Bio Monitor 4CAP

ADVANCED BIODIVERSITY MONITORING FOR RESULTS-BASED AND EFFECTIVE AGRICULTURAL POLICY AND TRANSFORMATION

Unsustainable agricultural practices are one of the main factors affecting habitat and species diversity in EU agricultural landscapes. Monitoring the status of agro-biodiversity is essential for effective management of agro-ecosystems and for appropriate and effective implementation of strategies and policies to maintain biodiversity. **The BioMonitor4CAP project aims to develop simple and advanced agro-biodiversity monitoring and surveillance systems to support and implement outcome-oriented policies in European agricultural landscapes.** Twenty-three partner organizations (ecologists, agronomists, data scientists, etc...) from ten European countries and Peru are participating in this project funded by the Horizon Europe research and innovation program.

BIODIVERSITY INDICATORS

Monitoring biodiversity involves four main areas: remote sensing, soils, insects and birds.

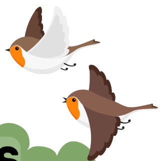
Remote sensing provides valuable information on a broad scale, but it is essential to complement these data with field surveys and observations that focus on the crucial roles of soil organisms, insects, and birds in maintaining biodiversity.

The integration of remote sensing data with field surveys is essential for a global understanding of biodiversity.

• REMOTE SENSING

Essential for large-scale environmental monitoring

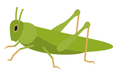
Remotely sensed data can be used to quantify a wide range of structural features, such as vegetation height, canopy cover, and forest structure, providing valuable information about the physical characteristics of ecosystems. **The comprehensive understanding provided by remote sensing indicators spans from individual species dynamics to ecosystem-level services**, underpinning decision-making processes for conservation, land management, and sustainable agriculture practices.



• BIRDS

Essential for measuring ecosystem pressure

Bird biodiversity indicators can be used as indicators of the overall health of ecosystems and biodiversity in different taxonomic groups, due to their sensitivity to environmental change. Monitoring the distribution of bird species, biogeographical patterns and trends in population abundance is a good indicator of anthropogenic environmental change and the pressures exerted on an ecosystem.



• INSECTS

Essential to monitor ecosystem structure and stability

Particularly important in agricultural and forestry landscapes, these indicators are becoming critical tools for assessing the impacts of land-use change and environmental variability on ecosystem health and resilience. Fluctuations in insect diversity or abundance can serve as early indicators of shifts in ecosystem composition and health, while changes in community structure provide insights into ecosystem resilience to disturbances such as habitat loss or climate change.

• SOILS

Essential for assessing the health and functionality of an ecosystem

Soil biodiversity indicators are particularly useful for monitoring the impacts of different types of land use and land management practices. They provide parameters for assessing the health and functionality of the ecosystem as a whole, from soil microbiology and fauna to the vertical profile of the ecosystem (e.g. soil organic matter), as well as the status of key ecosystem regulating services (e.g. soil fertility and nutrient cycling).

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FIELD RESEARCH : NEW MONITORING TECHNOLOGIES

Traditionally, biodiversity assessments have relied on field surveys, which can be time-consuming, labor-intensive, and limited in their geographical coverage. In recent years, Remote Sensor-based technologies have emerged as a valuable tool for biodiversity monitoring, offering the ability to collect large-scale data at frequent intervals.

The BioMonitor4CAP project will collect the biodiversity data in multiple and new complementary ways : the classical in-situ and ex-situ surveys (field observations and measurements) will be combined with **new methods: eDNA sampling, optical methods, acoustic sensors, drone-based systems, and satellite earth observation.** Field research is being carried out and biomonitoring approaches are being developed at several sites in Europe to measure **insect and bird abundance, soil biodiversity and soil physico-chemical parameters.**

ACOUSTIC RECORDER

Automated audio recorders can capture bird vocalizations. It can operate continuously and autonomously, allowing for long-term monitoring without human presence. Advanced software and algorithms can be used to identify species, determine population densities, etc...

REMOTE SENSING

This technology is widely used to monitor habitat heterogeneity, vegetation cover, land use changes, and the distribution of different habitats. Remote sensing is essential for large-scale environmental monitoring.

DRONE-BASED SYSTEMS

Equipped with cameras and sensors to monitor biodiversity and environmental conditions. They can cover large areas quickly and access remote or difficult-to-reach locations.

INSECT CAMERA

Automated insect cameras enable accurate AI-powered insect recognition. This technology reduces the need for manual sampling and allows for high-frequency data collection, improving the accuracy and resolution of biodiversity assessments.

eDNA

Environmental DNA refers to genetic material obtained directly from environmental samples, such as soil, water or air, without the need to capture organisms. eDNA samples provided further insights into the ground-dwelling biodiversity. eDNA metabarcoding (a method of DNA barcoding that uses universal genetic markers to identify DNA of a mixture of organisms) appears to be a promising tool for filling-in the knowledge gap on soil biodiversity.

TRAPS

Pan traps and vane traps are used to passively collect bees and other (flower-visiting) insects.

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FACILITATING THE ADOPTION OF BIODIVERSITY MONITORING AND GOOD FARMING PRACTICES

Identifying stakeholder groups and how they perceive agrobiodiversity is essential for the effective development of agrobiodiversity policy measures that promote positive agrobiodiversity decision-making.

• FARMERS

Farmers' agrobiodiversity perceptions and their motivations to adopt management practices set out by the agricultural policies have been studied. Farmers recognize how their management practices and agri-environmental programs are connected to biodiversity and how biodiversity positively benefits farming. However, conservation activities, farm management, and closely related agricultural policies often conflict with farmers' management decisions. Preliminary literature review results suggest key considerations for designing agrobiodiversity-enhancing policy measures :

- **Theoretical and practical agrobiodiversity education for farmers:** educational activities increase stakeholders' understanding and motivation towards agrobiodiversity;
- **Rewarding farmers for monitoring and enhancing agrobiodiversity:** various measures to improve adoption of the extant and development of novel agrobiodiversity-preserving farming practices;
- **Supporting cooperation between farmers and other stakeholders in the agricultural value chain**: encouraging and increasing information flows, shared goals and management practices for improving agrobiodiversity throughout the agricultural value chain;

• CITIZENS AND CONSUMERS

Consumers' food preferences indirectly influence farmers' production decisions. Consumer perceptions and their food choices may have significant influence on agrobiodiversity conservation. Citizens appreciate the intrinsic values of agrobiodiversity, which contrasts with farmers' perception that emphasizes its instrumental values. For citizens, agrobiodiversity is mainly associated with aesthetic values by those who prefer restored and traditional landscapes. Preliminary literature review results suggest key considerations for designing agrobiodiversity-enhancing policy measures :

- **Agrobiodiversity information on food products for consumers :** informing about the agrobiodiversity impacts of the products and farmers' agrobiodiversity-enhancing measures increases awareness;
- **Ensuring far-reaching agrobiodiversity research funding and dissemination activities:** increasing awareness of agrobiodiversity among lesser-studied stakeholders such as companies' representatives, authorities, children and students to emphasize the importance of agrobiodiversity in future food production.