Automation in agriculture as a direction for Czechia?

Technical Report · March 2024

2 authors:

Adam Hruška
Czech University of Life Sciences Prague

Hynek Roubík
Czech University of Life Sciences Prague

Automation in agriculture as a direction for Czechia?

Authors:

- *Adam Hruška**
- *Hynek Roubík**

2024 / Policy Paper / 07

Introduction:

In recent decades, advancements in technology have started to transform the agriculture industry. Field robots offer a promising solution to enhance efficiency, productivity, and sustainability. However, ambiguous, restrictive legislative boundaries in Czechia, such as confined operating areas or constant operator supervision, hinder the widespread adoption of autonomous agricultural technologies. This policy paper advocates for updating legislative frameworks to unlock the full potential of autonomous technologies in Czech agriculture, fostering a more efficient, sustainable, and prosperous future for farming communities.

Why support automation:

The current legislative framework governing the use of autonomous field robots in Czech agriculture presents challenges that hinder their widespread adoption and integration. Ambiguity and inconsistency in regulations have impeded innovation in the sector. However, there is a clear path forward. The policy recommendations advocate for clear regulations, risk-based approaches, R&D support, stakeholder collaboration, and adoption incentives to foster a supportive environment for autonomous agriculture. By implementing these recommendations, Czechia can unlock the transformative potential of autonomous technologies, driving innovation, improving competitiveness, and promoting sustainability in the agricultural sector. Collaboration between government, industry, and academia will be key in achieving this vision and positioning Czechia as a leader in agricultural automation.

POLICY PAPER

Introduction

In recent decades, the agriculture industry has witnessed a remarkable transformation driven by advances in technology. Among these innovations, the integration of field robots has emerged as a promising solution to improve efficiency, productivity, and sustainability in agricultural practices (Singh & Yogi 2022). However, despite the potential benefits offered by autonomous field robots, their widespread adoption in Czech agriculture faces significant challenges due to existing legislative boundaries.

Currently, legislative frameworks in the Czech Republic, due to the ambiguity regarding autonomous tools, mandate confinement to bounded areas or constant operator supervision, stifling the full potential of autonomous agricultural technologies. These requirements pose a substantial barrier to the full realisation of the capabilities and advantages inherent in autonomous agricultural technologies. While these regulations are based on the intention of ensuring safety and compliance, they inadvertently impede progress and innovation in the agricultural sector.

Through a comprehensive analysis and evidence-based arguments, this policy paper seeks to shed light on the importance of updating legislative frameworks to accommodate the integration of autonomous technologies into Czech agriculture. By addressing barriers that hinder the adoption of field robots and advocating progressive regulatory reforms, we can pave the way for a more efficient, sustainable and prosperous future for farming communities in Czechia.

The current state of legislature

The current legislative framework in Czechia regarding the use of autonomous field robots in agriculture is characterised by incompleteness and ambiguity, leading to varied interpretations and implementations in the agricultural sector. The statute on agriculture number 252/1997 lacks any clear position on such devices, and the statute on the use of public infrastructures number 361/2000 only prohibits the use of any autonomous vehicles on the public infrastructure. While clear regulations do not exist, the application often depends heavily on individual perspectives and interpretations, and thus motivates the existence of a legal grey zone. As a result, the most widely described understanding of the regulations includes the requirement for on-site operator supervision or field fencing.

At present, one of the most notable requirements of the Czech agricultural regulations is the mandatory presence of an operator on-site during the operation of field robots. This mandate is often interpreted as a safety measure to ensure human supervision and intervention capabilities, particularly in the event of unforeseen circumstances. However, interpretations can vary, leading to inconsistencies in enforcement and compliance in different agricultural operations.

Furthermore, existing legislation does not specify restrictions on the operating environments in which autonomous field robots can operate autonomously, as can be highlighted in greenhouses. In many cases, these regulations require the fencing of fields or other bounded areas to contain the operation of field robots. Alternatively, operators may be required to maintain constant supervision of robots, limiting their autonomy and operational flexibility. These interpretations of the legislation serve to mitigate potential risks associated with autonomous operation but may also hinder the full realisation of the benefits offered by these technologies.

Despite the aspirations for the widespread adoption of autonomous technologies in Czech agriculture, the practical deployment of field robots in production areas remains limited. Instead, these technologies are primarily utilised in demonstration, research, or non-production settings. The discrepancy between policy objectives and on-the-ground implementation highlights the major gap between regulatory aspirations and practical realities. Despite the potential benefits of field robots, regulatory barriers and operational constraints impede their widespread adoption and integration into mainstream agricultural practices.

Given the complexities and inconsistencies inherent in the current legislative framework, there is a pressing need for a comprehensive review and reform. Clearer guidelines and standards are essential to provide farmers and industry stakeholders with certainty and confidence in the adoption of autonomous technologies. By addressing ambiguities and streamlining regulations, Czechia can create a more conducive environment for agricultural innovation and technological advancement, ultimately enhancing the competitiveness and sustainability of its agricultural sector.

Summary of the benefits

Integration of field robots in agriculture highlights a transformative shift toward improved efficiency, productivity, and sustainability. However, the current legislative landscape in the Czech Republic presents formidable barriers to the widespread implementation and further research of these technologies. This chapter explores the compelling motivations for reforming legislative frameworks to facilitate the broader adoption of field robots in Czech agriculture.

Economic Imperatives

The economic benefits associated with the adoption of field robots in agriculture are substantial and multifaceted. Beyond the direct impact on farm profitability, autonomous technologies stimulate economic growth across various sectors of the economy. The review conducted by Forrest (2017) highlights the positive effects of increased agricultural productivity, including job creation, higher incomes for rural communities, and improved food security. Optimisation of resource utilisation through autonomous systems contributes to cost savings and improved market competitiveness for Czech farmers. By reducing reliance on available labour and streamlining operations, field robots enable farmers to allocate resources more efficiently, leading to higher overall profitability and economic resilience of both large-scale and medium- and smaller-scale farms (Lowenberg-DeBoer et al. 2021).

Furthermore, studies have emphasized the positive impact of autonomous technologies on reducing production costs and increasing revenue streams. Farms employing field robots could experience a significant reduction in operating costs, primarily attributed to labour savings and improved resource management (Mahmud et al. 2020). Current research highlights the potential implications on farm resource management and labour savings, which could help mitigate the shrinking number of available workers.

Environmental Sustainability

The utilization of field robots holds promise for promoting environmental sustainability in agricultural practices. Autonomous technologies offer a solution by enabling precise and targeted application of inputs, thereby minimising environmental impact (Rose et al. 2021). Research reveals that autonomous systems can significantly reduce chemical usage and mitigate soil and water contamination (Delavarpour et al. 2021). Furthermore, the implementation of autonomous systems can contribute to soil conservation efforts, thereby preserving biodiversity and ecosystem health. By promoting sustainable farming practices, field robots play a crucial role in mitigating environmental risks and ensuring the long-term viability of agricultural production systems.

In addition to reducing chemical input, field robots offer opportunities for optimising resource utilisation and minimising waste. By applying input only where and when needed, farmers can minimise environmental impact and maximise resource efficiency (Delavarpour et al. 2021). Furthermore, the adoption of autonomous technologies facilitates the implementation of conservation practices such as reduced tillage and cover cropping, which promote soil health and carbon sequestration thanks to the ability to precisely target each operation.

Labor Efficiency and Safety

Legislative reform to facilitate the deployment of field robots can address labour shortages and improve workplace safety in the agricultural sector (Rose et al., 2021). The adoption of autonomous technologies is crucial to maintaining operational efficiency. Autonomous technologies relieve farmers of tedious and physically demanding tasks, allowing them to reallocate their time and resources more efficiently. By automating repetitive and hazardous tasks, field robots not only enhance labour efficiency but also contribute to a safer working environment for farmworkers (Rose et al. 2021). Additionally, the implementation of autonomous technologies opens up new opportunities for workforce development and skills training, empowering agricultural workers to transition to higher-value roles that require advanced technical expertise.

Studies highlight the potential of field robots to address labour shortages and improve workforce productivity (Mahmud et al., 2020). Farms employing autonomous technologies are expected to experience a significant increase in labour productivity, attributed to reduced manual labour requirements and streamlined workflows. Observations underscore the critical role of autonomous technologies in enhancing labour efficiency and safety in the agricultural sector.

Innovation and Competitiveness

Enabling a conducive regulatory environment for the implementation of field robots can spur innovation and enhance the competitiveness of the Czech agriculture industry (Blind & Münch 2024). The adoption of field robots can enhance the overall competitiveness of Czech farms by improving efficiency, reducing costs, and meeting the growing demand for sustainable agricultural products in domestic and international markets.

Evaluation of risks

While the adoption of field robots in Czech agriculture holds promise for enhancing efficiency and sustainability, there are potential risks and downsides associated with the proposed changes in legislation. This chapter explores some of the challenges and concerns that may arise from the broader implementation of field robots in agricultural practices.

Economic Displacement

One of the primary concerns surrounding the widespread adoption of field robots is the potential displacement of agricultural workers. As farms transition towards automation, there is a risk of job loss for those employed in manual labor-intensive tasks (Sparrow & Howard, 2021). Although autonomous technologies may enhance overall productivity and profitability for farms, economic benefits may not be evenly distributed across the workforce. Vulnerable populations, such as low-skilled agricultural workers, may face challenges in finding alternative employment opportunities, leading to socio-economic disparities within rural communities.

Technological Dependency

The increased reliance on field robots may also lead to technological dependency among farmers. As autonomous systems become integral to farm operations, farmers may become increasingly dependent on complex technology and software platforms (Rose et al. 2021). This dependency poses risks in terms of system failures, cybersecurity threats, and technological obsolescence. In addition, the high upfront costs associated with investing in field robots may discourage smaller farms from adopting these technologies, exacerbating disparities within the agricultural sector.

Environmental Concerns

While field robots offer the potential for more precise and sustainable farming practices, there are environmental concerns associated with their widespread adoption. The increased use of machinery and automation can result in increased energy consumption and carbon emissions, particularly if the energy sources are not renewable. Moreover, the intensive use of autonomous technologies can disrupt natural ecosystems and biodiversity, particularly if not properly managed (Rose et al. 2021).

Regulatory and Ethical Considerations

The broader implementation of field robots raises important regulatory and ethical considerations that must be addressed (Sparrow & Howard, 2021). There may be concerns about data privacy and ownership rights, particularly regarding the collection and use of sensitive agricultural data by technology providers. In addition, there may be questions about liability and accountability in the event of accidents or malfunctions involving autonomous systems. Ensuring adequate regulatory oversight and ethical guidelines is crucial to mitigate these risks and protect the interests of all stakeholders involved (Sparrow & Howard, 2021).

Social Impacts

The adoption of field robots may also have significant social impacts on rural communities and agricultural traditions. The introduction of automation may disrupt traditional farming practices and cultural identities, leading to social tensions and resistance to change. Moreover, there may be concerns about the loss of local knowledge and expertise as farms become more reliant on technology (Rolandi et al., 2021). Balancing the benefits of innovation with the preservation of social cohesion and cultural heritage is essential in navigating the transition towards a more automated agricultural sector.

Conclusion

In conclusion, the examination of the current legislative framework governing the use of autonomous field robots in Czech agriculture has revealed a landscape characterised by ambiguity, inconsistency and the need for reform. Despite the potential benefits offered by these technologies, including enhanced efficiency, productivity, and sustainability, regulatory barriers have hindered their widespread adoption and integration into mainstream agricultural practices.

Key findings indicate that the existing legislative framework lacks clarity, leading to varied interpretations and implementations in the agricultural sector. Mandates for on-site operator presence, restricted operating environments, and limited deployment in production areas have posed significant challenges to farmers and industry stakeholders alike. These constraints have stifled innovation, hindered competitiveness, and impeded the realisation of the full potential of autonomous technologies in Czech agriculture.

However, amidst these challenges, there are opportunities for positive change and progress. Policy recommendations aimed at clarifying regulations, adopting risk-based approaches, supporting research and development, promoting stakeholder collaboration, and incentivising adoption offer a path forward toward a more supportive regulatory environment for autonomous agriculture in Czechia.

By implementing these recommendations, Czechia can pave the way for a future where autonomous technologies play a central role in driving agricultural innovation, enhancing competitiveness, and promoting sustainability. Through collaboration between government, industry, and academia, policymakers can harness the transformative potential of autonomous field robots to create a more efficient, resilient, and prosperous agricultural sector for the benefit of Czech farmers and rural communities. With strategic reforms and concerted efforts, Czechia can position itself at the forefront of agricultural automation, setting a precedent for technological advancement and sustainable development within the European Union and beyond.

Key findings

- Ambiguity in legislation hinders clear interpretation and implementation, limiting innovation.
- Mandates for on-site operator presence and restricted operating environments impede adoption, hindering efficiency gains.
- Regulatory barriers stifle innovation and hinder competitiveness, posing challenges to modernisation.
- Implementing recommendations can unlock transformative potential in Czech agriculture, driving efficiency, productivity, and sustainability while mitigating risks of regulatory complexity.
- The benefits of autonomous technologies include improved efficiency, productivity, and sustainability in agriculture.

Policy recommendations

In light of the current state of the legislative framework governing the use of autonomous field robots in Czech agriculture and the identified need for reform, several policy recommendations are proposed to facilitate the broader adoption and integration of autonomous technologies in agricultural practices.

Firstly, policymakers should prioritise the establishment of clear and adaptive regulations. These regulations should offer guidance on the operation, safety requirements, and oversight of autonomous field robots. Flexibility is crucial to accommodate technological advancements while ensuring safety and compliance standards are maintained (Basu et al. 2020). Secondly, adopting a risk-based regulatory approach is recommended. This approach allows regulators to assess the potential risks and benefits associated with the deployment of autonomous field robots in agriculture. Tailoring requirements and oversight mechanisms based on the level of risk posed by different applications of autonomous technologies promotes innovation while safeguarding against potential hazards.

Government funding and support should be allocated to research and development initiatives aimed at advancing autonomous technologies in agriculture. This includes funding for pilot projects, demonstration programs, and collaborative research efforts between government agencies, industry stakeholders, and academic institutions. By investing in R&D, policymakers can drive innovation, address technical challenges, and build confidence in the capabilities of field robots. Additionally, policymakers should actively promote stakeholder collaboration and participation in the legislative reform process. Soliciting input from farmers, industry representatives, researchers, and other relevant stakeholders ensures that regulatory changes reflect the needs and realities of the agricultural sector. By fostering dialogue and building consensus among diverse stakeholders, policymakers can create a more inclusive and effective regulatory framework.

Incentive programs should be implemented to encourage farmers to adopt autonomous technologies in agriculture. This may include financial incentives, tax breaks, or subsidies for the purchase and deployment of field robots, as well as incentives for participation in training programs aimed at enhancing technical expertise and skills in autonomous technology operation. By implementing these policy recommendations, Czechia can create a supportive regulatory environment that fosters innovation, enhances competitiveness, and promotes sustainability in the agricultural sector. Through collaboration between government, industry, and academia, policymakers can drive positive change and unlock the full potential of autonomous field robots in Czech agriculture.

Sources

Balafoutis, A., Beck, B., Fountas, S., Vangeyte, J., Van der Wal, T., Soto, I., ... & Eory, V. (2017). Precision agriculture technologies positively contributing to GHG emissions mitigation, farm productivity and economics. Sustainability, 9(8), 1339.

Basu, S., Omotubora, A., Beeson, M., & Fox, C. (2020). Legal framework for small autonomous agricultural robots. Ai & Society, 35, 113-134.

Blind, K., & Münch, F. (2024). The interplay between innovation, standards and regulation in a globalising economy. Journal of Cleaner Production, 141202.

Delavarpour, N., Koparan, C., Nowatzki, J., Bajwa, S., & Sun, X. (2021). A technical study on UAV characteristics for precision agriculture applications and associated practical challenges. Remote Sensing, 13(6), 1204.

Forrest, J. B. (2017). Rural development and food security in the 21st Century: A review and proposal. Journal of Developing Societies, 33(4), 448-468.

Lowenberg-DeBoer, J., Franklin, K., Behrendt, K., & Godwin, R. (2021). Economics of autonomous equipment for arable farms. Precision agriculture, 22, 1992-2006.

Mahmud, M. S. A., Abidin, M. S. Z., Emmanuel, A. A., & Hasan, H. S. (2020). Robotics and automation in agriculture: present and future applications. Applications of Modelling and Simulation, 4, 130-140.

Pearson, S., Camacho-Villa, T. C., Valluru, R., Gaju, O., Rai, M. C., Gould, I., ... & Sklar, E. (2022). Robotics and autonomous systems for net zero agriculture. Current Robotics Reports, 3(2), 57-64.

Rolandi, S., Brunori, G., Bacco, M., & Scotti, I. (2021). The digitalization of agriculture and rural areas: Towards a taxonomy of the impacts. Sustainability, 13(9), 5172.

Rose, D. C., Lyon, J., de Boon, A., Hanheide, M., & Pearson, S. (2021). Responsible development of autonomous robotics in agriculture. Nature Food, 2(5), 306-309.

Singh, G., & Yogi, K. K. (2022). Internet of things-based devices/robots in agriculture 4.0. In Sustainable Communication Networks and Application: Proceedings of ICSCN 2021 (pp. 87-102). Singapore: Springer Nature Singapore.

Sparrow, R., & Howard, M. (2021). Robots in agriculture: prospects, impacts, ethics, and policy. precision agriculture, 22, 818-833.

Úplné znění zákona č. 252/1997 Sb., o zemědělství, jak vyplývá z pozdějších změn (2009)

Úplné znění zákona č. 361/2000 Sb., o provozu na pozemních komunikacích a o změnách některých zákonů (zákon o silničním provozu) (2006)

Adam Hruška*,
& Hynek Roubík*

*Agri Policy Lab

Agri Policy Lab – A new unit established within the Biogas Research Team at the Czech University of Life Sciences Prague.
Agri Policy Lab is a dynamic, multidisciplinary and innovative unit dedicated to advancing agricultural and related policies and practices for sustainable and inclusive development. It is committed to evidence-based decision-making and operates at the intersection of research, stakeholder engagement, and policy advocacy.

Mission
To foster the development and implementation of effective agricultural and related policies through rigorous research, collaboration, and advocacy.

Reach out to Agri Policy Lab via roubik@ftz.czu.cz.