



The LifeWatch ERIC Biodiversity
& Ecosystem eScience Conference

PLOVDIV, BULGARIA

7-10 JULY 2026

Agroecology, Biodiversity & Digital Monitoring

New Directions in European Agri-Food System
Transformation

Presenter: Prof. Vladislav Popov

9th July 2026



Four Shifts Reshaping European Agroecology

RESEARCH TRENDS

Practices → Transition Framework

Crop diversification, intercropping and reduced tillage studied as part of wider economic and social change.

Living Labs & Research Infrastructures

Long-term, place-based co-design where farmers, researchers and policymakers test context-dependent solutions.

Digital & Electronic Monitoring

Remote sensing, eDNA, bioacoustics and AI measure biodiversity outcomes - supplementing, not replacing, field expertise.

Policy Evaluation & CAP

Agroecological practices linked to eco-schemes and results-based payments, demanding robust biodiversity indicators.

Scaling Agroecology Across Europe

European Agroecology Partnership

Covers **26 countries** with a budget of ~**€60 million**. Funds research aligned with the Strategic Research and Innovation Agenda, building stakeholder capacity and knowledge exchange.

- 2024 call: farm and landscape-level agroecology
- 2025 call: environmental, economic and social performance
- 2026 call: genetic diversity and farmer empowerment

BIOEAST: Central & Eastern Europe

Brings together **11 countries** supporting bioeconomy strategies across agriculture, forestry, aquaculture and food systems.

- Interactive map of agroecology Living Labs in the region
- BOOST4BIOEAST launched national hubs and a Knowledge Platform
- Bucharest event gathered **180+ stakeholders** to renew R&I priorities

Agroecology Living Labs: Science–Policy–Society Nexus

Science

Study practices under real conditions — outcomes depend on local soils, climate, biodiversity and markets.

Policy

Generate evidence for CAP eco-schemes, carbon farming and organic conversion; test which instruments farmers find acceptable.

Society

Rebuild trust between farmers, consumers and policymakers. Participatory formats make transition policies more legitimate when farmers are co-designers.



Critical challenge: Living Labs risk becoming "project islands" — active during EU funding but weak after. They need long-term governance, AKIS links and clear pathways to scale.



Agroecology, Organic Farming & Farmer Adoption



Two Complementary Approaches

Organic farming provides certification and market trust. Agroecology provides systemic design principles: diversity, recycling, synergy and resilience. Together they support a more sustainable agri-food system.

What Drives Adoption?

Adoption depends on **economic feasibility**, technical adaptation, advisory support & policy or market recognition — not awareness alone.

- **Drivers:** input reduction, soil fertility, eco-schemes, peer learning
- **Barriers:** labour demand, uncertain yields, weak value-chain support, administrative complexity

Four Tensions in Biodiversity & Agroecology

1

Ecological Indicator vs. Farming Asset

Scientists measure species richness; farmers focus on pest regulation and soil fertility. Both require different indicators.

2

Field-Level vs. Landscape-Level

Many biodiversity benefits appear only at landscape scale, requiring spatial monitoring and farm cooperation

3

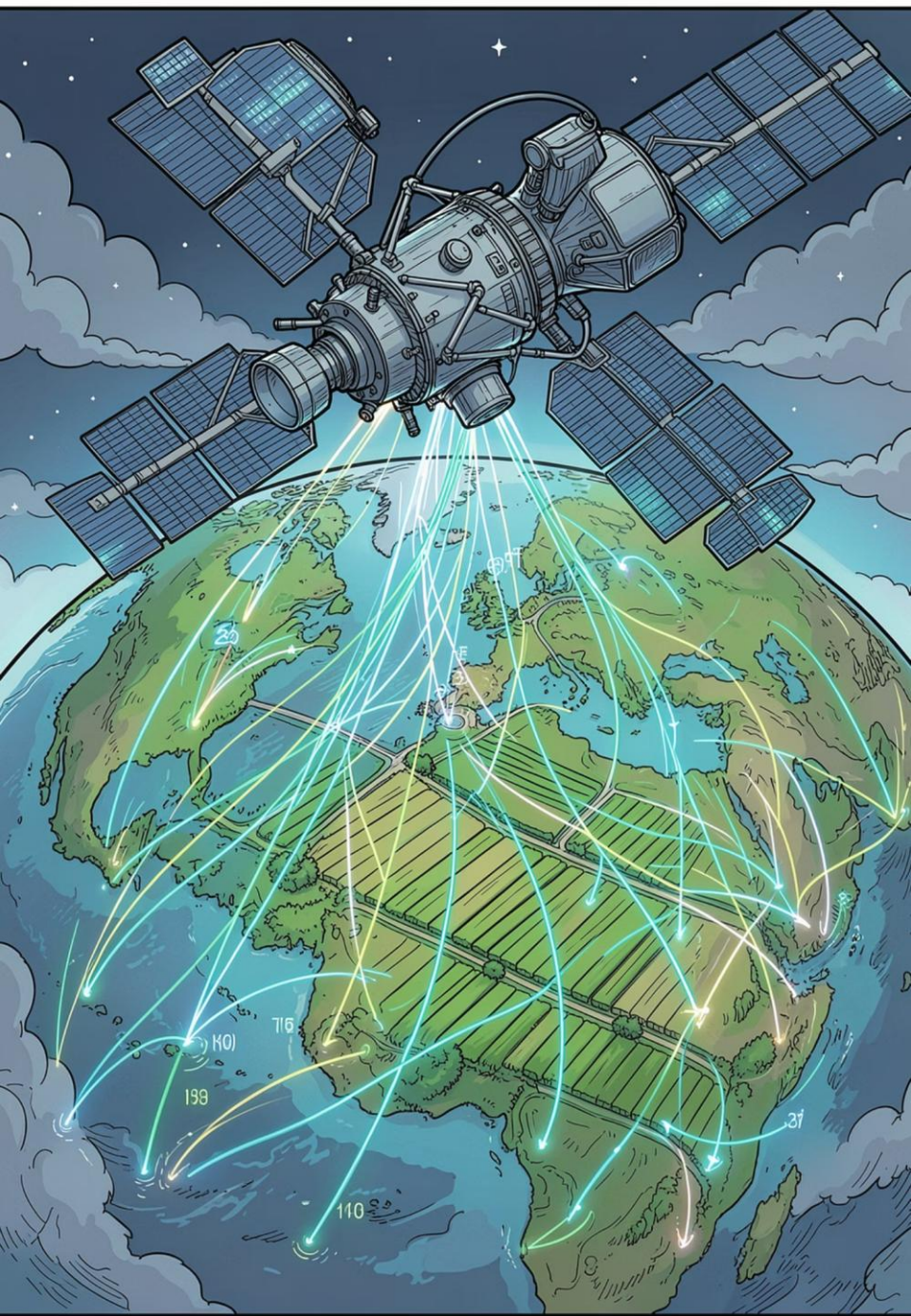
Short-Term Economics vs. Long-Term Recovery

Biodiversity restoration takes time while farmers face immediate costs — creating a policy–farm decision mismatch.

4

Standardised Monitoring vs. Local Specificity

CAP needs comparable indicators across Member States, but agroecology depends on context. Core EU indicators plus local metrics are needed.



DIGITAL MONITORING

Electronic Infrastructures for Biodiversity Monitoring



Remote Sensing & Drones

Copernicus satellites, LiDAR and UAVs monitor crop diversity, vegetation cover and habitat structure at high resolution.



eDNA & Bioacoustics

Environmental DNA screens soil and water biodiversity; acoustic sensors detect birds, insects and amphibians continuously.



IoT, AI & Citizen Science

Soil sensors, smart traps and AI integrate with citizen observations — but must complement, not replace, field ecology and taxonomy.

From Compliance Monitoring to Impact Monitoring

Traditional Compliance Monitoring

- Did the farmer plant cover crops?
- Was a hedgerow maintained?
- Were eco-scheme conditions respected?

Verifies implementation but not ecological outcomes.

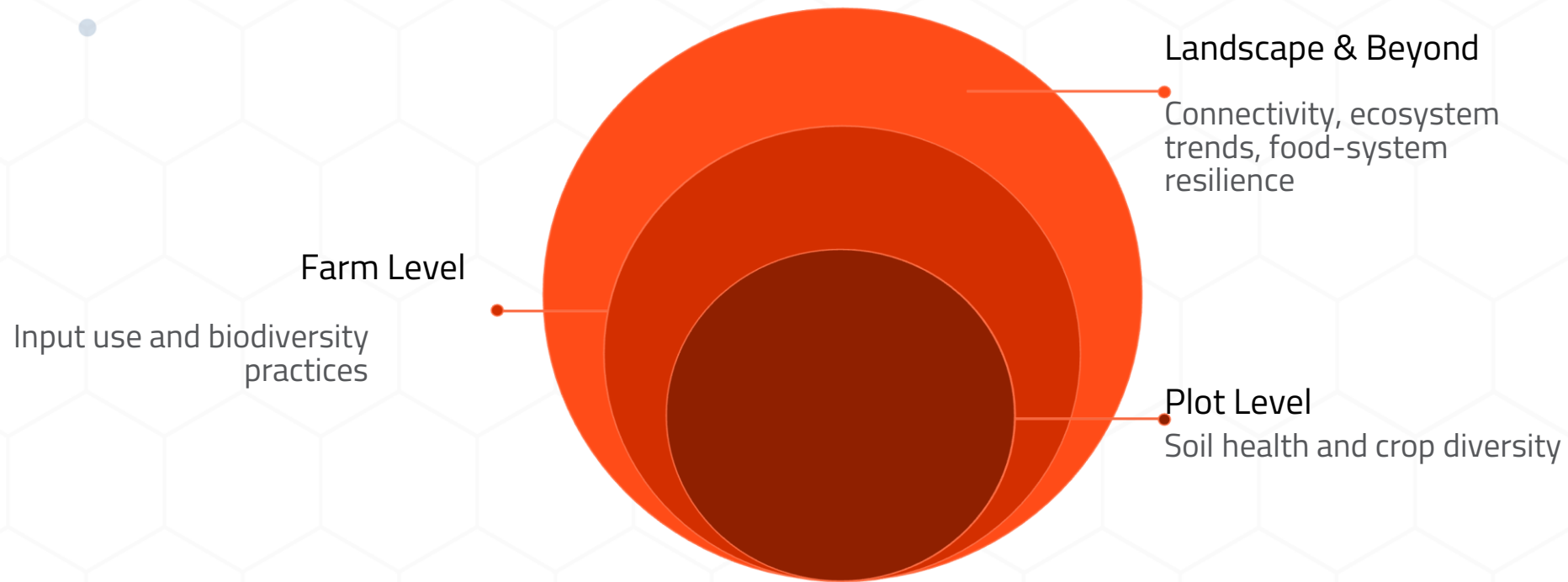
New Impact Monitoring

- Did pollinator abundance increase?
- Did soil biodiversity improve?
- Did landscape connectivity improve?
- Did carbon sequestration increase?

Measures whether biodiversity, ecosystem services and resilience actually improved.

Future CAP payments may increasingly depend on **measured ecological performance**, biodiversity outcomes and resilience indicators — evolving into ecosystem governance systems.

A Multi-Level Impact Monitoring Framework



Biodiversity effects often appear only at landscape scale — monitoring must work across all levels simultaneously.

Hybrid Approach

Digital tools + field science + farmer knowledge + participatory governance.

Key Challenges

Data interoperability, standardisation, long-term funding (5–15 years), farmer trust & infrastructure costs.

Living Labs as Platforms

Ideal for long-term observation, participatory validation and policy feedback loops.

Agroecology as a Science-Policy-Society Transition

- Long-term Living Labs
Embed in AKIS systems, CAP Strategic Plans and farmer organisations — avoid "project islands".
- Biodiversity-Centred CAP Monitoring
Shift from subsidy control to ecosystem governance with measurable outcomes.
- CEE & BIOEAST Opportunity
Frame agroecology as rural competitiveness: soil health, circular bioeconomy, organic farming and digital monitoring.
- Farmer-Led Innovation
Treat farmers as co-designers. Link agroecology with value chains and policy — not only agronomic recommendations.



From Compliance to Impact Monitoring in Agroecology and CAP

The Critical Shift in CAP Monitoring

Compliance Monitoring

- Did the farmer plant cover crops?
- Was a hedgerow maintained?
- Were eco-scheme conditions respected?

Verifies **implementation**, not ecological outcomes.

Impact Monitoring

- Did pollinator abundance increase?
- Did soil biodiversity improve?
- Did carbon sequestration increase?
- Did ecosystem resilience increase during droughts?

Measures **ecological and social outcomes** - driven by CAP 2023–2027, EU Biodiversity Strategy, Nature Restoration Law.

What Should Be Monitored?

Biodiversity

Pollinators, farmland birds, butterflies, soil organisms, habitat and functional diversity.

Ecosystem Services

Pollination, pest control, soil fertility, water regulation, carbon sequestration, nutrient cycling.

Climate Resilience

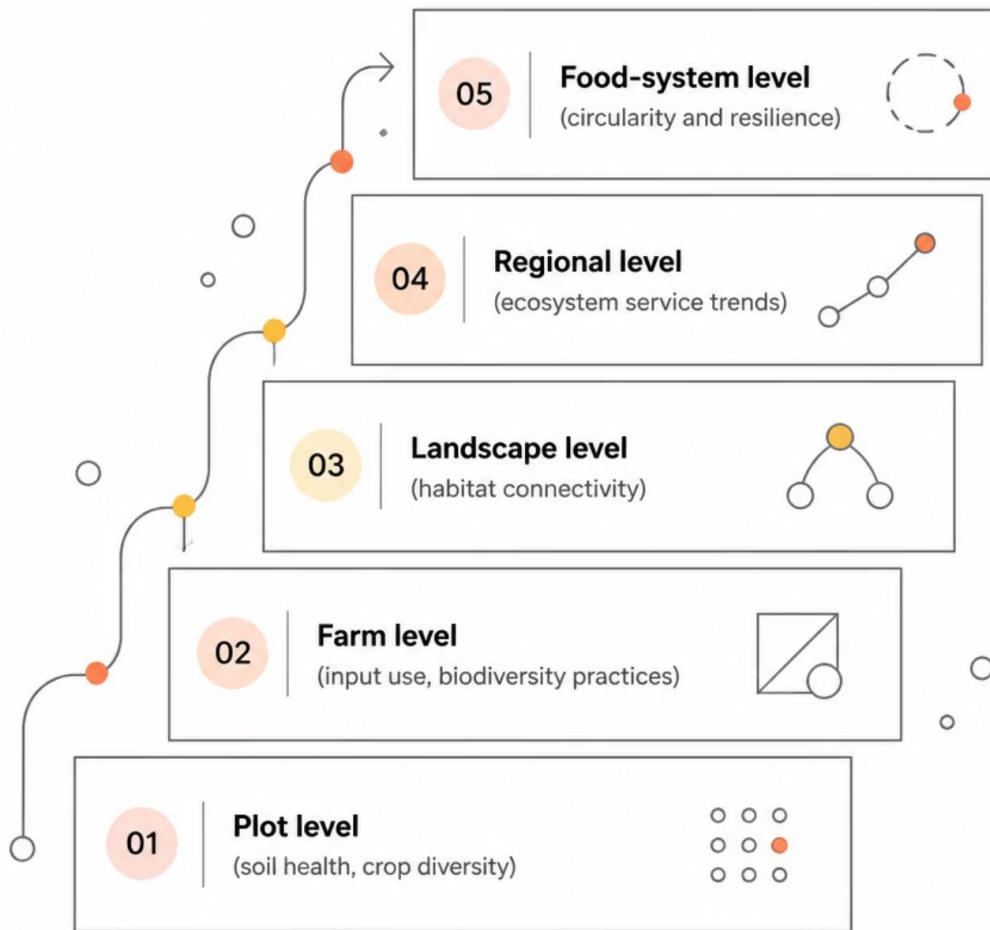
Drought resistance, soil organic carbon, water retention, yield stability, heat resilience.

Socioeconomic Resilience

Farm profitability, input dependency, labour conditions, farmer well-being, local value chains.



Multi-Level Monitoring Architecture



Why Scale Matters

Biodiversity effects often appear **only at landscape scale**. Effective monitoring must span plot, farm, landscape, regional and food-system levels simultaneously.

i CAP monitoring must evolve from farm-level compliance checks to landscape-scale impact evaluation.

Digital Tools for Impact Monitoring

Remote Sensing

Copernicus, Landsat, PlanetScope — crop diversity, vegetation cover, biomass, moisture stress.



Drones & GIS

High-resolution habitat monitoring, biodiversity corridors, landscape fragmentation mapping.



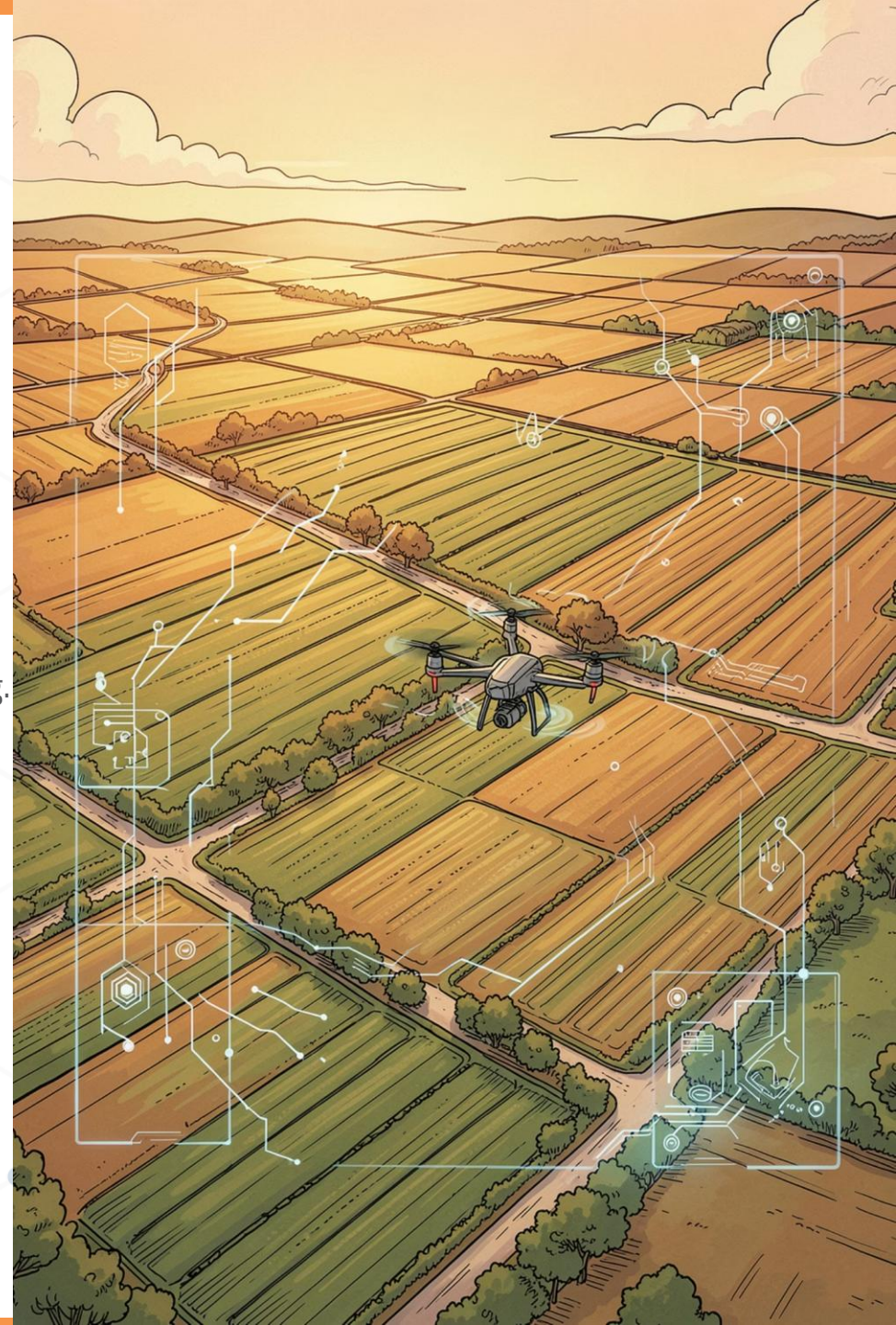
eDNA & Bioacoustics

DNA from soil/water; AI sound analysis for birds, insects, amphibians — non-invasive, continuous.



IoT & AI

Soil sensors, smart traps, weather stations; AI integrates data for predictive resilience models.



Hybrid Monitoring is Essential



The Future is Hybrid

Digital tools alone are insufficient. The IEEP briefing emphasises that technologies must **complement, not replace**, in situ ecological observations and taxonomic expertise.

Digital Tools

Satellite, AI, sensors, eDNA

Field Science

In situ ecology, taxonomy

Farmer Knowledge

Local expertise, co-design

Participatory Approaches

Citizen science, Living Labs

Agroecology Research Trends in Europe

1

Transition Framework

From isolated practices to systemic food-system change — climate, biodiversity, food security.

2

Living Labs

Place-based co-design with farmers, researchers, advisors and policymakers.

3

Digital Monitoring

Remote sensing, eDNA, bioacoustics, AI — supplementing field expertise.

4

CAP Policy Link

Eco-schemes, results-based payments, robust biodiversity indicators.

The **Agroecology Partnership** covers **26 countries** with ~**€60M**; **BIOEAST** connects **11 CEE countries** for bioeconomy and agroecology cooperation.

Living Labs & Farmer Adoption

Living Labs as Governance Tools

Connect science, policy and society.
Require long-term governance,
AKIS links, CAP Strategic Plan
integration and transparent data
rules to avoid "project islands".

Adoption Drivers

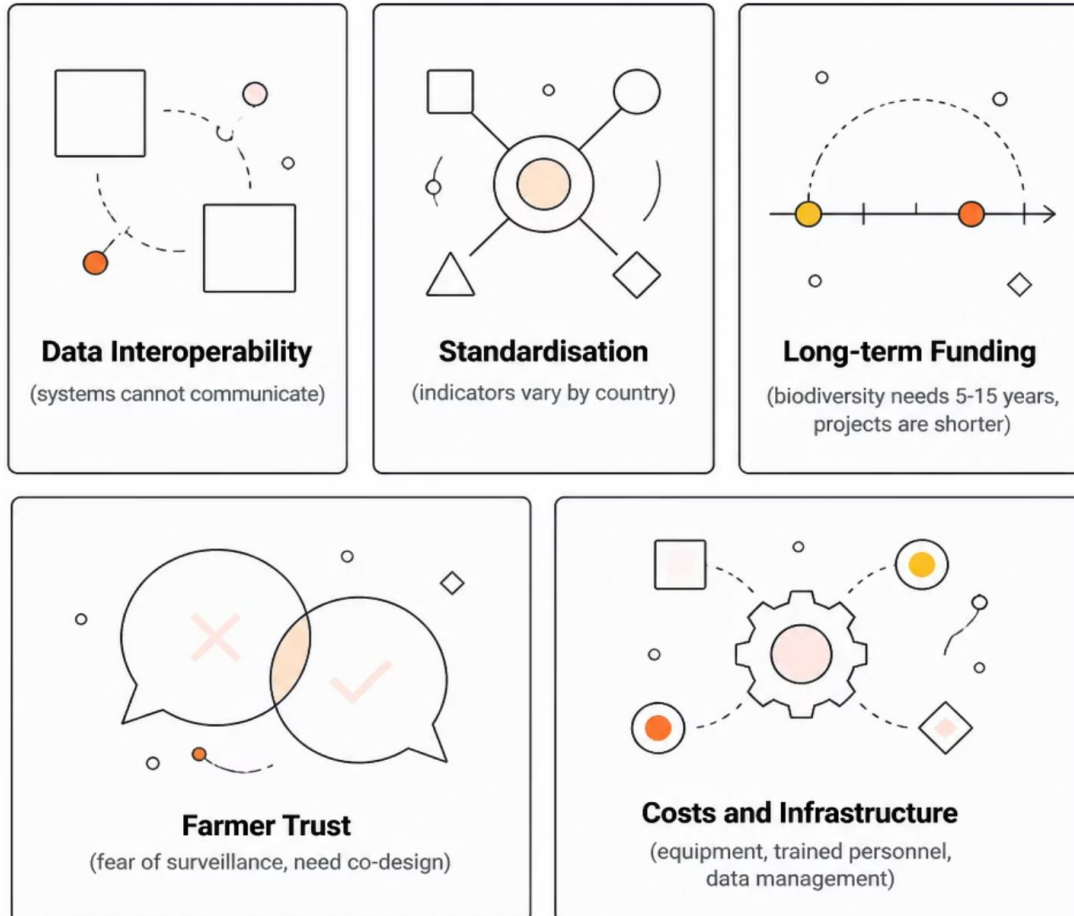
- Reduced input dependency, improved soil fertility
- Climate resilience, peer learning
- CAP payments, eco-schemes, premium markets

Adoption Barriers

- Higher labour demand, uncertain yields
- Lack of machinery, weak value-chain support
- Administrative complexity, policy distrust



Major Challenges of Impact Monitoring



Building Trust is Critical

Farmers may fear surveillance and excessive control.

Co-design, transparency and clear data ownership rules are essential for legitimate monitoring systems.



Biodiversity impacts require **5–15 years** of monitoring, yet most projects are far shorter - a critical funding gap.

From Subsidy Control to Ecosystem Governance

From

"Was the rule respected?"

To

"Did the ecosystem improve?"

Future CAP payments may depend on **measured ecological performance** - biodiversity, carbon sequestration, resilience and ecosystem services.

The most successful systems combine remote sensing, AI, GIS, eDNA, bioacoustics, field ecology and participatory governance - scientifically robust, economically feasible, and trusted by farmers.





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THANK YOU!

Questions?

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