Harnessing Precision Agriculture for Enhanced Bioprotection:

Innovations, Applications, and Challenges

Asefeh Golreihan

ABIM 2024

About us

Independent consultancy company with private owners

Founding year 2001

Extensive EU, UK & CH regulatory expertise and scientific knowledge

Strong performance in first registration and registration amendment of chemicals

Agrochemicals, biopesticides, fertilizer and biostimulants, biocides, veterinary medicines and industrial chemicals

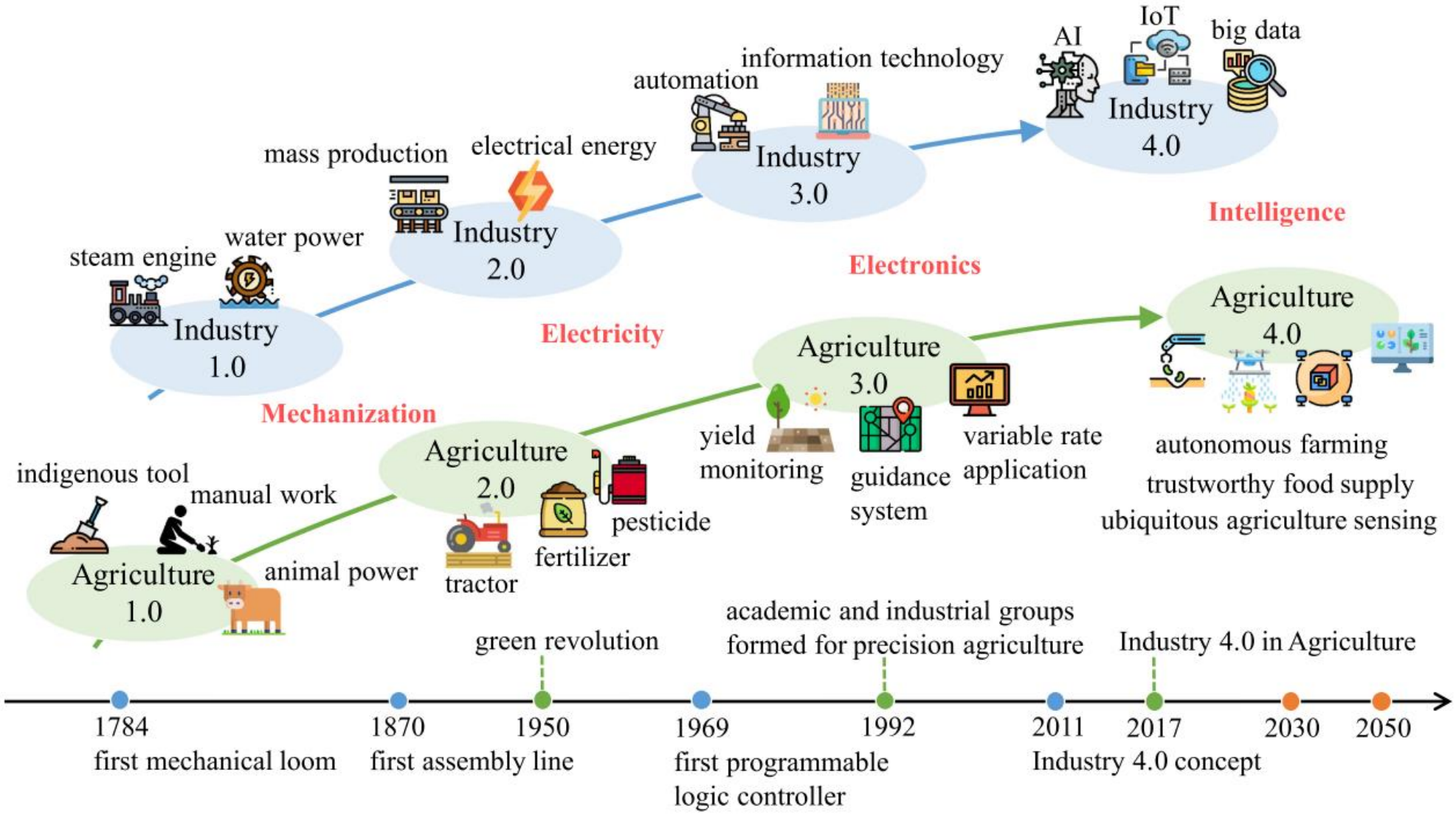
Specialists in development of proven successful regulatory strategies

Successful long-term working partnerships with global clients

LKC Switzerland Ltd.
LKC Chem-Regs Ltd.
LKC UK Ltd.

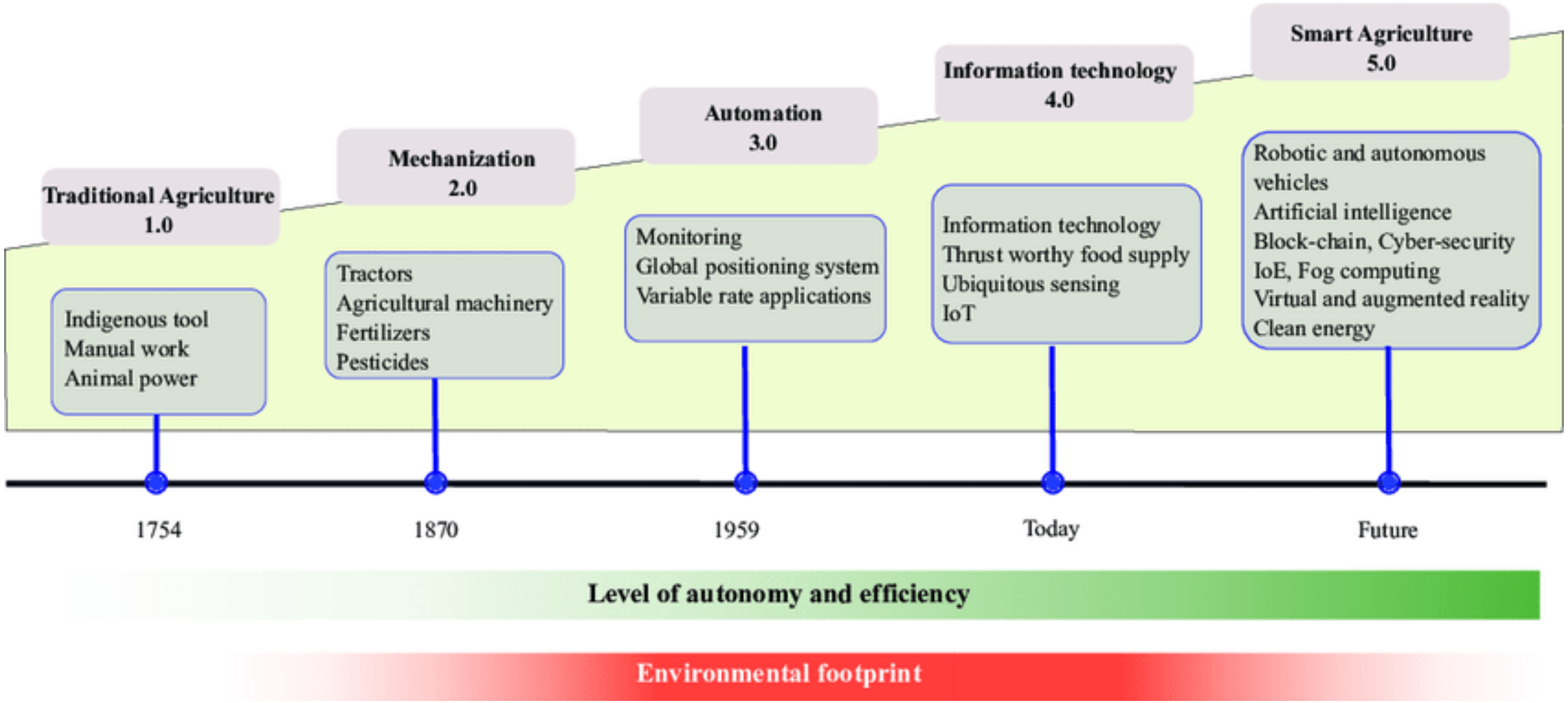
Hauptstrasse 10
P.O. Box 167
4414 Füllinsdorf
Switzerland
Phone: +41 (0) 61 906 8500
Email: LKC@lkc-ltd.com

Development roadmap of industrial & agricultural revolutions



Liu Y. *et al*, 2021

Development roadmap of agricultural revolution from Agriculture 1.0 to Agriculture 5.0



Ghobadpour A. *et al*, 2022

Bioprotection - IBMA definition

Bioprotection is used to protect against unwanted organisms including pests and pathogens and as such:

- it originates from nature and
- it can either be sourced from nature or is nature identical if synthetised and
- it has uses including in agriculture, forestry, amenity, home and garden, and public health.

It includes

- Macrobials: Invertebrate Biocontrol Agents
- Microbials
- Semiochemicals
- Natural substances

Precision Agriculture (PA)

Data-driven management

requires the collection, processing, and analysis of farming data

on individual, temporal and spatial levels

to ensure accuracy and precision.

Performing the right thing, in the right place, at the right time and following the correct protocols.

Technologies in PA

Data analytics

Monitoring tools (drones, satellite imagery)

Sensors (soil moisture, climate)

Benefits of PA

Optimized crop yields

Reduced environmental impacts

Enhanced resource use efficiency

Sustainable operations

Biocontrole Agent (BCA) challenges

- Environmental sensitivity (temperature, humidity, and UV exposure)
- Limited effective ranges
- Short residual effect and rapid degradation
- Complex application requirements and specific formulations
- Inconsistent effectiveness
- Limited coverage
- Pest-specific action
- Storage and handling challenges

Precision agriculture for biocontrole

- Drones and satellite imagery allow for targeted detection of pest outbreaks
- Real-time data and predictive models empower farmers to take timely action with BCAs
- BCAs can be applied directly by drone/robots to infested areas for precise control
- Minimizes BCA use while maximizing impact for sustainable pest management
- Reduces the need for chemical pesticides
- Supports environmental sustainability and food safety
- Aligned with European Green Deal & Farm to Fork Strategy goals

Innovative Approaches in Bioprotection

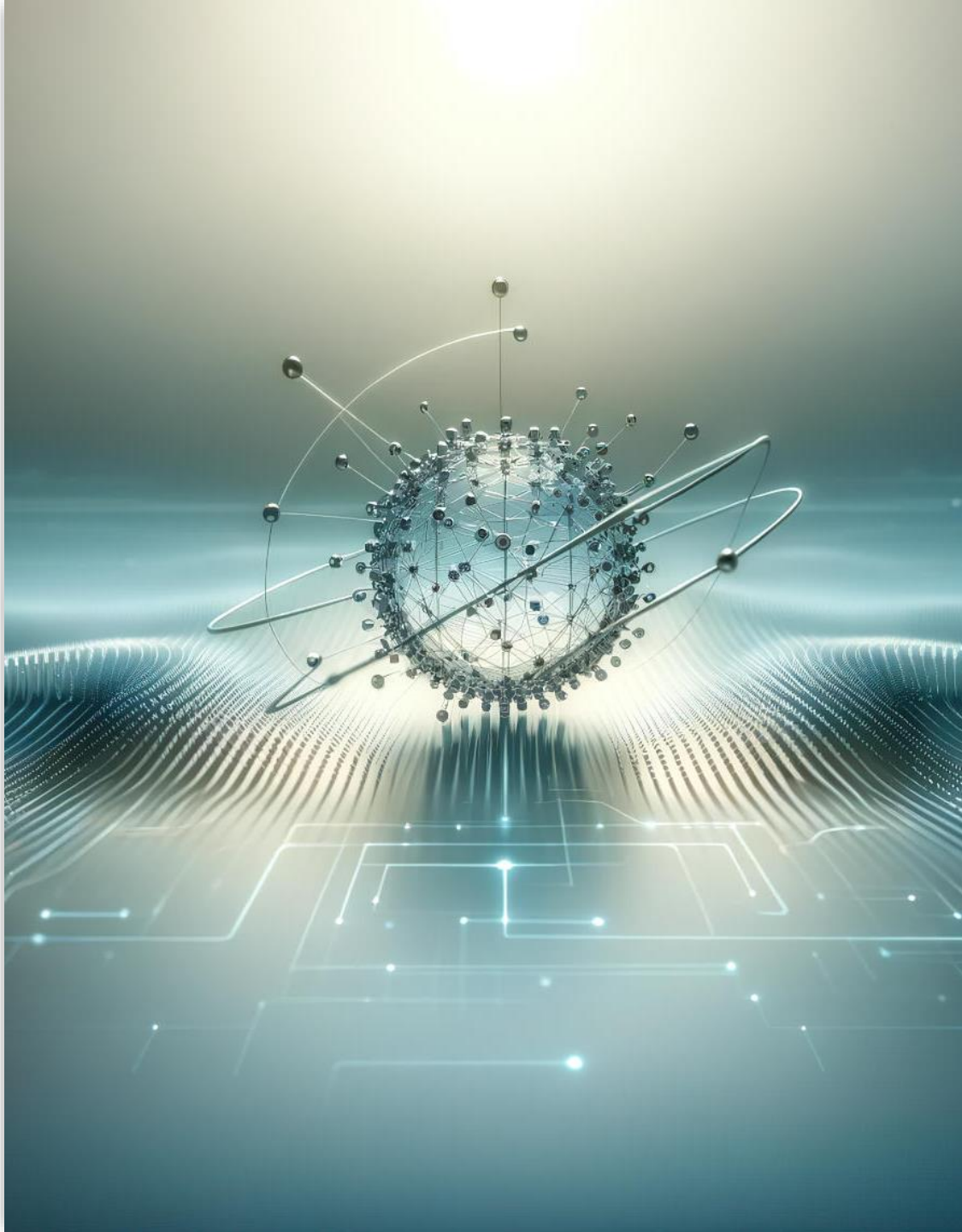
- Managed pollinators (entomovectoring)
- Nanotechnology
- Microbiome engineering

Entomovectoring: Pollinators Delivering BCAs

- Pollinators like bees deliver BCAs directly to crops.
- Combines pest control with enhanced pollination.
- Reduces the need for chemical treatments while improving crop health.
- This precision delivery aligns with precision farming principles, ensuring targeted and efficient BCA application.

Nanotechnology for Enhanced Bioprotection

- Improves BCA stability, delivery, and effectiveness.
- Nano-formulations protect BCAs from environmental stressors.
- Ensures sustained release and precise delivery of BCAs.
- Nanosensors provide real-time data on pest populations and crop health, allowing for timely interventions.



Microbiome Engineering for Bioprotection

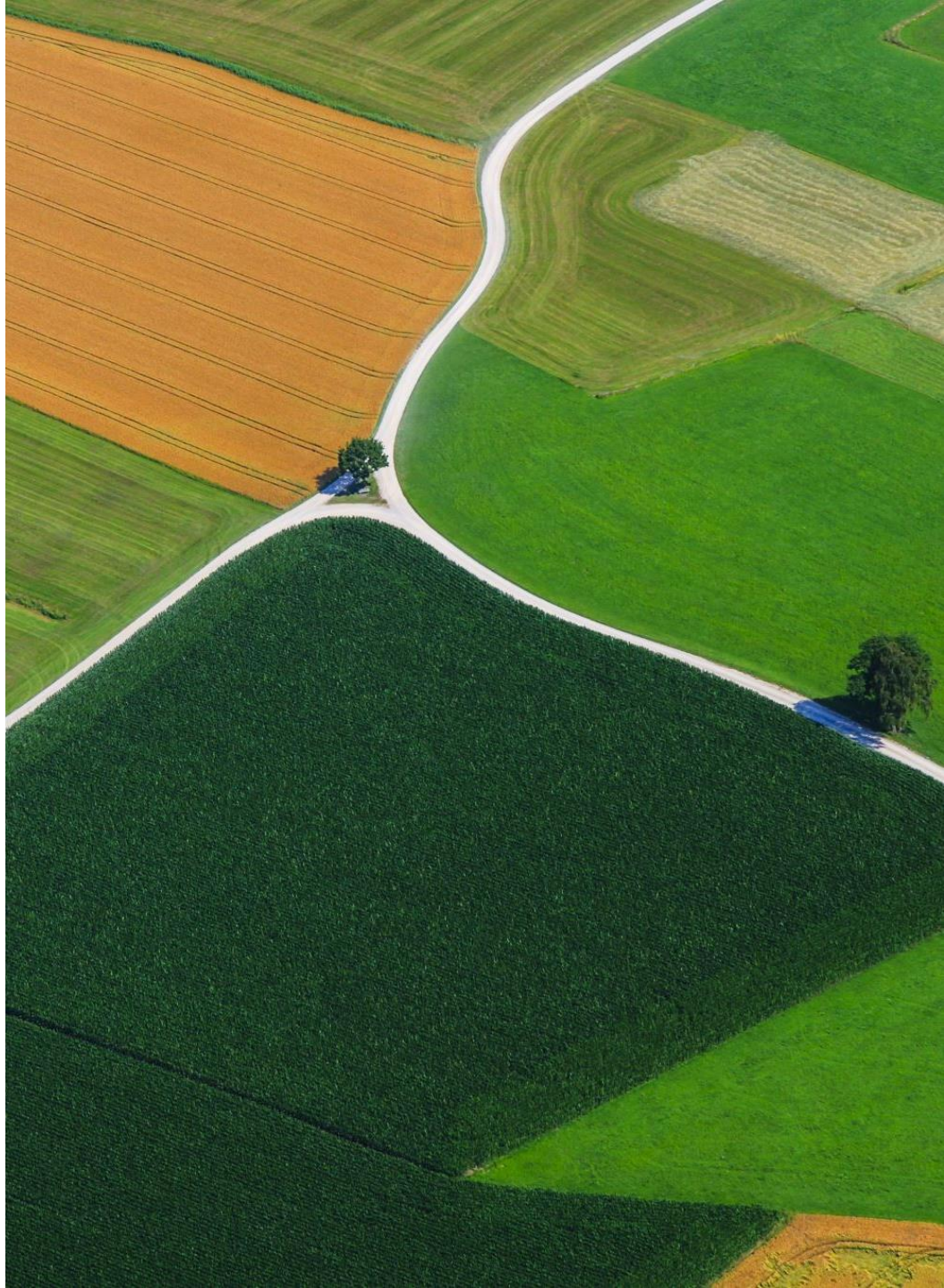
- Microbiome engineering manipulates plant-associated microbial communities.
- Beneficial microbes outcompete or antagonize pests and pathogens.
- Precision Monitoring tools monitor and maintain the stability of engineered microbial communities, ensuring they function optimally within the ecosystem.

Challenges & future prospects in PA and Bioprotection

- Challenges include high initial costs and variability in pest populations
- Potential resistance development remains a concern
- Regulatory approvals for new technologies
- Data privacy and ownership
- Standardization and compatibility
- Support for farmers
- Future innovations include AI, automation, and policy support for greater accessibility

Conclusion

- Precision agriculture enhances the application of biocontrole by:
  - addressing climatic sensitivities
  - overcoming application difficulties
  - promoting sustainable and effective pest management
- Ongoing research and innovation present a promising pathway to sustainable agriculture.
- A swift regulatory adaptation to recent advancements in agriculture and technology is essential.



LKC

Thank you, your LKC team!