

CA21134 - Towards zer0 Pesticide AGRiculture - Virtual Mobility Grant

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List of abbreviations

Abbreviation	Meaning	Abbreviation	Meaning
AI	Artificial intelligence	IPM	Integrated Pest Management
CAP	Common Agricultural Policy	MZe	Ministry of Agriculture of the Czech Republic
COST	European Cooperation in Science and Technology	NAP	National Action Plan for the Safe Use of Pesticides
EIP	European Innovation Partnership, particularly EIP-AGRI	NAZV	National Agency for Agricultural Research
EU	European Union	PPP	Plant Protection Product
HRI 1	Harmonised Risk Indicator 1, based on quantities and hazard weighting of pesticide active substances placed on the market	SZIF	State Agricultural Intervention Fund
HRI 2	Harmonised Risk Indicator 2, based on emergency authorisations of plant protection products	TA CR	Technology Agency of the Czech Republic
UAV	Uncrewed Aerial Vehicle	ÚKZÚZ	Central Institute for Supervising and Testing in Agriculture
WG	Working Group		

Executive summary

Czech crop protection is governed by the EU sustainable-use framework, Act No. 326/2004 Coll. on Plant Health Care and the third National Action Plan for the Safe Use of Pesticides (NAP) for 2025–2029. The NAP links human health, water protection, non-target organisms and optimisation of plant-protection-product (PPP) use through 36 measures. Implementation is led by the Ministry of Agriculture (MZe) with the Ministries of Health and Environment; the Central Institute for Supervising and Testing in Agriculture (ÚKZÚZ) performs core regulatory, monitoring, inspection, training and information functions. [1–4]

The direction of travel is favourable but incomplete. Reported active-substance use in PPPs on agricultural land fell from 5.31 million kg in 2011 to 3.29 million kg in 2025 (–38% in the published series), while HRI 1 reached 25 in 2024 against a 2011–2013 baseline of 100. HRI 2 remained volatile and was 70 in 2024, showing continued reliance on emergency authorisations in some years. Residues and metabolites in water, uneven application of preventive integrated pest management (IPM), limited independent advisory capacity and the economic risk of alternatives remain material constraints. [5–8]

A credible transition therefore requires more than a volume target. Priority should be given to measurable prevention at farm and landscape level, independent advice and demonstration, faster uptake of effective biological and low-risk tools, better linkage of use records with environmental monitoring, and stable multi-actor funding. Czech research and support instruments already provide useful foundations, notably ZEMĚ II, the Environment for Life programme, the national biological-control subsidy, CAP interventions and EIP Operational Groups. Horizon Europe projects add international research, demonstration and multi-actor learning. [1,9–13,21,22]

–38% reported PPP active-substance use, 2011–2025*	25 HRI 1 in 2024 (2011–2013 = 100)	70 HRI 2 in 2024; annual series remains volatile
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*The 2024 switch from calendar-year to crop-year reporting on agricultural land creates a methodological break; the trend should be interpreted accordingly.

1. How the report was built

The report was prepared through a structured review of authoritative sources available by 10 September 2026. Core evidence comprises the Czech NAP 2025–2029, ÚKZÚZ statistics on PPP use and harmonised risk indicators, Czech and EU legislation, MZe, State Agricultural Intervention Fund (SZIF), Technology Agency of the Czech Republic (TA CR) and CAP programme documents, and selected outputs from CA21134, other COST Actions and Horizon Europe. Evidence was organised against the five headings required by the VMG call. Sales, use, risk indicators and residue monitoring were kept conceptually separate because they answer different questions and are not interchangeable. [1–22,27,28]

The evidence review was complemented by targeted expert consultation. The AGRITEC team of Iva Smýkalová, Jana Mikisková and Marek Seidenglanz contributed expertise on legumes, intercropping, crop rotations, plant breeding and pest and disease interactions. Bojana Petrović contributed a perspective on precision agriculture, remote sensing, environmental modelling and AI-supported monitoring. Radim Kotrba contributed a combined research, farming and policy perspective on agroforestry, landscape management and the practical conditions faced by private farmers. These inputs were used to interpret the evidence, identify barriers and levers, and formulate the implementation priorities.

Consultation combined online exchanges with the AGRITEC expert team between 8 and 10 September 2026 and an in-person meeting with Bojana Petrović in Prague on 8 September 2026. The consultation tested the interpretation of national data, added evidence from current research and field practice, and refined the recommendations on diversification, digital support, advisory capacity and landscape-level prevention. The consulted experts and their thematic contributions are summarised below.

1.1 Expert contributions

Expert consultation broadened the national evidence base in three areas: crop and rotation diversification, digitally supported decision-making, and landscape-level prevention linked to farm implementation. The contributions below are integrated into the assessment of levers, funding instruments, stakeholder interaction and priorities.

EC1 Iva Smýkalová, Jana Mikisková and Marek Seidenglanz | AGRITEC, Research, Breeding & Services, Ltd.

Expertise and consultation: *legume crops, plant breeding, pest and disease interactions, crop rotations and preventive diversification; online consultation, 8–10 September 2026.*

Diversification in crop rotations can reduce pesticide dependency by interrupting pest, disease and weed cycles and by improving soil function and the resilience of cropping systems. Grain legumes are particularly relevant because they can widen cereal-dominated rotations, contribute biologically fixed nitrogen and create opportunities for more diverse crop sequences. Their practical contribution depends on suitable varieties, healthy seed, local agronomic knowledge and integration with monitoring and crop-protection planning. Legumes can also be incorporated as catch crops or companion crops, including cereal-legume intercrops. Large-plot trials conducted across Europe within the Horizon Europe project LEGUMINOSE show that intercropping can reduce pressure from several important cereal pests, including cereal leaf beetles and aphids, and from diseases, especially rusts. These findings indicate potential to reduce synthetic insecticide and fungicide use in cereal production without a negative effect on yield. Diversification nevertheless does not remove crop-specific risks. Important barriers include unstable market outlets, profitability compared with dominant crops, access to suitable varieties and seed, machinery and storage requirements, and the time needed for benefits to become visible. Research, breeding, advisory services and CAP incentives should therefore support regionally tested rotations, resistant or tolerant material, and multi-year evaluation of both crop-protection and economic performance. [21]

EC2 Bojana Petrović | Faculty of Tropical AgriSciences, Czech University of Life Sciences Prague

Expertise and consultation: *precision agriculture, remote sensing, environmental modelling and AI-supported agricultural monitoring; in-person consultation, Prague, 8 September 2026.*

Digital and remote-sensing tools, including satellite and UAV imagery, proximal sensors and predictive models, can make crop protection more preventive and spatially targeted. They support earlier detection of crop stress and more precise interventions instead of blanket treatment. In Czechia, uptake remains at an early and mostly project-based stage, illustrated by the ZEMĚ II-funded project on spatially differentiated PPP application (QL25020034), rather than standard farm practice. Broader adoption will depend on translating research projects into tools that advisers and farms can use in routine decisions. Digital tools should support field judgement rather than replace it. Their output depends on local calibration and ground-truthing, and models developed for one region or production system may perform poorly elsewhere without adaptation. Data quality, interoperability with farm records and clear responsibility for recommendations need attention before results are trusted. Investment costs, technical skills, connectivity gaps and reliance on unverified outputs remain barriers, especially for smaller farms. Public support should therefore fund independent validation as well as tool adoption, comparing digital recommendations with field observations and agronomic outcomes. Tools should remain accessible and interpretable for advisers and farms with different levels of technical capacity.

EC3 Radim Kotrba | Institute of Animal Science; Association of Private Farming of the Czech Republic; Czech Agroforestry Association

Expertise and consultation: *agroforestry, mixed farming, landscape management, farm-level implementation and agricultural policy; expert consultation, September 2026. Radim Kotrba is a researcher at the Institute of Animal Science, a member of the Board of the Association of Private Farming of the Czech Republic and a member of the Council of the Czech Agroforestry Association. [23–25]*

Agroforestry should be recognised as both a production system and a preventive component of integrated pest management, rather than treated only as landscape planting. Tree rows, hedgerows, orchard-pasture mosaics and silvoarable or silvopastoral systems increase structural diversity and can improve microclimate, water retention and soil protection. They also provide refuges, nesting sites and movement corridors for pollinators and natural enemies of crop pests. These functions can strengthen biological regulation and reduce runoff and spray drift towards water bodies and neighbouring habitats. The effect is not automatic, however. Woody vegetation can also harbour pests or diseases, create competition for water and light, and complicate field access or application technology. Preventive benefits therefore depend on appropriate design, tree and crop selection, spacing, maintenance and monitoring adapted to the farm and landscape context. From a private farmer's perspective, adoption depends as much on administrative and economic feasibility as on ecological potential. Establishment costs are immediate, while returns from timber, fruit, fodder or improved production stability develop over several years. Farmers also face uncertainty concerning land tenure, protection and replacement of young trees, machinery access, eligibility under CAP rules and the long-term valuation of ecosystem services. Public support should therefore cover design, establishment and early maintenance, provide stable rules for the lifetime of the system, and recognise productive as well as environmental outcomes. Advisory services and demonstration farms are essential because a workable agroforestry design must fit the whole farm enterprise, including labour, livestock, crop rotations, machinery and available markets. National crop-protection and landscape policies should connect agroforestry with IPM, water protection, biodiversity measures and climate adaptation. Long-term demonstration networks should compare pest pressure, natural enemies, pesticide use, yields, economic performance and landscape effects. Farmer-to-farmer learning, supported by research institutes, the Association of Private Farming and the Czech Agroforestry Association, can then translate evidence into locally workable practice.

2. Situation of crop protection and pesticide use

2.1 Policy, regulation and institutional responsibilities

Directive 2009/128/EC establishes the EU framework for sustainable pesticide use and requires National Action Plans and IPM. Regulation (EC) No 1107/2009 governs placement of PPPs on the market. In Czechia, Act No. 326/2004 Coll. is the central plant-health statute; Section 48a provides the basis for the NAP and Section 5 embeds IPM obligations. General IPM principles are detailed in Decree No. 205/2012 Coll., while Decree No. 132/2018 Coll. regulates PPP-related requirements. The Water Act No. 254/2001 Coll. and Public Health Protection Act No. 258/2000 Coll. address connected exposure pathways. [1–4]

The NAP 2025–2029 was approved by Government Resolution No. 14 of 8 January 2025. Its four objectives are to reduce risks to human health, surface and groundwater, non-target organisms and their environment, and to optimise PPP use without constraining the scale and quality of agricultural production. A cross-ministerial working group coordinated by MZe is expected to meet twice yearly; final evaluation is planned for 2030. ÚKZÚZ authorises products, supervises use and application equipment, certifies professional competence, monitors harmful organisms and publishes official statistics and decision-support information. [1,3,14]

2.2 Use, risk and impact signals

Year	PPP active substances used on agricultural land (kg)	HRI 1	HRI 2
2011	5,306,102	117	163
2020	3,515,932	52	153
2021	3,461,257	37	227
2022	3,446,867	37	130
2023	3,158,450	30	223
2024	3,194,574	25	70
2025	3,289,117	n.a.	n.a.

Sources: ÚKZÚZ [5–7]. HRI values use 2011–2013 = 100. HRI 1 is sales-weighted by hazard group; HRI 2 reflects emergency authorisations under Article 53 and is therefore highly sensitive to the number and scope of authorisations.

Use profile. In 2025, herbicides accounted for 1.695 million kg (51.5%) of active substances used in PPPs on agricultural land, fungicides 1.051 million kg (31.9%), plant growth regulators 0.459 million kg (14.0%) and insecticides 0.070 million kg (2.1%). The total was 3.0% higher than in 2024 but 38.0% below 2011 in the published series. Micro-organism-based products represented 3,964 kg; mass alone is not a valid measure of comparative efficacy or adoption. Eurostat separately reports a 44% decline in Czech pesticide sales between 2011 and 2024, the largest reduction among 21 Member States with comparable endpoints. [5,8]

Water and environmental exposure. The NAP identifies recurring detections of pesticide residues and metabolites. Frequently reported groundwater findings for 2018–2022 include metabolites linked to chloridazon, alachlor, metazachlor, metolachlor, dimethachlor and acetochlor; surface-water monitoring also identifies metazachlor, metolachlor, glyphosate and AMPA among relevant substances. The previous plan did not fully deliver all intended water-monitoring linkages, particularly the connection between field-use data and targeted environmental surveillance. [1]

Food, health and non-target organisms. Official monitoring indicates that maximum-residue-limit exceedances in Czech-origin samples are uncommon and mainly occur in low single-digit sample counts, with most exceedances associated with imports from third countries. At the same time, positive residues and mixtures require continued surveillance. Human-poisoning statistics are difficult to interpret because reporting is incomplete and diagnostic categories do not cleanly separate PPPs from biocides. Reported honeybee-poisoning incidents have declined markedly, but incident reports are not a complete measure of chronic or ecosystem-level risk. [1]

3. Levers and barriers for preventive and agroecological crop protection

Dimension	Enabling factors / levers	Barriers / unresolved needs
Policy governance	& Current NAP with 36 measures; legal IPM duties; inter-ministerial coordination; product and user controls.	Implementation quality varies; objectives span several ministries and data systems; emergency authorisations remain episodically important.
Knowledge advice	& ÚKZÚZ monitoring, Plant Health Portal, thresholds, professional training; strong public research organisations and universities.	NAP and TOP-AGRI evidence point to gaps in preventive IPM practice, independent specialist advice and adviser capacity for system-level redesign.
Farm economics	Public payments for integrated production, organic farming, biological control, agroforestry and innovation; precision tools can target interventions.	Yield and quality risk, transition costs, delayed returns from landscape measures, uncertain cost–benefit evidence, equipment and data costs, and weak value-chain reward for prevention.
Agronomy ecology	& Crop rotation, resistant varieties, intercropping, agroforestry, habitat management, biological control, forecasting and spot application can be combined.	Simplified rotations, long establishment periods for woody elements, operational constraints, weather variability, invasive pests and limited alternatives for some crop–pest combinations and minor uses.
Evidence monitoring	& Long national series on use and HRI; residue, water and harmful-organism monitoring; increasing digital traceability.	Sales, use, treated area, HRI, residues and biodiversity impacts are not equivalent; incomplete interoperability and a 2024 break in the use-data series complicate evaluation.
Innovation uptake	ZEMĚ II, Environment for Life, Horizon Europe, EIP Operational Groups and COST networks connect research, practice and international knowledge.	Short projects and scattered demonstrations do not automatically scale; registration, validation, long-term maintenance and reliable supply of low-risk or biological products can be slow or crop-specific.

Interpretation: the Czech transition should be evaluated as a risk- and system-reduction pathway, not only as kilograms of active substance. A lower-volume but higher-hazard profile, emergency authorisations or displacement between substances can otherwise be missed. Sources: [1,16].

Landscape diversification complements field-level IPM. Agroforestry, hedgerows, tree strips and other woody elements can support natural enemies, reduce erosion and runoff, moderate microclimate and create more resilient production mosaics. Their crop-protection effect remains context-specific and depends on design and management. Policy should therefore reward verified functions and long-term care rather than tree planting alone. Demonstration should monitor agronomic, ecological and economic outcomes over several years and include both small family farms and larger enterprises. [23–25]

4. Nationally funded projects and programmes

The following selection distinguishes national research support from CAP co-financed implementation instruments. It includes programmes with direct crop-protection objectives and programmes that generate evidence on environmental exposure, biodiversity and prevention. Sources: [1,9–13,22].

Instrument	Funding / period	Relevant content	Contribution to transition
ZEMĚ II applied research programme	National; MZe / National Agency for Agricultural Research (NAZV), 2024–2032	Supports applied agricultural research. Selected projects starting in 2025 address spatially differentiated PPP application (QL25020034), pesticide-risk areas in water (QL25020081), vole management (QL25020011), sugar-beet resistance to virus yellows (QL25020031) and agrobiodiversity on non-productive areas (QL25020080).	Creates evidence and tools for precision, prevention, resistance, biodiversity and environmental monitoring.
Environment for Life, Subprogramme 1	National; Ministry of the Environment / Technology Agency of the Czech Republic, 2020–2026	Supports applied research in the public interest. Relevant priorities include agricultural pollution of water, monitoring of surface and groundwater, biodiversity impacts and harmful substances. Past priority topics also addressed the effects of plant-protection products on non-target organisms and surface-water pollution.	Extends crop-protection assessment beyond field efficacy to environmental exposure, non-target effects and evidence for public administration.
Subsidy programme 3.a — Biological crop protection as a substitute for chemical protection	National agricultural subsidy; current 2026 rules	Supports replacement of chemical treatments with eligible biological crop-protection measures and selected health-status measures for field and special crops.	Directly lowers private cost of biological alternatives; uptake and additionality should be assessed.
Agri-environment-climate: Integrated Production	CAP Strategic Plan 2023–2027; EU-national co-financing; Government Regulation No. 80/2023	Integrated-production commitments for fruit, vines, vegetables and selected crops; residue sampling and training requirements accompany preventive production rules.	Links whole-system management and verification to multiannual farm payments.
Organic Farming intervention	CAP Strategic Plan 2023–2027; EU-national co-financing	Area-based support for systems excluding synthetic chemical PPPs and relying on preventive, biological and mechanical approaches within organic rules.	Maintains and expands a pesticide-independent reference system, while requiring crop-specific technical support.
EIP Operational Groups — intervention 53.77	CAP Strategic Plan 2023–2027; EU-national co-financing	Multi-actor innovation projects bring farmers, researchers, advisers and businesses together to test and implement technological or organisational innovations.	Provides a practical route from research results to farm-scale validation, peer learning and wider uptake.

4.1 Complementary European research funding

Horizon Europe is not a nationally funded programme, but it is an important complementary source for Czech research organisations and companies. The LEGUMINOSE project (2022–2026), with AGRITEC as a Czech partner, combines large-plot trials, farmer and adviser engagement, and analysis of barriers to cereal-legume intercropping. Its Czech and European results are relevant to pesticide reduction because they connect crop diversification with pest and disease pressure, soil function, yield and farm adoption. Horizon Europe projects should therefore be included in the national evidence map and linked to domestic demonstration and advisory channels, while remaining clearly distinguished from national funding. [21] Complementary digital initiatives include the ESA-supported DROMAS Agricultural Crop Monitoring and Farming Management Service, implemented in Czechia for country-wide crop monitoring and precision farm management, and AGRI-DIGITAL GROWTH (2024–2026), which links Czech actors to Central European training, knowledge transfer and living labs for precision farming. [27,28]

5. National stakeholder and policy interaction

Initiative / channel	Actors and function	Opportunity for stronger impact
NAP governance and public consultation	MZe, Ministries of Health and Environment, ÚKZÚZ and other bodies coordinate implementation. The 2025–2029 revision underwent public consultation; comments were submitted by, among others, the Agricultural Association, Fruit Growers' Union, Vegetable Growers' Union and National Institute of Public Health.	Publish a concise annual delivery dashboard and maintain structured farmer, adviser, water-sector and environmental input between formal five-year revisions.
ÚKZÚZ Plant Health Portal and monitoring	Public information on harmful-organism occurrence, warnings and IPM-relevant information; official monitoring supports threshold-based decisions.	Integrate locally validated decision tools, treatment records, weather, resistance alerts and non-chemical options in formats usable by advisers and farms.
Professional competence and integrated-production training	Mandatory certification and training provide broad contact with professional PPP users; integrated-production schemes add crop-specific requirements.	Shift more training time from legal compliance to prevention plans, field diagnosis, economics and evaluation of non-chemical sequences.
EIP Operational Groups and National Rural Network	Operational Groups form farmer–research–adviser partnerships; networking and dissemination channels can spread results.	Require open protocols, comparable indicators, farmer-facing outputs and post-project demonstration so successful practices persist after funding.
Farmer and agroforestry networks	The Association of Private Farming of the Czech Republic and the Czech Agroforestry Association connect practitioners, researchers and policy discussions on landscape measures, diversified farming and implementation of the CAP.	Use farm demonstrations and peer learning to test administrative feasibility, establishment and maintenance costs, agronomic performance and long-term ecosystem services.
Research, sector and COST networks	Universities, public research institutes, commodity organisations and Czech participants in CA21134 provide specialist and cross-border knowledge.	Create a recurring national crop-protection forum linking research portfolios, registration needs, farmer priorities and NAP monitoring.

Sources: Czech NAP, EIP intervention documentation, Plant Health Portal, CA21134 and stakeholder organisations [1,13–15,23–25].

6. Contribution of T0P-AGRI-Network and other COST Actions

CA21134 provides a useful organising framework for the Czech pathway. WG1 identifies research gaps and uses multi-actor methods; WG2 addresses transition pathways and value chains; WG3 covers biological breakthroughs; WG4 focuses on redesign of cropping systems and biodiversity-based prevention; and WG5 supports dissemination and community building. Its WG1 multi-actor synthesis highlights needs directly relevant to Czechia: credible cost–benefit evidence, adviser training, education, stronger interaction among science, legislation and industry, and living-lab or co-experimentation approaches. These outputs should inform national consultation, but European findings must be checked against Czech production systems and institutions. [15,16]

COST Action / output	Transferable resource	Potential Czech use
EuroXanth (CA16107)	Shared knowledge, diagnostics and the Xanthomonas Wiki for bacterial crop diseases.	Strengthen diagnostic capacity, surveillance and durable integrated disease-management protocols.
EUDaphobase (CA18237)	Open, harmonised pan-European soil-biodiversity data infrastructure.	Support indicators for soil biota and non-target effects in long-term evaluation of crop-protection strategies.
DIVERSICROP (CA22146)	Network on crop diversity and underutilised crops for resilient European food systems.	Inform rotation, crop-mixture and diversification options suited to Czech regions and markets.
MiCropBiomes (CA22158)	Resources and connections around crop microbiomes, plant health and biological solutions.	Connect Czech microbiome research to validation pipelines for preventive and biological crop protection.

These COST Actions are European networking and knowledge resources, not Czech nationally funded programmes. Their value lies in methods, datasets, communities and transferable outputs that can accelerate national implementation. [17–20]

7. Priorities for 2027–2030 and conclusion

Expert consultation identified three immediate implementation priorities:

- Build independent advisory and demonstration capacity through multi-actor formats used in Horizon Europe, including living labs and lighthouses. Establish multi-year farm networks that publish agronomic and economic results, including failures and boundary conditions, and use peer-to-peer learning to lower perceived transition risk. [26]

- Improve access to effective biological and low-risk options by aligning research, registration evidence, minor-use priorities, supply chains and public support; evaluate outcomes rather than subsidised input quantities alone.
- Institutionalise multi-actor governance around the NAP. Connect farmers and producer groups, advisers, researchers, regulators, water managers, environmental organisations and value-chain actors to define priorities, share costs and monitor delivery annually.

Two cross-cutting foundations support these priorities:

- Measure the transition with a balanced dashboard combining PPP use, HRI 1/HRI 2, treated area or application frequency where available, emergency authorisations, water and food residues, resistance, non-target indicators and adoption of verified preventive practices.
- Make prevention operational through crop- and region-specific IPM plans covering rotations and diversification, resistant varieties, soil and habitat management, agroforestry, monitoring and thresholds, forecasting, precision or spot treatment, and documented escalation to chemical control only when justified.

Czechia has achieved a substantial reduction in reported sales, use and HRI 1, and it has a current policy framework and several relevant funding instruments. The remaining challenge is implementation quality: converting legal IPM, research projects and isolated incentives into reliable preventive systems at farm and landscape scale. The next phase should prioritise demonstrable agronomic performance, independent advice, interoperable monitoring and sustained farmer–research–policy co-creation. National programmes, CAP instruments, Horizon Europe projects and COST networks can provide complementary parts of this system, but their results require long-term validation and routine uptake by advisers and farms.

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