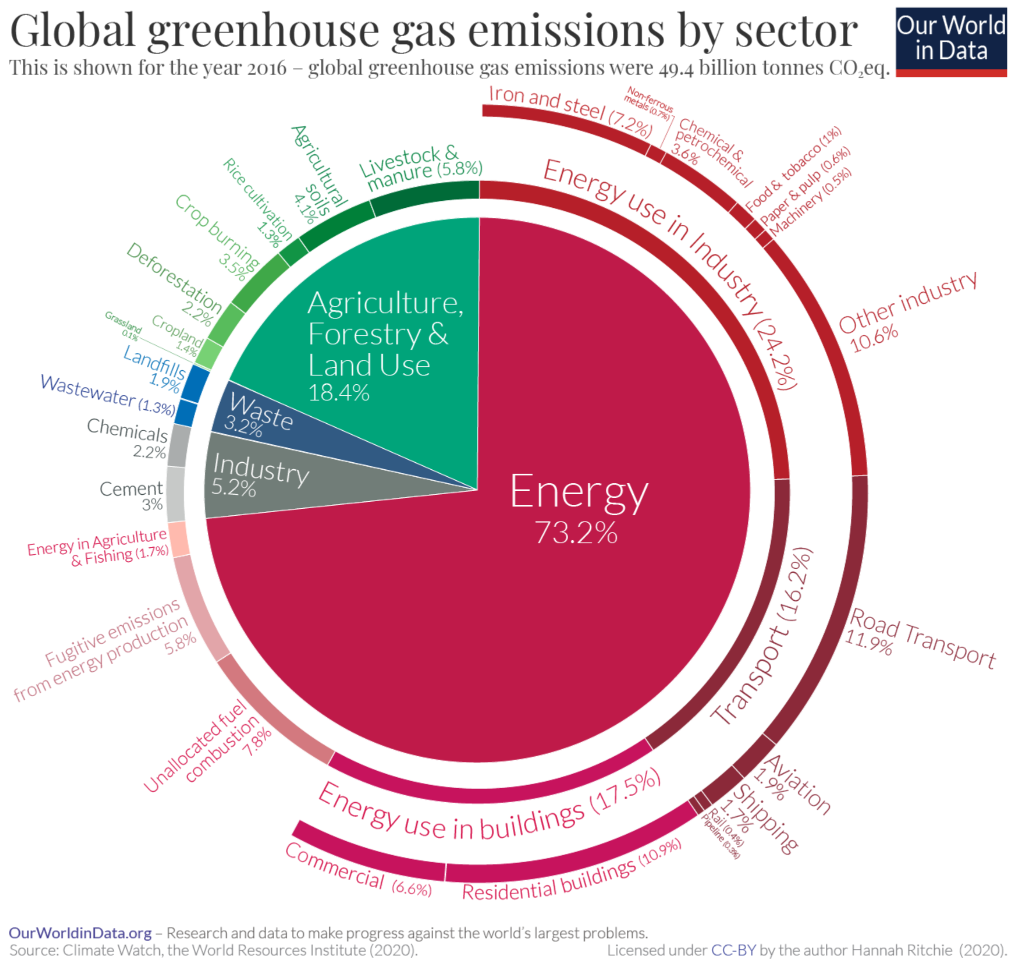
Robotics and AI in agriculture

Trends and future

DFKI | Christoph Tieben | 20.06.2024

Challenges of Modern Agriculture

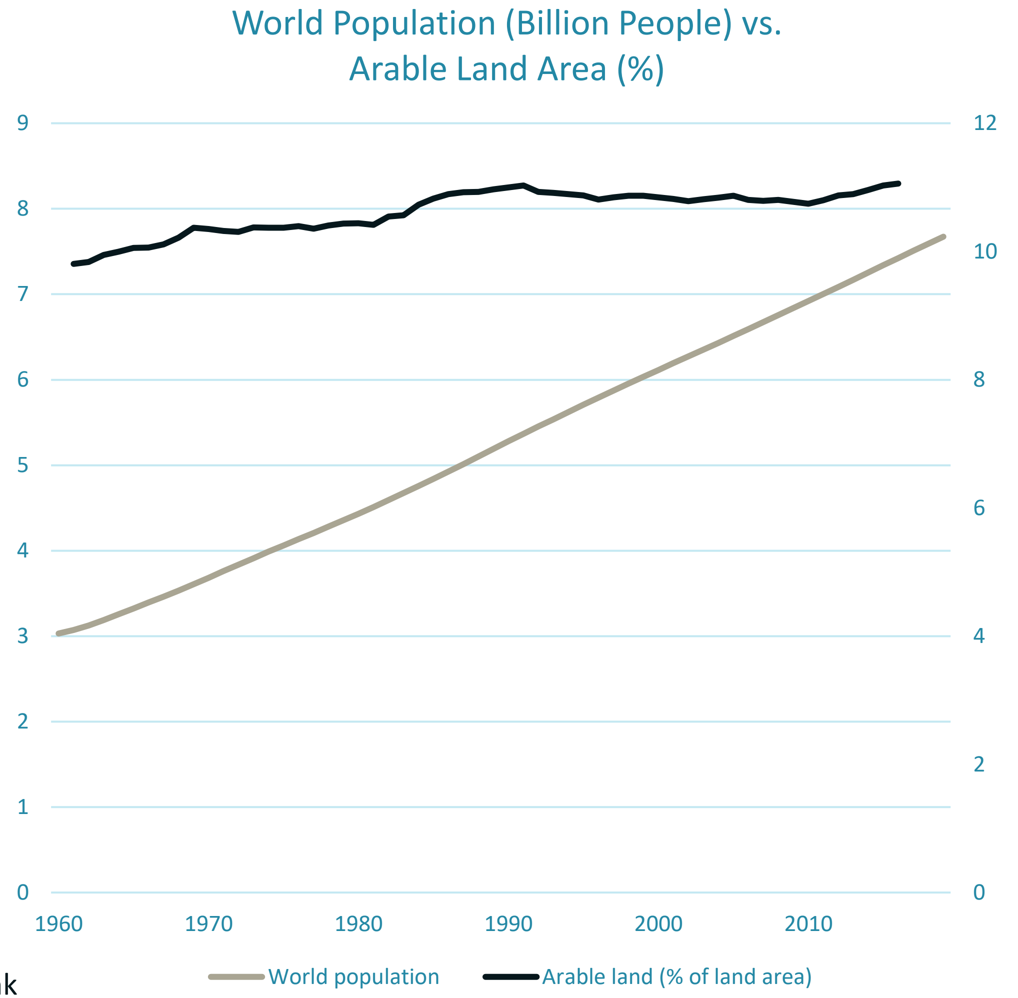


https://thisismold.com/event/experiences/on-pollinator-health-and-monoculture-farming#.YCEu8XkxkUE

Source: OurWorldinData.org

Challenges of Modern Agriculture

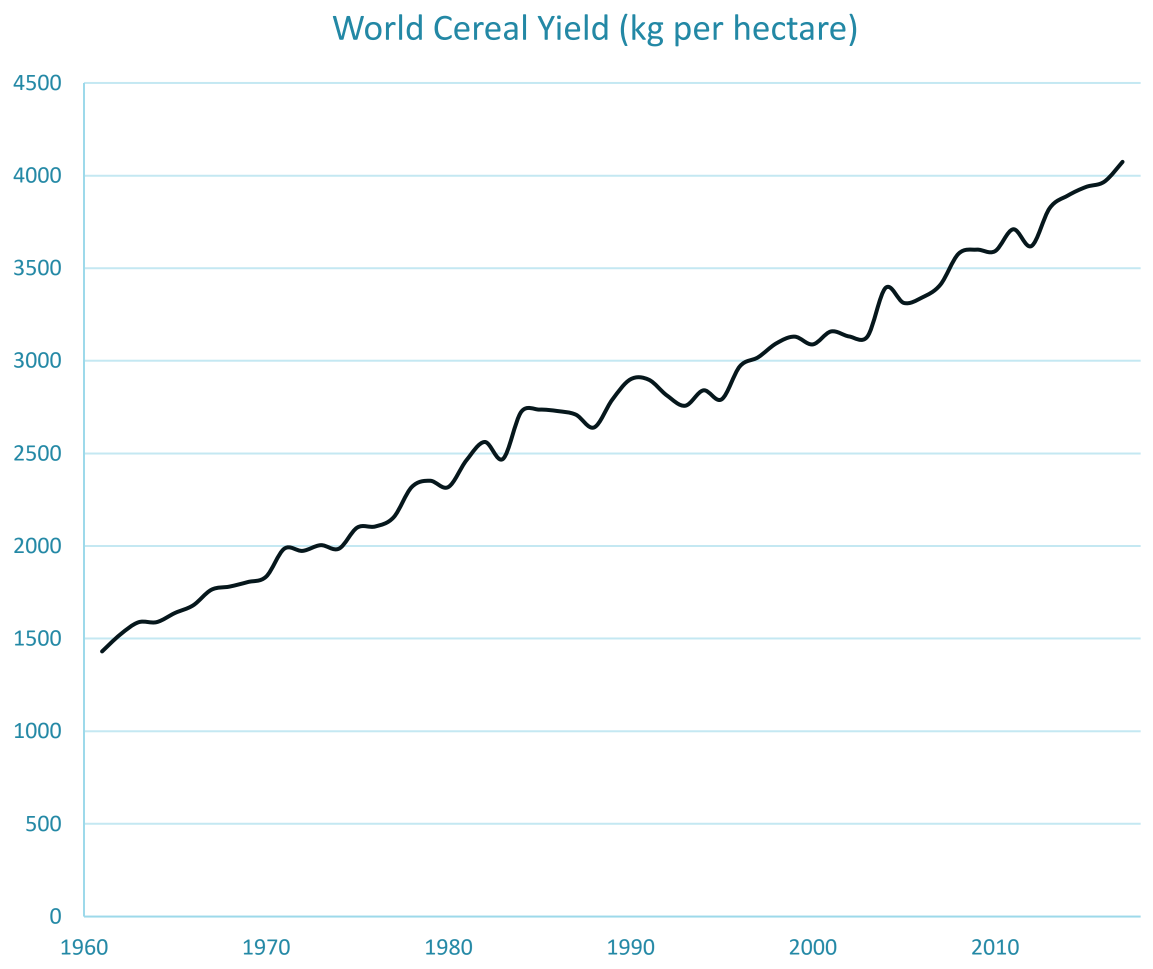
https://www.dw.com/en/lets-talk-about-overpopulation/a-37481009



Source: World Bank

Modern Agriculture

- Nitrogen fertilizer
  (Haber process, natural gas)
- Irrigation
- Use of pesticides (insecticides, herbicides, fungizides)
- Use of high-performance hybrids and GMOs
- Large monocultures maximizing area and machinery scale
- Agriculture in the context of the "Triple Planetary Crisis"



Source: Pixabay (DJI-Agras)

„New“ Agri. Revolution

Smart Agriculture & Precision Farming

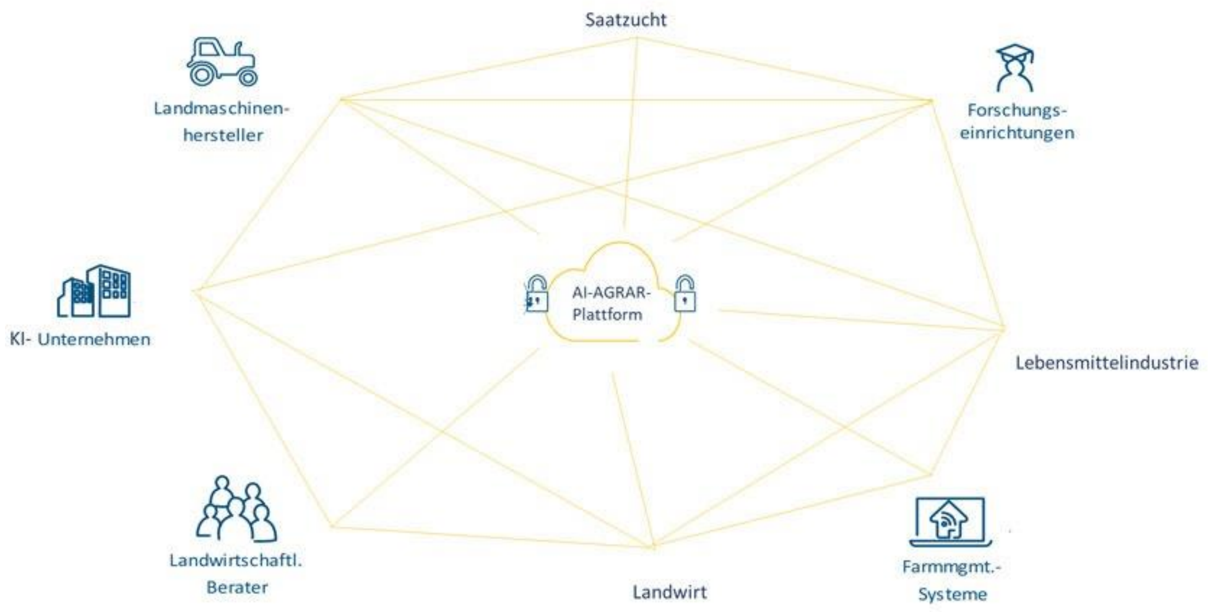
- Remote sensing
- Network communication (e.g. 5G)
- Automated processes
- Robotics
- A.I.
- (Big) Data & cloud technology
- …

Agri-Gaia: Agriculture in the European Cloud

- **GAIA-X** – the future European data infrastructure: https://www.data-infrastructure.eu

- **Agri-Gaia**:
  platform for agriculture (12 Mio € research project) aimed to provide cloud and AI technologies for agriculture

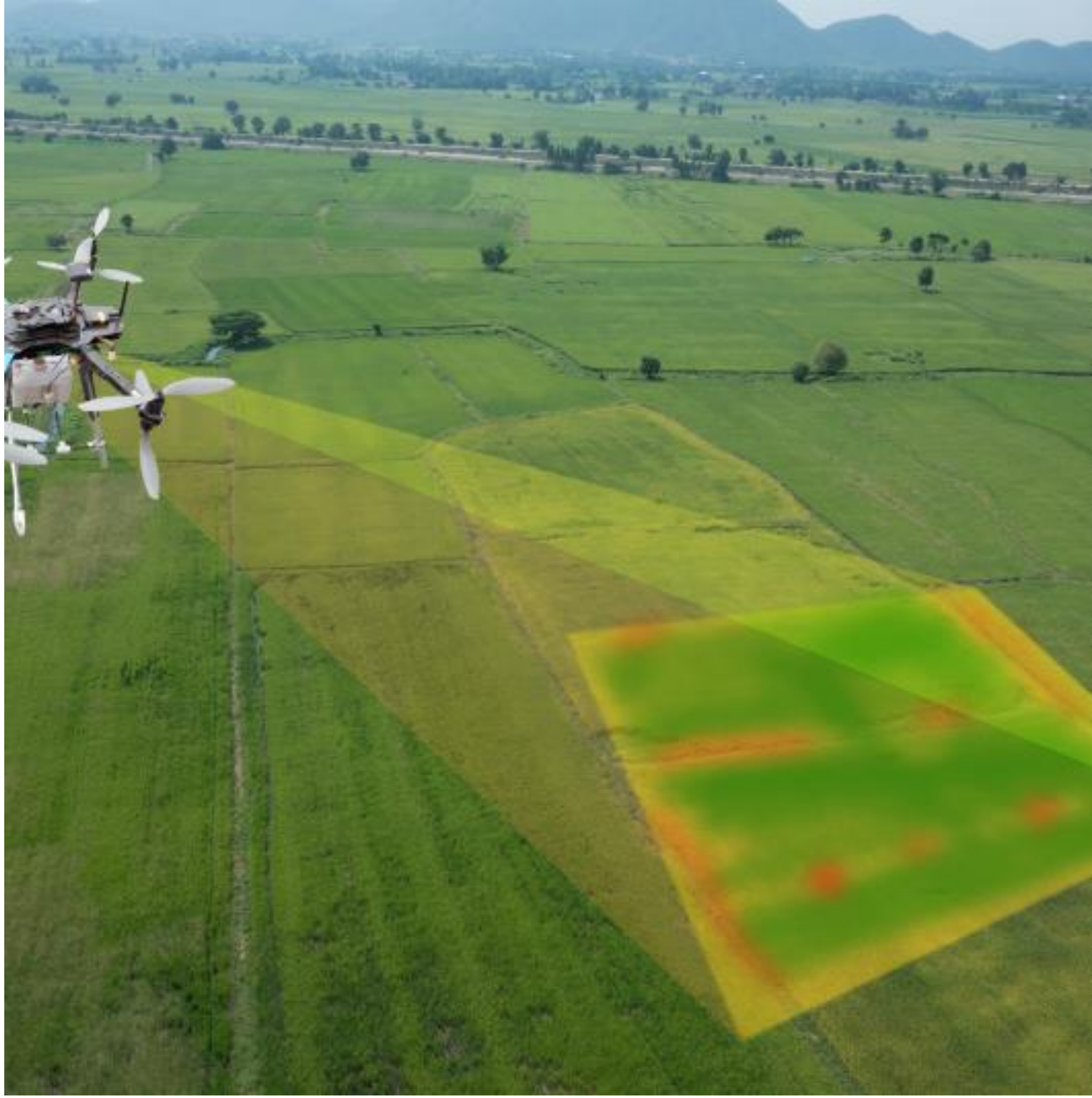
- **EU Data Act** & FAIR Data



Use Case: Automated Surveying

Drones collection data on large areas, detecting with AI:

- Crop development
- Water stress
- Nitrogen deficiency
- Pests and diseases



Source: https://www.activesilicon.com/news-media/news/applications-for-multispectral-and-hyperspectral-imaging/

Use Case: Autonomous Tractors / AgBots

Source: Krone

Autonomous Driving: Cars vs. Tractors

Cars

- Mostly structured environments
- Specific features: lane markings, signs, traffic lights, …
- Mobile actors: cars, cyclists, pedestrians, wildlife, …
- Static obstacles: building sites, traffic islands, parkes cars …
- High speeds, fast reaction times
- Environments typically marked, lit and constructed for cars

Tractors

- Mostly unstructured environments
- Unspecific features: crop rows, hedges, ditches, …
- Mobile actors: tractors, cyclists, hikers, wildlife, lifestock, …
- Static obstacles: haybails, trees, pylons, …
- Low speeds, fast reaction times
- Environment typically unmarked, unlit, not constructed for tractors

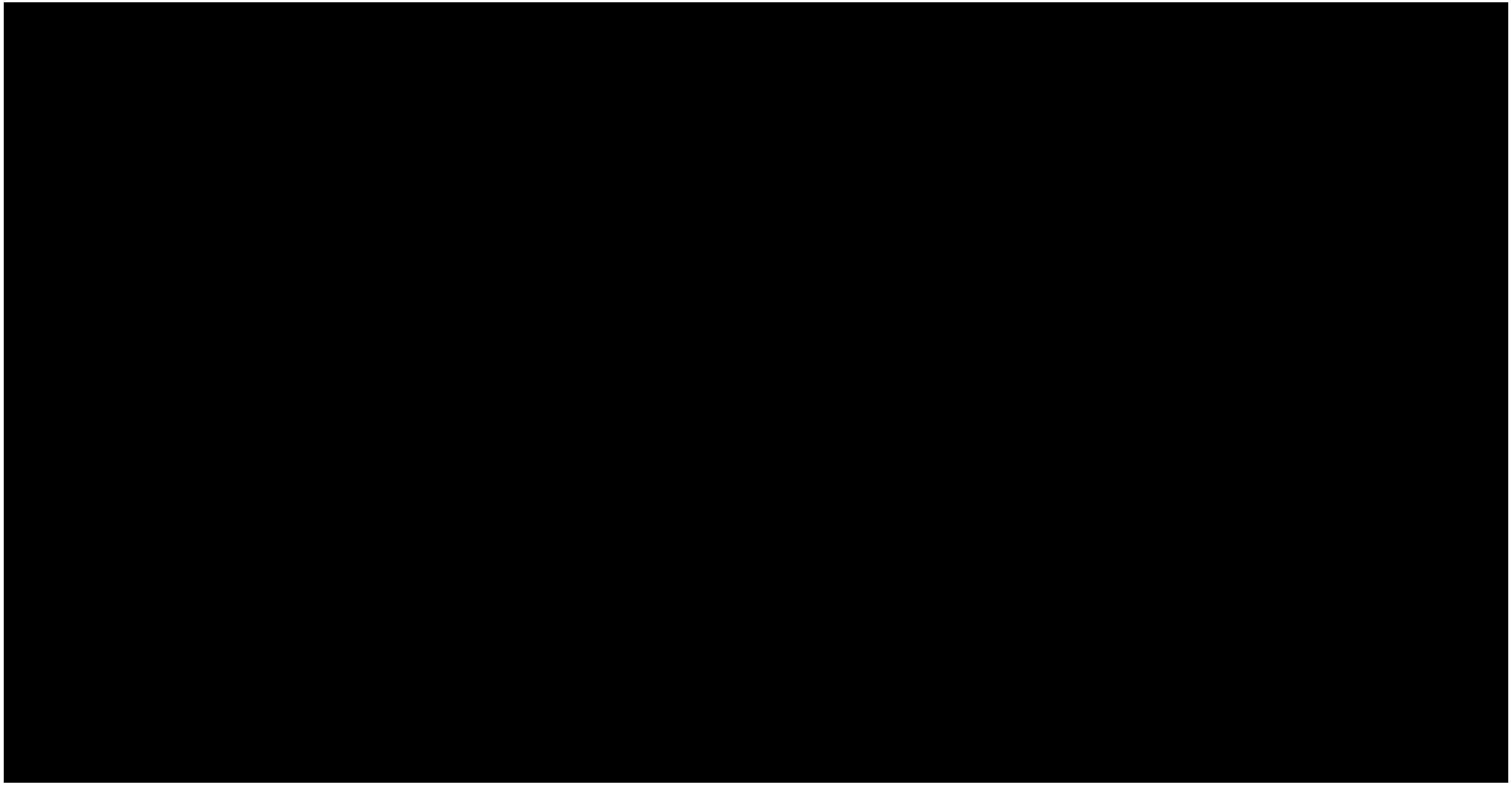
Use Case: Autonomous Robots

Small-scale autonomous robots selectively apply:

- Watering
- Fertilizer
- Herbicides
- (Mechanical) weeding tools
- Suction devices for pest removal
- Monitoring
- Harvesting of fruits
- …

Source: Nature Robots

Use Case: Selective Weeding



Source: Farming Revolution / Ecorobotix

Use Case: Harvesting with robots and AI

Which strawberries should be picked?

Model for fruit recognition and classification.

More than just strawberry recognition!

Source: FruitLogistica – TechStage, Enrico Neumann, Dr. Thimo Oehlschlägel, IAV, Berlin 07. Feb. 2023

Future of Agriculture?

Source: ChatGPT / DALL.E 3

Perspective in the next 5+ years

- Diverse fleets
  - Classic agricultural machinery
  - Highly automated (or autonomous) agricultural machinery or robots
  - Drones
- Digital Services (with AI)
- More diverse crop rotations
- Structured agricultural areas
  - Agri-PV
  - Agroforestry


Source: Dr. Henning Müller

Thank you for your attention!

special thanks to Dr. Henning Müller.

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