Finnish Future Farm (FFF)

- focuses on potential technologies close to market readiness (TRL 7+).
- the solutions are analyzed to identify core reasons for poor adoption → appropriate research, development, and innovation management actions are applied.

Finnish Future Farm (FFF)

- tailor-made education for users, designers, or marketers is designed as necessary.
- business development and acceleration services are available through the BioBoosters acceleration programme, including investors and venture capital.

The Tarvaala Smart Farm

Finnish Future Farm

Smart Bioeconomy Testbed*

Speeding up innovation in Biotalous

Nordic Testbed Network

Supporting digital transformation in the Nordic bioeconomy

* Member of Nordic Testbed Network since 2022

Excellent testing environment!

eit Food

Co-funded by the European Union

Test Farms Subcontractor in the Nordics region

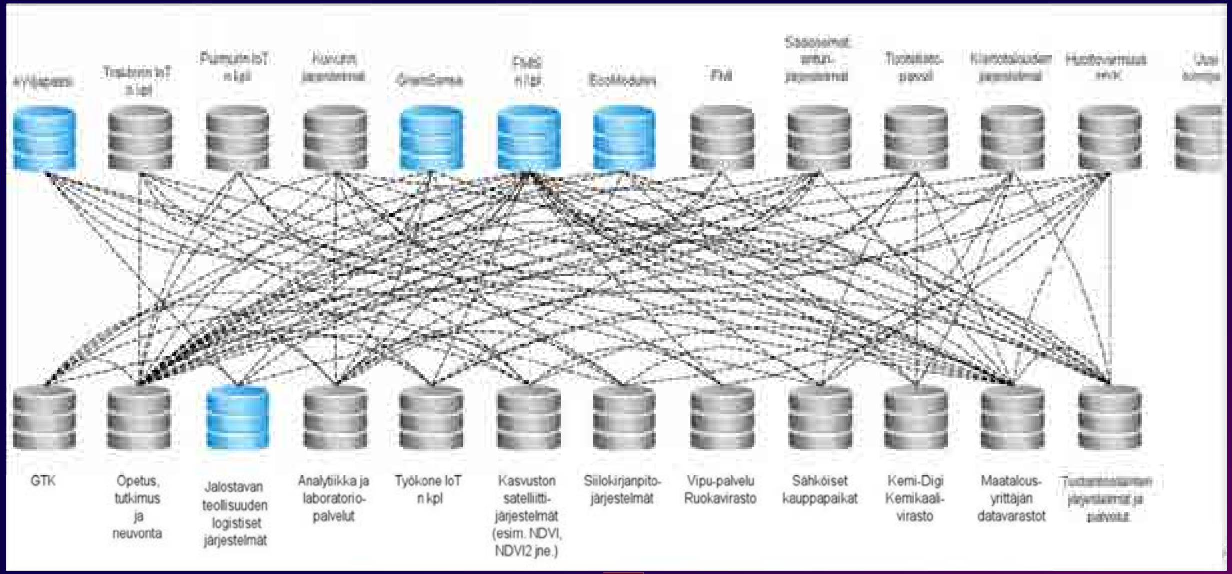
Variable heavily instrumented test fields: excellent and demanding testing facilities

Instrumented test fields

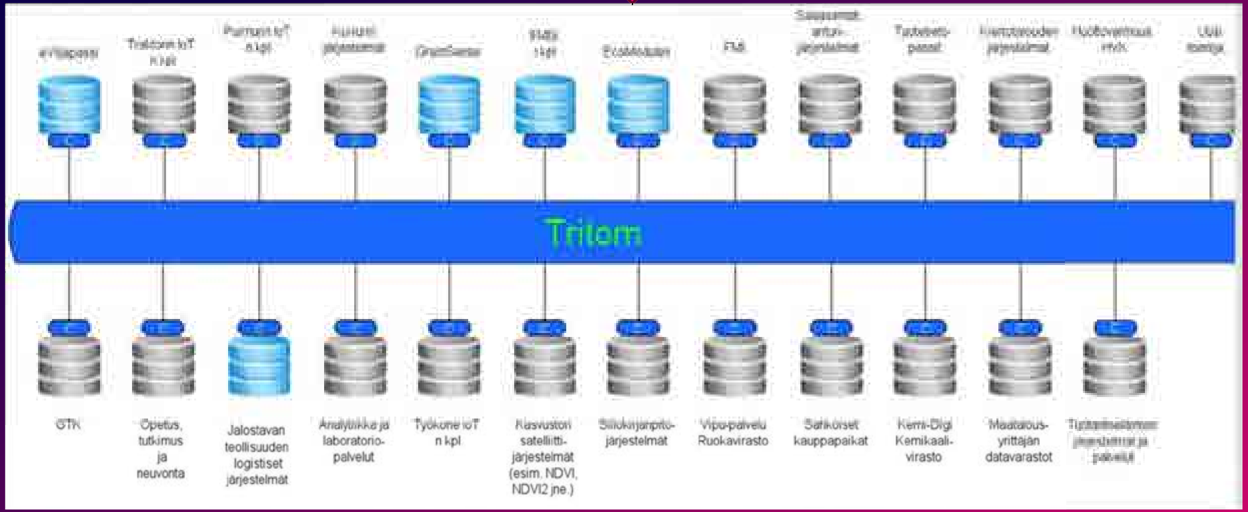
- Soil Scout wireless soil sensors
- Weather stations
- Drone measurements
- Soil scanning
- Yield quantity and quality mapping
- Economics mapping...

Top-notch ISOBUS technologies/ newest Valtra tractors

e.g. data transfer in dataspaces



Now

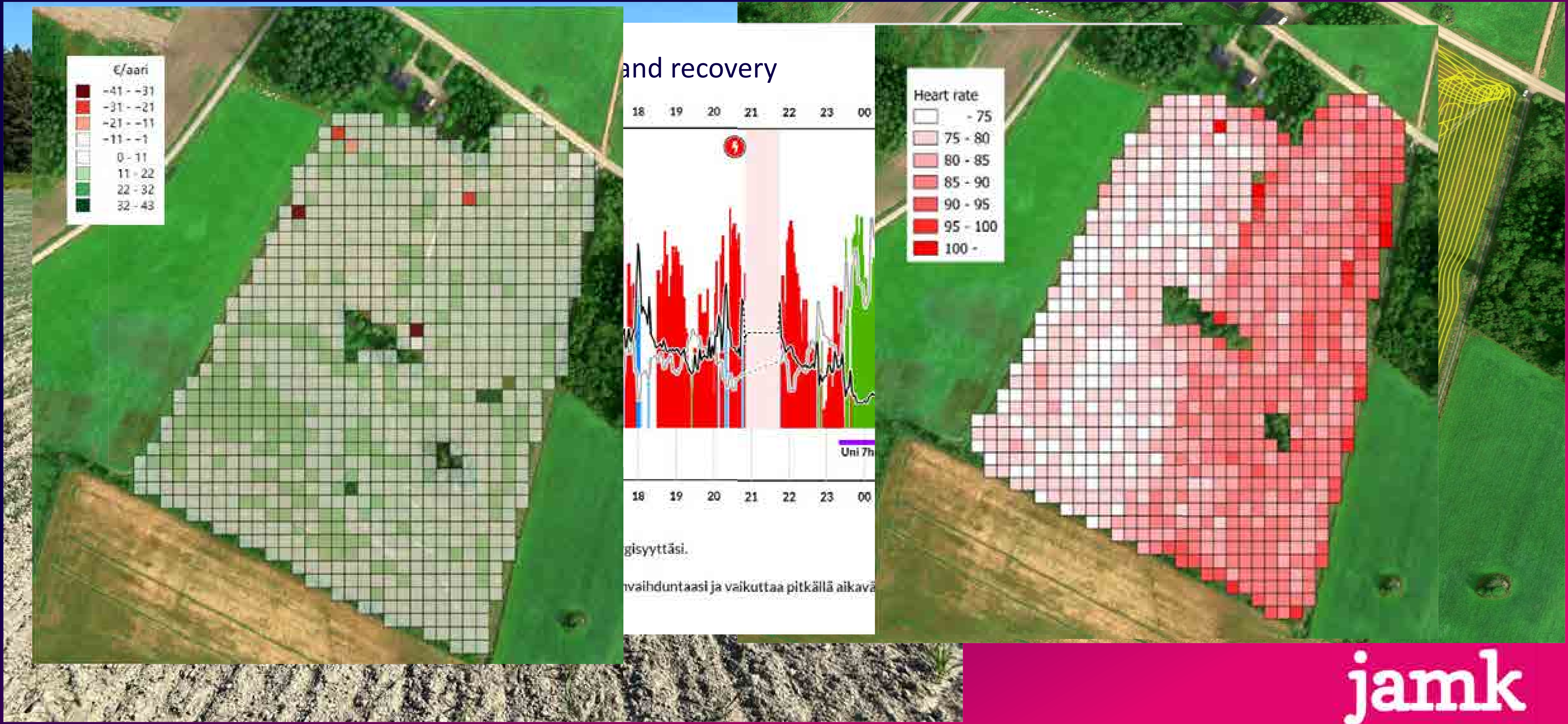


With Tritom

-finding co-op
-easy to make new data-based products
-reliable data transfer

Comparison of automated and traditional farming technologies

-e.g.: less energy, compaction and stress; challenges in usability and profitability



Finnish Future Farm

e.g. demonstrating Data Spaces

DataSpace Europe

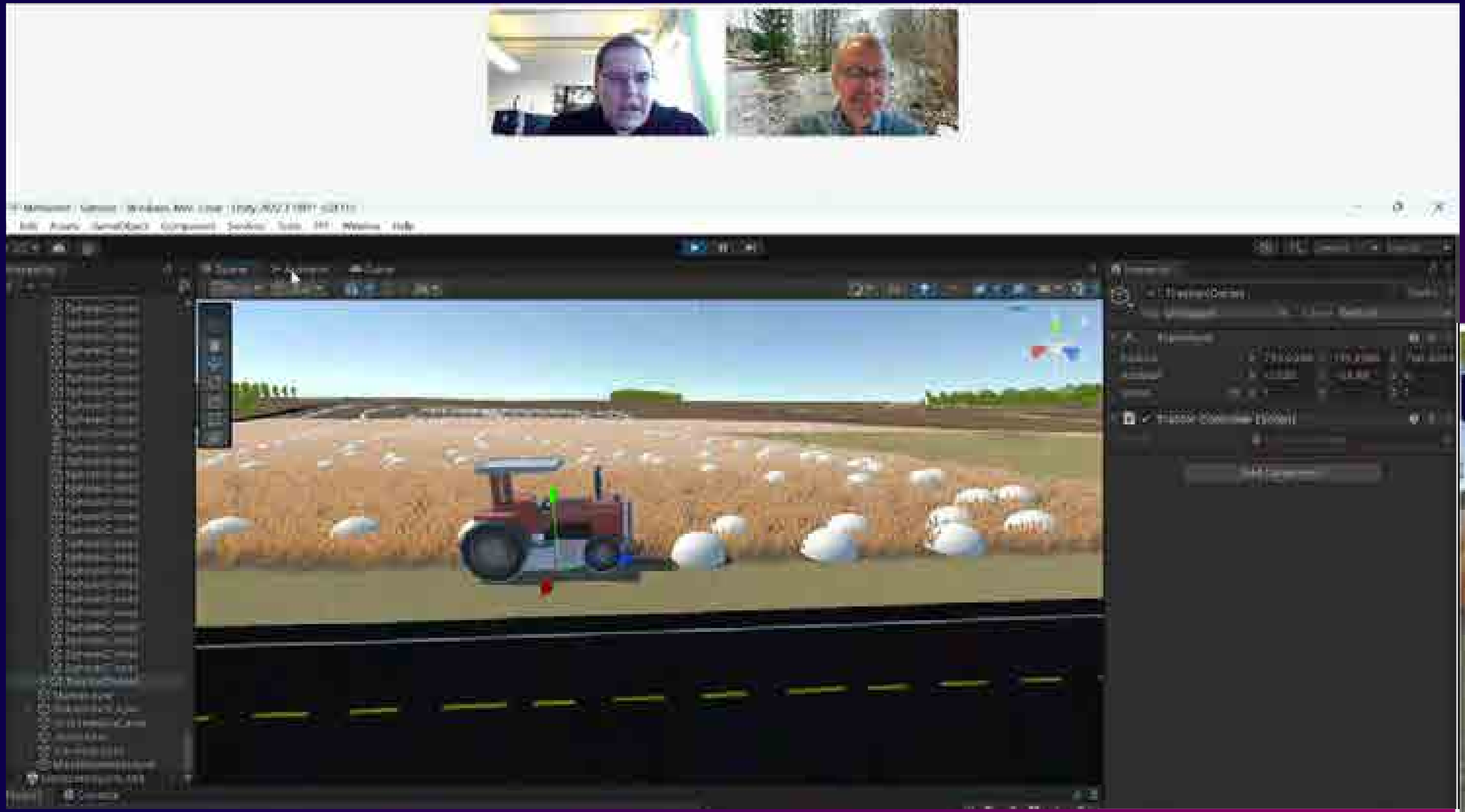
SOIL SCOUT

jamk

The Tarvaala Smart Farm Digital Twin and its metaverse

Finnish Future Farm

-For education, testing and RDI projects
-A combination of GIS data and metaverse environment



jamk

Metaverse/Smart Farm Digital Twin

Finnish Future Farm

-For education, testing and RDI projects
-A combination of GIS data and metaverse environment

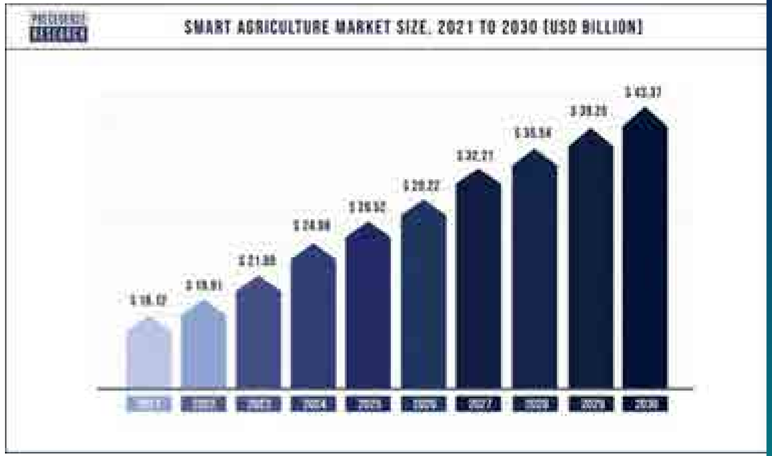
jamk

Finnish Future Farm

FFF metaverse

BioBoosters Accelerator Programme

- BioBoosters program strengthens start-ups and offers physical and virtual testbed environment for testing, validating and co-creating smart bioeconomy & agriculture in Nordic conditions



VALTRA | AGCO Your Agriculture Company | AGCO POWER | NESTE | nokian TYRES
BioBoosters by jamk | Valio | Data Space Europe | jamk

BIOBOOSTERS PROGRAMME 2024

Building collaboration with corporate and investor partners

600 startups
→ 10
selected

Workshop

Mentoring session from experienced JAMK staff and invited serial entrepreneurs

Onboarding

1. **Programme Agreement** between your Startup and JAMK (coordinator of the EU programme funding BioBoosters). No program fee!
2. **Launch** of the BioBoosters batch in August 2024
3. **Your representative(s) participating** in the following 4 workshops and mentoring sessions

1 – 28th Aug

Collaboration Co-Creation Kickoff @Valtra, Suolahti
- Goals for the programme
- Tools for the programme
- First ideas of the possible collaboration model

2 – 25th Sep

Drafting cooperation plan
- Online 1:1 meetings between startups and programme partners
- Target to draft a plan for cooperation

3 – 23rd Oct

Growth workshop @Neste
- Keynotes + group work
- 1:1 follow-up meetings for solving cooperation plan details

4 – 19th Nov

Deal Day @Oodi, Helsinki
- Startups pitching
- 1-on-1 meetings with selected corporate representatives & investors
- During SLUSH startups investment week

Composition of Startup's Pitch Deck for Deal Day. Support for corporate collaboration talks.

Mentoring sessions: 1 (6th Sep @2pm), 2, 3, 4

Student projects tailored for each startup
(e.g. market research to market of your choosing)

BioBoosters by jamk | Co-funded by the European Union | VALTRA | AGCO POWER | NESTE | INNOVESTOR | jamk

Finnish Future Farm

AgriVenture Finland 2025

Agritech & Sustainable Food Chain VentureDays

27-28th of May 2025

Bioeconomy Campus, Saarijärvi, Central Finland

jamk.fi/agriventure2023

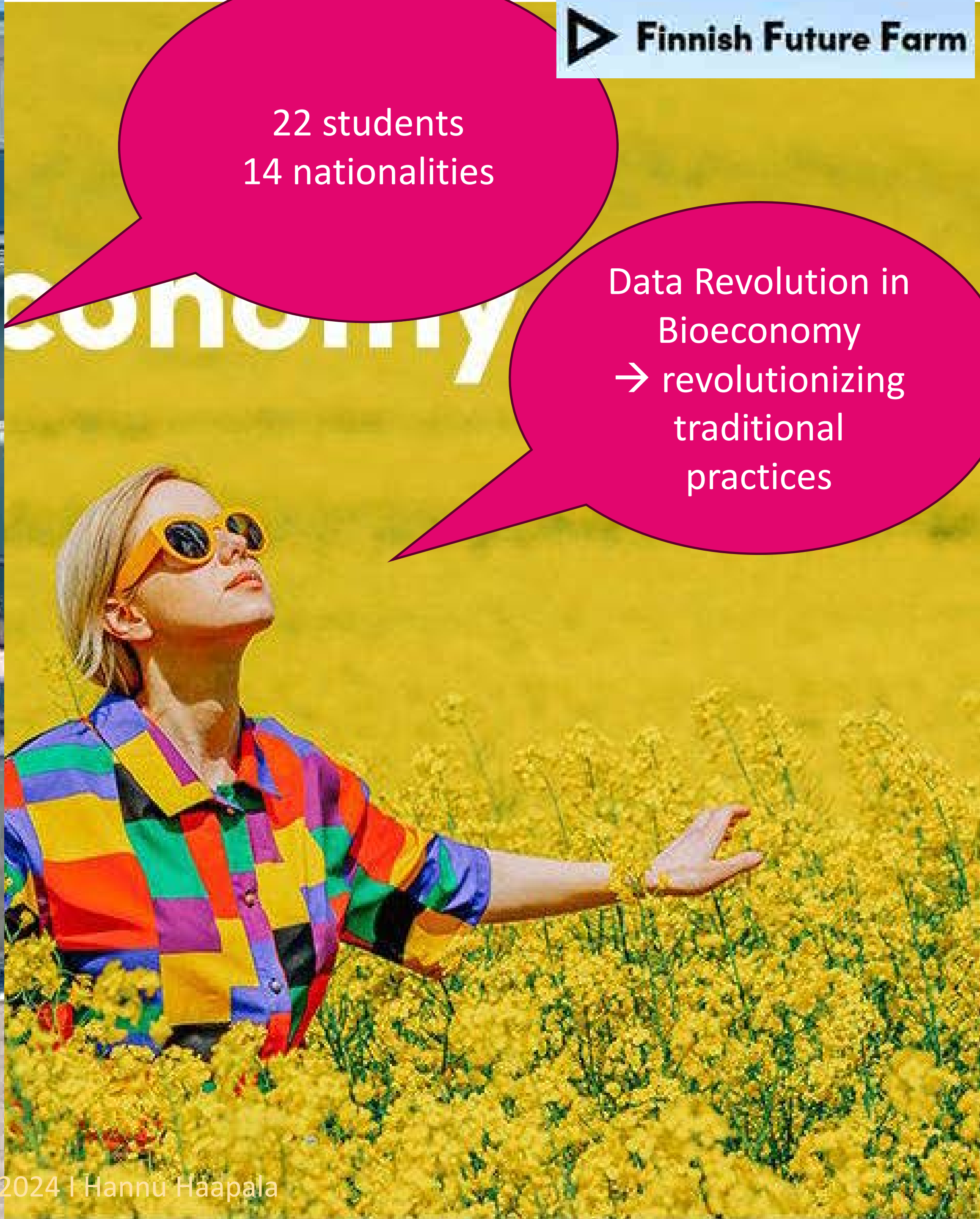
POHJOISEN KESKI-SUOMEN AMMATTIOPISTO

Euroopan unionin osarahoittama

KESKI-SUOMEN LIITTO

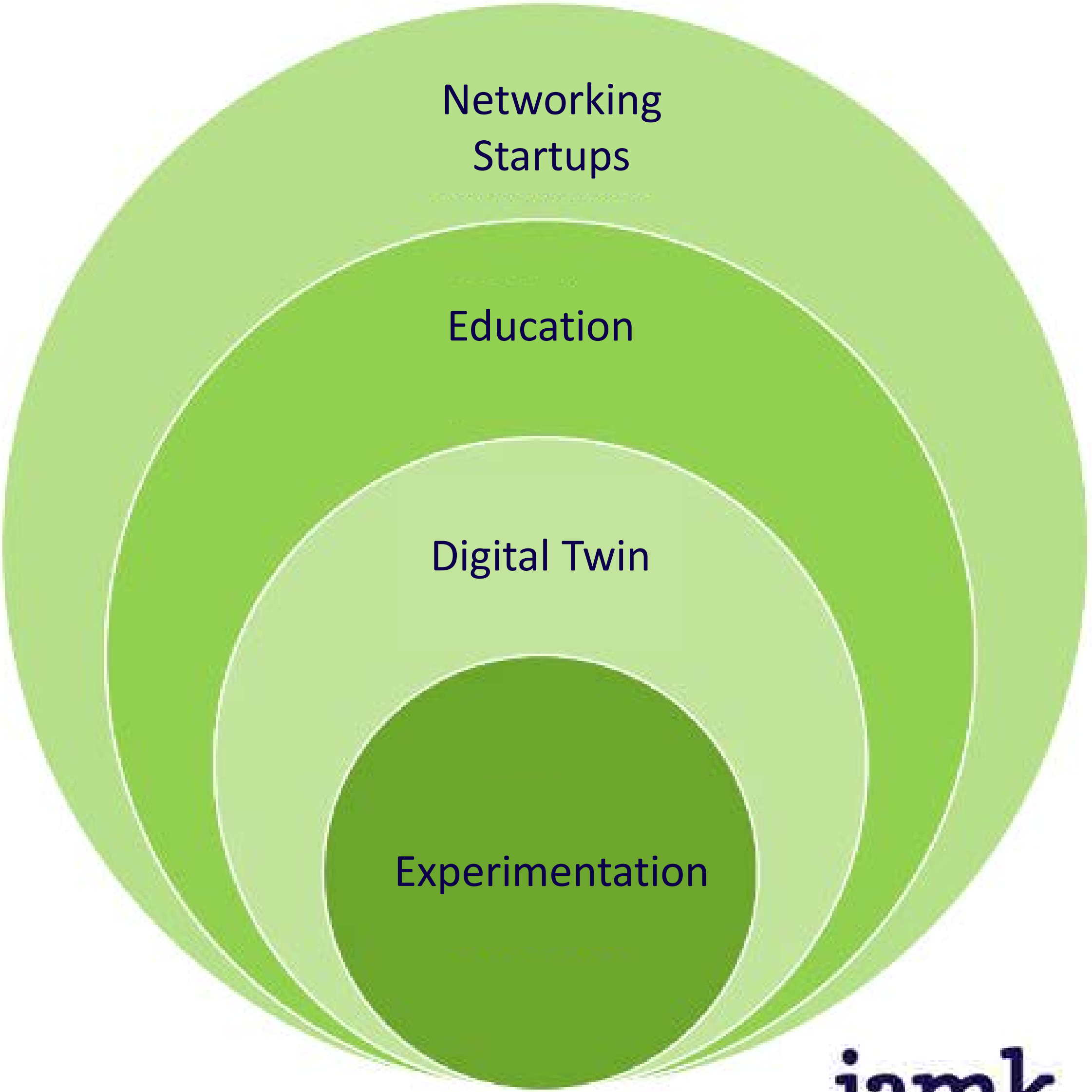
AgriVenture Finland 2025

Speeding the Uptake of Sustainable Technologies in Agri-Food Systems


Finnish Future Farm
22 students
14 nationalities
Data Revolution in Bioeconomy
→ revolutionizing traditional practices

Finnish Future Farm 2023-2026

Partnering in related projects?



jamk

The Smart Bioeconomy Team

engineering, agrotechnology, education, ecology, mathematics...

Hannu

Jyrki

Juho

Juha

Moona

Konsta

Gilbert

Samu

Iita

Janne

Hannariina

Marianne

...

jamk
Biotalous

Finnish Future Farm

Thank you!

jamk
Bioeconomy

Energy Conservation and Energy Efficiency in Agriculture – and Smart Farming

Sven Bernesson, Dept. Energy and Technology, SLU, Sweden

Objective:

* identify and compile measures that can be used together with smart farming to reduce energy use in agriculture and/or increase yield,

* and therefore increase the yield per unit of energy input,

* and because of this reduce greenhouse gas emissions and thus climate impact in the Swedish agricultural sector.

MISTRA FOOD FUTURES

Measures to reduce energy use (smart farming – green)

Field work

- Economical driving
- Tractors with low fuel consumption
- The right tractor for the right job
- Use electronic control of the tractor
- Automatic contr tractor w GPS/GIS
- Careful maintenance
- Combine work steps in the field
- Optimal wheel slip
- Optimise field work
- Reduced tillage
- Optimise fertilisation
- Optimise plant protection

Irrigation

- Maintenance is important
- Avoid flow obstructions
- Avoid leakage
- Choose system w lower pressure
- Choose ramp or centerpivot
- Irrigate after demand
- Control acc field cond w GPS/GIS
- Control acc weather forecasts
- Contr acc land prod capa GPS/GIS
- Use efficient engines
- Use efficient pumps

Farm workshop

- Insulation is important
- Avoid air leakage
- Seal gaps at doors and windows
- Do not heat more than necessary
- Insulate suff u underfloor heating
- Divide area into sections
- Control heating acc weath cond
- Control heating acc weath forecasts
- Use efficient LED-lighting
- Control light acc t attend and need
- Use biofuel for heating
- Use accumulator tanks
- Plant hedgerows

Drying cereal grains

- Clean the grain well before drying
- Threshing at the right water content
- Dry to correct final water content
- Have a good control of the dryer
- Contr dryer acc t water c a weather
- Optimise the operation of the dryer
- Dimension the fans correctly
- Avoid flow obstructions in air ducts
- Maintain the plant carefully
- Avoid air leakage
- Calibrate all sensors carefully
- Take good care of the boiler
- Dist grains evenly during cold air dr
- ..and adj layer thickness to water c
- Aut control acc to air rel moisture c

Animals

- Use efficient feed management
- Disc mill better than hammer mill
- Grind no finer than necessary
- Use mechanical conveyers
- Use electric equiment for roughage
- Optimise feeding of each animal
- Pre-cool milk w farm´s water source
- Preheat hot water with farm's milk
- Maintain all equipment carefully
- Frequency controls vacuum pump
- Frequency controls milk pump
- Recover heat from the milk cooling
- Scroll type vacuum and milk pumps
- Control milking and feeding digitally
- Maintain manure facility carefully
- Automate operation manure facility
- Few a straight scraping passages

Farm buildings

- Place thermostats not affected b air
- Use zone climate control
- Optimise temp for animal species
- Avoid inefficient heating equipment
- Insolate hot water pipes
- Avoid water leakage
- Clean ventilation devices and pipes
- Avoid flow obstructions in ventilatio
- Invest in more efficient fans
- Optimise ventilation acc animaltype

Farm home

- Use biofuel or electricity f transport
- Optimise home transport

Smart farming

- Several of the measures to reduce energy use in agriculture are thus linked to smart farming.
- A definition of smart farming from the literature:
  "Smart farming is about managing a farm, using modern information and communication techniques in order to increase the efficiency and quality of plant and animal production and to optimise human labour inputs".

Field work – smart farming

- Use electronic control of the tractor.
- Automatic control of tractor with GPS/GIS.
- Optimal wheel slip.
- Optimise field work.
- Optimise fertilisation.
- Optimise plant protection.

RESULTS:

- Lower fuel consumption (both per ha and per produced food unit).
- Lower time consumption for the work.
- Reduced use of fertilisers and pesticides,
  i.e. reduced use of indirect energy.
- Increased yield.
- Increased financial profitability.

Irrigation – smart farming

- Control according to field and soil conditions with GPS/GIS.
- Control according to weather forecasts.
- Control according to land production capacity with GPS/GIS.
- Optimisation of irrigation.

RESULTS:

- Lower electricity/fuel consumption (both per ha and per produced food unit) for pumping water.
- Lower time consumption for the work.
- Reduced use of fertilisers and pesticides,
  i.e. reduced use of indirect energy.
- Increased yield.
- Increased financial profitability.

Drying cereal grains – smart farming

- Have a good control of the dryer and the boiler.
- Control the dryer according to water content and weather.
- Automatic control according to air relative moisture content.
- Optimise the operation of the dryer.

RESULTS:

- Lower fuel/electricity consumption (both per ha and per produced food unit).
- More even water content in dried grain.
- Lower time consumption for the work.
- Lower risk of excessive water content in the grain.
- Lower risk of overdrying the grain.
- Lower risk of grain losses i.e. thereby reducing the risk of losses of both direct and indirect energy.
- Increased yield.
- Increased financial profitability.

Farm workshop – smart farming

- Control heating according to weather conditions.
- Control heating according to weather forecasts.
- Control of attendance and activity in the workshop.
- Control of light according to attendance and need.

RESULTS:

- Lower use of fuel/electricity for heating.
- Lower use of electricity for lighting.
- Increased comfort.
- Lower time consumption for the work.
- Increased financial profitability.

Farm buildings – smart farming

- Control heating according to weather conditions.
- Control heating according to weather forecasts.
- Control of attendance and activity in the building.
- Control of light according to attendance and need.
- Use of zone climate control.
- Optimise temperature for animal species.
- Optimise ventilation according to animal species.

RESULTS:

- Lower use of fuel/electricity for heating.
- Lower use of electricity for lighting.
- Increased comfort.
- Healthier animals.
- Increased production from the animals,
  i.e. reduced use of indirect energy for each produced unit of food.
- Lower time consumption for the work in the building.
- Increased financial profitability.

Animals – smart farming

- Optimise feeding of each animal.
- Frequency controls vacuum pump.
- Frequency controls milk pump.
- Control of milking and feeding digitally.
- Automate operation of the manure facility.

RESULTS:

- Lower use of electricity for animal care.
- Lower feed consumption, and therefore reduced use of indirect energy for each produced unit of food.
- Increased comfort.
- Healthier animals.
- Increased production from the animals,
  i.e. reduced use of indirect energy for each produced unit of food.
- Lower time consumption for the work for animal care.
- Reduced emissions of methane and ammonia.
- Increased financial profitability.

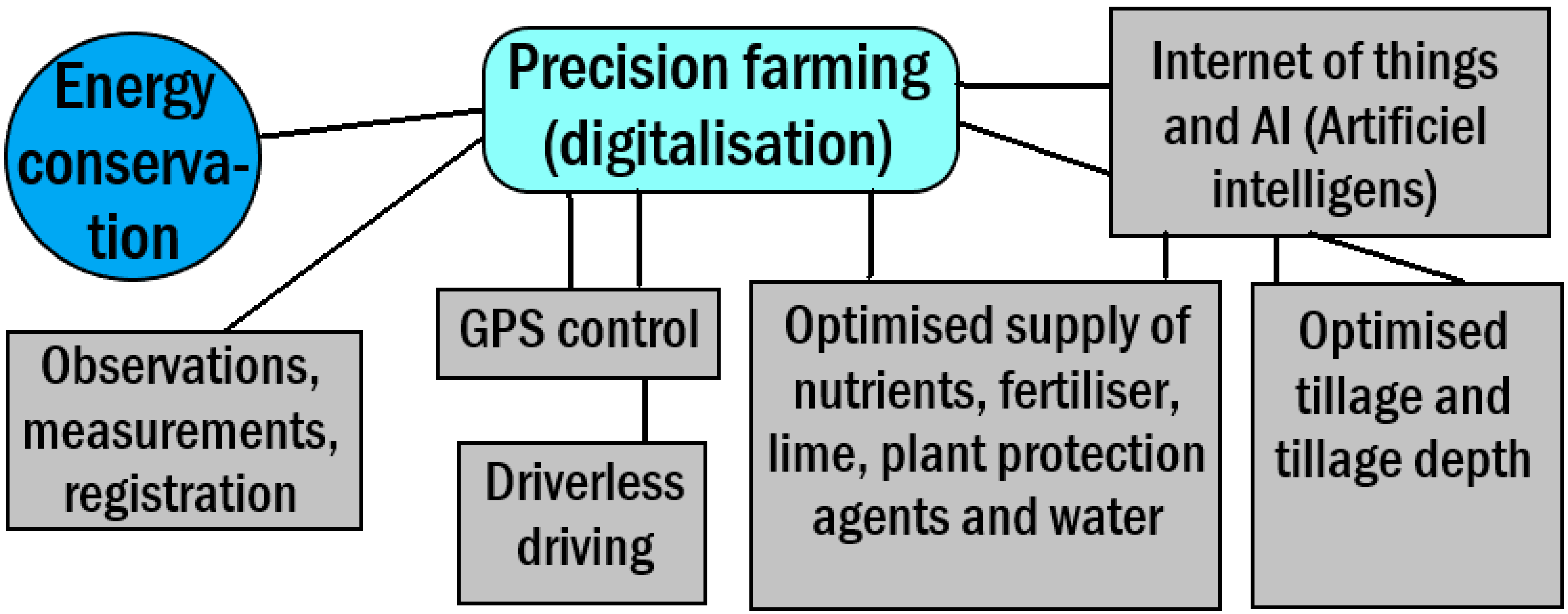
Farm home – smart farming

- Control heating according to weather conditions.
- Control heating according to weather forecasts.
- Control of attendance and activity in the building.
- Control of light according to attendance and need.
- Use of zone climate control.
- Optimise home transport.

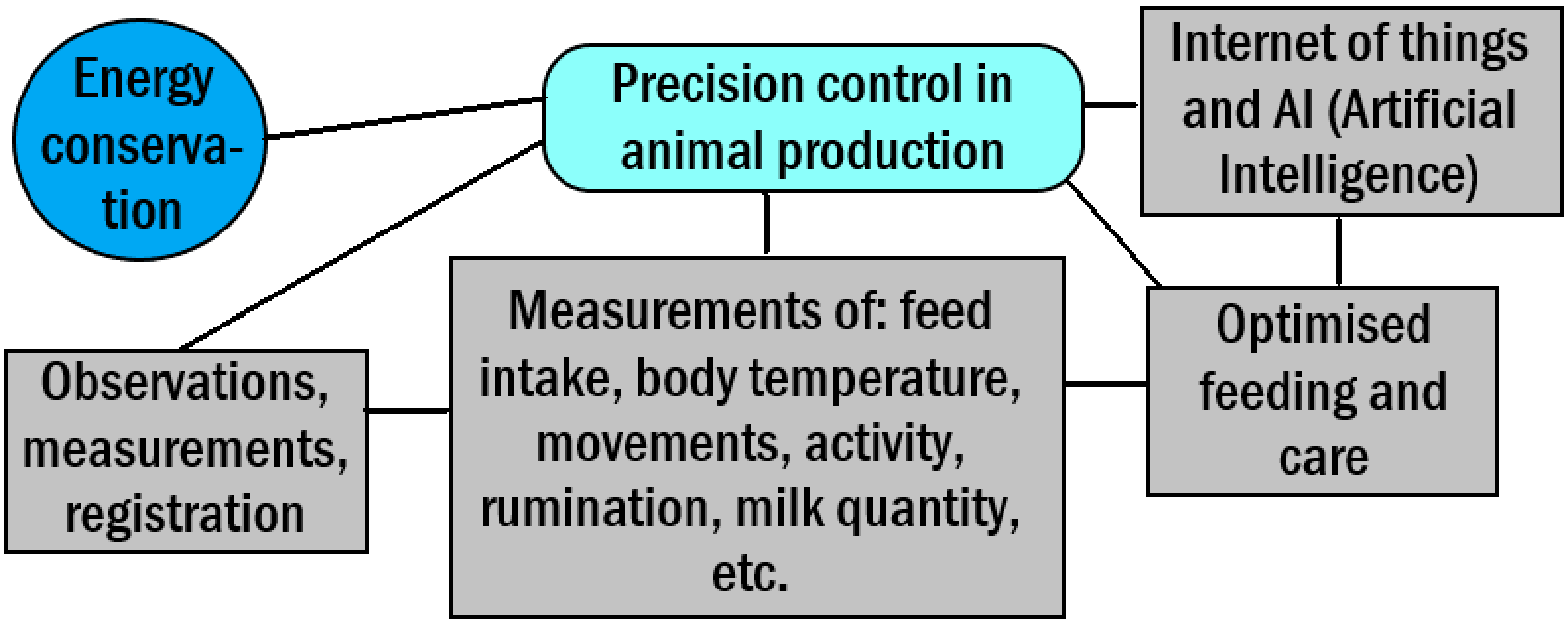
RESULTS:

- Lower use of fuel/electricity for heating.
- Lower use of electricity for lighting.
- Increased comfort.
- Healthier farmer and farmers family.
- Lower time consumption for the work in the building.
- Lower use of fuel/electricity for transports.
- Increased financial profitability.

Example: Precision farming (digitalisation)



Example: Precision control in animal production



Conclusions

- Energy conservation and energy efficiency together with smart farming, have a very large potential for energy savings and reduction of greenhouse gases.
- Several categories where the savings occur in different ways.
- There is a lot of knowledge
  - New technology brings great potential to go further than previously done.
- A lot of work remains before everything is implemented.
- Sensors and equipment used, must be developed further and become more reliable and easier to use.
- There is a need for future, both more applied and systems analytical, research projects to obtain more reliable data on the potential.
- Great potential to become a major future research area.

Thank you for your attention

Contact:

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Phone: +46 730 655013

Literature:

Bernesson S, Karlsson Potter, H., Hansson P.-A. 2023. Energieffektivisering i lantbruket – en litteraturstudie med fokus på svenska förhållanden. (Energy saving in agriculture - a literature study with an emphasis on Sweden). Mistra Food Futures Report nr. 19; SLU. ISBN:978-91-8046-678-3 (electronic), 978-91-8046-677- (print). 80 p. 156 ref. https://mistrafoodfutures.se/app/uploads/2023/06/19-Rapport-Energieffektivisering-i-lantbruket.pdf

SMART FARMING RSEARCH AT AU

CLAUS GRØN SØRENSEN
PROFESSOR
OPERATIONS MANAGEMENT
AARHUS UNIVERSITY, DENMARK

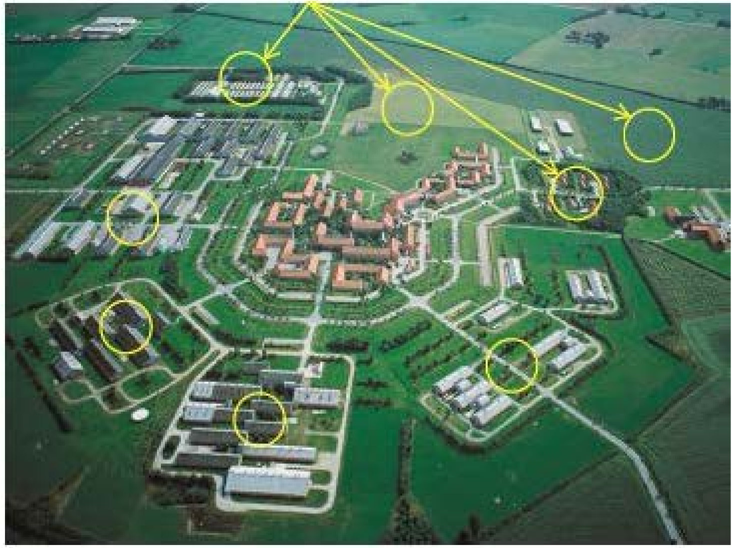
Department of Electrical and Computer Engineering, Aarhus University

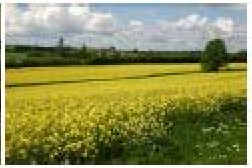
DANISH CENTER FOR FOOD AND AGRICULTURE

www.DCA.au.dk

- Facts of DCA:
  - Founded 1884. Part of AU 2007
  - 1000 employees
  - Annual turnover ~100 M$
  - Publish ~600 papers in international refereed journals pr. year
- Facilities include among others
  - State-of-the-art laboratories
  - Animal housing & animal herds
  - Feed mill & experimental abattoir
  - Test facilities for machinery, buildings etc
  - Greenhouses, semi field and lysimeter facilities
  - Wind tunnels
  - Experimental biogas plant
  - 1,300 hectares of farmland for experiments and feed production

Dedicated and Isolated Experimental Facilities



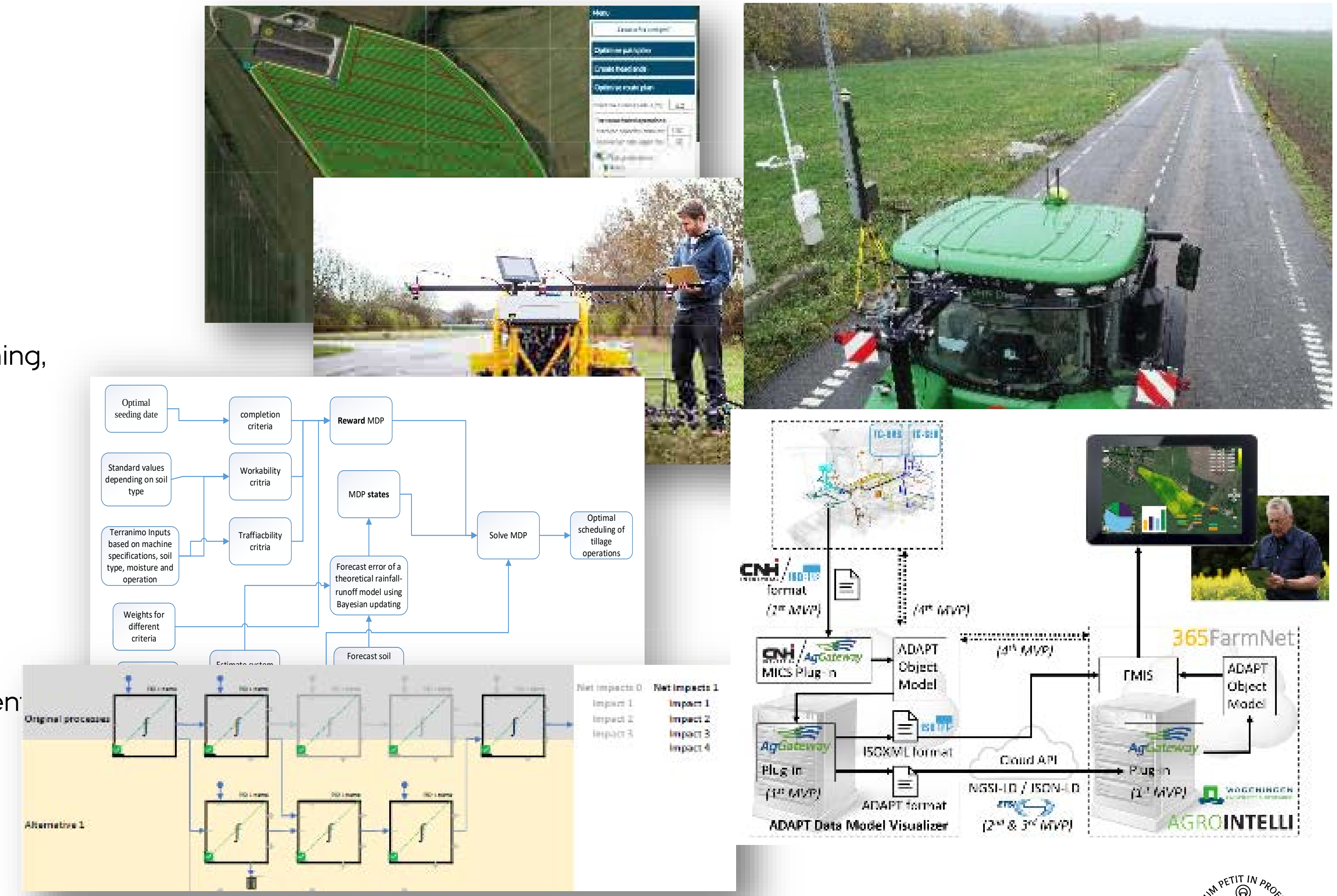


6

SMART AGRI-FOOD RESEARCH AREAS

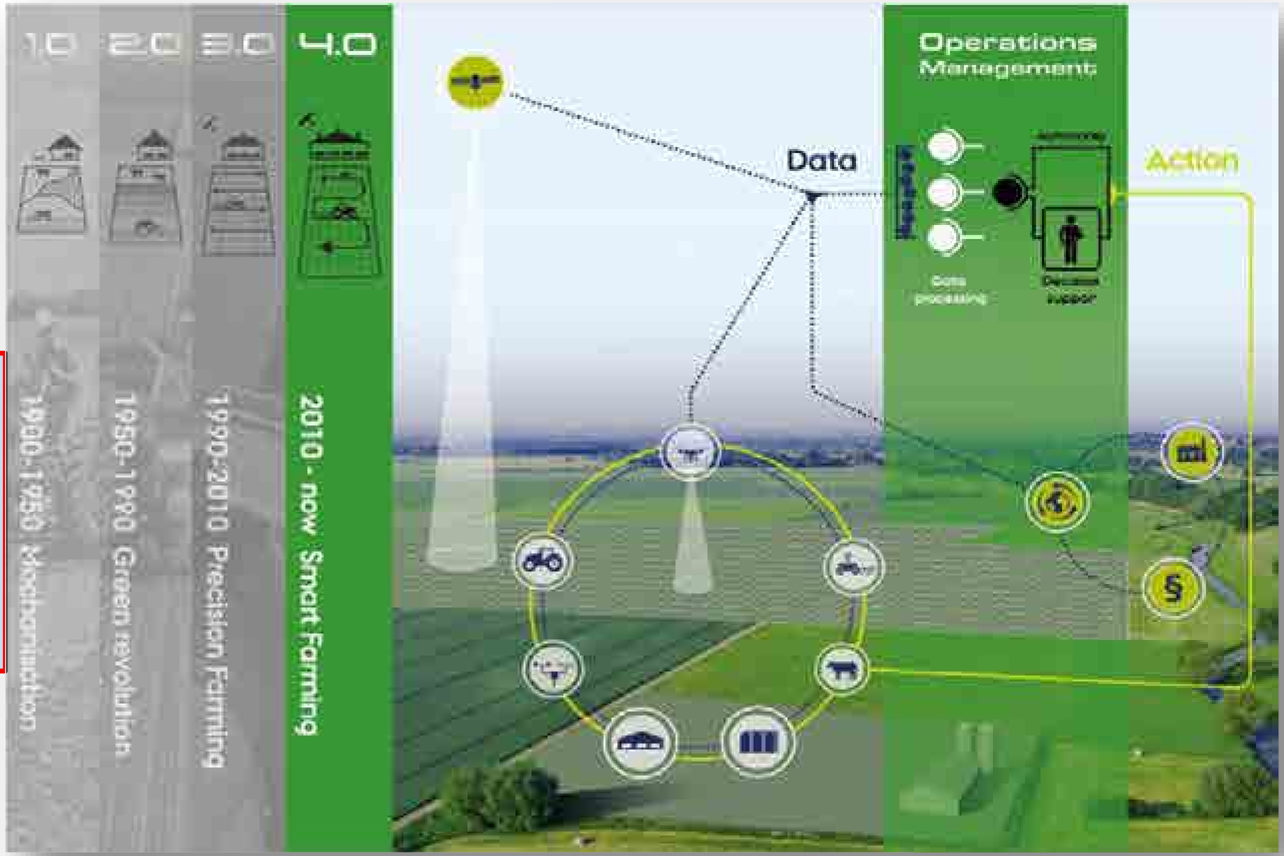
Focus areas:

- *Operations engineering*
  E.g. operations analysis, planning and optimization, supply chain management
- *Automation engineering*
  E.g. systems engineering, higher level machine learning, motion planning, decision support systems
- *Information engineering*
  E.g. data management, real-time data processing, decision optimization, information modelling
- *Sustainability engineering*
  E.g. multi-stakeholder analysis, technology assessmen
  risk analysis, scenario building, system design



OPERATIONS MANAGEMENT IN SMART FARMING AND THE ROLE OF SCIENCE

- "Data is gold"
- Sensors can create terabytes of data
- The value of data can be improved by processing the data into meaningful information and decision support
- This processing requires domain knowledge about the entire system:
  - Processes and operations
  - Actors and preferences
  - System constraints
- I.e. *Operations Management*



PRECISION AGRICULTURE VS SMART FARMING

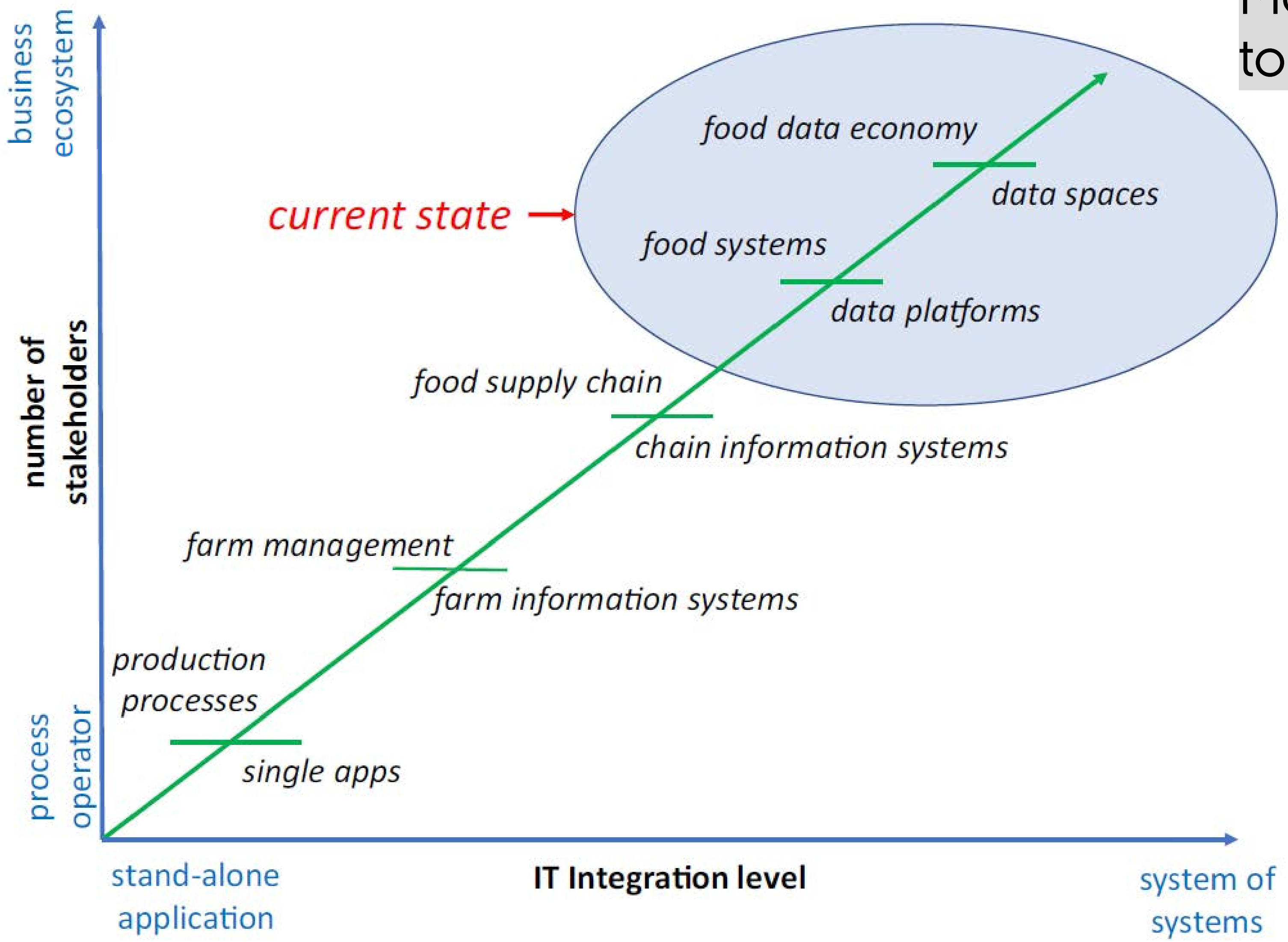
Precision agriculture

- … is about optimizing farm management by managing smaller units after individual needs
- Instead of fertilizing evenly over an entire field or treating all animals in a stabble equally, the operational unit is much smaller, e.g. a fraction of a square meter or an individual animal

Smart farming

- … is about utilizing data and technology to optimize on a higher level, e.g. a farming system
- Focus is more on how to obtain and make information available across different systems of the farm.
- Focus is also on how to use ICT technologies to select and support the decision maker (farm manager) with the required information whenever or wherever it is needed (e.g. on mobile devices).
- And to make the information available in an easy (automatic) way for the farm manager.

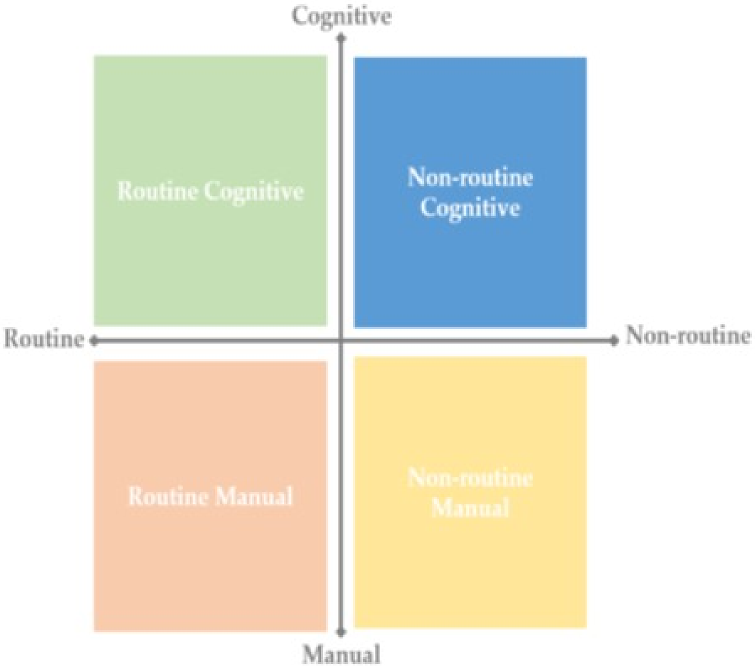
Moving from single processes to interconnected systems

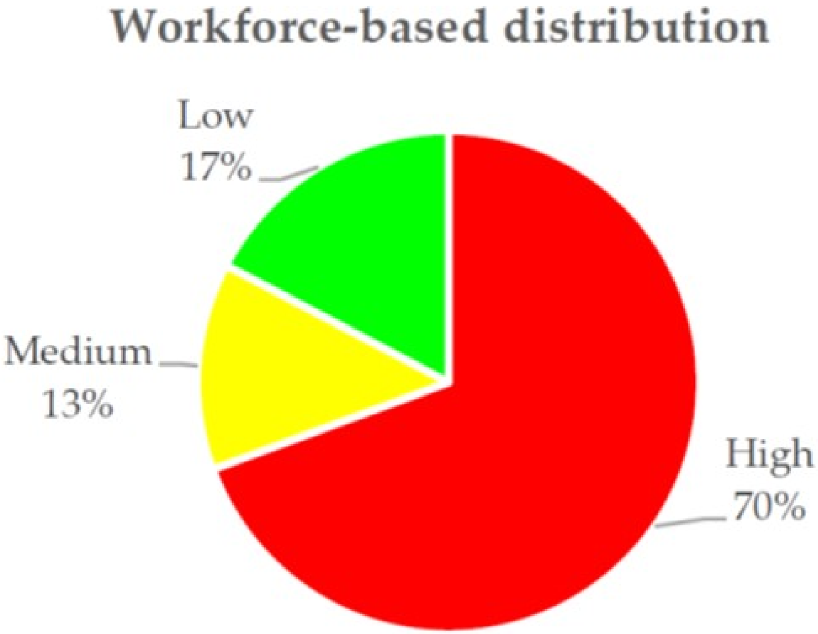


The evolution of IT systems in agri-food. Note: The ellipse points out the current state in which innovation ecosystems have become very complex. Adapted from Wolfert et al. (2021).

Automation and digitalization

Workforce-based (a) and annual budget-based (b) distribution of the agricultural operations terms of their susceptibility to robotization.





Marinoudi, V.; Lampridi, M.; Kateris, D.; Pearson, S.; Sørensen, C.G.; Bochtis, D. **The Future of Agricultural Occupations in View of Robotization**. Sustainability 2021, 13, 12109

Vision, a farm somewhere in 2035

Productive, sustainable, and resilient

Digitalization will enable:

"Optimized, individualized, real-time, hyper-connected and data-driven" operations as well as innovate new processes and practices..

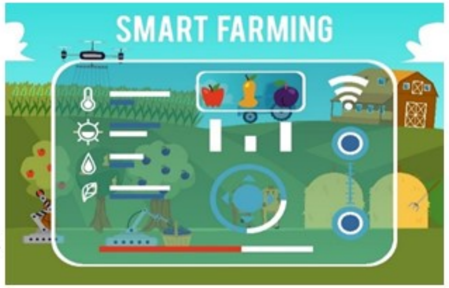
Data-driven:
> 4 mill data points per average farm

Autonomous machines:
- supervised 10–50%
- fully specific: 10-50%
- fully else <10%

Strategic management:
Scenario building and testing/digital twin, development pathways

New technologies/practises

Operations management:
On-line digital mirror of activities/operational control

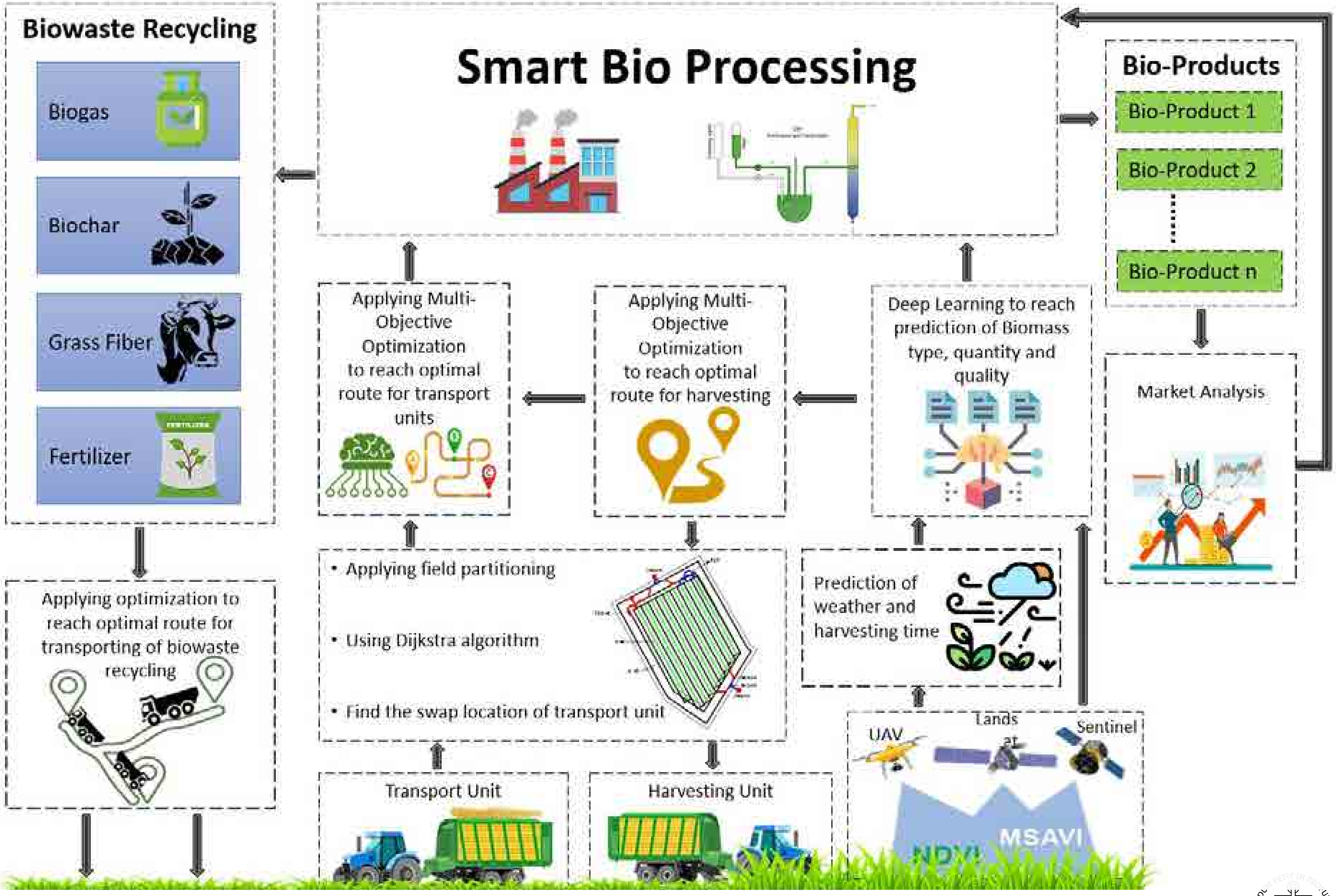


Key features:
- linking processes, equipment, actors
- identify risks
- workflow optimization
- precision application (fertilizing, weeding, etc.)
- sustainability compliance
- "diversity" identification
- ...

Rural BioReFarmeries

SMALL-SCALE CIRCULAR GREEN BIOREFINERIES FOR INCREASING FARMER SUSTAINABILITY AND COMPETITIVENESS AND BUILDING RESILIENT RURAL AREAS

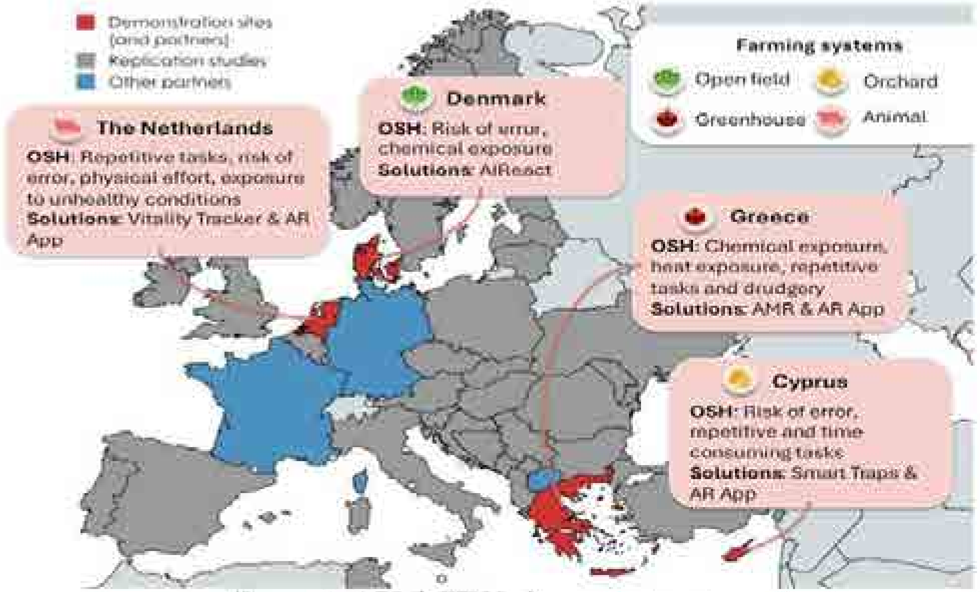
19 partners



Circular Bio-based Europe Joint Undertaking

AGRO-WELL: Agricultural Robotics and Augmented Reality for Workplace Enhancement and Labor Linkage

13 partners



Smart Traps, an AIoT system for reduced drudgery and failure avoidance in orchards at TRL7

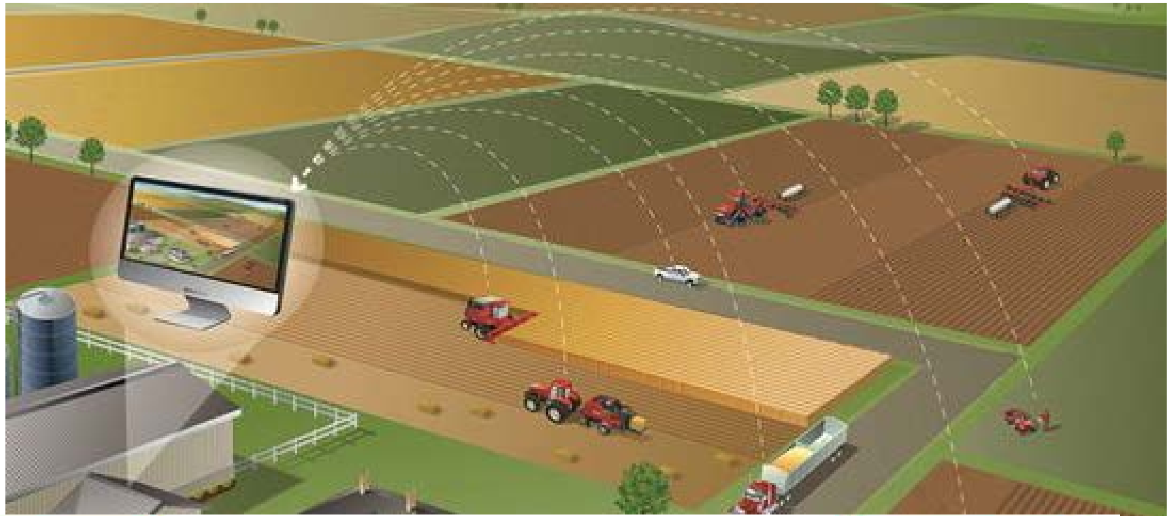
Autonomous Mobile Robot equipped with AI for greenhouses' unsafe and labour-intensive tasks at TRL7

Vitality Tracker for increased workers' safety and better pig farm management at TRL7

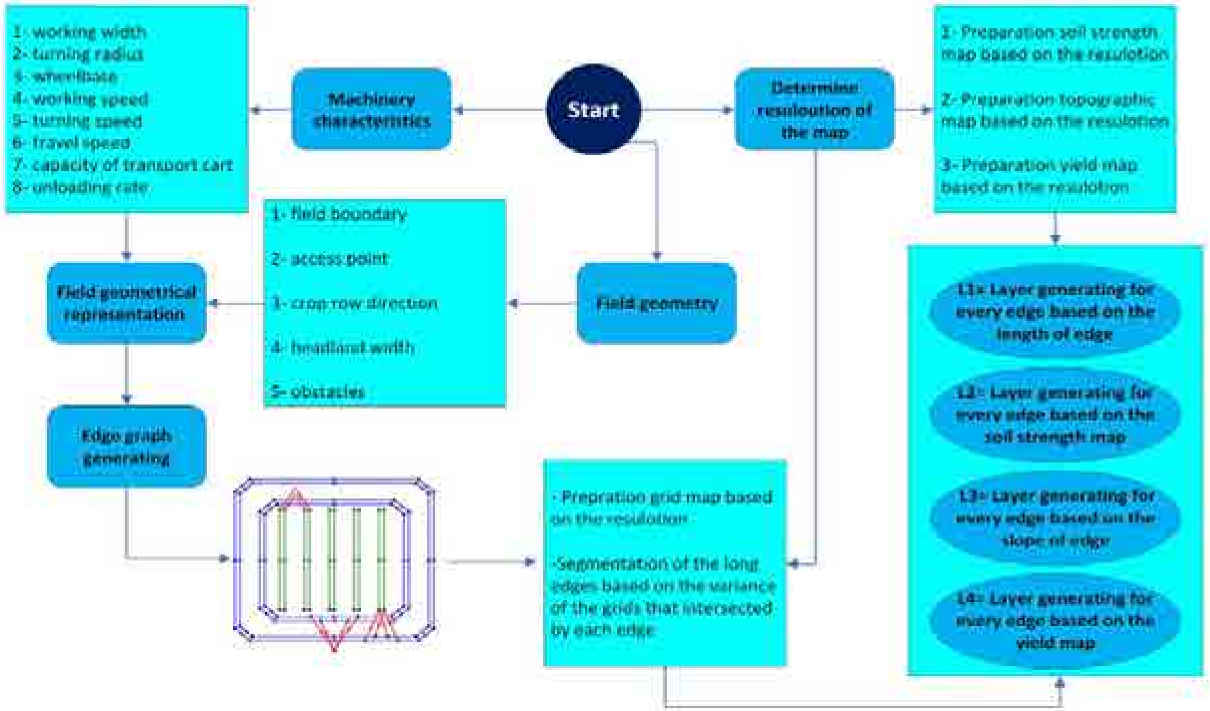
AR App for extended farmers' awareness supporting decision making and safety at TRL7

AIReact system pairing AI and AR for improved weeding and safety in open fields at TRL7-8

DECISION SUPPORT SYSTEM (DSS) FOR PLANNING FIELD TRAFFIC AND SOIL COMPACTION MITIGATION



- Optimizing yield
- Ensuring soil protection
- Improving work efficiency



- Estimate soil moisture content based on remote sensing data for top soil moisture content combined with a mechanistic model (e.g. DAISY)
- Estimate soil strength for risk of soil compaction
- Optimize routing of vehicles
- Algorithmic optimization
- …

Spade
physical-cyber drones ecosystem

Multi-purpoSe Physical-cyber Agri-forest Drones Ecosystem for governance and environmental observation

- Funded by the European Union under the Horizon Europe programme
- 21 partners from 10 European countries

Forestry Pilot	Open-field Pilot	Livestock Pilot
A case study in Southern Norway in forestry inventory, forest harvest and other forest operations	The open-field case study in Spain on potato crops and fruit farming in terraced crops, focusing on crop scouting, disease detection, monitoring and other operations	Pilot on the Greek island Lesvos with 3 use cases that aims to promote and improve breeding via grazing & health monitoring of sheep flocks

Bridging the digital divide and addressing the need of Rural Communities with Cost-effective and Environmental-Friendly Connectivity Solutions

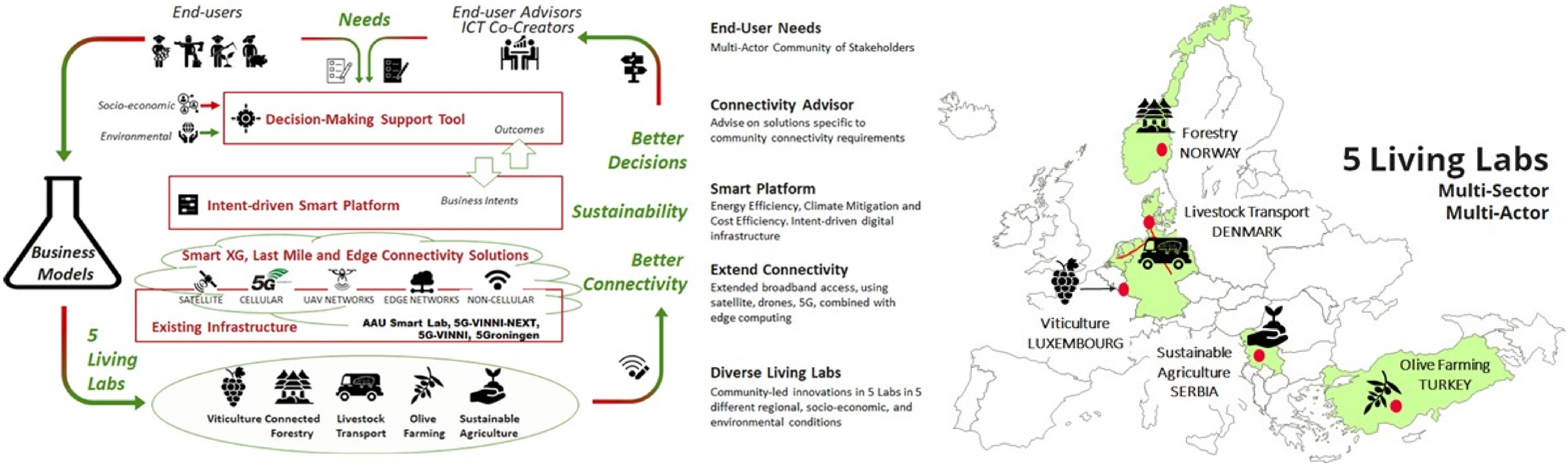
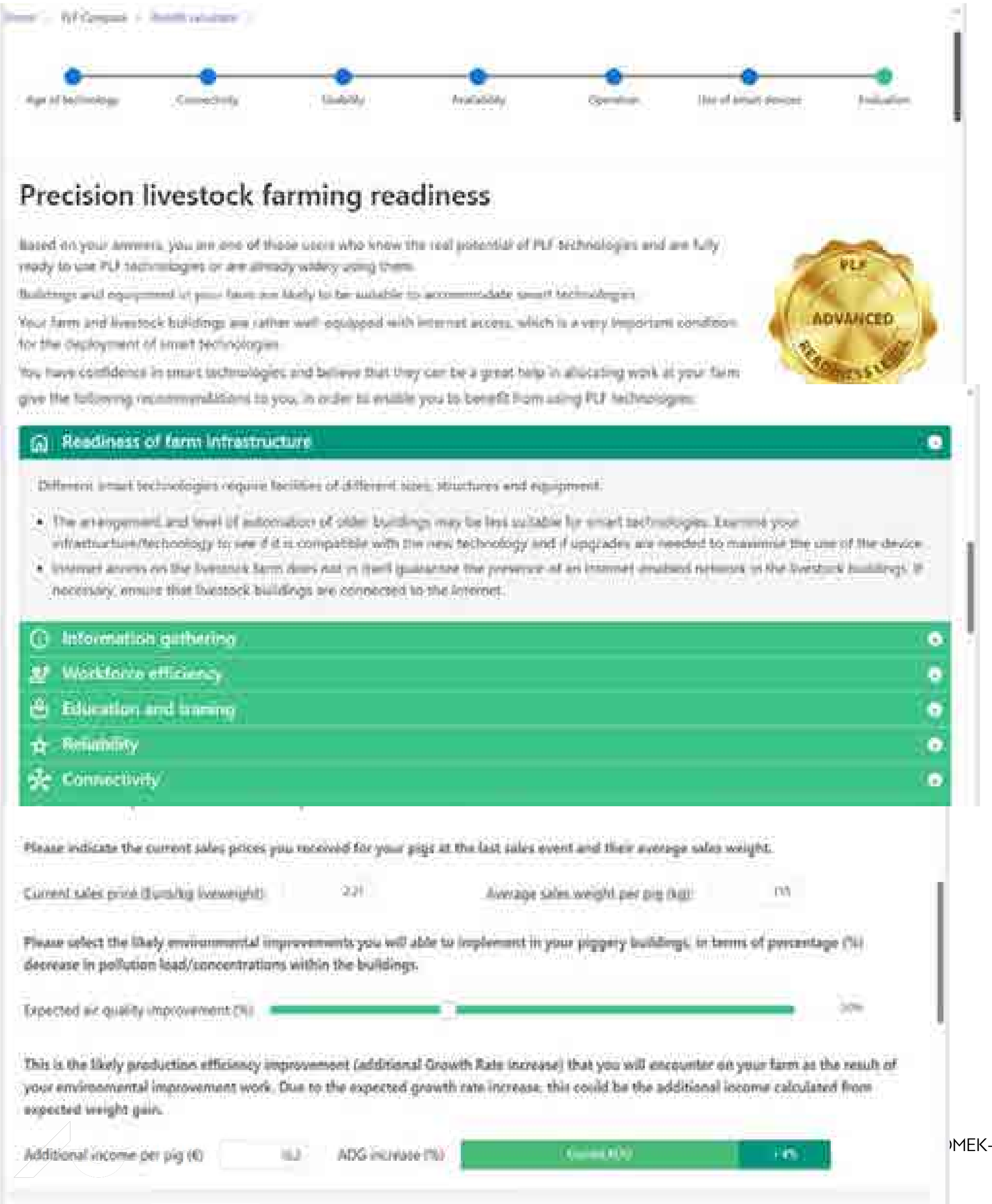


Figure 1: COMMECT Concept and Methodology

The COMMECT project will provide the basis of the connectivity solutions for rural areas and communities by carefully evaluating the heterogeneous needs of the end-users in various countries, regions, and sectors.

AI and technology adoption



User provide inputs and are classified into 3 categories (advanced, novice, and interested) and specific recommendations on what technology might be relevant.

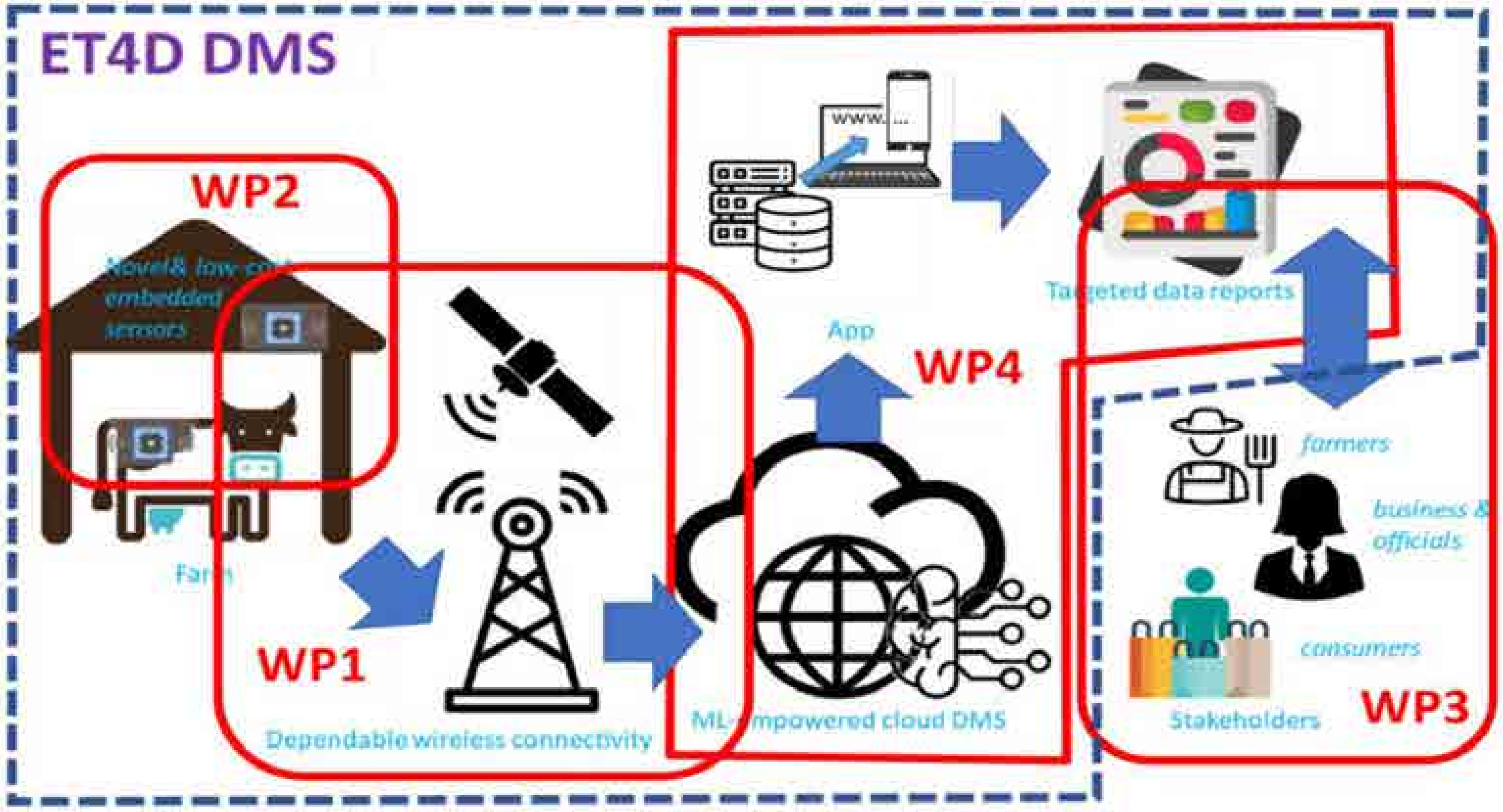
Indicate the likely environmental improvement implemented (% reduction in airborne pollutants) and calculate extra revenue as the results of production efficiency gained by the proposed technology

The "LivestockSense PLF Compass" application https://plfag.info/index

Banhazi, T. M., A. Banhazi, I. E. Tikasz, Sz. Palotay, K. Mallinger, T. Neubauer, L. Corpaci, U. Marchaim, I. Kopler, S. Opalinski, K. Olejnik, E. Kokin, S. Gunnarsson, T. Bjerre and C. Soerensen (2023) LivestockSense: A multinational project to remove barriers for PLF technology adoption within the pig and poultry industries In the proceedings of International Symposium on Animal Environment and Welfare (ISAEW 2023) (Ed: B. Li and Q. Zhang), pp: In-print, October 23-25, 2023 in Chongqing, China, IRCAEW

Development of a practical data management system with embedded sensors for improved environmental management and transparency of dairy farming

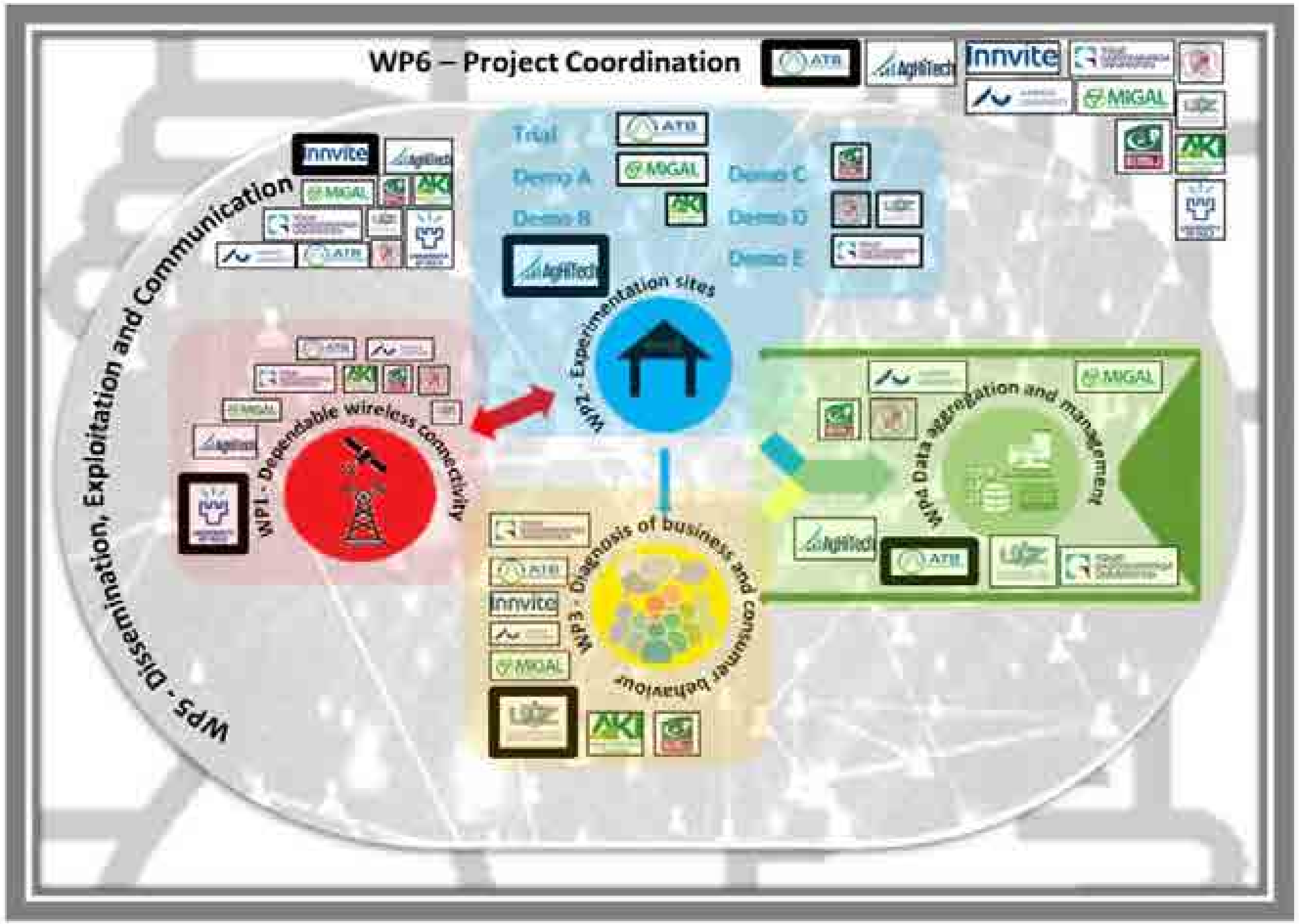
ET4D



Horizon 2020 Programme

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 862665 ERA-NET ICT-AGRI-FOOD.

Development of a practical data management system with embedded sensors for improved environmental management and transparency of dairy farming



Horizon 2020 Programme

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Looking into an Agriculture of Data

EU Partnership (AgData)

Via its unique concept of Use Cases (UCs), the AgData partnership will deploy a broad variety of activities in all relevant branches of agriculture based on modern digital-technologies and data sources. The UCs will all be based on the Strategic Research and Innovation Agenda (SRIA). Besides the UCs AgData will also implement joint calls for transnational proposals resulting in financial support to third parties (FSTP).

START
CENTRE FOR SUSTAINABLE AGRIFOOD SYSTEMS

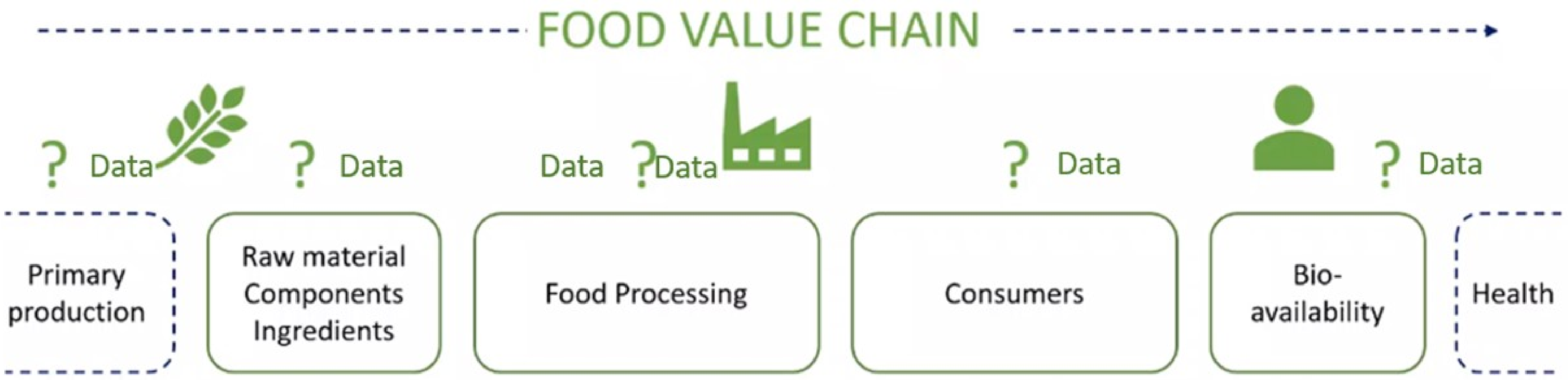
HUB on digitalization:
Digital Agri-Food EcoSystems (DIGITAL)

Triple-I approach:

Connect science, producers, supply chain actors, consumers, (e.g. Living Labs) (**Inclusive**)

Innovate the data-driven food system of tomorrow enabling a fundamental and disruptive socio-technical transformation (**Integrative**)

Establish multi-disciplinary competences from engineering, agroecology, modelling, social science, food processing, etc. (**Inter-disciplinary**)



Thank you for your attention

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POSTER

GIS-Based Assessment of Operator Stress: Hart Rate Analysis in Smart vs. Manual Field Operations

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