

Report on the outcomes of a Virtual Mobility

Action number: CA21134

Grantee name: Darija Lemić

Title: Crop protection and pesticide use in Croatia: transition towards preventive, integrated and agroecological approaches

1. Overview of Croatian Agriculture

Agriculture remains important for the economic, social and environmental sustainability of Croatian rural areas. In 2024, the value of agricultural output was EUR 3.09 billion and agricultural gross value added reached EUR 1.65 billion (Croatian Bureau of Statistics, 2025). Croatian agriculture is highly heterogeneous because of marked climatic, pedological and geographical differences. Continental and Pannonian Croatia are dominated by arable production, whereas permanent crops, vegetables and Mediterranean production systems are more important in the Adriatic region. Mountainous and karst areas generally support less intensive production systems and contain substantial grassland.

Croatian agricultural holdings used approximately 1.51 million ha of utilised agricultural area in 2023, including 888,000 ha of arable land and gardens, 539,000 ha of permanent grassland and about 78,000 ha of permanent crops (Croatian Bureau of Statistics, 2024). Maize and wheat are the main cereals, while soybean, sunflower, oilseed rape and sugar beet are important field crops. Vineyards, orchards, olive groves and citrus production occupy smaller areas but are highly relevant for crop protection because of their economic value, long production cycles and specific pest-management requirements. These production systems are therefore particularly important for the development and demonstration of integrated pest management (IPM), monitoring systems and alternative control approaches.

The structure of Croatian agriculture also varies considerably among regions and farm types. A large number of small and family-managed holdings coexist with a smaller number of highly commercialised farms, resulting in substantial differences in mechanisation, labour availability, advisory access, investment capacity and uptake of new technologies. Production conditions range from intensive lowland systems to karst, island and mountainous agriculture. Consequently, a single crop-protection model is unlikely to be appropriate nationwide, and the feasibility of monitoring systems, precision technologies, decision-support tools and non-chemical measures differs considerably among farming systems.

The diversity of crops, production environments and farm structures is reflected in equally diverse pest, disease and weed complexes. Croatian crop protection must therefore address intensive arable systems in continental regions, high-value perennial crops in Mediterranean and hilly areas, and increasingly variable climatic conditions. This heterogeneity provides the essential context for assessing pesticide dependency, implementation of IPM and the transition towards more preventive, knowledge-based and technology-supported crop-protection approaches.

2. Methodology

The Croatian country synthesis was prepared through a structured desk review combined with expert consultation. Official national legislation, strategic and policy documents, statistical data, institutional sources, public registers, and information on national and European research and innovation activities were reviewed. Priority was given to sources from the Ministry of Agriculture, Forestry and Fisheries, the Croatian Agency for Agriculture and Food (HAPIH), the State Inspectorate, the Paying Agency for Agriculture, Fisheries and Rural Development (APPRRR), the Croatian Bureau of Statistics, the Croatian Science Foundation (HRZZ), CroRIS, and the European Commission.

The review covered three main areas: the structure of Croatian agriculture; the regulatory, policy and institutional framework for plant health, pesticide use and integrated pest management (IPM); and research, development and innovation relevant to sustainable crop protection. Particular attention was given to recent policy developments and research and innovation activities, primarily from the last five years.

The Croatian country report was prepared by **Assoc. Prof. Darija Lemić, PhD, and Assoc. Prof. Ivana Pajač Živković, PhD**, University of Zagreb Faculty of Agriculture, in consultation with **Prof. Renata Bažok, PhD**, University of Zagreb Faculty of Agriculture, within the framework of COST Action CA21134 – T0P-AGRI-Network.

As part of the review process, the draft report was submitted for expert consultation to representatives of two key national institutions responsible for plant protection and plant health: **Božena Deždek, Univ. Spec. Agr., Head of the Service for Plant Protection Products, Sector of Phytosanitary Policy, Directorate for Agricultural Land, Plant Production and Market, Ministry of Agriculture, Forestry and Fisheries**, and **Dario Ivić, PhD, Department of Plant Health, Croatian Agency for Agriculture and Food (HAPIH)**.

The experts were invited to review the draft and provide comments within their respective areas of expertise. Written comments were received from the Ministry representative prior to the consultation meeting. An online consultation meeting was held via Microsoft Teams on **14 September 2026**, during which the national regulatory and institutional framework, current implementation issues, research and innovation activities, identified gaps, and potential areas for improvement were discussed. Additional comments and proposed revisions resulting from the consultation were considered in the finalisation of the report.

The expert consultation was used to verify the factual and institutional interpretation of the national situation, identify potential gaps or inaccuracies, and strengthen the relevance of the country synthesis.

The expert consultation process is documented in Annex 1.

3. National policy, regulatory and institutional framework for plant protection in Croatia

3.1. Legislative framework for plant health and crop protection

Plant protection in Croatia is governed by directly applicable EU legislation complemented by national laws, implementing regulations, official registers and phytosanitary programmes. The principal national act in the field of plant health is the **Act on Plant Health** (Official Gazette 127/2019, amended by 83/2022), which establishes the competent authorities and national procedures for the implementation of Regulation (EU) 2016/2031. Croatia therefore applies the EU regulatory framework for Union quarantine pests, priority pests, protected-zone quarantine pests and Union regulated non-quarantine pests (Croatian Parliament, 2019, 2022a).

The national pesticide regulatory framework is based on several complementary acts. The **Act on Sustainable Use of Pesticides** (Official Gazette 46/2022) regulates pesticide use, risk-reduction measures and integrated pest management and is discussed further in Section 3.2. The placing of plant protection products on the market is regulated through the national act implementing Regulation (EC) No 1107/2009 (Official Gazette 80/2013, 32/2019 and 32/2020; Croatian Parliament, 2013a), while pesticide residues are addressed through the act implementing Regulation (EC) No 396/2005 (Official Gazette 80/2013, 115/2018 and 32/2020; Croatian Parliament, 2013b). Official controls in the fields of plant health and plant protection products are further regulated by the **Act on Official Controls and Other Official Activities** (Official Gazette 52/2021; Croatian Parliament, 2021), which ensures national implementation of Regulation (EU) 2017/625, together with the relevant implementing legislation.

Plant-health preparedness is based on surveillance and, where required, contingency planning, eradication, containment and action plans. Annual surveillance supports the detection of regulated and emerging harmful organisms, while specific national measures may be introduced

in response to newly detected organisms or outbreaks. This system is particularly relevant to Croatia because of its geographical position, movement of plant material within the EU, major transport routes and the presence of both continental and Mediterranean production zones.

The Phytosanitary Information System (FIS) supports implementation through relevant registers, records and regulatory documentation. HAPIH provides scientific and technical support in plant health, including surveillance, diagnostics and risk assessment, while official controls are performed by the competent inspection authorities. Institutional responsibilities are discussed further in Section 3.3.

3.2. Sustainable use of pesticides and integrated pest management

The **Act on Sustainable Use of Pesticides** (Official Gazette 46/2022) regulates professional-user training, distribution and sale, handling and storage, record keeping, inspection of pesticide-application equipment, risk-reduction measures, integrated pest management (IPM), aerial application, protection of bees and sensitive areas, risk indicators and institutional responsibilities (Croatian Parliament, 2022b). Croatia adopted a **National Action Plan for the Sustainable Use of Pesticides for 2013-2023**. At the time of this review, the European Commission's public repository did not list a subsequent adopted national action plan (European Commission, 2026). However, adoption of a new National Action Plan for the Sustainable Use of Pesticides is expected by the end of 2026.

One of the three general objectives of the forthcoming Plan is to strengthen the development and application of alternative, non-chemical plant-protection methods. Several specific objectives directly address further development of IPM, digitalisation and new technologies, innovation, stronger advisory activities and knowledge transfer. A measurable indicator is the publication of at least ten sector- or crop-specific IPM guidelines. The Plan also foresees continued development of the Agricultural Knowledge and Innovation System (AKIS), further education of agricultural producers, training of plant-protection advisers, demonstration activities and public information. Digitalisation is treated as a priority through further development of the **eAdvisor** and **eSurveillance** platforms and the planned introduction of eLearning tools.

The Plan also foresees Ministry support for research and development aimed at reducing risks associated with plant protection products and advancing IPM and alternative plant-protection methods. Funding is intended to address strategic agricultural issues and specific plant-protection challenges, with IPM and new technologies explicitly identified among priority research topics. This policy direction is consistent with the **National Development Strategy of the Republic of Croatia until 2030**, in which the green and digital transition includes a public-policy priority under Strategic Goal 9 to contribute to climate neutrality, reduce pesticide use and increase organic production. The **Agriculture Strategy to 2030** further identifies a 25% reduction in pesticide use as an expected impact of its implementation (Croatian Parliament, 2022c).

A major recent development is the **Ordinance on Integrated Pest Management** (Official Gazette 65/2025), which provides a more operational framework for IPM implementation. It defines general IPM principles, baseline requirements, voluntary measures exceeding the baseline, record-keeping obligations, crop- and sector-specific guidance, and a programme for implementation and demonstration. Professional users are required to apply preventive and monitoring-based approaches, identify harmful and beneficial organisms, use decision thresholds where available, and give preference to biological, biotechnical, mechanical or physical measures when appropriate. The Ordinance also provides for demonstration farms and the involvement of universities, research institutes and other AKIS actors (Ministry of Agriculture, Forestry and Fisheries, 2025a).

The Ordinance therefore represents an important step from IPM as a general legal obligation towards a more structured framework for implementation and evaluation. Its practical effectiveness will depend on the availability of validated thresholds, crop-specific guidance,

advisory capacity, demonstration activities and economically feasible alternatives to conventional pesticide use.

3.3. Institutions responsible for implementation

Responsibilities for plant health, pesticide regulation and sustainable crop protection are distributed among several institutions. The **Ministry of Agriculture, Forestry and Fisheries** has the central policy and regulatory role, including legislation, phytosanitary coordination, authorisation of plant protection products, minor uses, emergency authorisations and permits for research and development. The **Croatian Agency for Agriculture and Food (HAPIH)** provides scientific and technical support through surveillance, diagnostics, laboratory analysis, risk assessment and professional evaluation, while the **State Inspectorate** performs official phytosanitary and pesticide-related controls.

The **Paying Agency for Agriculture, Fisheries and Rural Development (APPRRR)** implements CAP payments and rural-development interventions relevant to sustainable crop protection, while universities and research institutes contribute to research, training and demonstration activities. Advisory services are part of the **Ministry of Agriculture, Forestry and Fisheries** and are currently organised through the **Directorate for Professional Support to Agricultural Development**, which contributes to farmer training, knowledge transfer and the dissemination of crop-protection recommendations. The **Phytosanitary Information System (FIS)** provides digital support for regulatory procedures, registers and professional-user records. Overall, Croatia has a comprehensive institutional framework, but stronger operational links between regulation, surveillance, the Ministry's advisory services, research and CAP support would facilitate more consistent implementation of preventive and integrated crop-protection approaches. Regular exchange of surveillance results, research findings and advisory recommendations is particularly important for translating regulatory requirements and scientific knowledge into farm-level practice.

3.4. CAP Strategic Plan 2023-2027 and measures supporting sustainable crop protection

The Croatian **CAP Strategic Plan 2023–2027** is the principal financial and programming framework for agricultural and rural development. Measures relevant to sustainable crop protection are distributed across environmental, investment, organic farming, knowledge-transfer and innovation interventions rather than concentrated in a single programme (European Commission, 2025).

The intervention most directly related to pesticide reduction is **70.01 – Reduction of the use of plant protection products in permanent crops**, which supports pheromone, visual and food traps, mating disruption and mechanical weed control in vineyards, orchards and olive groves (APPRRR, 2026a). **Intervention 70.04** supports organic farming, while other eco-schemes and agri-environment-climate interventions can promote crop rotation, soil conservation, field margins and biodiversity. Together, these measures can reduce reliance on synthetic pesticides and support preventive and agroecological crop-protection approaches.

Investment support under **intervention 73.10** can facilitate technological modernisation, while **intervention 77.03** supports EIP Operational Groups that connect farmers, researchers, advisers and other actors in testing innovative solutions. Knowledge-transfer and advisory interventions, including **78.01 and 78.02**, provide additional channels for disseminating monitoring data, pest forecasts and crop-protection recommendations.

The CAP Strategic Plan also sets a result indicator for the specific objective **Sustainable and reduced use of pesticides**. Indicator **R.24 PR** measures the share of utilised agricultural area (UAA) under specific support-related commitments leading to the sustainable use of pesticides in order to reduce pesticide risks and their effects. The planned share increases from 10.97% in

2024 to 11.30% in 2025, 11.63% in 2026, 11.96% in 2027 and 12.63% in 2028, with 12.63% stated as the total target (European Commission, 2025).

Overall, the CAP framework provides several instruments relevant to pesticide reduction, IPM, innovation, digitalisation and preventive crop protection. The existence of R.24 provides a quantitative result indicator for sustainable and reduced pesticide use; however, the relevant measures remain distributed across different interventions and do not constitute a single coordinated programme for the systematic deployment of advanced or precision crop-protection approaches across major Croatian crops. No separate result indicator was identified for the adoption of precision crop-protection technologies.

3.5. Precision agriculture, digital crop protection and drones

Precision agriculture and digitalisation are recognised in Croatian strategic documents. The **Agriculture Strategy to 2030** identifies innovation as a horizontal strategic objective and refers to remote sensing, big-data analysis, the Internet of Things, artificial intelligence, robotics and precision production as development opportunities (Croatian Parliament, 2022c). Under the National Recovery and Resilience Plan investment **Smart Agriculture**, the eMotrenje service established 695 IoT sensors at more than 400 locations for monitoring weather, crop development, pests and diseases (Ministry of Agriculture, Forestry and Fisheries, 2024). Nevertheless, precision crop protection is not defined as a distinct national objective with specific adoption targets, pesticide-reduction indicators or a coordinated implementation roadmap.

The regulatory position of drones illustrates some of the remaining challenges. Drone operations are governed by harmonised EU UAS rules. Operations in the **open category** may not involve the dropping of material, while operations falling outside these conditions require compliance with the rules applicable to the **specific category**, including operational authorisation where required (EASA, 2026). In parallel, aerial application of pesticides in Croatia is subject to the restrictions and conditions established under the Act on Sustainable Use of Pesticides.

No dedicated Croatian operational framework was identified specifically addressing UAV application of plant protection products in terms of application requirements, drift management, operator competence or crop-specific conditions. Consequently, drones are increasingly relevant for imaging, mapping and crop monitoring, while their wider use for pesticide application remains more constrained. Further development of this area would require coordination between aviation safety requirements and plant-protection legislation, including pesticide authorisation, application quality, environmental exposure and record keeping.

4. Research, development and innovation in crop protection

4.1. Research capacity and funding

Croatia has a relatively small but active research community in plant protection and related fields. The principal institutions include the **University of Zagreb Faculty of Agriculture**, the **Faculty of Agrobiotechnical Sciences Osijek**, the **Agricultural Institute Osijek**, the **Institute for Adriatic Crops and Karst Reclamation**, and the **Institute of Agriculture and Tourism**. HAPIH contributes mainly through diagnostics, surveillance, monitoring and professional support, while additional interdisciplinary research is carried out by other universities and research institutes.

National competitive research is financed mainly through the **Croatian Science Foundation (HRZZ)**, whose calls cover all scientific disciplines rather than agriculture-specific priorities (HRZZ, 2026). This differs from the former Ministry of Agriculture **Council for Agricultural Research (VIP)**, which funded applied projects directly related to agricultural production; the Ministry's public repository lists approved VIP projects up to 2016, with no comparable continuous programme identified in subsequent years (Ministry of Agriculture, Forestry and Fisheries, 2026). Croatian agricultural researchers therefore rely largely on general HRZZ calls and European funding sources such as Horizon Europe, LIFE, COST and other EU programmes. **CAP**

intervention 77.03 provides an additional practice-oriented mechanism through EIP Operational Groups, but it does not replace a dedicated long-term agricultural research programme (APPRRR, 2026b).

This funding structure supports high-quality investigator-driven and international research, but provides limited continuity for nationally defined crop-protection priorities. Research topics are largely shaped by competitive calls and European programme priorities rather than by a dedicated national agricultural research agenda. As a result, sustained research on specific crop-protection problems of national importance may depend on the availability of suitable funding opportunities.

4.2. Research themes during the last five years

Recent Croatian research has addressed a broad range of crop-protection topics, mostly through individual crop- or pest-specific projects. Major themes include grapevine viruses and vectors, olive pests and pathogens, biologically based control compounds, reduced herbicide use, environmentally safer monitoring and control methods, conservation agriculture, soil and plant resilience, and responses to combined biotic and abiotic stress. Mediterranean perennial crops, particularly grapevine and olive, are strongly represented.

Digitalisation is an emerging cross-cutting theme, including UAV-based imaging, computer vision, machine learning, remote sensing and sensor-supported monitoring. However, relatively few projects focus specifically on precision crop protection, such as site-specific pesticide application, automated pest detection linked to treatment decisions, decision-support thresholds or economic assessment of digital IPM at commercial-farm scale.

Overall, Croatian research shows relevant scientific expertise and growing interest in pesticide reduction, sustainable crop protection and digital tools, but activities remain dispersed across individual projects and funding schemes rather than forming a coordinated national programme for IPM or precision crop protection (CroRIS, 2026).

4.3. Main research and innovation gaps

The main weakness is not the absence of research capacity, but limited strategic continuity and coordination. No dedicated national competitive programme was identified that systematically translates crop-protection needs into research priorities. Key gaps include long-term IPM implementation studies, pesticide resistance, economic assessment of IPM adoption, pest forecasting, precision pesticide application, decision-support systems and validation of digital crop-protection technologies under commercial farming conditions.

Future support would benefit from closer coordination between the Ministry, HAPIH, research institutions, advisers and farmers, together with a limited set of nationally defined crop-protection research priorities. Long-term applied research, demonstration and validation should complement HRZZ and EU funding, with particular emphasis on emerging and invasive pests, pesticide reduction and resistance management, non-chemical control, crop-specific IPM and precision monitoring and application.

5. Overall conclusions

Croatia has a comprehensive regulatory and institutional framework covering plant health, the assessment and authorisation of plant protection products, official controls, and the sustainable use of pesticides, including IPM; this framework is largely aligned with EU legislation. The **2025 Ordinance on Integrated Pest Management**, the forthcoming National Action Plan expected by the end of 2026 and relevant CAP 2023-2027 interventions strengthen the policy basis for prevention, monitoring, non-chemical measures, agroecological approaches and reduced reliance on pesticides. Digitalisation, knowledge transfer and research on new technologies are increasingly recognised as part of this transition. At strategic level, the Agriculture Strategy to 2030 identifies a 25% reduction in pesticide use as an expected implementation impact.

The main challenges are implementation, coordination and continuity. Sustainable crop-protection measures are distributed across several policies and institutions. While the CAP framework includes a quantitative result indicator for sustainable and reduced pesticide use, precision crop protection still lacks specific national adoption targets and a coordinated implementation framework. Research capacity and relevant expertise are present, but no dedicated national agricultural research programme was identified that systematically links practical crop-protection needs with long-term research priorities.

Stronger integration of surveillance, research, the Ministry's advisory services, CAP instruments, demonstration activities and farmers would support the transition towards more preventive, knowledge-based and technologically supported crop protection, with greater emphasis on IPM, non-chemical measures and reduced pesticide dependency.

6. References

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Annex 1. Documentation of expert consultation

The expert consultation described in Section 2 (Methodology) was conducted with **Božena Deždek, univ.spec.agr. (Ministry of Agriculture, Forestry and Fisheries)** and **Dario Ivić, PhD (Croatian Agency for Agriculture and Food – HAPIH)**.

The consultation included written expert comments and an online discussion held via Microsoft Teams on **14 September 2026**. The comments and recommendations received during the consultation process were considered in the finalisation of the Croatian country report.

Figure 1. Invitation to the expert consultation meeting concerning the draft Croatian country report (left) and online expert consultation held via Microsoft Teams on 14 September 2026 with the report authors and representatives of the Ministry of Agriculture, Forestry and Fisheries and HAPIH (right).

