction of a demonstration plant to treat fermentation products
- ✚ Selection and adaptation of suitable and approved microalgae strains

- ⋮ Investigation of possible coupling points with biogas plants as well as the suitability of treated liquid manure as a fertiliser for microalgae production
- ⋮ Performance of feasibility studies

#### 4. Planning erosion protection on the basis of EROSION 3D scenario maps

PROJECT BEING IMPLEMENTED

##### Objective

Development and provision of scenario maps on water erosion for arable land in Saxony as a basis for mapping scenarios on erosion risks and the implementation of erosion protection measures. The high-resolution erosion maps should provide farmers with detailed information on the erosion situation/risk for their operational arable land as well as tips for effective protective measures.

##### Project content

- ⋮ Development of 3D scenario maps for all arable land in Saxony
- ⋮ Presentation of the soil translocation and removal caused by water erosion events (10 and 50-year heavy rain events)
- ⋮ Development of scenario maps based on measures related to arable land, ground cover, soil moisture, structural conditions as well as additional influencing factors and/or protective measures
- ⋮ Publication of selected scenario maps



## 5. Testing innovative soil water management methods on agricultural land

PROJECT BEING PLANNED

### Objective

Drought has serious consequences for the production risk, above all on light soils with a low water storage capacity, because water is a yield-limiting factor. Inadequate soil moisture also affects the availability of the nitrogen in fertilisers and its absorption by the crop plants. Excess nitrate can be eluviated and become concentrated in the groundwater and surface water. Additional watering of crop plants is one measure to adjust to the yields lost as a result of climate change and to minimise nitrogen input.

- ✚ Construction of test fields with innovative irrigation and drainage, performance and analysis of tests, development of algorithms for regional simulations
- ✚ Determination of the water supply, future demand for water and nitrate leaching potential
- ✚ Profitability calculation and evaluation of effects on the environment
- ✚ Transfer of information and knowledge by providing information, training and educational material and by developing planning instruments for farmers

### Project content

- ✚ Performance and evaluation of irrigation experiments, deduction of parameters for regional simulations and improvement of the irrigation control models

## 6. LUMAT – Land Use Management Agencies and Tools

PROJECT BEING IMPLEMENTED

### Objective

The goal of the LUMAT project is to strengthen an awareness of ecosystem services that offer natural soils. A more sustainable use of space should strengthen the importance of soil in planning and implementation processes of the city and surrounding area. The relationships between central urban areas and the hinterland of the surrounding municipalities should be taken into account through inter-communal land management.

### Project content

- ✚ Development of an instrument ('LUMATO') for the integrated environmental analysis of threats to soil
- ✚ Implementation in the IT environment of the administrations of the city of Leipzig and surrounding area
- ✚ LUMATO should be planned in such a way that it can also be used in other regions in Saxony and central Europe

- ⌘ Preparation of feasibility studies for the development of fallow land
- ⌘ Development of a plan for compensation areas

## 7. Concept for the sustainable use of mineral wastes

### PROJECT BEING IMPLEMENTED

#### Objective

Development of a concept for the sustainable use of mineral wastes to support the implementation of the raw materials strategy for Saxony. Analysis of the disposal situation for mineral building and demolition wastes and assessment of the development of material flows with respect to the recovery and disposal of various waste fractions. In a second phase, determination of the demand for landfill capacities for mineral wastes in Saxony.

#### Project content

- ⌘ Analysis of the material flows for building and demolition wastes, in particular with respect to the recovery of non-mining mineral wastes in opencast mines
- ⌘ Assessment of the effects of the general conditions on the future recovery and disposal of mineral building and demolition wastes
- ⌘ Determination of the demand for landfill capacities
- ⌘ Development of scenarios to assess probable developments taking into account the dynamics of the market

## Subject area

NATURE CONSERVATION AND  
CLIMATE PROTECTION**1. Assessment of drought stress as a key predisposition factor for bark beetle infestation with the help of remote sensing methods**

PROJECT BEING PLANNED

**Objective**

The goal is to develop a method that enables a large-scale and prompt evaluation of the current level of drought stress for the main species of trees in Saxony. Remote sensing data should primarily be used for this purpose, which is provided in the shortest possible update increments, thus allowing an interval-based analysis during the vegetation period.

- ∴ Creation of a terrestrial test field to measure soil moisture and soil water tension
- ∴ Development of a method to derive the current drought stress situation
- ∴ Integration of the procedure in a forecasting tool to predict the risk of infestation and to ensure the transfer of data to existing systems
- ∴ Drafting of recommendations for action and organisation of training for users

**Project content**

- ∴ Research into suitable data bases such as satellite data, digital orthophotos, or from drones with subsequent data processing

## 2. Introduction of alternative sowing operations in active-climate variable forest restructuring strategies

PROJECT BEING PLANNED

### Objective

The goal is to adapt alternative sowing operations to the existing demands of sustainable forestry, to test these technologically and make them ready for the market. Climate development models have different scenarios with respect to the distribution of precipitation and temperature profile in the medium term. This results in altered requirements on the tree species composition for forests.

- ⌘ Setting up trial areas and analysis of qualitative area/structure data
- ⌘ Development of model variants whose technology can be adapted and sensory qualification/quantification
- ⌘ Evaluation of technological and technical aspects of the procedure
- ⌘ Qualitative analysis of the implementation and results data
- ⌘ Deduction of a recommendation for action and standardisation of technical solutions

### Project content

- ⌘ Analysis of existing forest rejuvenation methods and capacities that are in use and an analysis of existing sowing operations in forests

## 3. KliWES – Climate change and water balance in Saxony

PROJECT BEING PLANNED

### Objective

Provision of reliable, modelled water balance data for the ACTUAL status (1961 – 2018) and under the conditions of climate change (up to 2100) on the Internet. The existing system should also be optimised and updated. The project is based on the KliWES three-pillar concept, which is founded on an ensemble of mutually supporting and independent procedures. The concept combines various approaches to calculate the regional water balance. Scientifically substantiated and re-

liable water balance data has been derived from this that should now be able to be updated on the basis of an improved data basis and a qualified calculation module.

### Project content

- ⌘ Verification and customisation of input and results data from the model in the fields of pedology, system of watercourses, groundwater balance as well as climate and meteorology

- ⌘ Optimisation of the ArcEGMO® model system and updating with respect to the water balance calculations for the ACTUAL status and scenarios
- ⌘ Implementation of the necessary function and layout adjustments to the web applications in Saxony's water balance portal

## 4. RESIBIL – Tools for sustainable water resource management

PROJECT BEING IMPLEMENTED

### Objective

The project aims to strike a balance for the groundwater resources in the border area between Saxony and the Czech Republic and investigate its sensitivity with regard to climatic changes. Based on experiences and knowledge available from the earlier project GRACE (08/2011 – 03/2015), the effects of possible climate changes in future on the groundwater supplies will be analysed and the vulnerability and resilience of the system under consideration, including the water supply, examined with regard to climate and weather conditions.

### Project content

- ⌘ Extension of the investigations by including the soil hydrology to determine the formation of new groundwater as a dynamic balance parameter for the amount of groundwater (inclusion of the results of the KliWES project)
- ⌘ Development of a set of model instruments that allows reliable statements on the groundwater supplies, their sensitivity to climate change as well as their possible use and points out potential adjustment measures with regard to an altered landscape hydrology
- ⌘ Deduction of specific practical guidelines and measures

## 5. Operational nutrient management (web-based BEFU (inventory management system) to implement the DüVO (German Fertiliser Ordinance))

PROJECT BEING IMPLEMENTED

### Objective

Development of a consulting model to improve nutrient management for agricultural enterprises in the sense of increasing the nutrient efficiency and reducing environmentally-relevant nutrient losses. The model should help implement the requirements of the German fertiliser ordinance, ensure the prevention of water pollution (WRRL - water framework directive), retain and improve the soil fertility and reduce GHG emissions.

### Project content

- ⌘ Development of a web-based consulting model for operational nutrient management
- ⌘ Further development of the methods in the existing BEFU programme and addition of further components
- ⌘ Revision and implementation of the software architecture, in particular with regard to web-compatibility, as well as the integration of the GIS function
- ⌘ Inclusion of the increasing amount of data that is available in the enterprises
- ⌘ Extension of the content, e.g. calculation of nutrient losses, analysis of operational nutrient cycles

## 6. Further development, practical introduction and validation of the webBESyD web-based advisory model for operational nutrient management

PROJECT BEING PLANNED

### Objective

Further development, practical introduction and validation of the web-based advisory model for the operational nutrient management. webBESyD pursues the goal of optimising nutrient management in agricultural enterprises so as to increase the nutrient efficiency and improve the protection of biotic and abiotic resources. The operational system approach promises a variety of pos-

sible applications for agricultural practice and consulting. By extending the software to include site-specific calculation and evaluation modules, the consulting model supports the enterprises in the field of digital farming during the development of viable approaches to increase the efficiency and improve the sustainability of the enterprise.

## Project content

- ⌘ Further development, practical launch and model validation of webBESyD
- ⌘ Software distribution and installation, configuration, data protection concept, EULA
- ⌘ Establishment of the business organisation, training courses, determination of the material flow balance in accordance with the material flow balance ordinance
- ⌘ Planning further modules, interfaces and evaluation routines
- ⌘ Development of a concept for the use of webBESyD by other German federal states

## Subject area

# DIGITAL VILLAGES AND SMART RURAL REGIONS

## 1. Digital villages

PROJECT BEING PLANNED

### Objective

Introduction of the "Digital villages" platform with all basic modules in the Lommatzsch region, adaptation to the conditions in Saxony and logical expansion.

### Project content

- ⋮ Analysis of requirements for the Living Lab concept in the region and design of pilot applications in workshops with citizens
- ⋮ Introduction of the solutions DorfNews (village news) and DorfFunk (village radio)

in the region, expansion to include the aspects nursery/school, digital citizen's advice bureau and local recreation

- ⋮ Introduction of the BestellBar and LieferBar with add-on options for aspects of regional local recreation and incorporation of the digital trading platform
- ⋮ Evaluation of the solutions, definition of improvement measures and recommendations for action as well as dissemination to the general public and other regions

## 2. Mobile collection of recyclable material

PROJECT BEING PLANNED

### Objective

The project's goal is to improve closed-loop recycling in rural areas. An app should help ensure an efficient, digitised mobile collection of recyclable material at collection sites and via household waste bins. Furthermore, the

emptying of waste bins from rural households should be improved both economically and ecologically thanks to filling level measurements using sensors and transmission of the data to the waste disposal companies.



### Project content

- ⌘ Concept development: analysis of requirements in the model region as well as analysis of the state of the art in the field of filling level detection
- ⌘ Development of various alternatives for both the mobile collection of recyclable material as well as the collection of recyclable materials from households and designated collection sites
- ⌘ Cost analysis for the various alternatives and decision as to whether existing solutions can be used or a new development is needed
- ⌘ Implementation and trials of the system for the mobile collection of recyclable material
- ⌘ Comparison of the fixed and flexible collection systems taking into account their acceptance by the general public, their effects on the environment and the operational workflows
- ⌘ Expansion to other regions, in particular LEADER regions

## 3. Digital trading platform for regional products

### PROJECT BEING PLANNED

#### Objective

Development of a direct marketing concept as well as design and implementation of an online platform based on the marketing concept for regional products and brands. Development of a suitable, consumer-oriented marketing concept for the platform as a gateway to the regional foods. Development of a cooperation concept for planning, production, sales and administrative structures.

#### Project content

- ⌘ Development of a basic concept for the platform model
- ⌘ User-centred system development by translating the technical-functional requirements into technical system specifications and determining the adjustment requirements
- ⌘ Preparation of a technical and organisational business concept
- ⌘ Implementation through completion of the system components, subsequent testing, further optimisation and launch of the introductory phase
- ⌘ Market launch and gradual expansion of the portfolio of products, functions and sales
- ⌘ Dissemination and/or transfer of the solution to further regions





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