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Content

The Impact of Agricultural Subsidies on the Production Structure and Their Spatial Distribution in the Czech Republic

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Abstract

The main objective of this article is to assess whether changes in agricultural policy instruments influence the structure and volume of agricultural production in the Czech Republic (CR) and whether spatial disparities exist in the distribution of subsidies and payments. The analysis is based on time series data for 2000–2024 (2002–2024 for selected commodities) from the Czech Statistical Office and the Ministry of Agriculture, with nominal values adjusted to constant prices. The relationship between subsidies and production was examined using time-series methods, including causality tests, while spatial patterns were analyzed at the district level using Global and Local Moran's I.

The results indicate that total agricultural subsidies are not significantly linked to overall sector performance but show a strong relationship with livestock production, with a lag of approximately five years. At the commodity level, no significant causality was found in most cases. Spatial analysis reveals that most area-based payments do not form stable regional clusters, although significant spatial autocorrelation was identified for selected measures, particularly payments for areas with natural constraints and animal welfare support.

The findings suggest that the effects of agricultural policy instruments are structurally selective and spatially differentiated, highlighting the need to consider both sectoral and regional heterogeneity when evaluating policy effectiveness.

Keywords: Common Agricultural Policy, Czech Republic, agricultural subsidies, structural transformation

JEL Classification: Q18, Q11, R12

1. Introduction

Since joining the European Union in 2004, agriculture in the Czech Republic has been firmly integrated into the framework of the Common Agricultural Policy (CAP), and without subsidy programs, it would operate very differently under today's market and climatic conditions. In the Czech Republic, cultivated land accounts for approximately 45% of its territory, which corresponds to roughly 3.5 million hectares. Subsidies and payments represent both a key source of income for agricultural enterprises and a significant item of public expenditure, as agriculture remains one of the most heavily subsidized areas of the EU budget, specifically 25% (Jurčík, 2022; Vosta, 2010). In the Czech context, the support system relies primarily on direct payments from the first pillar of the CAP and rural development measures from the second pillar, supplemented by national support and co-financing. A distinctive feature of Czech agriculture is the above-average proportion of large enterprises (cooperatives, joint-stock companies, and other corporate forms); specifically, 75% of agricultural enterprises in the Czech Republic, which farm large tracts of land, absorb a significant portion of subsidy funds. This has a significant impact on the effects that individual support instruments have on the economy of enterprises, the structure of the sector, and rural areas (Doucha, 2004).

For a long time, the development of direct payments in the Czech Republic was linked to the SAPS system — that is, the Single Area Payment Scheme — which was relatively simple, predictable, and less administratively burdensome for farmers. However, recent CAP reforms have shifted toward more sophisticated schemes that are more closely tied to the achievement of environmental and social objectives. In the current programming period, direct payments in the Czech Republic consist of a combination of basic income support, redistributive payments favoring smaller and medium-sized holdings, payments under eco-schemes, coupled payments for sensitive sectors, and special support for young farmers (Lososová & Zdeněk, 2023).

The second pillar of the CAP, financed by the European Agricultural Fund for Rural Development, supplements direct payments with compensatory payments for Areas with Natural Constraints (ANC), agri-environment-climate measures, support for organic farming, investment support for farm modernization, processing, and diversification, and locally led development tools such as LEADER. Investment measures are among the most justifiable forms of support in terms of their impact on productivity and modernization (Lošťák & Hudečková, 2010). Among enterprises that have received investment support, there is a demonstrable increase in gross value added and labor productivity, particularly among medium-sized enterprises and farms in ANC. At the same time, however, large entities continue to dominate in terms of the absolute amount of support, which may reinforce structural concentration and consolidate the privileged position of capital-intensive enterprises (Jiří et al., 2022).

The Czech CAP Strategic Plan for 2023–2027 emphasizes a fairer allocation and more precise targeting of income support through direct payments. It envisages shifting part of the funds from large farms to small and medium-sized farms with the aim of strengthening their profitability; the first 150 hectares of all farms will be prioritized. Approximately €618 million has been allocated for sector-specific payments, particularly for the dairy sector and cattle farming; this support will benefit approximately 54% of Czech agricultural entities (SZIF, 2024). Selected groups of farmers will also receive compensation for income losses caused by adverse natural conditions, including unsuitable altitude, steep slopes that limit mechanization, extreme drought, poor drainage, high stoniness, or low soil fertility. These constraints affect more than two million hectares of agricultural land. Investment interventions are intended to enable the modernization of farms, increased productivity and quality of primary production, and faster adoption of innovative technologies; approximately 4,900 farms are expected to receive support for restructuring and modernizatio (Jurčík, 2022).

From the perspective of farm economics, subsidies clearly play a stabilizing role in the Czech context. Subsidies often constitute a decisive portion of net profit, particularly in sectors burdened by high fixed costs and price volatility, such as livestock production. Direct payments function as a relatively stable component of income, mitigating fluctuations between good and bad years and reducing operational risk. This stabilizing effect is particularly evident in enterprises that are more exposed to market and climate risks (Garrone et al., 2019; Staniszewski & Borychowski, 2020).

1.1 The Importance of Agriculture

Agriculture functions as a multifunctional sector whose significance extends far beyond the mere production of market commodities. The concept of "the multifunctionality of agriculture" encapsulates the fact that agricultural activity simultaneously produces food and feed, provides public goods (landscape, biodiversity, water and soil quality), sustains rural life, and contributes to cultural heritage (OECD, 2008).

The fundamental and historically most emphasized role of agriculture is ensuring food security. According to Pawlak & Kołodziejczak, (2020) growth in agricultural production and productivity has a greater impact on reducing poverty and malnutrition in developing countries than growth in other sectors of the economy, because most poor households are directly or indirectly dependent on agriculture. At the same time, they emphasize that the link between the structure of agricultural production, trade policy, and food availability does not merely address the question of “how much” agriculture produces, but also what commodities, where, and for whom. Closely related to this is the production of feed for livestock. Agriculture provides bulk and concentrated feeds, which are the basis for the production of meat, milk, and eggs. Fresco et al. (2021) highlights the tension between land use for feed versus food and the environmental impacts of intensive feed production (e.g., soybeans, corn).

However, the importance of agriculture has shifted significantly in the last two decades towards the production of non-food raw materials and the bioeconomy. Agricultural biomass is a crucial input raw material for bioenergy (bioethanol, biodiesel, biogas, biomass combustion) and also for bioplastics, paper, fibers, the chemical industry and construction materials. (Wang et al., 2023). Nasser Salifu (2025) shows that a sustainable supply of non-food biomass (energy crops, field residues, organic waste) is key to the transition to a low-carbon economy, but at the same time it comes up against the limits of available land, competition with food and the need to maintain ecosystem services.

Agriculture also plays a significant role as an employer and a source of livelihood. In many transition and developing economies, agriculture continues to employ 40–60% of the workforce and accounts for a substantial portion of GDP, making it crucial for poverty reduction and rural socioeconomic stability. This is true even in developed countries, where primary agriculture employs relatively few people. Pavlova (2022) highlights the creation of jobs in related sectors (the food industry, logistics, services, and agritourism) and the role of agriculture as an “anchor” for the local economy and for retaining the population in peripheral regions.

Musiał & Musial (2025) note that the role of agriculture is often emphasized as a key factor in the development of marginal areas. In mountainous, peripheral, or structurally disadvantaged regions, agriculture is often the sole or dominant land use and forms the basis of the local economy and identity. If agriculture in these areas disappears or is significantly reduced, this leads to a loss of job opportunities, the weakening of infrastructure and services, the exodus of residents, and ultimately to landscape degradation (overgrowth, fires, risk of erosion).

Hočevar & Juvančič (2006) emphasize that the agricultural landscape is a public good with significant aesthetic, recreational, and cultural value that the market alone cannot fully appreciate. Authors such as Daugstad et al. (2006) show that agriculture serves as a "bearer of cultural heritage," preserving traditional farm buildings, the fine-scale landscape structure (field boundaries, hedgerows, stone walls), as well as intangible cultural values (skills, customs, local varieties, and breeds). These functions are perceived, particularly in Europe, as part of the identity of rural regions and are also mentioned in the context of policies supporting agriculture and rural areas.

An important thematic area is soil management and the provision of ecosystem services. With appropriate farming practices, agriculture can contribute to the preservation of soil fertility, the reduction of erosion, the accumulation of organic matter and carbon in the soil, the protection of water resources, and the regulation of the local climate (Bayu, 2020). However, these benefits are often a "byproduct" of farming and, without public intervention, are undervalued because they are not reflected in the market prices of agricultural commodities. The concept of multifunctionality therefore emphasizes the need to view agriculture not only as a producer of private goods (food, raw materials), but also as a steward of the landscape and a provider of ecosystem services. At the same time, however, agriculture also has negative impacts on the environment. The intensification of production, associated with high use of pesticides and mineral fertilizers, specialization, and land consolidation, leads in many regions to a decline in biodiversity, water pollution, soil degradation, and significant greenhouse gas emissions (Rodriguez et al., 2004).

Modern research views agriculture both as a source of environmental problems and as a potential tool for addressing them. Public policy seeks to strike a balance between agri-environment-climate measures (AECM) and economic and food productivity (Coderoni et al., 2021).

1.2 Tools for Regulating Agricultural Business

In the economic world, regulation is viewed as government intervention in the economy. Such interventions include subsidies, grants, the setting of price ceilings or floors, and the imposition of taxes or standards. These interventions are enforced through administrative and legal measures. Government intervention is a response to market failures, the public interest, the interests of specific groups, or the protection of competition, among other factors.

1.2.1 Types of Agricultural Businesses

Agricultural business in the Czech Republic operates within the framework of national agricultural legislation and the Common Agricultural Policy of the European Union.

Czech agriculture is characterized by a relatively high share of large agricultural enterprises, cooperatives, and corporate farms, many of which are successors to the former unified agricultural cooperatives established during the socialist period. This specific ownership and production structure significantly influences production specialization, farm size distribution, and the allocation of agricultural subsidies.

Agricultural enterprises in the Czech Republic operate under both general business regulations and sector-specific agricultural and environmental requirements. In addition to production activities, agricultural businesses are increasingly affected by environmental conditionality linked to the Common Agricultural Policy. Farmers receiving subsidies must comply with cross-compliance requirements and standards related to soil protection, biodiversity, sustainable land management, animal welfare, and environmental protection. These requirements form an important part of the current agricultural policy framework and influence both production decisions and the economic conditions of agricultural enterprises (Zákon o ochraně přírody a krajiny, 1992).

1.2.2 Regulation of Production and Sales Volumes

The regulation of the volume and structure of agricultural production under the EU's Common Agricultural Policy, which fully applies to the Czech Republic, has undergone a fundamental transformation since the late 20th century. The original model, based primarily on price support, intervention purchases, and quotas, has gradually evolved into a comprehensive system in which decoupled payments, targeted coupled payments, stricter environmental conditions (cross-compliance, Good Agricultural and Environmental Conditions - GAEC, eco-scheme), and common market organization tools play a key role. The reforms collectively known as the 2003 Fischler Reform are considered one of the most radical turning points in the history of the CAP, as they entailed a significant decoupling of income support from production and the introduction of the Single Farm Payment or, in the new Member States, the SAPS flat-rate system (Cunha & Swinbank, 2011).

A key feature of the new system is decoupled payments, which provide farmers with support that is independent of current production levels or crop structure. Decoupled payments were seen as a necessary prerequisite for the depoliticization of the CAP and its alignment with international trade rules, particularly within the framework of WTO negotiations (Beard & Swinbank, 2001). In practical terms, the reform allowed most historical commodity-linked support (e.g., for cereals, beef cattle, milk) to be converted into a single payment per hectare, which was based on historical reference periods. This fundamentally changed farmers' behavior; that is, decisions regarding the structure and volume of production relied more on market signals (prices, demand, costs) rather than on maximizing the drawdown of subsidies tied to a unit of production. Decoupled payments have a smaller and often indirect impact on production volume than the previous coupled support, yet they still maintain a certain incentive to produce, for example by limiting exit from the sector or keeping agricultural land in production (Peter Howley et al., 2009).

Gohin (2006) points out that decoupling often leads to a decline in production in marginal or high-cost sectors and to the concentration of production in more productive regions, which has significant structural and regional implications.

Coupled support serves as a counterpoint to decoupled payments. These payments remain explicitly linked to the production of a specific commodity or to livestock numbers, and their aim is to maintain or support production in sectors that are strategically, socioeconomically, or environmentally significant for a given country or region, but are difficult to justify on market grounds. Member States may use a certain percentage of their national envelope for direct payments for coupled support for sectors such as livestock production (dairy cows, beef cattle, sheep, goats), protein crops, starch, certain types of fruits and vegetables, or hops (European Commission, 2022b).

In terms of its impact on the volume and structure of production, coupled support is a key instrument. Simulation models testing a hypothetical abolition of coupled support for ruminants show that it would lead to a significant decline in livestock numbers, a concentration of production in the most productive regions, and, in some areas, the abandonment of grasslands, which would have impacts on the landscape, biodiversity, and greenhouse gas emissions (Jansson et al., 2021).

Both decoupled and coupled payments are closely linked to the concept of cross-compliance and the GAEC rules, which have been supplemented in the new CAP by the eco-scheme as additional support for above-standard environmental commitments. While decoupled and coupled payments influence production decisions primarily through income incentives, cross-compliance and the eco-scheme shape the structure of farming through binding restrictions and requirements. These include, for example, the obligation to diversify crops, maintain the proportion of permanent grassland, protect landscape features, or set aside a certain portion of land as non-productive areas (Jansson et al., 2021). These conditions become a factor that farmers must consider when deciding what production structure to adopt if they wish to receive the full amount of support. These are not quotas in the traditional sense, but rather a regulatory framework that indirectly regulates land use and, consequently, the composition of production.

Regulation of the volume and structure of agricultural production is further based on the instruments of the Common Market Organization (CMO). The Single Common Market Organization comprises a set of rules for organizing markets for various commodities, with specific instruments—such as intervention purchases, support for private storage, sectoral programs, and marketing standards—existing for individual sectors (cereals, milk and dairy products, sugar, wine, fruits and vegetables, etc.). These instruments primarily serve a stabilizing function, allowing for the removal of part of the production from the market during periods of surplus or, conversely, the support of supplies during periods of shortage, thereby influencing the short-term volume of production brought to market and price signals for producers. In some sectors, such as wine, regulation has been supplemented by licensing or quota systems that limit the expansion of production capacity and thereby shape the sector's structure in the long term (Nolte et al., 2012).

Historically, the most significant instrument of direct regulation has been production and sales quotas, which directly determined the maximum volume of commodities that could be produced or placed on the market. The best-known example is milk quotas, introduced in 1984 in response to chronic milk overproduction in the then European Community. The quotas set national production ceilings and were further distributed among producers within individual member states. Exceeding the quota was penalized by a so-called superlevy, which very effectively limited the expansion of production. The abolition of milk quotas as of April 1, 2015, shows that in a number of member states, liberalization led to increased production, price fluctuations, and structural changes, including the concentration of production in the most productive areas and an acceleration in the decline of smaller farms (Salou et al., 2017). The removal of quotas was associated with an increase in total factor productivity in the dairy sector, primarily due to economies of scale and structural adjustment, although the regional impacts varied considerably (Čechura et al., 2021).

Sugar quotas, which regulated the production of sugar from sugar beets and isoglucose in the EU for several decades, played a similarly crucial role. These quotas, which have existed since the 1960s and have been in place in the new member states—including the Czech Republic—since their accession to the Union, determined the volume of production that could be placed on the EU internal market under subsidized conditions. Production exceeding the quota was intended for export without eligibility for support. The abolition of sugar quotas as of September 30, 2017, approved as part of the 2013 CAP reform and enshrined in the Single CMO Regulation, initially led to a significant increase in sugar production in the EU, a sharp drop in prices, and a subsequent reduction in sugar beet acreage and a decline in output in subsequent years (Nolte et al., 2012).

In addition to milk and sugar quotas, there were also quotas for potato starch in the past, as well as various capped premium schemes in livestock production (such as premiums for beef cattle or sheep), which, while not quotas in the strict sense of the word, effectively limited the maximum number of animals for which support could be claimed. This indirectly regulated production volumes and prevented further expansion in sectors prone to overproduction. The gradual phasing out of these quota and capped schemes over the past two decades is generally interpreted as part of a broader trend toward the liberalization of European agriculture. This marks a shift in which quantitative limits have been replaced by softer instruments such as decoupling, targeted production-linked support, and stricter environmental requirements.

1.2.3 Protection of the agricultural market

Agriculture represents a specific economic sector characterized by high price volatility, long production cycles, dependence on climatic conditions, and the provision of public goods such as landscape maintenance, biodiversity, and food security. Due to these characteristics, agricultural markets are subject to a higher degree of public intervention compared with most other sectors of the economy(Feindt, 2018; Swinnen, 1994).

Within the European Union, agricultural market regulation is primarily implemented through the Common Agricultural Policy, which combines direct payments, market support instruments, rural development measures, and environmental conditionality. The objective of these instruments is not only to stabilize farmers' incomes and agricultural production, but also to reduce market risks, support food security, and maintain agricultural activity in less-favoured regions (Brazhnyk et al., 2022; Olper, 1998).

Agricultural policy instruments simultaneously influence production structure and regional specialization. Coupled support may create direct incentives for maintaining specific types of production, particularly in sectors characterized by higher production costs or lower market competitiveness, such as livestock production. Area-based and environmental payments may additionally affect land use patterns and the spatial distribution of agricultural activity. The resulting effects of agricultural policy therefore depend not only on the design of subsidy instruments themselves, but also on regional production conditions, farm structure, and broader market developments (Przekota & Szczepańska-Przekota, 2020).

1.2.4 Support for the structure and volume of production

The public support system in Czech agriculture can be conceptually divided into three basic categories: entitlement-based payments, non-entitlement-based (project-based) schemes, and subsidies provided from national sources.

Entitlement-based support, the largest component in terms of volume, primarily includes direct payments and area-based rural development measures. Their "entitlement" nature means that every owner of agricultural land or livestock breeder acquires a legal entitlement to receive support upon fulfilling predefined conditions. The applicant is required to submit a formal application and comply with the specific requirements of the measure in question (e.g., deadlines for mowing grasslands or the age limit for the Young Farmer measure). The primary purpose is to stabilize farmers' income base and support environmentally friendly, long-term sustainable land management (Ministerstvo zemědělství, 2024a).

Non-entitlement measures are institutionalized within the Common Agricultural Policy through the Rural Development Program, which is a key pillar of CAP instruments. Administration takes place along two lines: non-project measures linked to entitlement payments and the Single Application, and project measures that are non-entitlement in nature. Project-based interventions focus primarily on strengthening the competitiveness of agriculture and forestry, improving the management of natural resources, implementing climate measures, and developing agricultural enterprises; the dimension of rural territorial development and support for local communities under the LEADER initiative is also significant. Obtaining support requires the preparation of a project in accordance with the announced conditions and subsequent evaluation based on predefined criteria, with specific rules defining the procedures for individual application rounds.

National grants are fully funded from domestic budgetary resources and are aimed at restructuring the sector, strengthening its competitiveness, and simultaneously supporting the development of rural areas. Their provision is subject to notification procedures ensuring compliance with competition rules in the single European market. The portfolio of national instruments includes 23 main programs and 99 specific grant schemes; in addition to standard schemes, extraordinary support is also provided, for example, to compensate for damage caused by natural disasters (Ministerstvo zemědělství, 2024b).

National subsidies (Czech Republic)

National subsidies in agriculture in the Czech Republic represent a specific public support instrument, which is financed exclusively from national sources and complements the subsidy framework of the Common Agricultural Policy of the European Union. Their importance lies primarily in the possibility of responding in a targeted manner to the needs of Czech agriculture, which may not be fully covered by European support mechanisms. Through these programs, the state supports the maintenance of the production potential of agriculture, the stabilization of selected sectors, the development of rural areas, the preservation of genetic resources, the improvement of production quality, the support of education, consultancy and other activities related to agricultural production and food production. From an institutional point of view, the system of national subsidies is based on the Principles, which set the conditions for the provision of subsidies, and since 2020, the administration of most of these subsidy programs has been fully within the competence of the State Agricultural Intervention Fund (Žáková Kroupová et al., 2023).

In the context of the development of Czech agriculture, national subsidies can be understood as a more flexible component of subsidy policy, which allows for compensating for the structural, production or regional specificities of the national agricultural sector. Unlike the main instruments of the Common Agricultural Policy, which are determined by the European legislative and programming framework, national subsidy programs can more flexibly take into account domestic priorities, such as support for selected commodities, livestock welfare, livestock rehabilitation, genetic resources, educational activities, or measures related to risks and crises in agriculture (Šimpachová Pechrová & Šimpach, 2020).

Direct payments

Direct payments are a key instrument of agricultural intervention policy; by design, they include both production-linked support and decoupled schemes (Baldoni & Ciaian, 2023). Their main purpose is to stabilize and strengthen Czech primary agricultural production and mitigate producers' income risks. In terms of budgetary weight, they account for the largest share of all funds allocated to agricultural subsidies. The central pillar is Basic Income Support for Sustainability, which is supplemented by newly designed mechanisms such as supplementary redistributive payments and payments for small farmers; at the same time, the conditions for the whole-farm eco-payment have been reformulated to better meet environmental objectives and be operationally feasible for various types of farms.

Eligibility for support is subject to meeting basic eligibility criteria: the applicant must be an "active farmer" and either demonstrably cultivate at least 1 ha of agricultural land registered in the LPIS system, provided that this land is properly used for agricultural purposes, or raise eligible livestock listed in the Central Register in accordance with breeding legislation (Adams et al., 2025). These rules ensure that funds are directed to entities that actually carry out agricultural activities, while also creating a framework for the verifiability and transparency of their use.

The rate for each direct payment measure is set annually by the Ministry of Agriculture. The rate depends on the relevant budgetary ceilings and the exchange rate announced by the European Central Bank before October 1 of the given year; in practice, the rates for the relevant subsidy period (calendar year) are usually published in mid-October. This methodology allows for the alignment of national implementation with the EU financial framework while providing applicants with predictability for planning production and investment decisions (Chatellier & Guyomard, 2023).

Basic Income Support for Sustainability - BISS

The Basic Income Support for Sustainability (BISS) program is designed as a tool to stabilize the incomes of active farmers and represents one of the key pillars of the direct payment system. Eligibility for this support is contingent upon the applicant actually engaging in agricultural activities and, at the same time, properly managing at least 1 hectare of agricultural land. This area does not include land used for non-agricultural purposes, non-productive elements, areas used for containers or ponds, or other non-productive or special crops that do not fall under the definition of eligible agricultural land. Additionally, the relevant land must be recorded in the LPIS land use registry throughout the entire reference period, i.e., from the submission of the application until August 31 of the given calendar year. This ensures both administrative verification of compliance with the conditions and consistency with other agricultural policy instruments linked to this registry (Chatellier & Guyomard, 2023).

Complementary Redistributive Income Support for Sustainability – CRISS

CRISS (Complementary Redistributive Income Support for Sustainability) is a supplementary income support tool designed to address structural disparities in favor of smaller agricultural enterprises, which have historically generated lower income per hectare and are more vulnerable in terms of economic sustainability. The mechanism has a strong redistributive character: it specifically mitigates the competitive advantage resulting from economies of scale in large enterprises and contributes to a fairer distribution of direct payments across the sector's size structure (Luca et al., 2023). CRISS is linked to BISS and functions as its complement, eligibility is therefore conditional on meeting the eligibility criteria applicable to BISS. This arrangement strengthens the income stability of smaller farms without undermining the coherence of the overall architecture of direct support.

Coupled Income Support – CIS

CIS (Coupled Income Support) payments are a targeted support tool for farms specializing in the production of selected, so-called sensitive commodities, the cultivation or rearing of which involves above-average labor requirements or specific agroecological conditions. Without additional financial intervention, these enterprises would often exhibit lower economic competitiveness and face the risk of scaling back or completely ceasing their operations. Support is directed primarily toward the sectors of fruit, vegetable, sugar beet, hop, starch potato, and protein crop cultivation, as well as cattle, sheep, and goat farming. The primary objective of these payments is to stabilize and strengthen the income situation of agricultural enterprises focused on these commodities, thereby contributing to the preservation of their production capacity, the maintenance of agricultural production diversity, and the assurance of a continuous supply to the domestic market (Röse, 2011). This category includes income support linked to selected agricultural commodities and livestock sectors. In crop production, it covers support for sugar beet, protein crops, starch potatoes, hops, labor-intensive vegetables, moderately labor-intensive vegetables, and labor-intensive fruit. In livestock production, it includes income support for dairy cattle farming, the rearing of beef calves, and sheep and goat farming.

Eco-schemes

In the 2023–2027 programming period, eco-schemes represent a new type of intervention tool under the CAP, designed to provide financial incentives for farmers to adopt farming practices with lower negative impacts on the environment and climate. This mechanism creates a framework to support the transition from conventional farming practices to more sustainable production models that better account for the environmental and climate aspects of agriculture. Support under the eco-schemes is intended for farmers who are introducing or have long practiced practices contributing to the fulfillment of the European Union's environmental and climate goals, whether regarding the protection of soil, water, biodiversity, or the reduction of greenhouse gas emissions. In this way, the European Union financially rewards the provision of so-called public goods—services and benefits to society that are not reflected in the market price of agricultural commodities (e.g., preserving landscape features, increasing the landscape's water retention capacity, and improving animal welfare). The thematic focus of eco-schemes is based on priorities defined at the EU level (Zieliński et al., 2026). The supported areas include, in particular, organic farming, precision agriculture based on targeted and data-driven application of inputs, agroecological approaches utilizing nature-based processes, agroforestry combining agricultural production with the planting and care of trees, as well as so-called carbon farming focused on carbon sequestration in soil and biomass, and measures leading to improved living conditions for farm animals. In this way, eco-schemes link the productive function of agriculture with its environmental and social roles (Zieliński, Józwiak, et al., 2025).

Young Farmers Scheme

Support for young farmers is a targeted instrument of the Common Agricultural Policy aimed at facilitating the entry of a new generation of entrepreneurs into primary agricultural production and at strengthening the long-term sustainability of the sector (Zagata & Sutherland, 2015). An eligible beneficiary is a person under the age of 40 who can demonstrate that they are starting an agricultural business and meets the criteria for "active farmer" status. Basic eligibility is further contingent upon the cultivation of at least 1 hectare of agricultural land registered in the LPIS, and the applicant must also meet additional requirements under relevant national and EU legislation. The support provided typically targets areas with a direct impact on structural modernization and competitiveness: it finances investments in technology and equipment, supports the adoption of environmentally friendly practices, and fosters the development of business capabilities. In the Czech context, this intervention is part of the implementation of the CAP and serves a dual function: on the one hand, it contributes to generational renewal, and on the other, it stimulates innovation and the professionalization of farming. In a broader sense, the measure thus strengthens the continuity of agricultural production, aids the development of rural areas, and supports the qualitative improvement of both production and environmental standards (Balezentis et al., 2020).

Small Farmers Scheme

This subsidy program is designed to support and stabilize the operations of small-scale farmers who cultivate up to 10 hectares of agricultural land registered in the LPIS as of the date of application. Financial support is effectively applied only to areas of up to 4 hectares, and this eligible area does not include land with non-agricultural crops, non-productive features, areas with containers, or ponds (Gall et al., 2023). This payment is designed as a simplified scheme that replaces all other direct payments, which in practice means that a beneficiary cannot simultaneously receive this specific support and claim other types of direct payments. The aim is administrative simplification and the targeted allocation of support to small agricultural entities (European Commission, 2014).

Agricultural production systems

The structure and volume of agricultural production in the EU are increasingly influenced by which production systems are politically supported and economically viable. In addition to traditional conventional farming, organic (bio) farming, biodynamic farming, precision (digital) farming, agroforestry, and various forms of regenerative and conservation agriculture are gaining ground. Each of these systems is characterized by a specific relationship between yields, environmental impacts, and the need for public support. Conventional agriculture, often referred to as traditional or industrial agriculture, is generally understood as a modern farming system that is highly input-intensive, relying on the frequent use of synthetic mineral fertilizers, fungicides, insecticides, and herbicides; the cultivation of high-yielding varieties in monocultures; the use of genetically modified organisms; the deployment of heavy machinery; intensive tillage; and extensive irrigation (Le Campion et al., 2020). These systems are therefore often associated with problems such as the accumulation of pesticides in the environment, disruption of soil structure, leaching of nitrates into deeper soil layers, and groundwater contamination, as well as a gradual decline in the overall nitrogen and carbon content of the soil (Poudel et al., 2002).

Precision agriculture is more of a technological approach than a distinct ideological movement. It is defined as a data- and digitally-driven farming method that uses sensors, GPS, remote sensing, and variable-rate application of inputs to tailor fertilization, plant protection, and irrigation to the spatial and temporal variability of crops (European Parliament, 2016b). Precision technologies typically lead to a significant reduction in the use of mineral fertilizers and plant protection products while maintaining or slightly increasing yields, which improves input efficiency and can help maintain or increase production volumes while reducing the environmental impact (Archer et al., 2019; Randall & James, 2012). In the European context, precision agriculture is viewed as a tool for achieving goals of higher or stable production while reducing inputs and emissions.

Christel et al. (2021) show that organic farming systems yield lower average yields than conventional systems (often by 15–25%), while at the same time having a lower environmental impact (lower pesticide use, better soil health, and greater biodiversity). At the same time, organic farms are often economically competitive, as lower yields are typically offset by higher purchase prices and support under the CAP. Santoni et. al. (2022) confirms that organic farming systems promote greater species diversity among plants, insects, and soil organisms, albeit at the cost of lower yields—a trade-off that is central to the debate over production volumes in the context of growing food demand.

Biodynamic agriculture can be considered a specific form of organic farming that combines organic production standards with the use of so-called biodynamic preparations and an emphasis on "closed" farm cycles. Reganold & Wachter (2016) show that biodynamic farming exhibits very high soil biological activity, often even when compared to other organic approaches. It frequently maintains lower or comparable yield levels compared to conventional farms and similar or higher profitability per hectare.

Agroforestry refers to systems in which trees are combined with agricultural crops or livestock on the same land. Agroforestry has the potential to increase biodiversity, improve soil and water quality, sequester carbon, and enhance resilience to climate stresses. In many cases, it maintains comparable or only slightly reduced yields of major crops per unit area compared to other systems (Yiridomoh et al., 2025).

Conservation agriculture, which is based on minimizing tillage, maintaining permanent soil cover, and crop diversification, is also attracting considerable attention. Conservation agriculture can lead to a significant increase in soil organic carbon content and improved soil health, with yields comparable to those of conventional tillage on a long-term average, provided that other agronomic practices are properly implemented. Regenerative agriculture is generally understood as a set of practices focused primarily on improving soil health, increasing soil organic carbon, biodiversity, and soil water retention capacity (typically through reduced tillage, the use of cover crops, crop rotation diversification, the integration of grazing livestock, and the reduction of synthetic inputs). (Tadiello et al., 2023). Regenerative practices have been shown to have positive effects on soil carbon, soil structure, and biological activity (Teng et al., 2024). Padbhushan et al. (2024) points out the lack of clarity in the definition of regenerative agriculture and the tendency to overestimate its climate potential, which complicates its clear classification within production support policies. As noted above, it is evident that these schemes are very similar; the difference lies in their main objectives and priorities.

In addition to these systems, other hybrid and integrated systems are also gaining attention. Integrated farm management is seen as a "third way" between purely conventional and fully organic farming. These systems contribute to higher overall productivity and more stable incomes through diversification, without necessarily leading to a significant decline in production volume (Morris & Winter, 1999).

Agricultural subsidies influence production structure through several economic mechanisms. Direct payments reduce income volatility and stabilize farm revenues, thereby lowering production risk and enabling long-term planning and investment decisions. Subsidies may therefore contribute to maintaining production even in sectors characterized by lower profitability or higher production costs, particularly livestock production and production in less-favoured areas. Coupled support creates direct incentives for maintaining or expanding the production of selected commodities, while investment support contributes to technological modernization, productivity growth, and the reduction of capital constraints. Similar conclusions regarding the stabilizing and structural effects of CAP subsidies were identified by (Garrone et al., 2019; OECD, 2023; Staniszewski & Borychowski, 2020).

However, agricultural production is simultaneously influenced by a broader set of external factors. Commodity prices significantly affect farmers' production decisions, particularly in market-oriented sectors where profitability strongly depends on price fluctuations and global market conditions (OECD, 2024). Climatic conditions, including droughts, floods, temperature variability, and other extreme weather events, also influence production volumes and may partially offset or amplify the effects of agricultural support mechanisms (OECD, 2023). In addition, production structure is shaped by political and institutional factors, including reforms of the Common Agricultural Policy, environmental conditionality, trade conditions, energy prices, and changing consumer preferences (European Parliament, 2025). Consequently, the identified causal relationships should be interpreted within the broader context of multiple interacting economic, environmental, and institutional determinants of agricultural production.

1.3 The Framework for Agricultural Business in the Czech Republic and the Common Agricultural Policy

The development of the agricultural sector in the Czech Republic in recent years represents a case of significant transformation of the business environment, in which the motivations, strategies, and organizational structures of enterprises have fundamentally changed. Before 1990, agriculture was centrally planned with no connection to market principles. The primary form of agricultural organization was the Unified Agricultural Cooperatives, which were established as part of collectivization. After 1990, following decades of a planned economy, farmers gained entrepreneurial freedom; at the same time, however, they faced extraordinary uncertainty caused by the transition from regulated prices to market-based pricing. Land restitution determined the basic trajectory of many entities. Some entrepreneurs resumed farming on restituted property, while others built businesses on leased land with limited capital, which led to cautious investment strategies and a preference for cost-saving production schemes, often accompanied by a reduction in livestock production (Bičík et al., 2015; Svatoš & Smutka, 2012; Swinnen, 1999). In the first half of the 1990s, survival strategies such as minimizing fixed costs, postponing modernization, and cautiously managing market risks prevailed amid high volatility in both output and input prices.

Between 1998 and 2003, the business environment gradually stabilized and began to professionalize. Pre-accession programs, particularly SAPARD (Special Accession Programme for Agriculture and Rural Development), enabled investments in business competitiveness on a larger scale for the first time. These investments involved the modernization of livestock facilities and technologies for both animal and plant production, and the introduction of quality, hygiene, and welfare standards. Some entrepreneurs diversified their activities into rural services or organic farming (Bojnec et al., 2014; Hudečková & Lošťák, 2003). At the same time, business structures with better access to capital (limited liability companies, joint-stock companies) gained traction, allowing for the sharing of risks and the investment burden. However, not all players were able to meet the investment and regulatory requirements and were forced to leave the sector. This further accelerated structural changes in the sector.

The turning point came in 2004 when Czech agricultural entrepreneurs entered the single market and the Common Agricultural Policy regime. The single area payment system stabilized incomes and significantly reduced perceived business risk, thereby opening the door to long-term investments and a shift in strategic thinking. Farms began to optimize production and financial decisions with regard to the subsidy framework, both in terms of crop structure and input intensity, as well as in terms of technology selection and the scope of operations (Latruffe et al., 2017; Ratinger et al., 2013). This gave rise to a two-tier business structure. Capital-rich entities accumulated land and investments, introduced elements of precision agriculture, automation, and sophisticated cost management, while smaller family farms survived primarily through family labor, income diversification, and specialization in niche products with higher profit margins (Zahradník & Zahradníková, 2019). At the same time, contractual ties with customers (food processing companies, retail chains) grew stronger, which not only improved sales security but also heightened demands for standardization and quality.

Between 2004 and 2013, investment grants from the Rural Development Program further accelerated the technological transformation of farms. In Central and Eastern Europe, it has repeatedly been shown that publicly supported investments increase the technical efficiency of farms, but at the same time accelerate the concentration of production and assets into a smaller number of larger entities that are better able to leverage economies of scale and complex subsidy and market instruments (Bojnec et al., 2014; Latruffe et al., 2017). This process further widened the gap between business models and led to long-term pressure to professionalize management, implement data-driven production management, and establish systematic cost control.

Following the CAP reform after 2013, the environmental dimension has had a significant impact on business strategies. New requirements, including greening and expanded AECMs, redirected part of the investment activity toward soil- and landscape-friendly technologies, precise application of inputs, and systems that reduce labor and energy intensity. At the same time, the importance of organic farming grew as a business choice combining subsidy certainty with a market premium (Pe'er et al., 2020; Zahradník & Zahradníková, 2019).

Between 2020 and 2022, the COVID-19 pandemic hit businesses, leading to disruptions in labor and supply chains, followed by a sharp rise in energy and fertilizer prices, as well as geopolitical uncertainty. The stabilizing role of direct payments and the availability of liquidity mitigated the immediate impacts (Meuwissen et al., 2021). At the same time, preparations were underway for the CAP Strategic Plan 2023–2027, which emphasizes the redistribution of support, small and medium-sized enterprises, and environmental conditionality, all of which further influence investment and production decisions.

1.3.1 Financial instruments for agricultural support in the CR from 1990 to 2004

The period from 1989 to 2004 reflects the transition from a centrally planned economy to a market-oriented economy, as well as the gradual integration into the structures of the European Union. The development of Czech agriculture in the 1990s can be divided into several stages reflecting economic transformation and preparations for EU accession. (Doucha & Sokol, 1999; Věžník & Bartošová, 2004).

The transformation period brought about a dramatic restructuring of the agricultural sector and to the emergence of a diverse structure of agricultural enterprises ranging from large corporate farms to smaller family farms. (Seják & Zavíral, 2007; Svatoš & Chovancová, 2013).

After 1989, state farms were rapidly privatized and JZDs were transformed, dispersing ownership and control of agricultural enterprises among new private entities and various forms of collective ownership (Bezemer, 2002; Divila & Sokol, 1994).

The early transformation period was associated with declining livestock numbers, lower input use, and reduced agricultural employment (Bičík & Jančák, 2006; Spěšná et al., 2009).

Price liberalization exposed agricultural producers to market conditions and increased pressure on the competitiveness of domestic production (Rozelle & Swinnen, 2004). The removal of state subsidies and increasing foreign competition significantly affected the economic stability of agricultural enterprises (Swinnen, 2018; Toman, 2012).

In this situation, agricultural subsidies took on new significance. Whereas in the centrally planned system they were primarily in the form of across-the-board price subsidies and hidden subsidies in the form of preferential inputs, in the transitioning system they were intended to serve as a tool for mitigating price shocks, stabilizing farmers' incomes, and supporting structural adaptation to the market environment. The development of agricultural subsidies between 1989 and 2004 thus reflects a transition from "soft" budgetary constraints and massive transfers to more selective forms of support, as well as preparations for adopting the mechanisms of the Common Agricultural Policy (Csaki et al., 1999).

In the first half of the 1990s, the Czech government introduced a set of programs aimed at revitalizing and stabilizing the agricultural sector. These included income support, production-linked subsidies, and investment grants (Kubíčková & Fišerová, 2019; Svobodová et al., 2022). Trade liberalization increased competitive pressure on domestic agricultural production (Francesconi et al., 2009; McCalla & Nash, 2007).

In terms of the institutional framework for agricultural policy, the State Market Regulation Fund emerged as a key state instrument, later transformed into the State Agricultural Intervention Fund (SZIF). This institution was established in the early 1990s as the main instrument for implementing intervention policy in agriculture (Doucha et al., 2002).

At the same time, a specialized financial institution, the Support and Guarantee Fund for Agriculture and Forestry (PGRLF), was established in 1994 with the aim of facilitating access to credit for agricultural enterprises through guarantees and subsidies covering part of the interest costs. In a situation where commercial banks showed limited willingness to finance the riskier agricultural sector and enterprises lacked sufficient own resources, the PGRLF became a key instrument of credit intermediation for agriculture (Bečvářová, 2005; Bičík & Jančák, 2006; Janda et al., 2013).

The impact of subsidies on the economic performance of Czech farms varied significantly by region, size, and type of operation. Research shows that larger farms generally benefited more from subsidies due to their stronger bargaining position, professional management, and easier access to capital, which enabled them to invest in modern technologies, diversify their production, and increase efficiency (Kašparová, 2018; Svobodová et al., 2022). Smaller family farms, on the other hand, often faced complicated administrative requirements and the transaction costs associated with submitting applications, while at the same time lacking sufficient resources of their own to co-finance investments (Kubíčková & Fišerová, 2019; Náglová & Rudinskaya, 2021). Unequal access to subsidies thus widened disparities within the sector: large companies further strengthened their market position, while smaller businesses faced greater economic pressures and often teetered on the brink of economic viability (Nešpor, 2006; Seják & Zavíral, 2007).

The increased emphasis on certain types of subsidies, particularly those supporting organic farming, reflected a broader trend toward shifting agricultural policy toward environmental and landscape management functions. (Živělová & Jánský, 2007). At the same time, however, the question remained as to what extent these subsidies actually contributed to the long-term sustainability of farming operations and to improving farmers' economic situation (Střeleček et al., 2011). The Czech Republic's accession to the European Union in 2004 fundamentally transformed the agricultural support system through the implementation of CAP direct payments, market measures, and rural development instruments (Lapka et al., 2011; Van der Horst et al., 2018). EU accession accelerated modernization and investment activity within Czech agriculture (Navrátil et al., 2019).

1.3.2 The EU's Common Agricultural Policy

In 2004, the Czech Republic became a full member of the CAP, which by that time had already undergone a long evolution. This historical context shaped the conditions under which the Czech Republic joined the common policy, and it is therefore desirable to analyze the roots and principles upon which the CAP was built.

The European continent emerged from World War II economically and institutionally devastated, with an urgent need to restore production capacity and stabilize the food supply for the population. In response to this situation, six countries—France, West Germany, Italy, Belgium, the Netherlands, and Luxembourg—established the European Economic Community (EEC) in 1957 under the Treaty of Rome. The Benelux countries had already formed a customs union as early as 1944. Discussions on post-war reconstruction naturally included agriculture as well, but the key impetus for the creation of the Common Agricultural Policy came from the meeting of EEC agriculture ministers in Stresa in 1958, where, with the participation of farmers' representatives, preparations for the CAP's institutional framework began.

At the same time, the EEC was addressing rules for the gradual elimination of internal tariffs and ensuring the free movement of goods. While France, relying on its agricultural strength, advocated rapid liberalization and the opening of markets, West Germany, burdened by a demanding reconstruction effort, preferred a gradual approach that would allow for the restructuring of domestic agriculture. This view was also shared by Italy (Sotte, 2023). Essentially, the aim was to establish a development framework that would allow agriculture to keep pace with industrialization while also addressing the significant disparities among member states and the ongoing exodus of people from rural areas.

The primary objective of the CAP became the reorganization of the agricultural sector to strengthen food security for the population and overcome persistent fears of shortages. Two approaches were identified to achieve this goal: (i) increasing productivity through technological progress and more efficient use of production factors (especially labor), and (ii) ensuring fair agricultural incomes through functioning markets and stable prices acceptable to consumers.

Given that the backbone of European agriculture consisted of family-run farms, often technologically backward (even in major agricultural nations such as France and Italy), modernization became an urgent priority. The policy was based on the principles of price unity, free movement of products, Community preference, financial solidarity, and shared responsibility. In 1960, the EEC Commission submitted a proposal for a comprehensive framework to the Council of Ministers, which also served as an incentive for other applicants for membership. In 1962, the Council adopted a set of regulations establishing the CAP.

The CAP's implementation architecture rested on two pillars: the common market organizations (CMOs) and the European Agricultural Guidance and Guarantee Fund (EAGGF) as the financial instrument. The CMOs were intended to manage production and stabilize supply and prices in order to ensure a continuous supply and stable farm incomes. External policy was harmonized at the Community level, replacing diverse national regimes. The CMO mechanism relied on a triad of instruments: minimum guaranteed (target/intervention) prices, tariffs, and export subsidies. Target prices were set annually for individual commodity markets. When the internal price fell by roughly 5–10% below this reference point, the Commission intervened through purchases and the storage or export of surpluses; conversely, when the market overheated, it released stocks.

Because domestic target prices generally exceeded world prices, exports required a subsidy to offset the price difference; imports, conversely, were curbed by variable tariffs to prevent a collapse of the domestic price level. While this regime stabilized markets, it also generated distributional effects: price support gradually concentrated among large enterprises—strong in both capital and scale—focused on grains and other "preferred" commodities, while smaller farms specializing in fruits, vegetables, or wine had weaker bargaining power and lower coverage rates. The uneven allocation of support thus accompanied the CAP from the outset (Sotte, 2023).

In 1964, the EAGGF was divided into a Guarantee Section (covering the costs of market measures: intervention purchases, storage, processing of surpluses, and export subsidies; funded primarily from the European Community budget) and a Guidance Section (co-financed structural measures, modernization of processing and marketing, and rural development). The set of market measures and the Guarantee Section constitute the so-called first pillar of the CAP.

In terms of agricultural performance, the CAP delivered indisputable results; between the 1960s and 1990s, the EEC transformed from a net importer into a net exporter. Price guarantees facilitated investment and accelerated modernization in the context of the global "Green Revolution." At the same time, however, the industrial approach to production gave rise to significant environmental externalities: genetic uniformity and commercial breeding weakened biodiversity, while the intensive use of fertilizers and pesticides degraded the soil; the effectiveness of chemical inputs declined over time, and their consumption increased. Pressure on water resources (e.g., for corn) and dependence on fossil fuels in mechanization further exacerbated the environmental burden.

Price stability and a continuous supply to consumers were largely achieved, although for some commodities (e.g., beef, sugar), price levels in the EU remained above world prices for a long time, which effectively shifted the costs to consumers. In the long term, however, agricultural prices in the EU fell or rose more slowly than inflation, with implications for wage dynamics in line with Ricardian arguments (Bourgeois & Pouch, 1993).

The goal of bringing farmers' incomes in line with those in other sectors was not achieved. Low profitability, combined with restructuring, accelerated the exodus of labor from agriculture, a trend further fueled by early retirement schemes. The intended generational shift toward enterprises with stronger management and capital often manifested in practice as the decline of smaller farms and the concentration of production. This transformation facilitated the gradual transition of member states from an agrarian economy to the Fordist industrial model and later to an urbanized tertiary sector in the postwar decades (Bell & Mickiewicz, 2013; Macours & Swinnen, 2000).

The Evolution of CAP Instruments from 2002 to 2022

Since 2002, the so-called "classic" form of the CAP, based on the MacSharry reforms and Agenda 2000, has prevailed. The primary instrument was market regulation: intervention purchases of cereals, milk, butter, and milk powder; minimum intervention prices; and export subsidies for markets outside the EU. These instruments were supplemented by production-linked support (e.g., for cattle, sheep, sugar, or potato starch) and extensive quota systems (particularly milk and sugar quotas), which limited production volumes and stabilized the internal market. At the same time, AECM and rural development began to gain prominence, particularly through the SAPARD pre-accession program in candidate countries, including the Czech Republic. This program financed the modernization of agricultural enterprises and rural infrastructure and prepared beneficiaries for standard CAP instruments following accession to the Union. The Czech Republic's accession to the EU in 2004 brought about a fundamental change. The main instrument of direct support became the single area payment, which represents a simplified regional system decoupled from specific production. The Czech Republic, like other new Member States, took advantage of the option to introduce the SAPS instead of the Basic Payment Scheme (BPS), which significantly reduced the administrative burden.

The SAPS was supplemented by national top-up payments financed from the national budget, as well as production-linked payments in sensitive sectors. At the same time, payments for ANC were introduced, and the range of AECM measures was expanded, with the aim of encouraging farmers to use land more sustainably, support permanent grassland, and protect landscape features. During this period, preparations were also underway for gradual decoupling, i.e., the separation of payments from production. As analyses of the Fischler reform show, decoupling was intended to limit production incentives, reduce market distortions, and transform the CAP toward income support for farmers rather than support for a specific volume of production. The so-called Health Check reform (2008) built on the Fischler reform and further reinforced the trend toward decoupled payments. The aim was not to radically overhaul the CAP, but to conduct a "thorough review" of the system's functioning and adapt it to new challenges, particularly climate change, water management, and bioenergy (European Commission, 2008).

The role of market interventions and export subsidies has been gradually reduced, while the importance of the Rural Development Program 2007–2013—which is structured into four axes (competitiveness, environment, quality of life in rural areas, and LEADER)—has grown. Modulation is taking place, i.e., the transfer of part of the funds from direct payments (Pillar I) to rural development (Pillar II), thereby strengthening the financing of environmental and structural measures (Meyn, 2008). The Health Check also introduced adjustments to set-aside (mandatory withdrawal of land from production), further restrictions on market measures, and the gradual liberalization of certain sectors. This confirmed the trend in which the CAP is moving away from direct market regulation toward indirect instruments—direct payments and targeted rural development measures (Quaker Council for European Affairs, 2009). Between 2010 and 2012, the system of instruments tended to stabilize. In the Czech Republic, SAPS continues to dominate as the main form of direct support, supplemented by limited production-linked payments in sensitive sectors (e.g., cattle, sheep, certain crops). The Rural Development Program has become a key framework for farm modernization, investment in technology, support for young farmers, and the diversification of economic activities in rural areas. From an environmental perspective, payments in less-favored areas (LFA/ANC), Natura 2000 measures, and a wide range of agri-environmental commitments are gaining importance, motivating farmers to protect soil, water, and biodiversity. Export subsidies are gradually being phased out, and SOT intervention tools are used only in a targeted manner during crisis situations, such as in the dairy sector (European Commission, 2022a). The CAP reform for the 2014–2020 period entails a fundamental overhaul of the direct payment system. At the EU level, the BPS has been introduced as the new standard instrument; however, the Czech Republic is exercising its option to continue under the SAPS scheme until 2020. At the same time, new instruments are being created to strengthen the CAP's social targeting and environmental performance: in particular, the payment for young farmers, the scheme for small farmers, and the mandatory "greening" payment (European Commission, 2013). Greening accounts for roughly 30% of the direct payments allocation and is linked to three basic obligations: crop diversification, the maintenance of permanent grassland, and the establishment of ecological focus areas (EFAs). The aim is for direct payments to contribute not only to income stability but also to the provision of environmental public goods (European Commission, 2017).

Between 2013 and 2019, average factor income per worker in the EU rose by 15% in real terms. This increase was not primarily due to higher agricultural prices, but rather to a significant rise in labor productivity, which was linked in particular to the long-term decline in the sector’s workforce. The CAP has significantly contributed to stabilizing these incomes through direct payments and market measures, which have reduced price volatility for most agricultural commodities and mitigated the impacts of market crises. Since 2014, price fluctuations in the EU have been significantly lower than on international markets, enabling farmers to better respond to adverse price changes.

The CAP has significantly contributed to the growth of European agriculture’s competitiveness. Between 2013 and 2019, total factor productivity increased by 6%, while labor productivity rose by 24%. This growth was supported by investment measures that increased the availability of capital on farms and stimulated modernization. The policy also strengthened supply chain organization; the number of recognized producer organizations rose by 7%, and their share of the fruit and vegetable market exceeded 45%. The EU’s trade position proved resilient despite external shocks (including the Russian embargo). In 2019, the EU accounted for 18% of global agri-food exports, with high-value-added products and products certified under EU quality schemes serving as key pillars of competitiveness. During the 2014–2020 period, the CAP provided a comprehensive framework for the protection of natural resources through mandatory cross-compliance and greening, which covered 80–84% of agricultural land. These mechanisms prevented soil degradation, the loss of permanent grassland, and excessive intensification. Although the 2013 green component helped prevent further environmental degradation, its potential was not fully realized, primarily due to the low ambition of Member States and the limited relevance of certain measures for different types of farms. Although greenhouse gas emissions from agriculture have fallen by more than 20% since 1990, they have stagnated since 2010. The CAP has contributed more to reducing emissions from managed soils than from livestock production, with measures related to feed optimization, manure management, and grassland maintenance showing the highest potential. Support for carbon sequestration through permanent grasslands has become a key mitigation tool (European Commission, 2021). At the same time, the focus on climate change, soil degradation, and biodiversity loss is intensifying, leading to a gradual tightening of GAEC (Good Agricultural and Environmental Condition) standards and greater pressure to target support more effectively, including discussions on future eco-schemes.

The strategic plans for 2023–2027 continue to support redistribution through increased redistributive payments, which now account for more than 10% of direct payments, or approximately €4 billion annually. The volume of this support is more than double that of the previous period and significantly strengthens the economic position of smaller farms. The aging of the agricultural population remains a structural challenge. A total of 32% of the CAP budget was allocated to voluntary environmental, climate, and welfare measures, which include, in particular, eco-schemes (€44.7 billion) and rural development commitments (€33.2 billion). Flexibility in their design has allowed Member States to tailor interventions to local conditions and leverage synergies between them. Examples include support for organic fertilizers (Portugal, Bulgaria, Croatia, etc.), agroforestry (Germany), winter soil cover (Finland), sustainable pastures (Spain), and improved livestock farming conditions (Poland). (European Commission, 2023).

CAP Strategic Plan 2023–2027

The implementation of the Common Agricultural Policy for the 2023–2027 period represents a fundamental transformation in the management of the European agricultural sector, defined by a shift from a model based on strict adherence to procedural rules to a model focused on performance and the achievement of concrete results. This so-called New Delivery Model transfers a significant portion of responsibility and flexibility to Member States, which are required to develop national CAP Strategic Plans covering interventions under both pillars. The aim of this reconceptualization is to ensure a higher degree of subsidiarity and to enable Member States to adapt policy instruments to specific territorial and socioeconomic needs, within a single EU strategic framework (Bourget, 2021; Cagliero et al., 2021).

A central element of the new policy architecture is an ambitious "green architecture" that integrates environmental and climate objectives directly into the structure of direct payments and rural development programs. A key innovation is the eco-schemes under the first pillar, to which Member States must allocate at least 25% of the direct payments budget. These measures are mandatory for Member States but remain voluntary for farmers, and are designed to reward practices that go beyond basic cross-compliance requirements. Under the second pillar, at least 35% of funds must be directed toward agri-environment-climate commitments (AECC) and other climate and environmental protection measures. Practical implementation in the first year (2023) shows, using Poland as an example, that approximately one-third of farms applied for eco-schemes, with straw incorporation into the soil being the most frequently chosen practice, and simplified tillage systems dominating in terms of area (Bourget, 2021; Zieliński et al., 2024; Zieliński, Gołębiewska, et al., 2025).

A key aspect of the reform is the strengthening of internal convergence and a fairer redistribution of income support. Supplementary redistributive income support for sustainability is becoming a mandatory tool, for which Member States must allocate at least 10% of their national ceiling for direct payments to small and medium-sized agricultural enterprises. An analysis of Italy's Strategic Plan confirms that the process of internal convergence is moving toward a gradual alignment of the unit value of payment entitlements with the national average. This mechanism effectively transfers financial resources from large farms and intensive production areas toward smaller farms and marginal or mountainous rural areas (Pierangeli et al., 2023).

Areas of high nature value (High Nature Value farmlands – HNVf), which are crucial for preserving biodiversity and providing ecosystem services, require specific attention under the CAP 2023–2027. Research in Poland suggests that farms in these areas show lower participation rates in eco-schemes compared to more intensively farmed regions, which may be due to administrative complexity or a mismatch between the requirements of the measures and the reality of extensive farming systems. Conversely, in HNVf areas, there is greater interest in organic farming and second-pillar agri-environment-climate measures, which better align with nature conservation objectives in these systems. Extensive livestock grazing in these locations plays an irreplaceable role in maintaining semi-natural habitats and landscape heterogeneity (Zieliński et al., 2024).

A new Performance Monitoring and Evaluation Framework has been introduced to monitor and evaluate the policy's progress. This system uses a set of common indicators for outputs, outcomes, and impacts, designed to enable data aggregation at the EU level and verification of the effectiveness of the funds spent. Evaluation practices are shifting toward ongoing assessment through mandatory Evaluation Plans, which are an integral part of Strategic Plans. Despite the proclaimed simplification, however, critical reflection highlights the risk of increased administrative burden and system rigidity, where a strong focus on quantifiable performance indicators may stifle a deeper understanding of qualitative changes in the territory and limit the ability of states to respond to specific local challenges (Becker, 2024; Röder, 2025).

1.3.3 The Impact of the CAP on the Czech Republic's Agricultural Policy, 2002–2024

Implementation of Common Agricultural Policy Instruments in the Czech Republic

The implementation of Common Agricultural Policy instruments in the Czech Republic was a complex institutional, economic, and structural process that fundamentally reshaped the conditions under which the agricultural sector operates. The following subsections summarize this transformation across several interrelated dimensions.

Institutional Origins and Pre-Accession Adaptation

The decisions of the European Council's Copenhagen Summit in December 2002 established the framework for agricultural conditions in the new Member States following their accession to the EU. For the Czech Republic, this primarily meant the establishment of production limits and quotas, minimum levels of direct payments financed from the EU budget, and the total amount of funds allocated for structural support, particularly under the Horizontal Rural Development Plan (HRDP) and the sectoral operational program. Under the compromise reached in Copenhagen, the new Member States were entitled to a phased introduction of direct payments, starting in 2004 at 25% of the level of payments made to farmers in the EU-15, with a subsequent gradual increase. At the same time, it was made possible for direct payments to be supplemented by national "top-ups" up to a predetermined ceiling, which for most commodities could reach roughly 55% of the support level in the existing Member States during the initial phase (European Commission, 2002).

The Impact of the Common Agricultural Policy on the Transformation of the Czech Agricultural Sector: The period 2000–2004 represents a critical phase of institutional development and pre-accession adaptation, the central mechanism of which was the SAPARD program (Hudečková & Lošťák, 2003; Věžník et al., 2013). This program was not designed merely as a financial instrument for modernization, but served primarily as a comprehensive institutional "laboratory" intended to prepare Czech entities—from individual farmers to government agencies—for the CAP's rigorous rules and administrative standards (Věžník et al., 2013).

A key element of institutional adaptation was the establishment of an administrative infrastructure capable of managing EU funds. During this period, the State Agricultural Intervention Fund was established, which became a cornerstone for the future administration of direct payments (Pillar I) and rural development programs (Pillar II) (Bičík & Jančák, 2001). The implementation of the SAPARD program marked the first time in history that EU external assistance to candidate countries was provided on a fully decentralized basis, which required extensive legislative and technical preparation. Despite initial administrative difficulties and delays, this process is assessed in national evaluation reports as an exceptionally successful learning process that laid the groundwork for the effective use of structural funds following accession to the Union (European Commission, 2006).

From the perspective of a sociological and economic impact analysis, SAPARD served as a significant catalyst for the stratification of rural actors, creating distinct groups of "winners" and "losers" in the grant competition. The group of "winners" consisted mainly of medium-sized enterprises and forward-thinking farms that viewed participation in the program as strategic preparation for future operation within the EU single market. In contrast, smaller agricultural entities often found themselves in the role of "losers," as they lacked the necessary social capital, the professional capacity to process complex project applications, or sufficient financial liquidity to meet co-financing requirements (Bičík & Jančák, 2001).

The main priority of pre-accession adaptation was to support investment in agricultural enterprises with the aim of increasing their competitiveness and ensuring compliance with the EU acquis communautaire in the areas of hygiene, food safety, veterinary standards, and animal welfare (European Commission, 2006; Hudečková & Lošťák, 2003). Investments were directed primarily toward the modernization of equipment and the renovation of technological facilities. At the same time, however, the economic viability criteria applied under the SAPARD program indirectly favored larger and financially stronger entities, thereby reinforcing the historical path dependency on large-scale production structures in the Czech context.

Methodologically, the preparation of the program in the Czech Republic was marked by a transition from an initial "shock approach," characterized by administrative anomie and a lack of clear procedural rules, to a gradual adoption of EU standards and an increase in institutional stability. This process was accompanied by the building of social capital and mutual trust between national agencies and applicants, which led to a gradual reduction in the transaction costs of the entire system (Hudečková & Lošťák, 2003).

Production Restructuring and Commodity Specialization

The transformation of the agricultural sector in the Czech Republic can be characterized as a response to a massive exogenous shock associated with integration into the Common Agricultural Market and the transition to a system of decoupled payments (Opatrny, 2020). The integration of the CAP brought about a radical shift in the motivations of agricultural entities, which were forced to adapt their production structures to the new price levels of the EU market and subsidy incentives. A dominant feature is the marked divergence between crop and livestock production, often referred to in the literature as the "scissors effect." While Czech crop production, particularly the production of cereals and oilseeds, proved highly competitive at European price levels after 2004, livestock production experienced a deep structural decline (Doucha & Divila, 2004). Crop production has stabilized at a relatively high level, but at the cost of narrow specialization in a few key market crops. Wheat and oilseed rape have become the dominant components of crop rotations, with oilseed rape effectively replacing traditional crops with higher added value, such as potatoes, in many areas. This shift toward large-scale monocultures was driven by efforts to maximize subsidy income per hectare while minimizing labor and material inputs (Věžník et al., 2013).

The livestock sector experienced a dramatic decline in livestock numbers, which was most pronounced in pig and cattle farming. According to available statistics, approximately three-fifths of the cattle population disappeared from Czech farms, and the pig population was reduced by half. This collapse was caused by a combination of several factors: the inability to compete with cheaper imports from other EU member states, the loss of food self-sufficiency in key commodities, and the high investment costs associated with the need to adapt to EU standards in the areas of hygiene, food safety, and animal welfare (acquis communautaire). Legal entities, which dominate Czech agriculture, responded to these pressures by abandoning more labor-intensive and economically riskier livestock operations in favor of less demanding crop production (Doucha & Divila, 2004).

The socioeconomic consequence of this specialization is a steady decline in employment in the agricultural sector. Crop production is significantly less labor-intensive than livestock production, which has led to workforce reductions and increases in technical labor productivity driven more by mechanization than by growth in production volume (Svobodová & Věžník, 2011). Agricultural enterprises have thus transformed into highly mechanized units focused on market crops, which, while improving their aggregate profitability, has simultaneously weakened the traditional links between livestock and crop production and negatively impacted the rural socioeconomic structure (Doucha & Foltyn, 2008; Lososová et al., 2017).

An analysis of comparative advantages (measured using the RCA and LFI indices) confirms that the Czech Republic has established a strong position in the export of low-value-added commodities, such as live animals, grains, sugar, and animal feed. Conversely, for products with higher added value, particularly meat, meat products, vegetables, and fruit, the Czech agricultural sector exhibits a long-term competitive disadvantage and dependence on imports. (Kuzmenko et al., 2022). This specialization profile suggests that, although the CAP has brought financial stability to the sector, it has not yet supported a shift toward more diversified and technologically sophisticated production with a higher degree of domestic value added (Zdráhal et al., 2023).

Socioeconomic Duality and the Persistence of Large-Scale Production Structures

Another feature of the transformation of the Czech agricultural sector in the context of the CAP is the emergence and stabilization of a specific socioeconomic duality, characterized by the coexistence of large-scale corporate structures and a segment of individual farmers. This structure is unique within the European Union, as the Czech Republic has long had the largest average farm size in the entire bloc (Kremmydas & Tsiboukas, 2022; Lososová et al., 2023). The persistence of these structures is not accidental but stems from long-term historical developments. After 1989 and following the Czech Republic's accession to the European Union in 2004, institutional conditions and economic incentives were designed to continue supporting the large-scale production model rather than to bring about a fundamental transformation of it (Ratinger et al., 2012).

This duality stems from the historical legacy of collectivized agriculture, whose infrastructure and organizational structure created high "sunk costs" that hindered a massive transition to a family farming model. While in countries such as Poland or Slovenia, agriculture largely resisted collectivization, in the Czech context, the original JZDs and state farms were transformed into modern legal entities (cooperatives and joint-stock companies). This corporate sector farms approximately 70% of agricultural land, with a small share of the largest entities (approx. 0.5%) controlling more than 30% of the total area of farmed land (Doucha & Foltýn, 2006).

One aspect of the Czech duality is the extreme discrepancy between land ownership and land use. The Czech Republic has one of the highest proportions of leased land in the EU, which often exceeds 90% for legal entities (Bičík & Jančák, 2001). This fragmentation of property rights, combined with a high concentration of land use, creates specific economic tensions. In this environment, CAP direct payments are often factored into lease prices, leading to an inefficient transfer of public support from active farmers to landowners (Ratinger et al., 2012). Between 2011 and 2015, land leasing in the Czech Republic doubled, further raising barriers to entry for new entrants, particularly young farmers, into the sector (Lososová et al., 2017).

The socioeconomic gap between the two poles of this duality is also reflected in the nature of the workforce and productivity. Large enterprises rely on wage labor and exhibit a significantly lower labor intensity per unit of area—approximately 2.60 labor units per 100 hectares—while small farms have a labor intensity of 5.73 labor units (Žáková Kroupová et al., 2026). Large entities are able to leverage economies of scale more effectively, which allows them to invest in costly technological innovations such as precision agriculture. In contrast, smaller farms are regarded as providers of multifunctional benefits, such as biodiversity conservation, landscape mosaic diversification, and the sustainability of rural communities. The CAP's design in previous programming periods tended to preserve this duality, as the area-based payment system without effective capping naturally favored entities with larger land holdings (Zdráhal et al., 2023).

Subsidy dependence and the sector's economic resilience

The economic stability of the Czech agricultural sector in the context of the CAP highlights a fundamental contradiction between the sector's nominal profitability and its deep structural dependence on public transfer payments.

The implementation of CAP mechanisms, particularly direct payments and supplementary payments, has led to a significant increase in the income of agricultural entities. This financial injection has increased the sector's economic resilience to exogenous economic shocks; during periods of recession (e.g., after 2009), agriculture recorded a lower number of insolvencies compared to other sectors of the national economy, which is attributed to the stabilizing effect of subsidies and relatively inelastic demand for food.

Despite the growth in profitability, sources indicate an extremely high degree of dependence on subsidy programs. Surveys among agricultural entities confirm that 85% of corporate entities and 81% of private farmers would be unable to continue their economic activities without regular subsidies (Svobodová & Věžník, 2011). This dependence is precisely reflected in the subsidy dependency index, which has not fallen below 100% since 2000—meaning that market revenues do not cover total production costs. The situation is particularly critical in mountainous areas (LFA/ANC), where subsidies often account for more than 100% of generated profits and agriculture effectively serves as a public service for landscape management (Lososová et al., 2017).

Although subsidies increase net profitability, they tend to induce technical inefficiency, a phenomenon known as the production paradox. Firms receiving high levels of support often achieve a lower percentage of their production potential (e.g., 44.6% compared to 60.4% for unsubsidized entities), as guaranteed non-market income reduces the marginal incentive to maximize output and engage in efficient production practices. This phenomenon is exacerbated in the Czech context by the duality of structures, where large-scale production units optimize their activities more toward maximizing subsidy revenue per hectare than toward production intensity (Čechura & Malá, 2014; Pechrová, 2015).

The Paradigm of Post-Productivism and Environmental Transformation

While the socialist economic model was based on politically driven maximization of production even in marginal areas, which led to widespread environmental damage, integration into the EU in 2004 introduced the concept of multifunctional agriculture. This paradigm redefines the role of the farmer, who is no longer merely a producer of food and raw materials but becomes a steward of the landscape providing environmental public goods (Doucha et al., 2002).

This transformation is accompanied by significant regional variation and spatial polarization of activities. Geographically, there has been a polarization of agricultural land use. Fertile lowland areas (e.g., the Elbe River Valley or the South Moravian Plain) continue to focus on intensive crop production, while in marginal, mountainous, and submontane areas (LFA/ANC), a process of extensification is underway. The dominant manifestation of this transformation is the conversion of arable land to grassland and afforestation, leading to an increase in permanent grassland areas at the expense of traditional field crop production. This change is directly stimulated by subsidy mechanisms under the CAP's second pillar, particularly the AECM and payments for ANC (Konečný, 2017).

Organic farming has become a key element of environmental transformation in the Czech Republic, concentrated primarily in peripheral areas characterized by high elevations and steep terrain. In these regions, organic production is viewed as a rational survival strategy that compensates for lower yields through higher levels of subsidy support and the provision of non-production functions, such as biodiversity conservation, water management, and erosion control. Despite the growing importance of the organic sector, however, sources point to a persistent "biodiversity paradox." Environmental subsidies are often used more as social income support for farmers than as an effective tool for increasing actual crop diversity or restoring ecosystems (Janík et al., 2024).

The environmental shift is also linked to the energy transition in agriculture, which is reflected in the expansion of energy crops and the construction of biogas plants. This shift toward bioenergy production is particularly evident in the cultivation of oilseed rape, which has replaced potato farming in many areas, and silage corn, which serves as a feedstock for biogas plants. Although these technologies are presented as an environmental benefit for the climate, their uncontrolled development in the past has led to unintended consequences, such as a reduction in biodiversity on arable land and increased pressure on soil degradation (Radlińska, 2024; Žáková Kroupová et al., 2023).

Tariff Barriers in Agricultural Trade in the Czech Republic

The regulation of trade in agricultural products is an integral part of the CAP and applies to transactions between EU Member States and third countries, i.e., entities outside the single internal market. As a general rule, all external agricultural trade of Member States is governed by both CAP rules and the Common Commercial Policy, while mutual trade within the EU is considered internal trade conducted within the single market. This institutional framework implies that competence in the areas of trade and agriculture lies with EU institutions, particularly the Council of the EU and the European Commission, while Member States, including the Czech Republic, participate only in the exercise of these powers through participation and implementation.

Because the price level of many agricultural and food commodities (or processed agricultural products) has long been higher in the EU than world prices, the EU protects the internal market through relatively high tariffs against cheaper imports from third countries. At the same time, it strengthens the competitiveness of EU exporters in external markets through export support in cases where EU prices cannot compete effectively.

Regulation of external agricultural trade is based on horizontal regulations of general application and on vertical regulations for individual commodity sectors, which implement so-called trade mechanisms, specifically import and export licenses, export subsidies, security deposits (guarantees), and related control mechanisms (Neumann, 2004).

Import and export licenses function as securities that entitle importers or exporters to conduct trade under preferential terms compared to standard market rules, thereby increasing the potential economic return on a given transaction. Import licenses are primarily used to administer preferential tariff quotas, the purpose of which is to allow certain goods to be imported into the EU at lower tariff rates. The system of import and export licenses and certificates is based on Commission Regulation (EC) No. 1291/2000, which establishes common implementing rules for the application of licenses in EU member states.

The export license system applies primarily to commodities that may be supported by export subsidies. Without a valid export license, subsidies cannot be claimed in the EU. Export subsidies offset the difference between higher domestic prices and lower world prices, enabling exports from the EU to be conducted on the basis of world market prices. The system of export subsidies for agricultural products is governed by common implementing rules set forth in Commission Regulation 800/1999. The issuance of licenses and the granting of subsidies are subject to the EU's (and the Czech Republic's) obligations under the WTO.

If an EU exporter applies for an export subsidy, they are required to post a security deposit, the amount of which is derived from the requested subsidy. If the export is not carried out, the security deposit is forfeited to the EU. A security deposit is also required when issuing an import or export license to prevent the blocking of quotas or licenses without the actual execution of the trade. After the trade is properly executed, the guarantee is returned; the security may take the form of cash or a non-cash guarantee, with non-cash guarantees being more commonly used in practice (typically provided by the applicant's bank or insurance company, approved by the paying agency). For multiple transactions, a block guarantee may be arranged, which covers a set of obligations by blocking funds in the account of the applicant for a license or subsidy. The guarantee system for trade in agricultural products is governed by Commission Regulation 2220/1985.

Payment agencies ensure the implementation of trade mechanisms in member states. In the Czech Republic, this role is fulfilled by the State Agricultural Intervention Fund, which, together with the Czech Customs Administration, conducts rigorous oversight of the management of EU budgetary funds earmarked for export support. The export subsidy system is therefore closely monitored and accompanied by physical inspections of goods to ensure transparency, compliance with EU and WTO law, and the effective use of public funds (Gardner, 1996).

Greening and environmental conditionality

Klí A key innovative feature of the reform was the introduction of a mandatory "greening" component, for which Member States were required to allocate 30% of their national envelope for direct payments. This payment is conditional on compliance with three basic agricultural practices beneficial to the climate and the environment: crop diversification, the maintenance of permanent grassland, and the creation of Ecological Focus Areas (EFAs) covering at least 5% of arable land. The Czech Republic took advantage of the flexibility of the rules and implemented so-called equivalent practices within agri-environment-climate programs, thereby enabling farmers to meet these requirements through already established practices. Although CAPRI model simulations suggested a positive impact of greening on reducing ammonia and greenhouse gas emissions, analyses based on FADN (Farm Accounting Data Network) data show that the actual impact on agricultural biodiversity in the Czech Republic was negligible and that subsidies served more to support income than to bring about a fundamental change in farming practices. Greening also increased the administrative burden on farmers and government agencies, particularly due to the need for precise mapping of EFA areas (European Commission, 2016; Kroupová et al., 2022).

Redistributive payments

The redistributive payment was introduced as a voluntary tool allowing member states to shift part of the financial support from large enterprises to small and medium-sized farms by increasing payments for the first hectares. In the 2014–2020 programming period, the Czech Republic decided not to use this tool, unlike countries such as Poland, Bulgaria, and Lithuania. The main reason was concern about an adverse impact on medium-sized enterprises, which form the backbone of Czech agriculture, and a preference for degressivity—that is, a mandatory 5% reduction in basic payments for amounts exceeding €150,000 per farm. The debate over the redistributive payment intensified in the Czech Republic only toward the end of this period in connection with the preparation of the Post-2023 Strategic Plan, which proposed allocating a record 23% of the direct payments budget for this purpose, sparking significant opposition from professional associations representing larger enterprises. This shift reflects growing political pressure to address the concentration of support, which in the Czech Republic is historically one of the highest in the EU (European Parliament, 2016a; European Parliament et al., 2015).

Areas with Natural Constraints

Support for agriculture in areas with natural or other specific constraints (ANC, formerly LFA) remains an integral part of the second pillar of the CAP. These compensatory payments are intended to offset additional costs and lost income in regions with disadvantaged production conditions, such as mountainous areas (ANC-M) or areas with specific limitations (ANC-O), and are of crucial importance for maintaining land management and preventing land abandonment. In the Czech Republic, these restrictions apply to more than 2 million hectares of agricultural land. Expert studies indicate that the economic viability of farms in ANC areas is strongly correlated with the level of subsidies provided, and that without this support, mountain farms focused on cattle breeding in particular would report negative net value added. Analyses also confirm that while farms in favorable conditions (non-ANC) achieve higher profitability, entities in the ANC play a key role in providing public goods, such as the maintenance of the cultural landscape and the protection of biodiversity. For the 2023–2027 period, the weight of ANC payments was included in the calculation of environmental "ringfencing" (50% share), underscoring their importance for the environmental objectives of the Strategic Plan (Hlavsa et al., 2020).

The 2013 CAP Reform and Its Impact on Czech Agricultural Policy

The 2013 reform introduced the Basic Payment Scheme as the core income support mechanism, intended to replace the earlier Single Payment Scheme. While "old" Member States had to transition to the BPS with an internal convergence mechanism, new Member States were allowed to continue under the simplified Single Area Payment Scheme until the end of 2020. The Czech Republic opted to continue with the SAPS system, which allowed it to maintain stability in the distribution of direct payments without the need to allocate payment entitlements to individual farms. Under this scheme, the option to provide transitional national support to sectors that received it in 2013 was retained, which, in the Czech context, served to partially offset differences in support levels. The total financial ceiling for direct payments in the Czech Republic saw a slight decrease of 3.4% compared to the previous period as a result of the external convergence mechanism (Espinosa et al., 2020).

CAP Reform 2021–2024 and the Czech Republic's National Strategic Plan

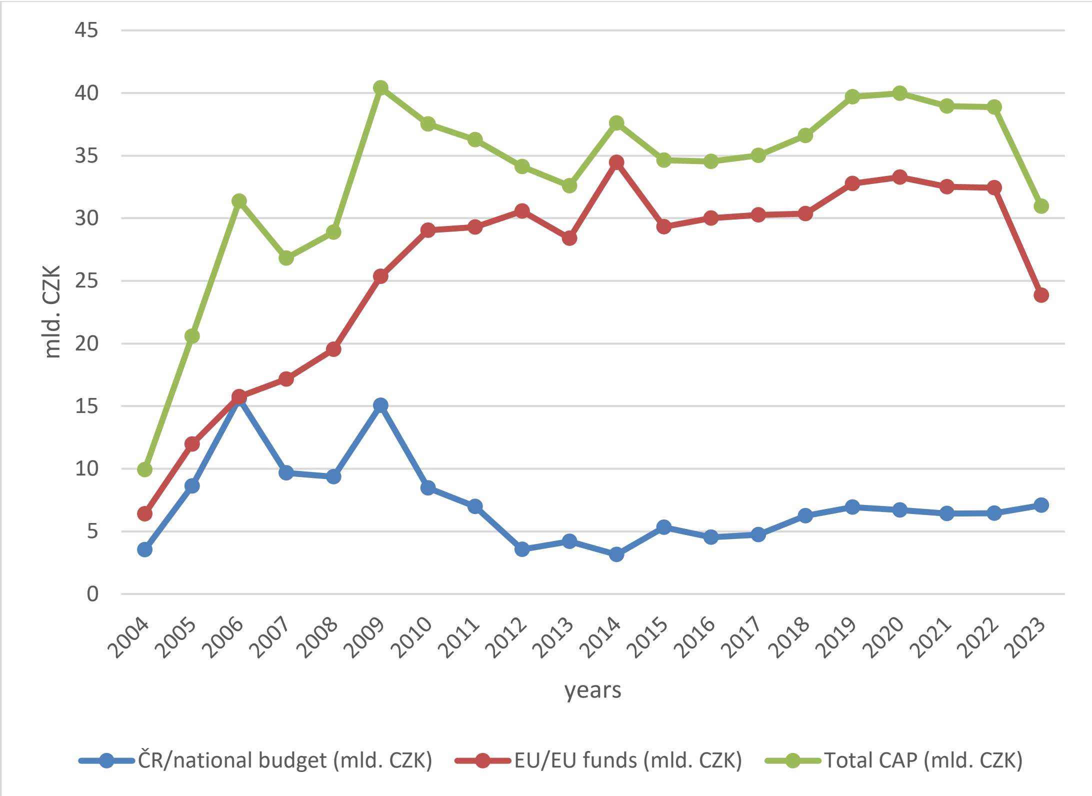
The cornerstone of the reform is the introduction of the so-called New Delivery Model, which marks a shift away from strict compliance with detailed EU-level rules toward a focus on performance and the achievement of concrete results. Under this system, Member States are required to develop a single CAP Strategic Plan that integrates interventions from both pillars—namely direct payments, sectoral support, and rural development programs—into a single coherent framework.

This model provides Member States with considerable flexibility in designing measures tailored to their specific agri-environmental and structural conditions, provided that these measures contribute to the fulfillment of the ten specific CAP objectives defined at the EU level. Part of the implementation involves the obligation to monitor progress through a common set of result indicators, with member states required to submit annual performance reports to the Commission, which serve as the basis for financial settlement. Despite the stated intention of simplification, however, academic analyses point to the growing complexity of administrative processes and the risk of fragmentation of the common policy due to divergent national approaches.

1.3.4 Trends in the Volume of Subsidies in the Czech Republic

The development of agricultural subsidies in the Czech Republic is closely linked to the implementation of the CAP. The transformation of the subsidy environment took place in several phases. The total use of Common Agricultural Policy funds from European Union sources and the national budget between 2004 and 2023, shown in Fig. 1, illustrates the dynamics of the development of subsidy support in Czech agriculture.

Fig. 1: Total use of Common Agricultural Policy resources from the national budget of the Czech Republic and the EU (2004–2023)



Source: SZIF

During the initial period (2004–2006), the level of direct payments from European funds for the new Member States was capped at 25% of the level received by the original EU-15 countries, with a subsequent gradual increase. This discrimination was partially offset by national supplementary payments, which allowed support levels to be raised by up to 30% beyond the level of EU funds. The growth in the volume of support was further bolstered by the implementation of the Horizontal Rural Development Plan. The total value of operating subsidies per hectare increased progressively during this period; for example, the SAPS rate rose from CZK 1,830.40 in 2004 to CZK 2,517.80 in 2006 (Stuchlik, 2024).

The decline in 2007 was linked to the transition between programming periods, when payments under older structural programs (particularly SAPARD) were winding down and the new Rural Development Program (RDP) was only gradually getting off the ground administratively.

The peak in drawdown was recorded in 2009, when total utilization of funds exceeded CZK 40 billion. This development was linked to the government's response to the global economic crisis, which involved accelerated disbursement of grant funds and, at the same time, the payment of a record volume of national top-up payments. The subsequent decline in 2010–2013 represented a return to the normal pace of funding following the winding down of crisis measures, as well as a gradual reduction in the importance of national top-up payments, as direct payments from the EU budget approached full levels.

The slight increase in funding in 2014 was linked to the drawdown of financial resources from the concluding 2007–2013 programming period. The decline in 2015, on the other hand, was linked to the onset of the CAP reform for the 2014–2020 period, which introduced new support instruments, notably greening and voluntary coupled support. In the following years, 2015–2017, the volume of drawdowns stabilized, reflecting the gradual stabilization of the administration of direct payments and project support (Nagy, 2024; Tomášková & Michal, 2024).

A modest increase in financial flows was subsequently recorded between 2018 and 2022. This development was influenced primarily by the full utilization of Rural Development Program allocations and, later, by extraordinary support measures responding to crisis situations, including drought compensation, support during the COVID-19 pandemic, and emergency aid related to the energy crisis and the war in Ukraine. Additional funds from the EURI instrument (NextGenerationEU) were also incorporated into the support system.

The decline in 2023 is related to the launch of the new programming cycle of the CAP Strategic Plan 2023–2027. The introduction of new intervention tools and changes in payment methodology led to delays in the disbursement of support. In the long term, however, the trend confirms that subsidy policy represents a significant stabilizing factor for the agricultural sector.

The effectiveness of subsidy interventions is fundamentally limited by the existence of the so-called deadweight effect. Empirical research conducted in the Czech Republic and Slovakia in 2012 estimated the average level of this effect at 36.8%, meaning that more than one-third of public funds were spent on projects that would have been implemented even without subsidy support. For investment projects focused on the purchase of new technologies, the probability of this effect occurring reaches up to 53,4% (Sipikal et al., 2013).

Previous research suggests that agricultural subsidies do not affect all production segments equally. While decoupled payments primarily stabilize farm income, coupled support remains particularly important for structurally sensitive and capital-intensive sectors such as livestock production (Jansson et al., 2021). Livestock production is characterized by higher fixed costs, longer production cycles, and greater exposure to market volatility, making it more dependent on long-term support mechanisms than crop production (Garrone et al., 2019; Staniszewski & Borychowski, 2020). At the same time, several studies indicate that subsidy effects may materialize with a temporal lag due to delayed investment responses and structural adjustment processes. Based on these considerations, it can be expected that changes in subsidy levels will be reflected particularly in selected quantitative indicators of Czech agriculture, especially in livestock production. Based on these theoretical assumptions and empirical findings, the following hypothesis is formulated:

H1.1.: The trend in agricultural subsidies is reflected in the quantitative indicators for agriculture in the Czech Republic.

Commodity-specific subsidy schemes and production-linked support are designed to maintain production in strategically important or economically vulnerable sectors. Previous studies indicate that these instruments may influence farmers' production decisions by reducing income risk and supporting the economic viability of selected commodities, particularly in sectors exposed to high market volatility or production constraints (European Commission, 2022b; Jansson et al., 2021). Historical quota systems and commodity-linked support mechanisms also demonstrate that agricultural policy has traditionally attempted to directly influence production structures and volumes. Based on these assumptions, a relationship between selected subsidy programs and the production volume of supported commodities can be expected. Based on these considerations, the following hypothesis is formulated:

H1.2.: Trends in tied agricultural subsidies are reflected in the production volumes of selected agricultural commodities in the Czech Republic.

1.3.5 Spatial Disparities in the Development of Agriculture in the Czech Republic

Regional economics has long highlighted the fact that economic activities tend to be unevenly concentrated across the landscape due to differences in natural conditions, historical development, and the structural characteristics of individual regions. The above-mentioned facts regarding the nature, objectives, and actual implementation of subsidy support for agricultural enterprises suggest the existence of a significant spatial dimension to their impact on the socioeconomic environment of agriculture. Although many Common Agricultural Policy instruments are designed to be universal and formally neutral with respect to the geographical location of beneficiaries, their actual impacts may exhibit significant spatial differentiation. This is determined by both the structure of agricultural production and the historical development of the agricultural sector, as well as the differing natural and economic conditions of individual regions.

As noted in previous sections, some support instruments are explicitly geographic in nature, while others may lead to an indirect spatial concentration of funds. A typical example is the compensatory payments for Areas with Natural Constraints, which are directly linked to the specific natural conditions of the territory. This support is specifically targeted at mountainous and sub-mountainous regions with the aim of stabilizing agricultural production, maintaining landscape management, and supporting the socioeconomic stability of rural areas. In addition to these explicitly spatially targeted instruments, however, there are also forms of support that can create indirect spatial effects, for example through differing farm structures, production specialization, or varying regional absorption capacities when drawing on investment support.

As a result of these mechanisms, agricultural subsidy policy in the Czech Republic may contribute to uneven regional development within the agricultural sector, with some regions exhibiting a higher concentration of economic activity and financial resources than others.

The degree of inequality in the sector is analytically quantified using the Gini coefficient, which, in the case of the economic performance of crop production enterprises in the Czech Republic, reaches an average value of 0.84. Such a high level of inequality indicates a significant concentration of economic performance among enterprises. Given the spatial organization of agriculture in the Czech Republic, it can be assumed that this concentration may also translate into regional disparities. Studies at the district level (LAU 1) identify clear clusters of economically weak regions, located predominantly in border areas (e.g., Jeseník, Bruntál, Tachov, or Ústí nad Labem), which show below-average results in both size and profit indicators. This spatial polarization is exacerbated by the varying ability of regions to absorb different types of support (Trnková & Malá, 2013).

Within the EU, the Czech system is unique in that approximately 80% of direct payments are received by only the top 20% of the largest entities. This mechanism leads to a relatively higher concentration of funds in regions dominated by large agricultural complexes, thereby creating spatial disparities even in payments that are theoretically location-neutral (Svobodová et al., 2022).

From the perspective of economic efficiency, there is a demonstrable correlation between farm size and productivity. Very large farms in the Czech Republic achieve statistically significantly higher labor productivity and total factor productivity compared to small and medium-sized farms. Economies of scale and better access to investment capital allow large enterprises to modernize more efficiently, while small farms exhibit greater relative dependence on subsidy revenues, which can account for up to 30% of their revenue. Despite the introduction of redistributive payments favoring the first hectares—which in the Czech Republic results in small enterprises receiving up to 2.3 times higher subsidies per unit of production—the absolute volume of funds remains concentrated in regions with intensive agricultural production (Svobodová et al., 2022).

Comparative analyses suggest that spatial disparities are further modified by specific compensatory mechanisms, such as payments for Areas with Natural Constraints (ANC). However, research shows that even after accounting for these location-specific compensations, significant differences in subsidy income persist across regions. These differences stem from varying production structures (e.g., greater support for sensitive commodities in fertile lowlands) and the ability to draw investment support from the Rural Development Program, which exhibits strong spatial autocorrelation with a region's overall economic strength (Sirohi et al., 2019; Střeleček et al., 2009).

The findings outlined above regarding the distributional effects of the CAP in the Czech context and the demonstrated disparities in the uptake of support suggest the existence of a significant spatial dimension to agricultural policy. Regional differentiation may be conditioned by both the structural characteristics of individual types of territories and the spatial links between neighboring regions. For this reason, the spatial dimension is examined in the subsequent analytical section of this study using two complementary approaches:

- by analyzing the differences between types of environments (ZVO and rural typology) using the Kruskal–Wallis test

- and by analyzing spatial autocorrelation using Moran's I statistic

Based on these considerations, the following hypothesis is formulated:

H2.1.: Although most subsidies and payments are "universal" in nature, there are significant differences in the amounts received across regions of the Czech Republic; this difference does not include area-specific subsidies, such as the former ANCs (LFAs).

2. Methodology

2.1 Data for assessing subsidy impacts on the agricultural economic sector

To serve as the data basis for testing hypothesis H1.1, a time series of indicators for the agricultural sector was compiled for the period 2000–2024 (25 years), based on data from the Czech Statistical Office's Satellite Account of Agriculture in constant 2000 prices. Three aggregate variables were selected as the main output indicators of the sector's performance: total agricultural production, as well as two sub-components of production (crop production and livestock production). This choice allows for monitoring not only the overall dynamics of the sector but also the potentially different responses of crop and livestock production to changes in the support framework.

The same data set also includes data on subsidies for agricultural production, which are, however, reported in current prices. To ensure temporal comparability, these nominal values were deflated to constant 2000 prices using information on the average annual inflation rate published by the Czech Statistical Office (ČSÚ). The following table presents the basic descriptive statistics for the variables used in testing hypothesis H1.1 concerning the relationship between agricultural subsidies and quantitative indicators of agriculture in the Czech Republic. Units are CZK mil.

Table 1: Variables used in testing hypothesis H1.1

Variable	Mean	Median	Min	Max	SD
Crop production	55625.57	55978.07	44032.08	64274.13	4714.99
Livestock production	47289.06	47731.01	43153.44	50550.59	2192.96
Total agricultural production	107072.37	107409.98	97219.41	115679.39	5296.67
Agricultural subsidies	17596.13	20430.53	4984.91	23984.71	6353.23
Economic result	5715.62	6390.63	-2533.2	13743.36	4145.52
Animals	23394.05	21651.49	20340.35	28274.53	2954.99
Cattle	5950.01	5829.3	5085.34	7445.12	445.16
Pigs	11650.86	10238.7	8526.78	16155.48	2618.99
Sheep and goats	155.69	113.63	36.74	371.78	112.81
Poultry	5589.37	5578.06	4618.55	6795.76	520.08
Animal products	23895.01	22845.72	21436.02	28579.12	2231.4
Milk	21116.99	20262.93	18493.85	25583.75	2100.75
Eggs	2746.91	2704.98	2257.48	3368.1	335.31

Source: Own processing

Similarly, a time series of data was compiled for subsequent testing of hypothesis H1.2. This consists of data on the production of selected agricultural commodities and subsidy programs related to this production. The data were taken from the annual reports of the Ministry of Agriculture of the Czech Republic (Agriculture 2002–2026), with the time range of this source beginning in 2002 and ending in 2024. To ensure consistency with the start of the series, subsidy values were converted to constant 2002 prices to maintain temporal comparability within the analyzed period while respecting the price base corresponding to the first year of available data. Within H1.2, selected commodities from both crop and livestock production were analyzed sequentially, specifically: potato starch, hops, sugar beets, grapes, milk, beef, fish, honey, and pork. This commodity mix allows for an assessment of the relationship between subsidy support and performance trends in heterogeneous segments of agricultural production, which differ in production cycles, market conditions, and the type of support mechanisms. The following tables presents the basic descriptive statistics for the variables used in testing hypothesis H1.2.

Table 2: Variables used in testing hypothesis H1.2 - crop production

Variable	Unit	Mean	Median	Min	Max	SD
Potato starch production	t	30795,43	30948,0	19248,0	38728,0	5493,49
Potato starch subsidies	thous. CZK	80736,96	76756,0	21434,0	151767,0	28148,25
Hops production	t	6287,83	6311,0	4338,0	8306,0	1099,86
Hops subsidies	thous. CZK	67552,17	56974,0	26555,0	126367,0	26413,02
Sugar beet production	t	3682527,48	3724309,0	2884645,0	4584713,0	487888,77
Sugar beet subsidies	thous. CZK	528168,87	453329,0	0,0	1218096,0	404224,28
Grapes production	t	75119,0	69279,0	45923,0	103704,0	16186,72
Grapes subsidies	thous. CZK	113688,57	113470,0	24500,0	331673,0	63014,66

Source: Own processing

Table 3: Variables used in testing hypothesis H1.2 - animal production

Variable	Unit	Mean	Median	Min	Max	SD
Milk production	mil. l	2909,0	2775,0	2602,0	3534,0	273,56
Milk subsidies	mil. CZK	1931,65	2050,0	1000,0	2917,0	437,45
Beef production	thous. t	174,27	170,6	164,0	201,7	9,66
Beef subsidies	mil. CZK	1567,13	941,0	378,0	4082,0	1186,08
Fish production	thous. t	20396,57	20400,0	18696,0	21800,0	767,94
Fish subsidies	thous. CZK	148137,87	144094,0	65000,0	293050,0	69265,11
Honey production	t	7735,77	7477,5	4997,0	11302,0	1574,63
Honey subsidies	thous. CZK	130353,7	141420,0	80000,0	180443,0	32030,29
Pork production	thous. t	367,0	310,5	262,9	585,4	101,59
Pork subsidies	thous. CZK	498873,78	340928,0	0,0	1329800,0	463485,53

Source: Own processing

2.2 Data for identifying spatial disparities in grant receipts and payments

The aim of testing Hypothesis H2 is to assess whether the size of a subsidy is independent of its location. Two approaches will be used for this purpose: a test of the difference in subsidy size between territorial units with ties to agriculture, and a test of spatial randomness in the distribution of subsidies. For the first test, the Czech Republic will be divided into Agricultural Production Areas (Konečný, 2015) and Rural Development Areas (Perlín et al., 2010). For this type of test, data covering the entire territory of the Czech Republic must be used (the smallest such territorial unit is the district—see the following paragraphs). These indicators have a clear link to agricultural production, and if there is no spatial link to the provision of subsidies, then these should be spatially random, and the test should reject the null hypothesis of the relevant statistical tests.

The basis for the empirical analysis of the spatial distribution of financial support in the Czech Republic's agricultural sector consists of two primary datasets: one reflecting subsidy data, which contains information on national and European subsidy programs, and another comprising spatial data, including all available data on land use and socio-economic characteristics. We used data sets publicly provided by the SZIF (https://szif.gov.cz/cs/seznam-prijemcu-nd, https://szif.gov.cz/cs/seznam-prijemcu-dotaci) for the most recent available year, which was 2023. Given the differing nature of the sources, currency units, and recipient structures of the two datasets, the data underwent specific standardization and cleaning processes to ensure their mutual compatibility for subsequent spatial analysis. The data could be used for spatial analysis because, in addition to information on the recipient and the amount of the grant, it includes information on the location of the recipient's headquarters within a municipality and/or district. The data thus holds potential for analysis at the municipal or district level.

Redistribution entities (member associations, umbrella organizations, and food banks) were excluded from the grant data for the area of national support, as it is not possible to validly assign a grant to the location of implementation for these entities, since the registered headquarters of the recipient never corresponds to the spatial distribution of the final users of the support. For the following analyses, a threshold of over CZK 1 million in total received funds was applied for exclusion. The reason was a fundamental methodological limitation that had to be taken into account during processing, namely the recording of subsidy flows based on the recipient's administrative registered office. The database records the location of subsidy implementation, but the recipient's registered office, which for large enterprises is unrelated to the location of subsidy implementation. In the case of large agricultural enterprises and holding structures (particularly entities within the Agrofert group), this fact can significantly distort the actual geographical targeting of funds, as operational activities are often carried out in districts other than those where the company's registered office is located. Data for national support are in Czech korunas (CZK).

Data on subsidies financed from European Union funds are recorded in euros (EUR). Unlike the national subsidy database, this dataset does not show a significant concentration of funds in supra-regional holding structures or umbrella organizations. A more substantial volume of funds was identified only in individual cases (e.g., Madeta, a.s. or the Czech Beekeepers' Association), but these cases did not represent a systematic spatial distortion. Only funds directed toward technical assistance provided through the SZIF and the Ministry of Agriculture were explicitly removed from the database, as these constitute institutional expenditures (EUR 3.7 million) related to the administration of subsidy policy, rather than direct support for agricultural enterprises. For multiannual measures, particularly "Investments in Tangible Assets" and "Fruit for Schools," only those records for which an actual payment from EU funds was recorded in 2023 were retained. Cases where only national co-financing took place in the given year without a financial flow from European sources were excluded from the analysis. In terms of the construction of financial variables, only amounts by operation under the EMFF and amounts by operation under the EAFRD were used, as these represent actual expenditures from both relevant European funds. Subsequently, the amounts from the EMFF and EAFRD were consolidated into a single variable allowing for aggregation by grant type and spatial unit.

Unlike national grants, which were analyzed as a whole, the structure of the EU grant database allows for analysis by individual measure. Only those grant titles containing at least 1,000 records in the prepared database were included in the detailed analysis to ensure sufficient statistical robustness and limit the influence of random outliers. Specifically, these are the following measures:

- SAPS
- Organic farming
- Voluntary coupled support
- Financial discipline compensation
- GREENING

- Animal welfare
- Payment for young farmers
- LEADER
- Investments in tangible assets
- Afforestation and forest establishment
- Area-specific constraints
- AECM

At the same time, the total volume of all EU subsidies was analyzed as a separate variable representing the overall flow of European funds to agricultural enterprises in the Czech Republic.

All records without territorial identification at least at the district level (these data could not be further processed), items with an unidentified subsidy fund, and all refund transactions expressed as negative values were subsequently removed from both databases. Records for which the recipient's municipality of residence was specified could be further processed down to the municipal level; all records could then be processed down to the district level. Subsidy data for individual recipients were aggregated for further analysis to the municipal level, or to the level of municipal districts with an authorized municipal office (POÚ), and to the district level.

Preliminary analyses of the data prepared in this manner at the level of district-aggregated data showed that the absolute amount of subsidies at the district level is always strongly dependent on the size of the territorial unit. Analyses not related to district size yielded statistically significant results, but the spatial pattern was identical across individual subsidy programs: districts with a small area (especially in northwestern Bohemia) were systematically identified as areas with low subsidy values, while the extensive districts of the Vysočina Region and southern Bohemia were identified as areas with high subsidy values. This pattern indicates a structural influence of district size on the total volume of subsidies.

To eliminate this effect, the area of agricultural land in the territorial unit designated for further analysis (municipality, POÚ, district) in which the recipient's registered office is located data on the area of agricultural land were obtained at the municipal level from the Territorial Analytical Data for 2023, available from the Czech Statistical Office. The analytical variable thus became the subsidy value converted to one hectare of agricultural land. This transformation does not serve as a normative expression of “subsidy per hectare” in an economic sense, but rather as a tool to filter out the influence of territorial size and enable comparability between units. Although individual measures exhibit different relationships to the area of agricultural land (direct, indirect, or none), uniform standardization was chosen for the sake of methodological consistency and the ability to analyze both the aggregate flow of national and European funds and selected measures within a unified analytical framework.

For the analyses, three datasets were thus created on aggregated national and European subsidies related to the area of agricultural land at the levels of municipalities, POÚs, and districts. The following table presents the basic descriptive statistics for subsidy variables expressed per hectare of agricultural land. Units are subsidy per ha.

Table 4: Variables used in testing hypothesis H2.1

Variable	Mean	Median	Min	Max	SD	CV (%)	Obs.
National subsidies_ha	1379,1776	258,1291	0,2938	160725,3174	5401,0995	391,62	2741
EU subsidies_ha	312,6429	156,6086	0,0125	9443,509	488,492	156,25	5218
AECM_ha	32,1961	15,4464	0,0591	1238,9135	58,0497	180,3	3624
VCS_ha	38,8641	13,3123	0,0568	1023,1498	70,4785	181,35	4226
AW_ha	24,4582	15,8302	0,065	313,8605	30,0595	122,9	780
Organic farming_ha	28,8627	12,0836	0,0125	1212,0109	60,4448	209,42	1887
GREENING_ha	65,681	31,0711	0,2009	1881,5058	104,4671	159,05	5032
ITA_ha	71,463	32,8948	0,1283	2004,0489	154,7903	216,6	1011
FDR_ha	3,5008	1,5053	0,0001	101,7345	5,7753	164,97	4735
LEADER_ha	27,623	14,8467	0,3834	1752,7331	64,614	233,91	1875
SAPS_ha	118,3162	56,9073	0,3652	3344,2345	185,9669	157,18	5036
Afforestation_ha	2,8896	0,3264	0,0082	769,4637	36,03	1246,87	460
Young farmers_ha	3,8173	1,8519	0,0248	147,3285	6,5545	171,7	1441

Source: Own processing

2.3 Analysis of the Relationship Between Agricultural Indicators and Subsidy Levels

Before testing causal relationships between agricultural subsidies and selected agricultural indicators, the stationarity of all time series was verified. Stationarity represents a key assumption for time-series analysis, as non-stationary data may lead to spurious regression results and misleading statistical inference. The Augmented Dickey–Fuller (ADF) test and the KPSS test were applied to assess the order of integration of individual variables. Variables identified as stationary at levels were analyzed using standard Granger causality tests, while non-stationary variables were evaluated using the Toda–Yamamoto causality approach, which allows causal inference without requiring prior differencing or cointegration testing.

Causality tests were used to examine whether changes in subsidy volumes preceded changes in agricultural production indicators. For stationary series, the standard Granger causality framework was applied. In cases where variables exhibited non-stationarity, the Toda–Yamamoto procedure was preferred, as this method reduces the risk of invalid inference caused by integrated processes and enables testing within an augmented VAR framework.

Testing hypotheses H1.1 and H1.2 involves testing the relationship between the time series of subsidies and the time series of the agricultural index. This is therefore an econometric analysis. The data collected as a basis for testing the hypothesis can be successfully analyzed using the approach named after its author, Granger causality, which essentially tests whether the values of one variable can be used to model the future values of the other variable better than the historical values of that second variable, and vice versa. Therefore, if we cannot reject the null hypothesis that there is no Granger causality relationship between these two variables, then it follows that some relationship between these variables exists; our goal here is not to "prove" Granger causality, but to identify a potential relationship between the two variables. The problem is that this test was statistically performed on stationary time series. The Granger causality model is expressed as:

$$\boldsymbol{Y_t = \alpha + \sum_{i=1}^{p} \beta_i Y_{t-i} + \sum_{i=1}^{p} \gamma_i X_{t-i} + \varepsilon_t} \tag{1}$$

Where Y_t represents the selected agricultural indicator, $X_t$denotes subsidy volume, $p$is the lag length, and $\varepsilon_t$is the error term.

Unfortunately, the data obtained for testing the H1 hypothesis are generally not stationary (tested using the Augmented Dickey-Fuller test for the null hypothesis of a unit root of a univariate time series x and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test for the null hypothesis that x is a stationary univariate time series in R using commands from the tseries package). (Dickey & Fuller, 1979; Kwiatkowski et al., 1992)). Therefore, the Toda-Yamamoto Causality Test was used to test the hypothesis, specifically the version published here: https://github.com/nicolarighetti/Toda-Yamamoto-Causality-Test. The lag length was selected based on the results of the *VARselect* function, which analyzes the four indicators AIC, HQ, SC, and FPE. Subsequently, the stability of the model was tested using this lag length with the Portmanteau–Breusch-Godfrey test for serially correlated errors and a stability plot. If the data are stationary, the *grangertest* function from the lmtest package was used directly. (Zeileis & Hothorn, 2002). For non-stationary variables, the Toda–Yamamoto approach was used:

$$\boldsymbol{VAR}(\boldsymbol{p} + \boldsymbol{d_{max}}) \quad (2)$$

Where p represents the optimal lag length and $d_{max}$the maximum integration order of the variables. All calculations were performed in R.

2.4 Spatial Data Analysis

Hypothesis H2 was tested using two approaches. The first approach tests for potential differences in the amount of subsidies across individual agricultural production areas and rural municipalities, classified according to their type in the rural development categorization.

Under the current classification, agricultural production areas include corn-growing (K), sugar beet-growing (Ř), potato-growing (B), and mountain areas (H) (Konečný, 2015). The typology of rural development then includes municipalities in the following regions: – Developing Rural Areas (rural1), Non-Developing Neighbouring Rural Areas (rural2), Moravian Peripheries (rural3), Well-Equipped Moravian Rural Areas (rural4), Problematic Recreational Rural Areas (rural5), Intensive Recreational Areas (rural6), Structurally Disadvantaged Industrial Rural Areas (rural7), and Non-Distinctive Rural Areas (rural8) (Perlín et al., 2010).

The statistical analysis was conducted at the municipal level, or rather at the POÚ level, and only for those units that were explicitly identified in the grant data (see subsection 2.2). In the case of ZVO, the analysis was conducted directly at the municipal level. ZVO are listed at the cadastral level, and municipalities were assigned the ZVO that predominates in terms of area within the municipality. The rural typology is defined at the POÚ level; therefore, the data for municipalities were first aggregated according to their affiliation with POÚs.

To test hypothesis H2, the Kruskal-Wallis test with a Dunn post-hoc test and Bonferroni correction was always used for individual subsidy types. The data were visualized using a violin plot. The calculations were performed in the R environment.

The second approach to testing hypothesis H2 was a spatial autocorrelation test. If the grants are spatially independent, then their distribution should be random—if it is not random, then this fact can be revealed by spatial autocorrelation analysis, and the distribution of grants is therefore not spatially random. The spatial analysis was performed at the district level, as complete data covering the entire territory of the Czech Republic are available only at this level (see subsection 2.2.)

First, Global Moran's I, an index of global spatial autocorrelation, was applied to test whether the spatial distribution of the observed variable is random, regular, or clustered.

Subsequently, a local cluster analysis was performed using Anselin's Local Moran's I (LISA), enabling the identification of specific districts forming high–high and low–low clusters, i.e., areas where there is a concentration of districts with high or low subsidy levels. Global Moran's I is expressed as:

$$\boldsymbol{I} = \frac{\boldsymbol{n}}{\boldsymbol{W}} \frac{\sum_i \sum_j \boldsymbol{w_{ij}}(\boldsymbol{x_i} - \boldsymbol{\bar{x}})(\boldsymbol{x_j} - \boldsymbol{\bar{x}})}{\sum_i (\boldsymbol{x_i} - \boldsymbol{\bar{x}})^2} \tag{3}$$

Where I denotes the Global Moran's I statistic, n is the number of spatial units included in the analysis, x_i and x_j represent the values of the analyzed variable in spatial units i and j, $\bar{x}$ is the mean value of the analyzed variable, w_{ij} is the element of the spatial weights matrix expressing the spatial relationship between units i and j, and W is the sum of all spatial weights.

The K-nearest neighbors method was chosen for constructing spatial weights, with the number of nearest neighbors set to k = 8. This choice corresponds to the average nature of district neighborhood in the Czech Republic and is methodologically more appropriate than working with centroid distances, particularly given the size and shape of the districts. The data were standardized prior to the actual calculation. The chosen specification of spatial relationships proved to be statistically stable for most of the analyzed grant programs and represents a methodologically appropriate model configuration. The calculations were performed for all grants in the ArcGIS PRO environment.

3. Research results

3.1 The Impact of Subsidies on Agricultural Production Indicators

As part of the testing of hypothesis H1.1, the statistical relationship between changes in subsidy support and selected output variables of the agricultural sector was analyzed. No statistically significant association was found for economic performance ($\chi^2 = 3.99$; $p = 0.136$), suggesting that the intensity of subsidies alone at this level does not explain changes in the sector's overall economic performance. Similarly, no relationship was confirmed for the indicator of agriculture as a whole ($\chi^2 = 5.35$; $p = 0.148$); thus, it cannot be claimed that changes in subsidy support are directly linked to changes in the aggregate performance of agriculture.

When broken down by production components, a marked asymmetry emerges. No statistically significant relationship was identified for crop production ($\chi^2 = 3.95$; $p = 0.684$), meaning that the level of subsidy support cannot predict trends in crop production. In contrast, a clear and statistically highly significant association was found for livestock production ($\chi^2 =$

51.88; $p = 1.97\times10^{-9}$). The results also show that the significance of the relationship is consistently evident at a lag of 5, implying that the impact of subsidy support on livestock production materializes with a lag of approximately five years. In interpretive terms, this means that the development of subsidies represents a relevant predictor of the future trajectory of livestock production, whereas this effect may not be apparent in the sector's aggregate indicators because it is masked by the dynamics of crop production, for which a relationship with subsidies has not been confirmed.

To verify the robustness of this conclusion, the analysis was extended to a more detailed breakdown of livestock production based on CZSO data. At this level, the original finding is confirmed: the aggregate category "animals" (11) shows a statistically significant relationship with subsidies ($\chi^2 = 38.81$; $p = 7.80\times10^{-7}$). A statistically significant relationship was further identified for cattle (11.1) ($\chi^2 = 17.81$; $p = 0.0067$) and particularly for pigs (11.2), where the association is exceptionally strong ($\chi^2 = 153.07$; $p < 0.001$). Conversely, no association was demonstrated for the sheep and goats category (11.4) ($\chi^2 = 4.23$; $p = 0.646$). For poultry (11.5), it was not possible to apply the test in a statistically valid manner due to a violation of the assumption of no autocorrelation in the analyzed time series.

A similar picture is provided by the results for the animal products group (12), where a highly significant association was found ($\chi^2 = 54.27$; $p = 6.49\times10^{-10}$). Significance is also confirmed for milk (12.1) ($\chi^2 = 57.25$; $p = 1.63\times10^{-10}$), while for eggs (12.2) it was not possible to perform the test for the same methodological reason, i.e., a violation of the assumption of no autocorrelation in both time series.

In summary, the results show that total subsidies have a statistically significant impact on the development of livestock production, both at the level of animals and at the level of animal products, with the effect manifesting itself with a lag of around five years. At the same time, however, this relationship is not apparent in aggregated indicators of agriculture as a whole or in crop production, which supports the interpretation that subsidy impulses materialize unevenly within the sector and predominantly influence production segments with higher input intensity and a more complex production structure, typically livestock production.

Hypothesis H1.2 was tested at the level of selected commodities to verify whether commodity-specific subsidies statistically significantly precede (and thus "influence") the development of commodity production. Depending on the properties of the time series, standard causality tests were used for stationary series (with the lag selected according to lag), and in cases of non-stationarity, the Toda–Yamamoto causality test was applied.

For starch (stationary series; lag = 1), no statistically significant relationship between subsidies and production was found (F = 1.57; p = 0.225). Similarly, for hops (stationary series; lag = 6), the result did not indicate a causal relationship in the direction of subsidy → production (F = 0.61; p = 0.718). However, the opposite direction is interesting for hops, where a statistically significant relationship between production and subsidies was demonstrated (F = 38.17; p = 0.0017), suggesting that future developments in subsidy allocation may be shaped to some extent by actual production, rather than the other way around.

For sugar beets (stationary series; lag = 6), the subsidy → production relationship was not confirmed, although the test statistic suggests an increased effect; the result remains just below the threshold of statistical significance (F = 10.90; p = 0.086). Similarly, for wine (stationary series; lag = 6), the subsidy → production relationship was not demonstrated, though the result is again very close to being insignificant (F = 5.22; p = 0.0658). These two cases indicate the potential existence of a weaker relationship, which did not prove statistically significant at the conventional significance level under the available test settings.

For commodities with non-stationary series, the Toda–Yamamoto test (lag = 1) was used. For milk, no causality was demonstrated in the direction of subsidy → production (χ^2 = 1.54; p = 0.674). Similarly, no statistically significant relationship was identified for beef (χ^2 = 0.67; p = 0.714) or fish (χ^2 = 0.47; p = 0.789). For pork, the subsidy → production relationship was also not confirmed (χ^2 = 4.25; p = 0.236). The results thus consistently show that, based on the analyzed time series, it cannot be claimed for these commodities that the development of commodity subsidies predetermines the subsequent development of production.

For honey (stationary time series; lag = 6), no statistically significant causality was identified in the direction of subsidy → production (F = 1.32; p = 0.441); thus, it cannot be demonstrated that subsidy support systematically precedes changes in honey production.

Overall, therefore, H1.2 is not supported at the level of individual commodities: commodity-specific subsidies do not, in most cases, exhibit a statistically demonstrable causal relationship with subsequent production trends. The only significant exception is the finding of reverse causality for hops (production → subsidies), which suggests that subsidy allocation may in some cases respond to production trends. At the same time, the results complement the conclusions from H1.1 in the sense that, although commodity-specific subsidy → production relationships are not generally evident in this analysis, sector-aggregated subsidies may have a significant impact on broader segments of production (particularly livestock production), which may not be statistically apparent at the level of individual commodities.

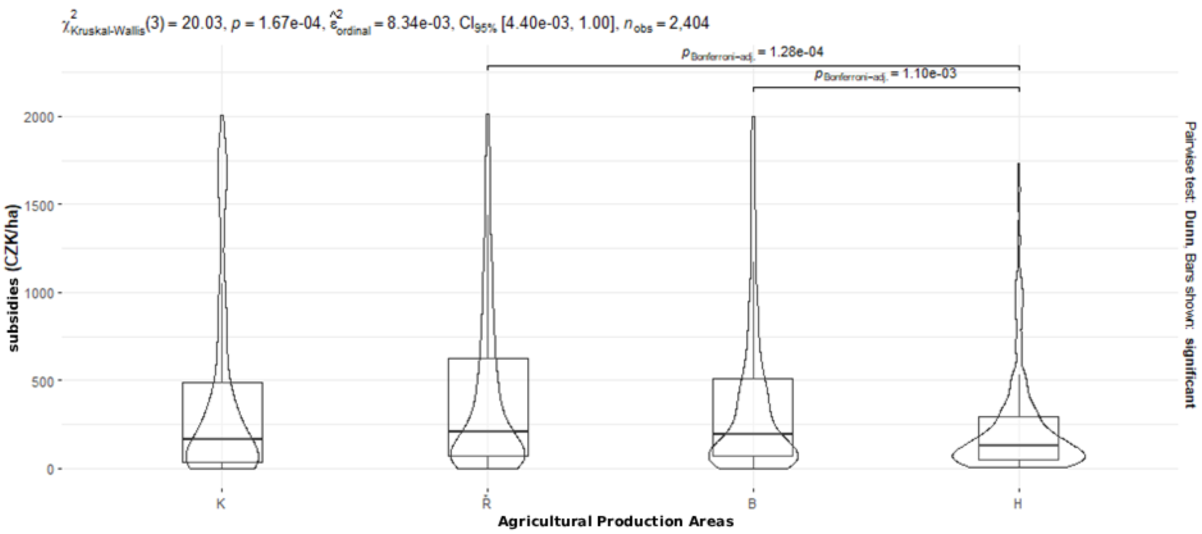
3.1.1 Statistical Analysis

3.1.2 National Subsidies (Czech Republic)

The results of the distribution of national agricultural subsidies per hectare revealed statistically significant differences between the regions under study ($H(3) = 20.03$; $p = 1.67 \times 10^{-4}$; $n = 2{,}404$), although the effect size was relatively small ($\varepsilon^2 = 8.34 \times 10^{-3}$). A post-hoc analysis using Dunn's test with Bonferroni correction identified statistically significant differences, particularly between the sugar beet and mountain regions ($p\_adj = 1.28 \times 10^{-4}$) and between the potato and mountain regions ($p\_adj = 1.10 \times 10^{-3}$). These results confirm that the distribution of national subsidies per hectare differs statistically significantly among individual agricultural production regions.

The visualization using a violin plot (Fig. 2) also shows that the distribution of subsidy amounts is relatively heterogeneous across all production regions and characterized by significant right-skewed distributions, suggesting the presence of a small number of units with relatively high subsidy amounts. Median values differ across regions, with the lowest level of support observed in mountainous areas, while higher values are concentrated primarily in regions more favorable for production. The results show that national subsidies are significantly less allocated in mountainous areas, while higher support intensity is evident primarily in the sugar beet production area. This pattern corresponds to a spatial logic in which national support, in aggregate, is linked to territories with more favorable production conditions for arable farming.

Fig. 2: National Subsidies (Czech Republic) - Agricultural Production Areas



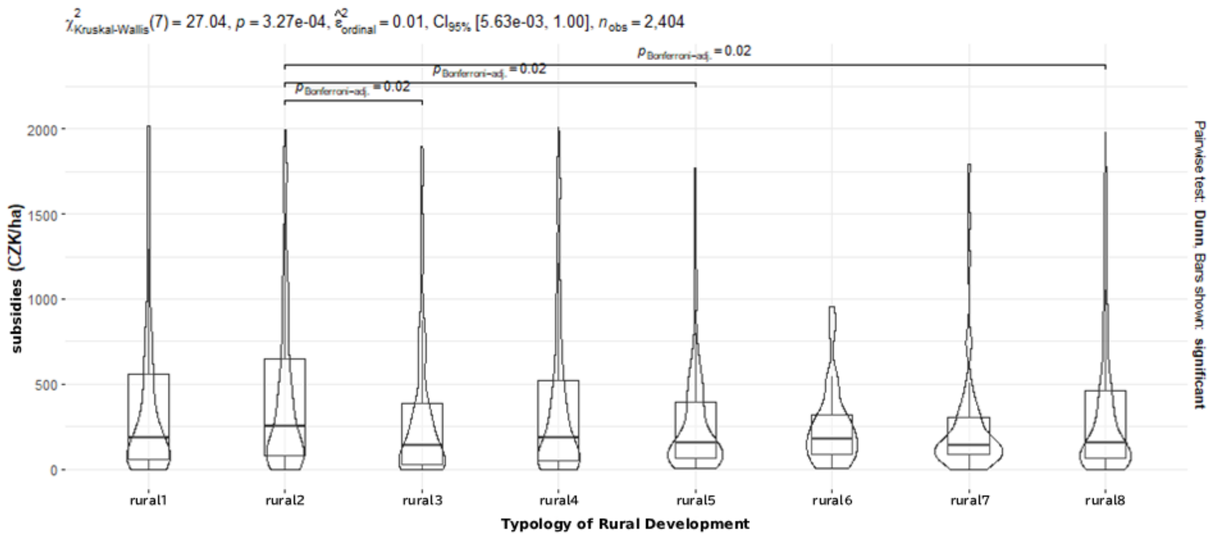
Source: Own processing

A more detailed analysis based on rural development typology (Fig. 3) suggests that high values in the sugar beet-growing ZVO are not necessarily linked to the “development status” of the area. The highest intensity is concentrated primarily in rural2 (non-developmental rural areas of Bohemia and western Moravia), which suggests that the decisive factor may be a combination of suitability for agricultural production and the institutional/practical capacity to utilize support, rather than the general development profile of the rural area.

The Kruskal-Wallis test also confirms statistically significant differences between individual types of rural areas ($\chi^2(7) = 27.04$; $p = 3.27 \times 10^{-4}$), although the effect size is small ($\varepsilon^2 \approx 0.01$). The violin plot shows a heterogeneous distribution of values with right-skewed variances, suggesting the existence of a smaller number of municipalities with higher support intensity.

The spatial pattern is also consistent with the results from the ZVO, where higher values were identified in areas more favorable for production, while mountainous areas showed lower levels of support. The distribution of national subsidies thus exhibits a statistically significant, albeit rather moderate, differentiation between rural types, which supports Hypothesis H2 regarding the existence of regional differences in their distribution

Fig. 3: National Grants (Czech Republic) – Typology of Rural Development



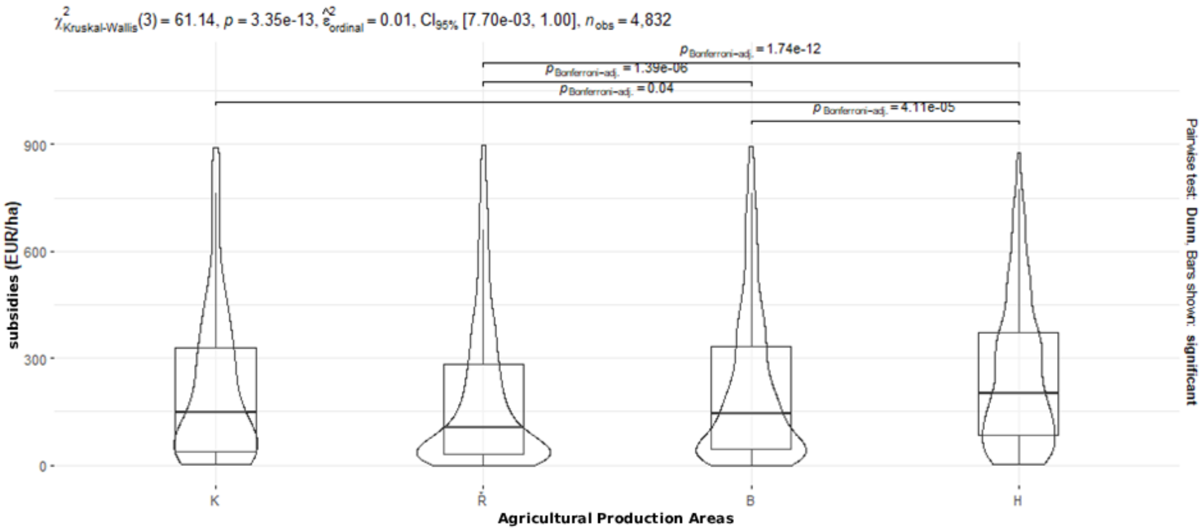
Source: Own processing

3.1.3 EU subsidies

The results of the distribution of total European Union subsidies per hectare revealed statistically significant differences between the regions under study ($H(3) = 61.14$; $p = 3.35 \times 10^{-13}$; $n = 4{,}832$), although the effect size remains relatively small ($\varepsilon^2 = 0.01$). A post-hoc analysis using Dunn's test with Bonferroni correction identified significant differences between several pairs of production areas, particularly between the mountainous area and the other ZVO categories. The results confirm that the intensity of European agricultural subsidy uptake per hectare differs statistically significantly among individual production areas.

The violin plot (Fig. 4) shows that the distribution of subsidy amounts is relatively heterogeneous across all production areas, with the highest median subsidy amounts observed in mountainous areas. EU subsidies thus exhibit a different spatial logic than national support. Significantly higher support intensity is directed toward mountainous areas than toward other production areas. At the same time, higher median values also appear in the potato-growing region compared to the beet-growing region, although this difference is not as pronounced. This pattern corresponds to the spatial distribution of agricultural production areas in the Czech Republic, where mountainous areas are primarily located in border mountain ranges (e.g., Šumava, Krušné hory, Krkonoše, Jeseníky, or Beskydy), which are characterized by less favorable natural conditions for intensive agriculture. EU subsidies, in aggregate, correspond more closely to territorial targeting of disadvantaged and climatically less favorable areas, which is in line with the CAP's objectives aimed at supporting Areas with Natural Constraints.

Fig. 4: EU Subsidies – Agricultural Production Areas

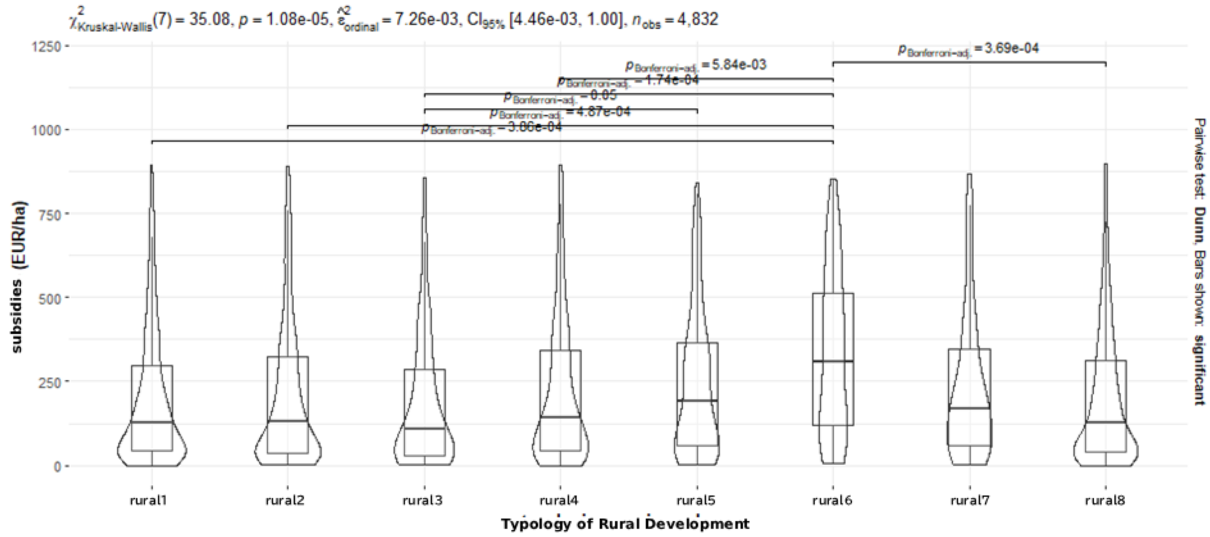


Source: Own processing

In the typology of rural development (Fig. 5) rural6 (intensive recreational areas) stands out clearly; it corresponds primarily to mountainous regions and exhibits the highest median support values. The Kruskal-Wallis test confirms statistically significant differences between rural types ($\chi^2(7) = 35.08$; $p = 1.08 \times 10^{-5}$), although the effect size remains low ($\varepsilon^2 \approx 0.007$).

The higher values for rural5 (problematic recreational rural areas) compared to rural3 (Moravian periphery) can be largely explained by geographical location; municipalities in rural3 are more often found in valleys and areas more favorable for production, while rural5 includes a significant portion of mountainous and submontane regions. This pattern is consistent with the results from the ZVO, where the highest intensity of EU subsidies is directed precisely toward mountainous areas. The rural typology thus confirms that European subsidies are concentrated to a greater extent in areas with less favorable natural conditions, which corresponds to the CAP's targeting of disadvantaged regions.

Fig. 5: EU Subsidies – Types of Rural Development



Source: Own processing

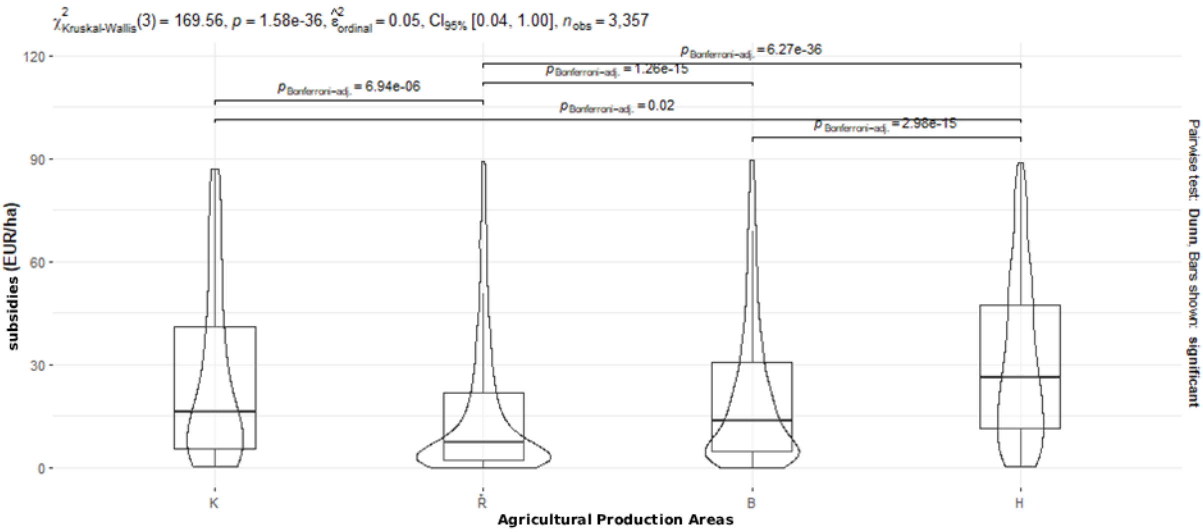
Rural typology confirms that the spatial logic of European subsidies differs from that of national support. While national subsidies are more closely linked to productive areas suitable for intensive arable farming, EU subsidies, on the whole, are directed to a greater extent toward disadvantaged areas, particularly mountainous and sub-mountainous regions. This pattern is consistent with the objectives of the Common Agricultural Policy, which include supporting agricultural production in ANC and stabilizing rural regions with harsher natural conditions.

Agri-environmental and Climate Measures

The results of the agri-environmental and climatic measures revealed statistically significant differences between the studied regions ($H(3) = 169.56$; $p = 1.58 \times 10^{-36}$; $n = 3{,}357$), with a larger effect size compared to previously analyzed studies ($\varepsilon^2 = 0.05$). A post-hoc analysis using Dunn’s test with Bonferroni correction identified statistically significant differences between most pairs of production areas, particularly between the mountainous area and the other ZVO categories. The results confirm a marked differentiation in the intensity of AECM support among individual agricultural production areas.

Visualization using a violin plot (Fig. 6) shows that the highest mean support values are concentrated primarily in the mountainous production area, while lower values appear mainly in the sugar beet area. Higher support values also appear to a greater extent in the corn area, although the difference here is not as pronounced as in the mountainous area. This pattern corresponds to the nature of AECM measures, which are closely linked to environmental management regimes and landscapes with a higher degree of ecological constraints or protection. The spatial distribution of production areas in the Czech Republic shows that mountainous areas are concentrated primarily in border mountain ranges, where agricultural management is often associated with a higher degree of environmental constraints. These areas are also characterized by a higher proportion of permanent grasslands, extensive pastures, and ecologically valuable habitats, often located in protected landscape areas or within the Natura 2000 network. It is precisely these types of areas and farming practices that align with the focus of agri-environment-climate measures, which support, for example, sustainable grassland management, reduced production intensity, or biodiversity conservation—which may explain the higher intensity of this support in mountainous regions. The higher intensity of AECM support in these regions thus aligns with the environmental focus of this subsidy program and its targeting of more sustainable forms of land management.

Fig. 6: AECM – Agricultural production areas

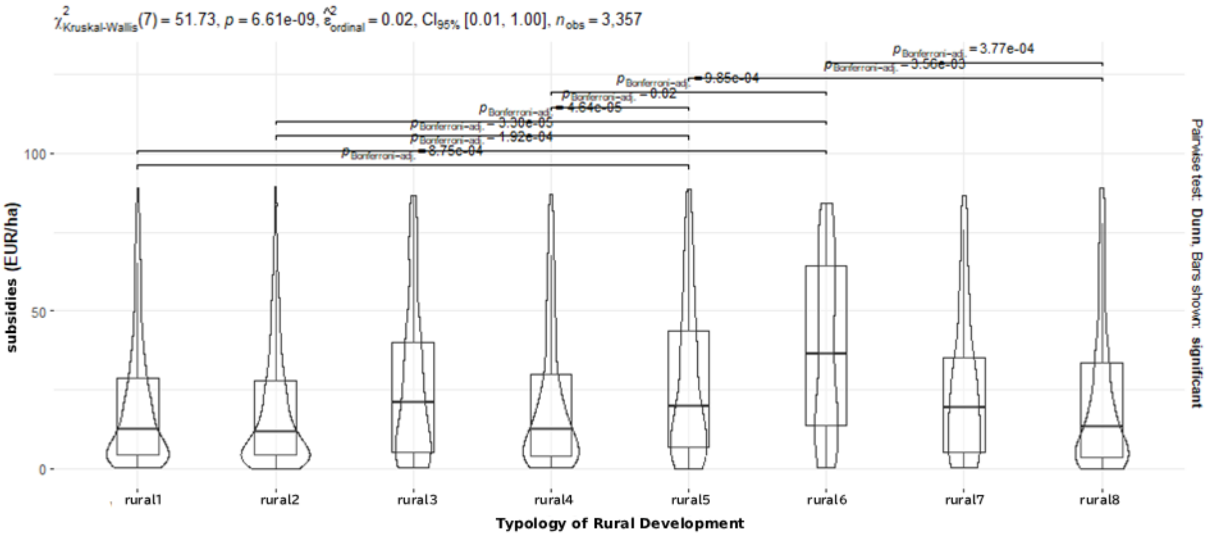


Source: Own processing

Higher values in the rural typology (Fig. 7) are particularly evident in rural6 (intensive recreational areas), which corresponds mainly to mountainous and foothill regions. The Kruskal-Wallis test also confirms statistically significant differences between individual rural typologies ($\chi^2(7) = 51.73$; $p = 6.61 \times 10^{-9}$), with the effect size being slightly higher compared to previous grant programs ($\varepsilon^2 \approx 0.02$). The violin plot shows relatively pronounced differences in medians and variability of values among individual rural types, with the highest median support values concentrated precisely in recreation-oriented mountain areas.

This pattern is consistent with the results of the ZVO analysis, where the highest AECM support values were identified in mountainous production areas. The rural typology thus confirms that agri-environment-climate measures are more strongly associated with areas subject to greater environmental constraints and with landscapes featuring a higher proportion of permanent grassland and extensive farming practices. Higher support values in these areas therefore reflect the environmental focus of this subsidy program and its targeting of more sustainable farming practices in mountainous and sub-mountainous regions.

Fig. 7: AECM – Typology of Rural Development



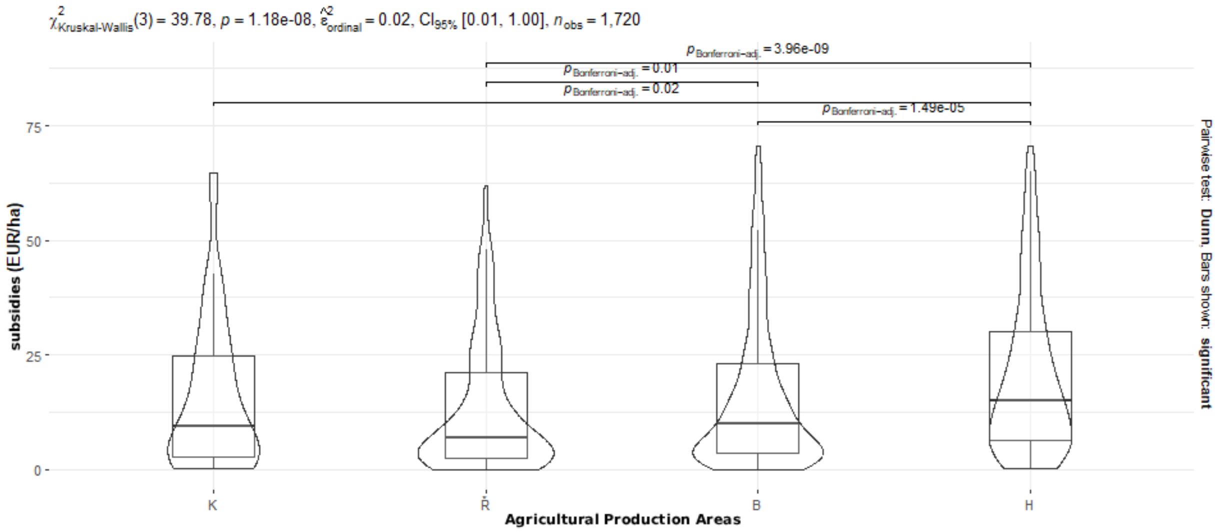
Source: Own processing

Organic Farming

The distribution of subsidies for organic farming was analyzed by agricultural production region using the Kruskal-Wallis nonparametric test. The results showed statistically significant differences between individual production areas ($H(3) = 39.78$; $p = 1.18 \times 10^{-8}$; $n = 1{,}720$), with the effect size being relatively low to moderate ($\varepsilon^2 = 0.02$). A post-hoc analysis using Dunn's test with Bonferroni correction confirmed statistically significant differences, particularly between the mountainous production area and the other ZVO categories. The results thus suggest that the intensity of support for organic farming differs statistically significantly among individual production areas.

Visualization using a violin plot (Fig. 8) also shows that the highest mean support values are concentrated primarily in the mountainous production area, while lower values are evident particularly in the sugar beet-growing area. In organic farming, there is thus a clear link between the intensity of support and mountainous areas. This result also corresponds to the spatial distribution of agricultural production areas in the Czech Republic, where mountainous areas are concentrated primarily in border mountain ranges, such as the Šumava, Krušné hory, Krkonoše, Jeseníky, and Beskydy regions. Organic farming here can be interpreted as a phenomenon associated primarily with extensive farming systems and a higher proportion of grasslands and pastures, which are dominant in these regions. The higher level of support for organic farming in mountainous areas thus corresponds both to the production conditions of these territories and to the environmental objectives of agricultural policy aimed at promoting more sustainable forms of land management.

Fig. 8: Organic Farming – Agricultural Production Areas

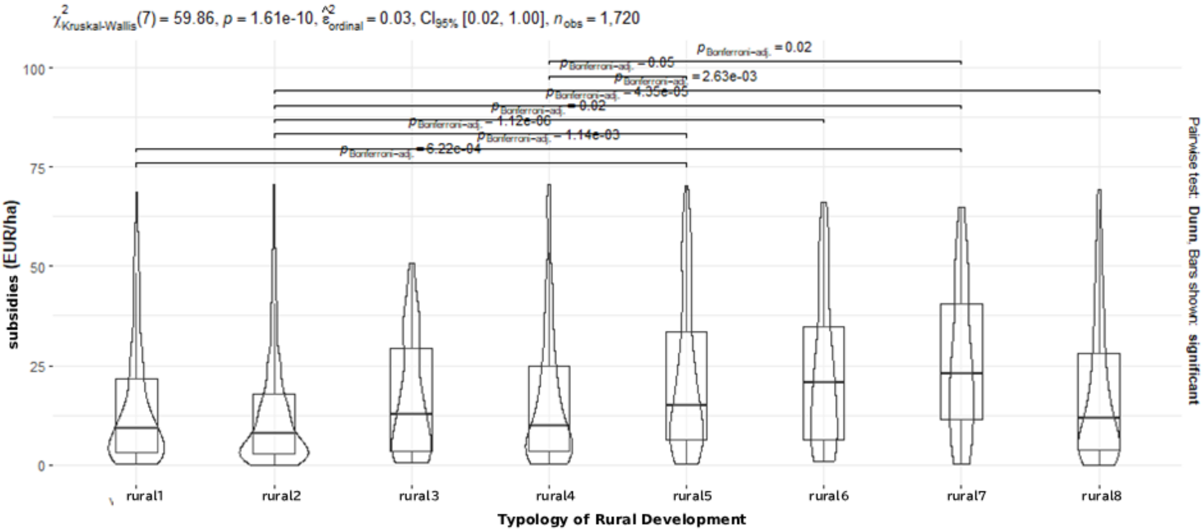


Source: Own processing

In the rural development typology (Fig. 9) lower values are observed in underdeveloped rural areas (rural2), which, according to the typology map, are concentrated primarily in the inland regions of Bohemia and western Moravia. The Kruskal-Wallis test also confirms statistically significant differences between the individual rural types ($\chi^2(7) = 59.86$; $p = 1.61 \times 10^{-10}$), with the effect size reaching slightly higher values than in some previous studies ($\varepsilon^2 \approx 0.03$). Conversely, higher support values are concentrated primarily in types associated with mountainous and submontane environments, particularly in intensive recreational areas (rural6) and problematic recreational rural areas (rural5). These types are located primarily in the border mountain ranges of the Czech Republic on the rural development typology map. Higher values are also evident in the structurally disadvantaged industrial countryside (rural7), which is located primarily in the northwestern and northern parts of Bohemia.

This spatial pattern also corresponds to the results of the analysis based on the ZVO, where the highest intensity of organic farming support was identified in mountainous production areas. The rural typology thus confirms that organic farming is spatially more strongly linked to mountainous and peripheral regions with a higher proportion of grassland and extensive farming practices.

Fig. 9: Organic Farming – Typology of Rural Development



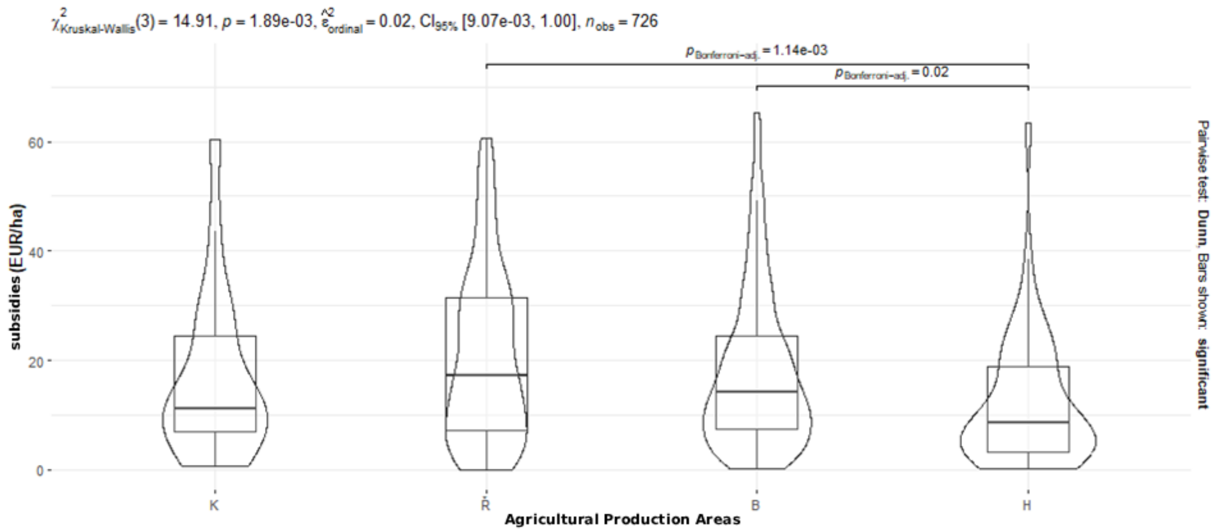
Source: Own processing

Animal welfare - AW

The distribution of subsidies under the Animal Welfare measure was analyzed by agricultural production area using the Kruskal-Wallis nonparametric test. The results showed statistically significant differences between the individual production areas (H(3) = 14.91; p = 1.89×10^{-3}; n = 726), although the effect size is relatively low ($\varepsilon^2 = 0.02$). A post-hoc analysis using Dunn's test with Bonferroni correction identified statistically significant differences, particularly between the sugar beet and mountain regions, and further between the potato and mountain regions. The results thus confirm that the intensity of AW support differs statistically significantly among individual agricultural production regions.

Visualization using a violin plot (Fig. 10) shows that the lowest intensity of support occurs in the mountainous production area, while the highest values are concentrated in the sugar beet-growing area, with the potato-growing area falling roughly between these two categories. This pattern also corresponds to the spatial distribution of agricultural production areas in the Czech Republic, where sugar beet-growing areas are concentrated primarily in the fertile lowland regions of Central Bohemia, the Elbe River Basin, and parts of South Moravia, where there is also a higher concentration of intensive livestock production. Conversely, mountainous production areas are found mainly in the mountainous border regions, where more extensive forms of farming prevail and there is a lower concentration of intensive livestock farming. The result thus suggests that the subsidy intensity of the AW measure is strongly influenced by the production structure of agriculture in individual regions, and not merely by the general characteristics of the rural area.

Fig. 10: AW - Agricultural production areas



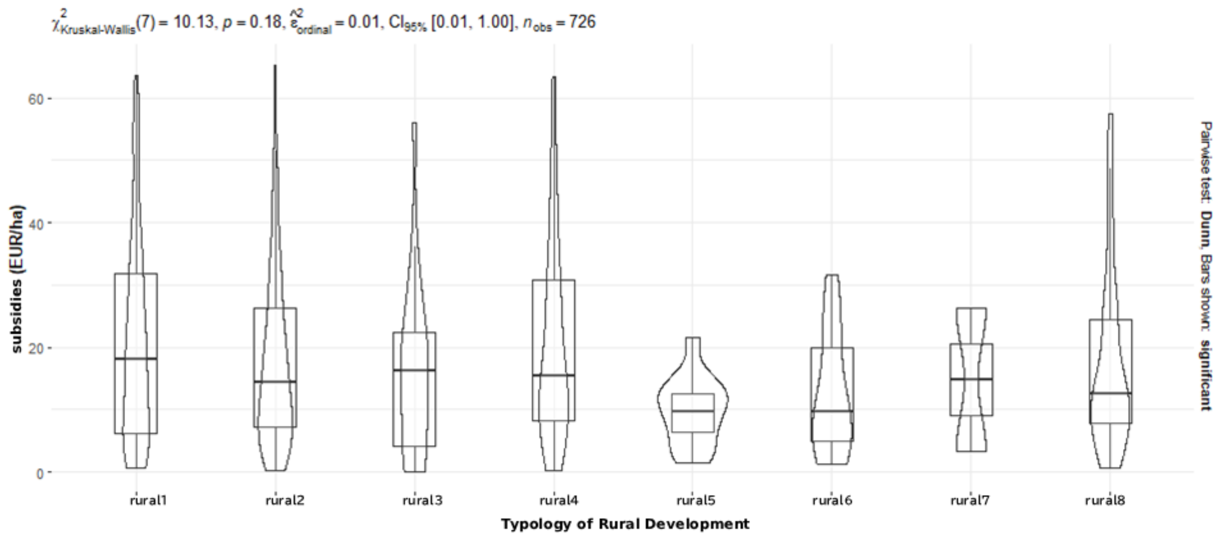
Source: Own processing

In the typology of rural development, no significant correlation was found between the intensity of AW support and the individual rural categories. The Kruskal-Wallis test did not reveal statistically significant differences between individual rural categories ($\chi^2(7) = 10.13$; $p = 0.18$), suggesting that this grant program is not significantly differentiated according to the broader socioeconomic typology of rural areas.

Lower support values appear primarily in problematic recreational rural areas (rural5) and, to some extent, in intensive recreational areas (rural6), which, according to the typology map, are concentrated mainly in mountainous and foothill regions. Conversely, relatively higher values are evident, for example, in the Moravian peripheries (rural3) or in the well-equipped Moravian countryside (rural4), which, according to the cartographic distribution of the typology, are located in the inland areas of Moravia, including part of the Bohemian-Moravian Highlands.

This spatial distribution shown in Fig. 11 s also consistent with the results of the analysis by agricultural production areas, where the highest intensity of support was identified in the sugar beet-growing area, and conversely, lower values in the mountainous area. The distribution of AW support thus reflects the production structure of agriculture—particularly the concentration of more intensive livestock production in regions with more favorable production conditions—rather than the general typology of rural areas.

Fig. 11: AW - Typology of Rural Development



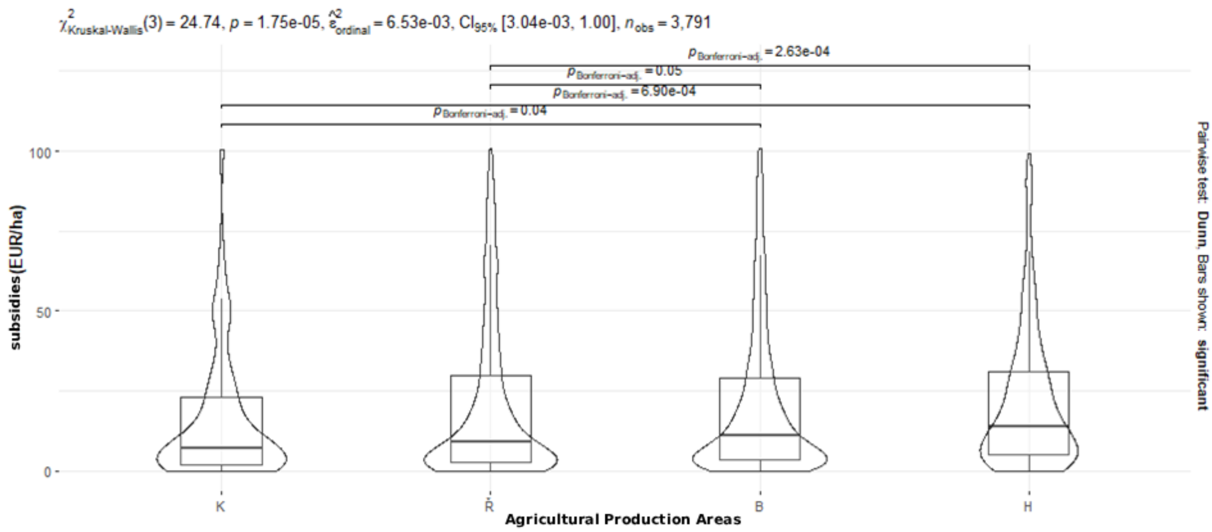
Source: Own processing

Voluntary Coupled Support - VCS

The distribution of subsidies under the voluntary production-linked support scheme was analyzed by agricultural production region using the Kruskal-Wallis nonparametric test. The results showed statistically significant differences between individual production areas (H(3) = 24.74; $p = 1.75 \times 10^{-5}$; n = 3,791), although the effect size remains very low ($\varepsilon^2 = 6.53 \times 10^{-3}$). A post-hoc analysis using Dunn's test with Bonferroni correction identified statistically significant differences between certain pairs of production areas, particularly between the mountainous area and the corn or sugar beet areas. The results thus confirm the existence of statistically significant differences in the intensity of support between individual agricultural production regions, although the overall magnitude of these differences remains relatively small.

Visualization using a violin plot (Fig. 12) suggests that the intensity of support increases slightly from the corn-growing region toward the mountainous region, with the potato-growing region situated between these categories. Although these differences are statistically significant, their practical significance is limited, as confirmed by the very low effect size ($\varepsilon^2 = 0.0065$). This means that the type of agricultural production area explains less than one percent of the variability in subsidy amounts per hectare. This pattern can be interpreted in the context of the spatial distribution of agricultural production areas in the Czech Republic, where mountainous areas are concentrated primarily in border mountain ranges with less favorable production conditions, while corn and sugar beet areas are located mainly in the fertile lowland regions of Central Bohemia, the Elbe River Basin, and parts of South Moravia. The results may thus suggest a support structure that takes regional disadvantages into account to a limited extent, although confirmation of this interpretation would require a more detailed analysis of the specific conditions for subsidy allocation.

Fig. 12: VCS – Agricultural production areas



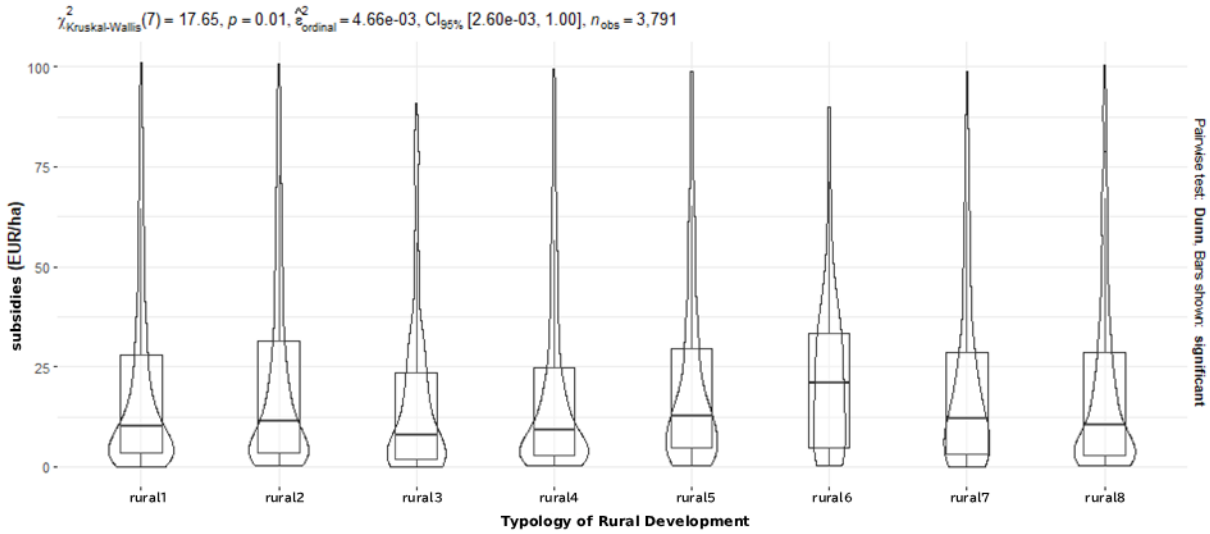
Source: Own processing

In the typology of rural development, no significant correlation was found between the intensity of VCS support and the individual rural categories. Although the Kruskal-Wallis test shows statistically significant differences between individual rural categories ($\chi^2(7) = 17.65$; p = 0.01), the effect size remains very low ($\varepsilon^2 \approx 0.005$), suggesting that these differences have rather limited practical significance.

Visualization using a violin plot (Fig. 13) indicates only slight differences in medians among individual rural categories. Relatively higher values appear, for example, in intensive recreational areas (rural6), while lower values can be observed, for example, in the Moravian peripheries (rural3). According to the rural typology map, intensive recreational areas are primarily located in the mountainous and foothill regions of the Czech Republic, while the Moravian peripheries are found mainly in the inland parts of Moravia.

This spatial distribution is partly consistent with the results of the analysis by agricultural production areas, where a slightly higher intensity of support was recorded in mountainous areas compared to more production-friendly corn or sugar beet regions. Overall, however, the results suggest that the distribution of VCS support is not significantly differentiated according to a broader typology of rural areas and is more closely related to the specific production structure of individual agricultural enterprises than to the general characteristics of rural areas.

Fig. 13: VCS – Typology of Rural Development



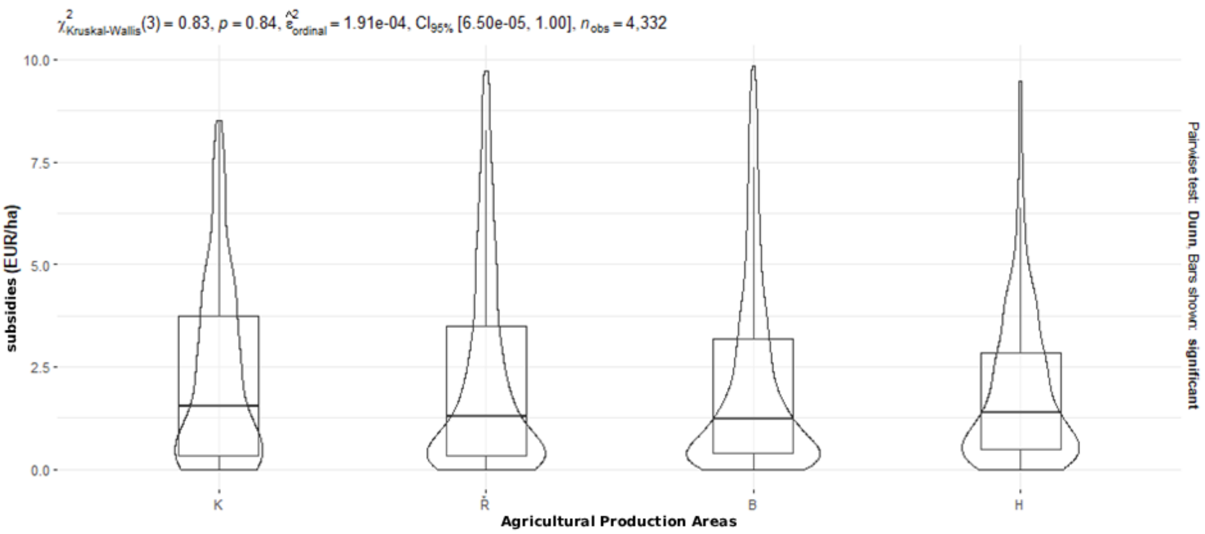
Source: Own processing

Financial discipline reimbursement - FDR

The distribution of subsidies under the financial discipline compensation scheme was analyzed by agricultural production region using the Kruskal-Wallis nonparametric test. The results did not show statistically significant differences between individual production areas (H(3) = 0.83; p = 0.84; n = 4,332), with the effect size being practically zero ($\varepsilon^2 = 1.91 \times 10^{-4}$). This means that the type of agricultural production area does not explain the variability in the amount of this support, and the differences between individual ZVO categories are not statistically significant.

Visualization using a violin plot (Fig. 14) also shows a very similar distribution of support values across all production areas, with no clear concentration of higher or lower values in any of them. Thus, no link was found between the intensity of support and a specific agricultural production area, which is consistent with the nature of this payment. Financial discipline compensation is not designed as a spatially selective agricultural policy tool but rather represents a financial correction mechanism applied uniformly across all recipients of direct payments. The absence of statistically significant differences between production areas thus corresponds to the institutional design of this tool, which is not targeted at the specific production or geographical conditions of individual regions.

Fig. 14: FDR - Agricultural production areas



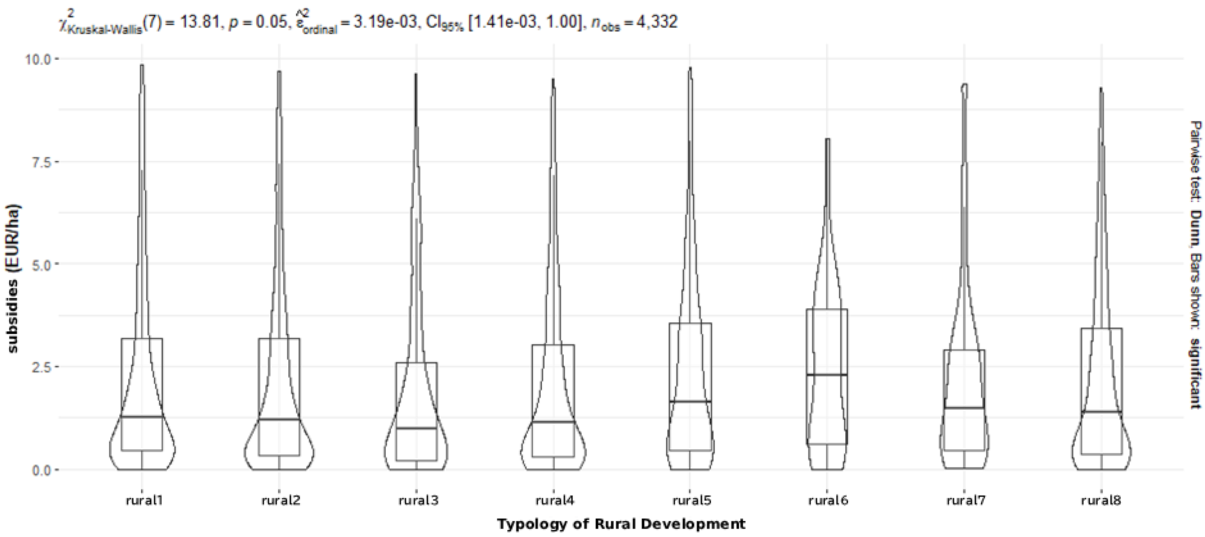
Source: Own processing

Similarly, no link to rural development typology was confirmed. The Kruskal-Wallis test shows only marginal statistical significance for differences between individual rural categories ($\chi^2(7) = 13.81$; $p = 0.05$), with a very low effect size ($\varepsilon^2 \approx 0.003$). This suggests that the differences between individual rural categories have only limited practical significance.

Visualization using a violin plot (Fig. 15) also shows a very similar distribution of support values across individual rural categories, without a significant concentration of higher or lower values in any of them. Slightly higher medians can be observed, for example, in intensive recreational areas (rural6) or in problematic recreational rural areas (rural5), which, according to the typology map, are concentrated primarily in mountainous and foothill regions. However, these differences are not significant, and the overall picture of support distribution remains relatively homogeneous.

The results thus correspond to the nature of this payment. The financial discipline compensation is not designed as a spatially selective agricultural policy tool but represents a financial correction mechanism applied uniformly across all recipients of direct payments. The absence of significant spatial differentiation by agricultural production areas or by rural typology is therefore consistent with the institutional framework of this tool.

Fig. 15: FDR - Typology of Rural Development



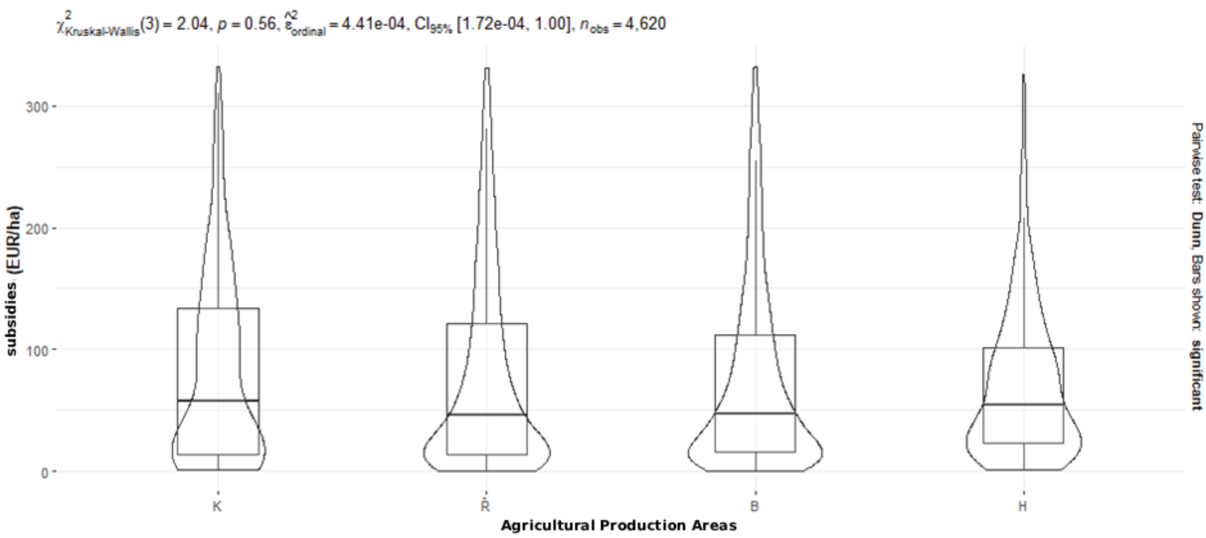
Source: Own processing

Single Area Payment Scheme

The distribution of subsidies under the single area payment scheme was analyzed by agricultural production region using the Kruskal-Wallis nonparametric test. The results did not show statistically significant differences between individual production areas (H (3) = 2.04; p = 0.56; n = 4,620), with the effect size being practically zero ($\varepsilon^2 = 4.41 \times 10^{-4}$). This means that the type of agricultural production area does not explain the variability in the amount of this support, and the differences between individual ZVO categories are not statistically significant.

Visualization using a violin plot (Fig. 16) also shows a very similar distribution of support values across all production areas, with no clear concentration of higher or lower values in any of them. SAPS, as a single area payment standardized by the size of the farmed land, therefore does not show systematic differences between individual agricultural production areas. This result is consistent with the design of this Common Agricultural Policy instrument, which is based on the principle of area-based support provided per hectare of agricultural land without directly taking into account the production or geographical characteristics of individual regions.

Fig. 16: SAPS - Agricultural production areas



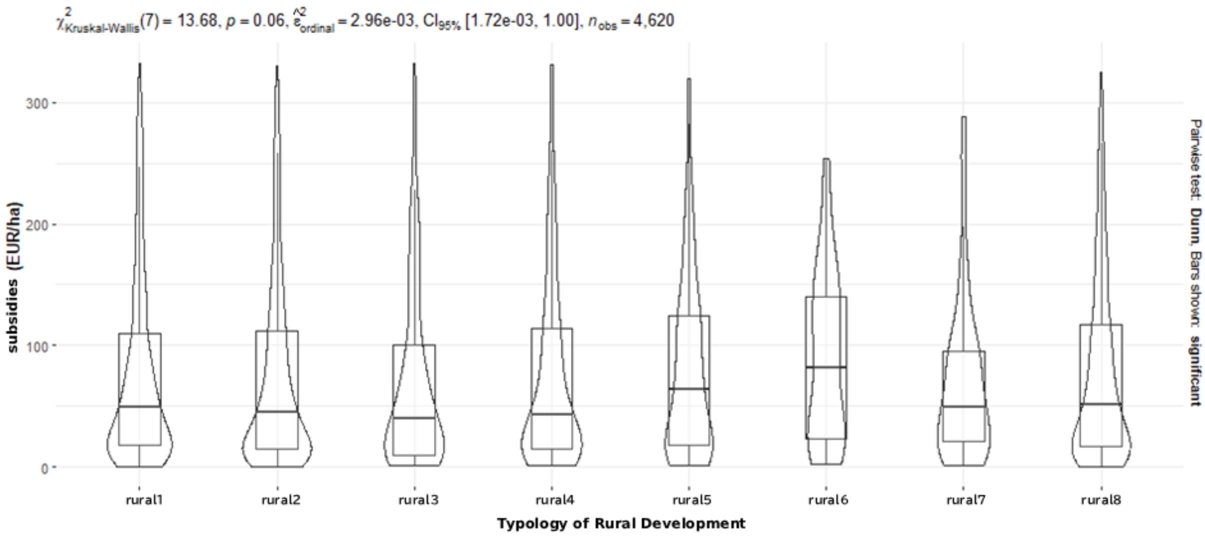
Source: Own processing

Similarly, no differences are observed between the individual rural categories in the rural development typology. The Kruskal-Wallis test indicates only marginal statistical significance of the differences ($\chi^2(7) = 13.68$; $p = 0.06$), while the effect size is very low ($\varepsilon^2 \approx 0.003$). This suggests that the rural typology explains only a negligible portion of the variability in the amount of this support.

Visualization using a violin plot (Fig. 17) also shows a very similar distribution of support values across individual rural categories. Although slightly higher medians can be observed, for example, in intensive recreational areas (rural6) and to some extent also in problematic recreational rural areas (rural5) —which, according to the typology map, are concentrated primarily in mountainous and foothill regions — these differences are not significant, and the overall distribution of support remains relatively homogeneous.

The result thus corresponds to the very design of the SAPS scheme, which is based on the principle of a uniform payment per hectare of agricultural land without directly taking into account the production or geographical characteristics of individual regions. The absence of significant spatial differentiation by agricultural production areas or by rural typology is therefore consistent with the institutional framework of this Common Agricultural Policy instrument.

Fig. 17: SAPS - Typology of Rural Development



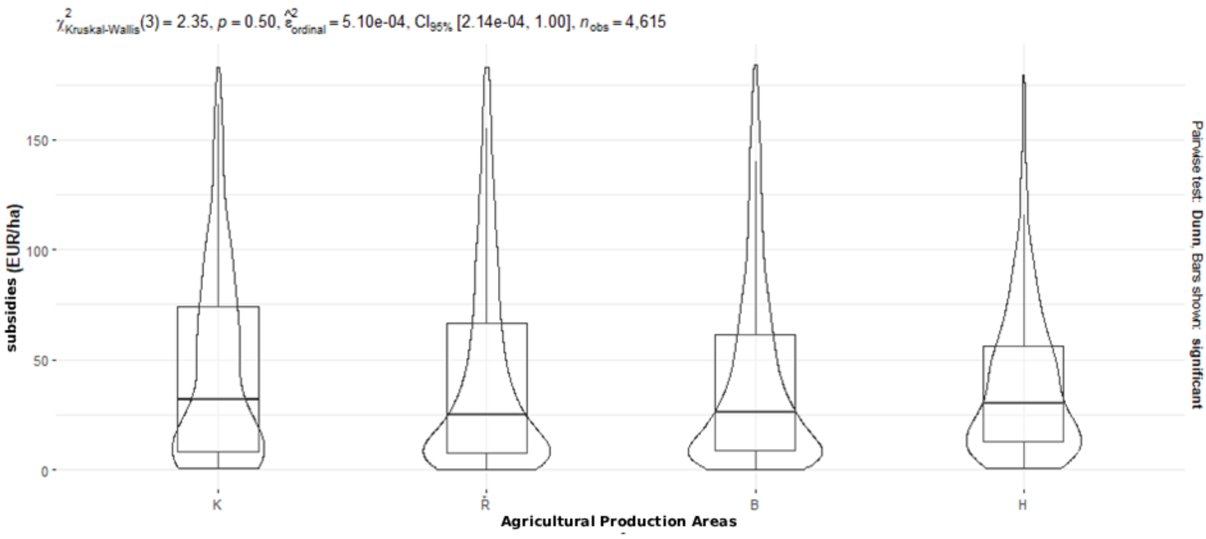
Source: Own processing

Climate- and Environment-Friendly Practices - Greening

The distribution of subsidies under the payment scheme for agricultural practices beneficial to the climate and the environment (greening) was analyzed by agricultural production area using the Kruskal-Wallis nonparametric test. The results did not show statistically significant differences between individual production areas (H(3) = 2.35; p = 0.50; n = 4,615), with the effect size being practically zero ($\varepsilon^2 = 5.10 \times 10^{-4}$). The type of agricultural production area therefore does not explain the variability in the amount of this support, and the differences between individual ZVO categories are not statistically significant.

Visualization using a violin plot (Fig. 18) also shows a very similar distribution of support values across all production areas, with no clear concentration of higher or lower values in any of them. The distribution of subsidies is thus practically homogeneous across agricultural production areas. This result corresponds to the design of this component of direct payments, which is provided across the board as a supplement to the basic area payment and is not directly conceived as a tool targeting the specific production or geographical characteristics of individual regions.

Fig. 18: Greening – Agricultural production areas



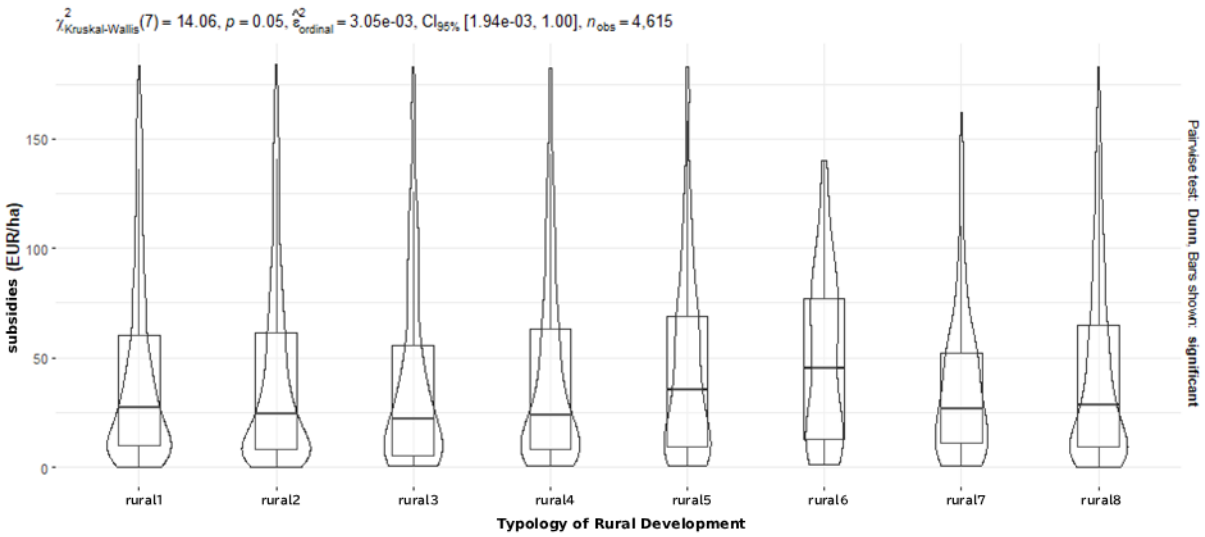
Source: Own processing

Homogeneity is also confirmed in the distribution according to rural development typology. The Kruskal-Wallis test shows only marginal statistical significance in the differences between individual rural categories ($\chi^2(7) = 14.06$; $p = 0.05$), with a very low effect size ($\varepsilon^2 \approx 0.003$). Rural typology thus explains only a negligible portion of the variability in the amount of this support.

Visualization using a violin plot (Fig. 19) also shows a very similar distribution of support values across individual rural categories. Slightly higher medians can be observed, for example, in intensive recreational areas (rural6) and, to some extent, in problematic recreational rural areas (rural5), which, according to the typology map, are concentrated primarily in mountainous and foothill regions. However, these differences are not significant, and the overall picture of support distribution remains relatively homogeneous.

The result thus corresponds to the design of this component of direct payments. Greening is provided across the board as a supplement to the basic area payment and is not conceived as a tool targeting specific production or geographic characteristics of individual regions. The absence of significant spatial differentiation by agricultural production areas or by rural typology is therefore consistent with the institutional framework of this support.

Fig. 19: Greening - Typology of Rural Development



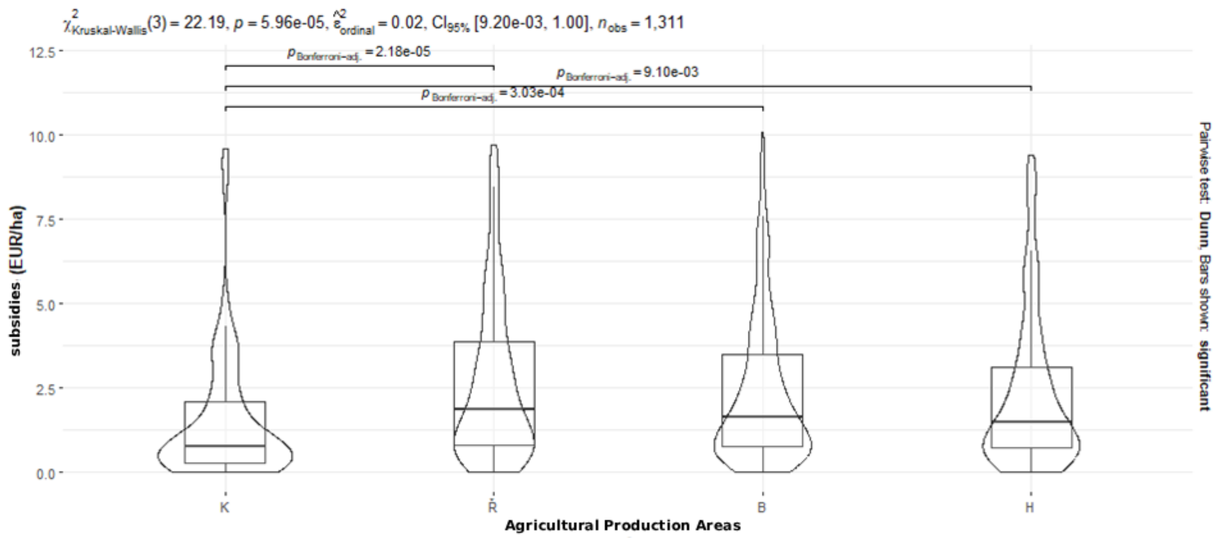
Source: Own processing

Payment for young farmers

The distribution of subsidies under the Young Farmers' Payment Scheme was analyzed by agricultural production area using the Kruskal-Wallis nonparametric test. The results showed statistically significant differences between individual production areas (H(3) = 22.19; p = 5.96 × 10^{-5}; n = 1,311), although the effect size is relatively small ($\varepsilon^2 = 0.02$). A post-hoc analysis using Dunn's test with Bonferroni correction identified statistically significant differences between certain pairs of production areas, particularly between the corn-growing area and the other ZVO categories. The results thus confirm that the intensity of support for young farmers differs statistically significantly across individual agricultural production areas.

Visualization using a violin plot (Fig. 20) also shows that the lowest intensity of support is concentrated in the corn-growing region, while higher values are evident particularly in the sugar beet, potato, and mountain regions. This result can also be interpreted in the context of the spatial distribution of agricultural production regions in the Czech Republic, where the corn-growing region primarily encompasses the warmest and most production-intensive agricultural regions, particularly in southern and central Moravia. The observed lower intensity of support in this area corresponds with the results of a spatial analysis, which indicates a deficit in support for young farmers precisely in these regions. The results thus suggest that generational renewal of agricultural enterprises may be relatively weaker in the most production-intensive areas than in other types of agricultural production areas.

Fig. 20: Payment for young farmers- Agricultural production areas



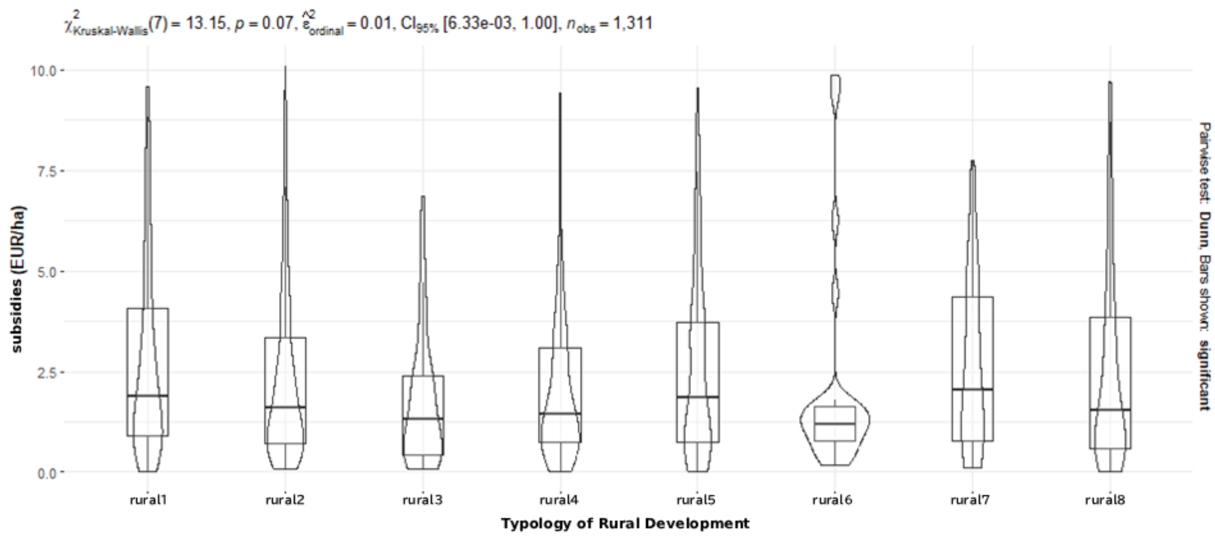
Source: Own processing

The Kruskal-Wallis test shows that the differences between rural categories are not statistically significant ($\chi^2(7) = 13.15$; $p = 0.07$), and the effect size remains very low ($\varepsilon^2 \approx 0.01$). The rural typology therefore explains only a very small portion of the variability in the amount of this support.

Visualization using a violin plot (Fig. 21) also shows a relatively similar distribution of support values across the individual rural categories. Slightly lower medians are evident, for example, in intensive recreational areas (rural6), which, according to the typology map, are concentrated primarily in mountainous and foothill regions, while relatively higher values can be observed, for example, in structurally disadvantaged rural areas (rural7) or in non-developmental rural areas (rural2). However, these differences are not significant, and the overall distribution of support remains relatively homogeneous.

This spatial distribution is consistent with the results of the analysis by agricultural production areas, where the lowest intensity of support was identified in the corn-growing area and higher values in the sugar beet, potato, and mountain areas. The results thus suggest that the distribution of support for young farmers is influenced more by the production structure of individual regions than by the general characteristics of rural typology.

Fig. 21: Payment for young farmers- Typology of Rural Development



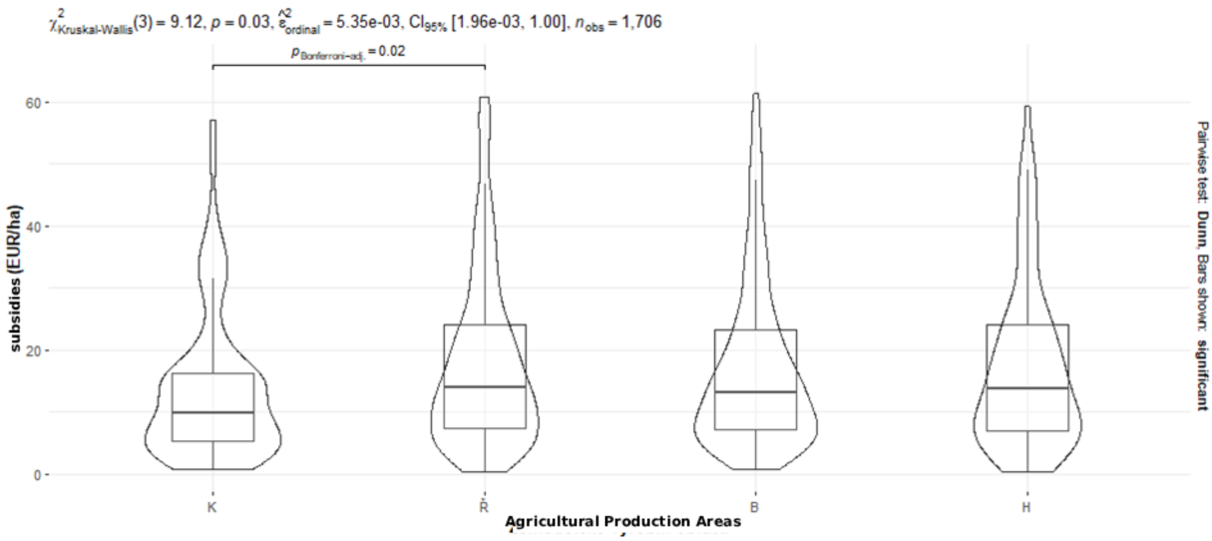
Source: Own processing

Local development - LEADER

The distribution of grants under the LEADER program, which focuses on supporting local development, was analyzed by agricultural production area using the Kruskal-Wallis nonparametric test. The results showed statistically significant differences between individual production areas (H (3) = 9.12; p = 0.03; n = 1,706), with a very low effect size ($\varepsilon^2 = 5.35 \times 10^{-3}$). A post-hoc analysis using Dunn's test with Bonferroni correction identified a statistically significant difference, particularly between the corn and sugar beet production regions (p_adj = 0.02). Although these differences are statistically detectable, their practical significance remains relatively limited.

Visualization using a violin plot (Fig. 22) suggests that the lowest intensity of support occurs in the corn-growing region, while support values are slightly higher in the other production regions. This result can be interpreted in the context of the spatial distribution of agricultural production areas in the Czech Republic, where the corn-growing region primarily comprises the most intensively produced lowland regions with a higher concentration of agricultural production. However, the LEADER program is designed primarily as a tool to support rural communities and local development, not as a tool focused on specific agricultural production conditions. The lower intensity of support in corn-growing regions may thus be related more to the different structure of the rural landscape and local development activities than to the nature of agricultural production in these regions.

Fig. 22: LEADER - Agricultural production areas



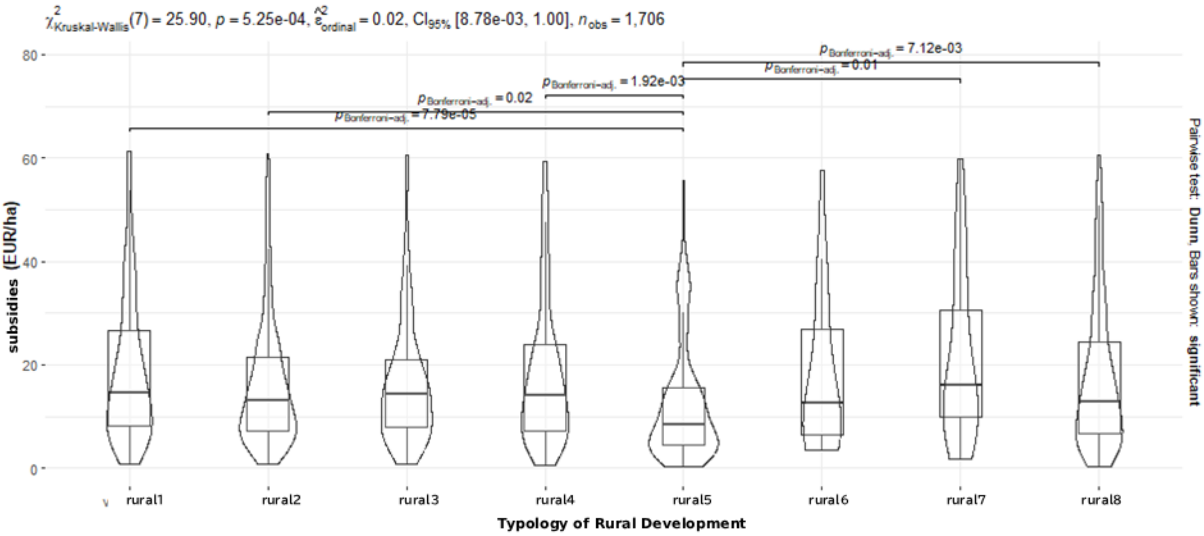
Source: Own processing

In the rural development typology, the differences between individual rural categories are less pronounced, yet they are statistically significant (χ^2 (7) = 25.90; p = 5.25 × 10^{-4}), although the effect size remains relatively small ($\varepsilon^2 \approx 0.02$). The rural typology thus explains only a limited portion of the variability in the amount of this support.

Visualization using a violin plot (Fig. 23) shows a relatively similar distribution of support values across the individual rural categories; however, significantly lower medians appear in problem recreational rural areas (rural5). According to the rural development typology map, this type of rural area is concentrated primarily in the mountainous and foothill regions of the Czech Republic. Conversely, relatively higher support values can be observed, for example, in structurally disadvantaged rural areas (rural7) or in intensive recreational areas (rural6).

The lower intensity of support in problem recreational rural areas may be related more to the structure of implemented projects and the institutional capacity of local action groups than to the productive characteristics of agriculture. The LEADER program is, in fact, designed primarily as a tool for community-led local development, and its spatial distribution therefore primarily reflects the activity of local actors and their ability to prepare and implement development projects at the level of rural communities.

Fig. 23: LEADER - Typology of Rural Development



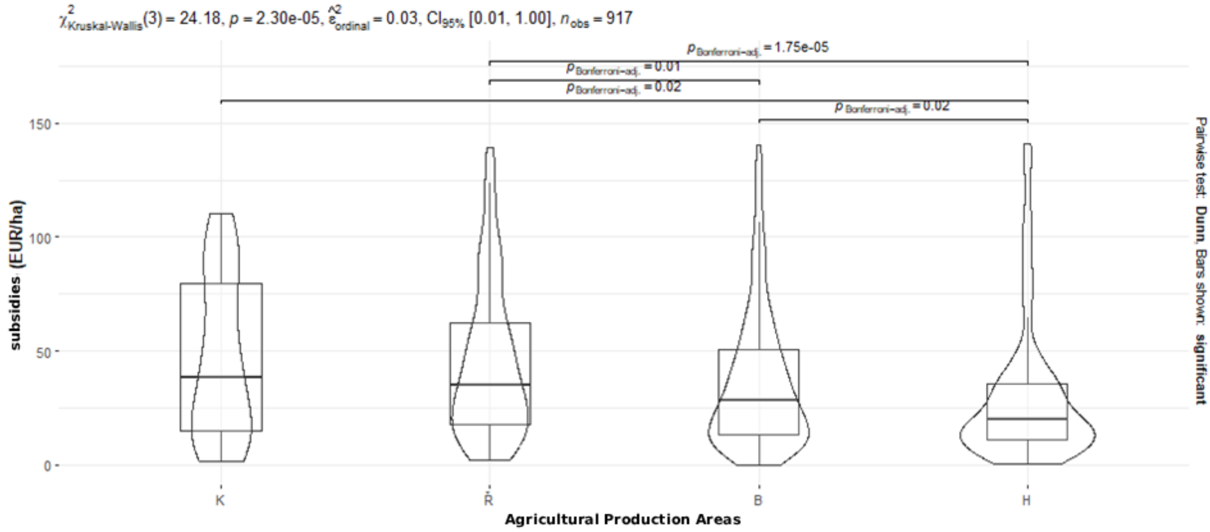
Source: Own processing

Investments in tangible assets - ITA

The distribution of subsidies under the Investments in tangible assets support program was analyzed by agricultural production region using the Kruskal-Wallis nonparametric test. The results showed statistically significant differences between individual production areas (H(3) = 24.18; $p = 2.30 \times 10^{-5}$; n = 917), with the effect size being relatively low to moderate (ε^2 = 0.03). A post-hoc analysis using Dunn's test with Bonferroni correction identified statistically significant differences, particularly between the corn-growing and mountainous production areas, as well as between certain other pairs of areas. The results thus confirm that the intensity of investment support differs statistically significantly across individual agricultural production areas.

Visualization using a violin plot (Fig. 24) indicates a decreasing trend in support intensity from the corn-growing region toward the mountainous region, with the potato-growing and beet-growing regions lying between these categories. This pattern can be interpreted in the context of the spatial distribution of agricultural production regions in the Czech Republic, where corn-growing regions primarily include the most production-intensive lowland regions with more favorable soil and climatic conditions for agricultural production. Conversely, mountainous areas are concentrated primarily in border mountain ranges with less favorable production conditions and a predominance of more extensive farming practices. The identified trend thus suggests a concentration of investment support in areas more favorable for production, where a higher return on investment and more intensive development of agricultural production can be expected.

Fig. 24: ITA - Agricultural production areas



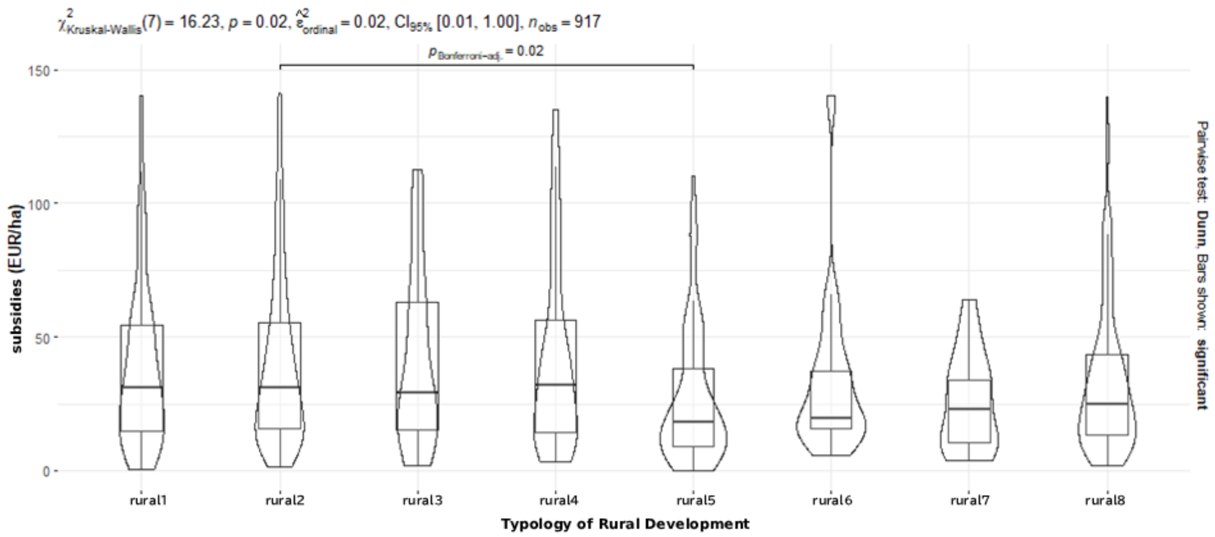
Source: Own processing

In the typology of rural development, the differences between the individual rural categories are only slight. The Kruskal-Wallis test reveals statistically significant differences between rural categories (χ^2 (7) = 16.23; p = 0.02), but the effect size remains relatively low ($\varepsilon^2 \approx 0.02$), suggesting that these differences have rather limited practical significance.

Visualization using a violin plot (Fig. 25) shows a relatively similar distribution of support values across the individual rural categories, with the lowest medians appearing in the problematic recreational countryside (rural5). According to the rural development typology map, this type of rural area is located primarily in the mountainous and foothill regions of the Czech Republic. Conversely, slightly higher support values can be observed, for example, in the Moravian peripheries (rural3) or in the well-equipped Moravian countryside (rural4).

This spatial distribution is consistent with the results of the analysis by agricultural production areas, where the highest intensity of investment support was identified in the corn-growing region, and conversely, lower values in the mountainous region. The results thus suggest that investment support is more concentrated in regions with more favorable production conditions and more intensive agricultural production, while its intensity is lower in mountainous and recreation-oriented rural areas.

Fig. 25: ITA - Typology of Rural Development



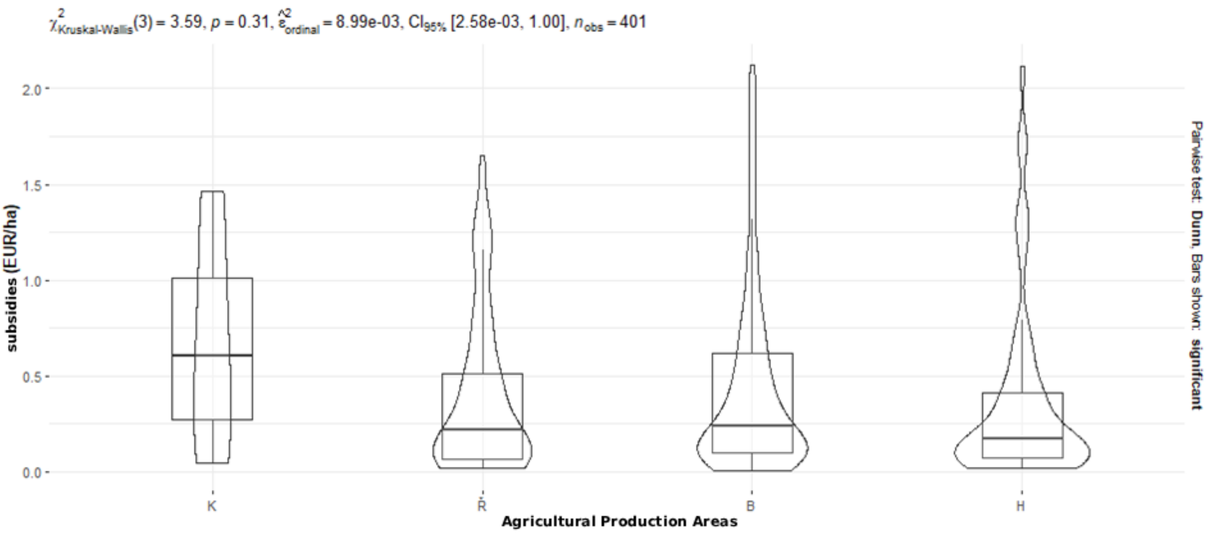
Source: Own processing

Afforestation and creation of woodland

The distribution of subsidies for afforestation and forest establishment was analyzed by agricultural production area using the Kruskal-Wallis nonparametric test. The results did not show statistically significant differences between individual production areas (H(3) = 3.59; p = 0.31; n = 401), with a very low effect size ($\varepsilon^2 = 8.99 \times 10^{-3}$). The type of agricultural production area therefore does not explain the variability in the amount of this support, and the differences between individual ZVO categories are not statistically significant.

Visualization using a violin plot (Fig. 26) also shows a relatively similar distribution of support values across individual production areas without a clear concentration of higher or lower values in any of them. No link between support intensity and a specific agricultural production area was thus identified. This result corresponds to the nature of the measure aimed at afforestation and forest establishment, which is not primarily designed according to agricultural production conditions, but rather according to the local environmental and landscape needs of individual territories.

Fig. 26: Afforestation and creation of woodland – Typology of Rural Development



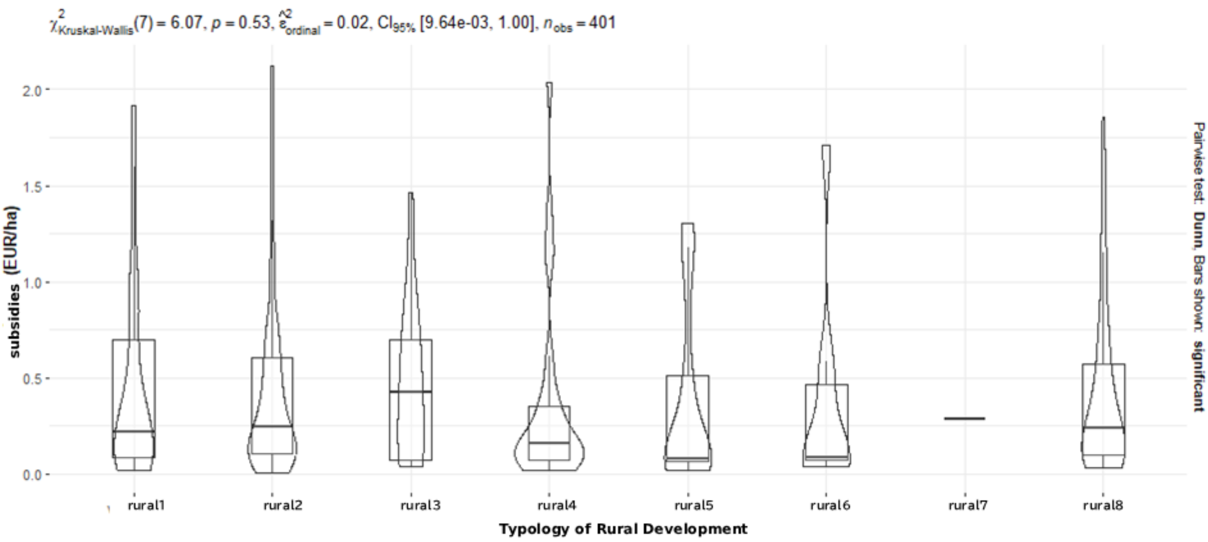
Source: Own processing

No association with the rural development typology was found. No association with the rural development typology was found. The Kruskal-Wallis test did not reveal statistically significant differences between individual rural categories ($\chi^2(7) = 6.07$; $p = 0.53$), with the effect size remaining very low ($\varepsilon^2 \approx 0.02$). Rural typology therefore does not explain the variability in the amount of this support.

Visualization using a violin plot (Fig. 27) also shows a relatively similar distribution of support values across individual rural categories without a significant concentration of higher or lower values in any of them. While slight differences in medians can be observed, for example, between the Moravian peripheries (rural3) or the well-equipped Moravian countryside (rural4) and some other categories, these deviations are not significant, and the overall picture of support distribution remains relatively homogeneous.

This result corresponds to the nature of the measure aimed at afforestation and forest establishment. Support is not primarily structured according to agricultural production conditions or a broader typology of rural areas but rather responds to the specific local environmental and landscape-shaping needs of individual territories.

Fig. 27: Afforestation and creation of woodland – Typology of Rural Development



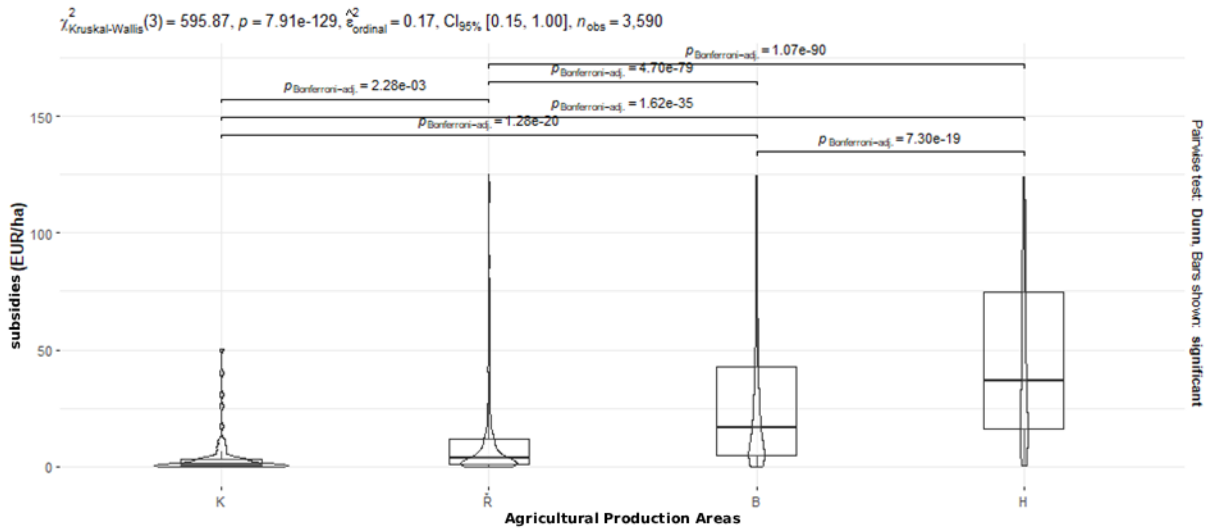
Source: Own processing

Areas with Natural Constraints

The distribution of subsidies under support schemes for areas with natural or other specific constraints was analyzed by agricultural production area using the Kruskal-Wallis nonparametric test. The results showed very pronounced statistically significant differences between individual production areas (H (3) = 595.87; p = 7.91 × 10^{-129}; n = 3,590), with the effect size being significantly higher compared to other analyzed subsidy programs ($\varepsilon^2 = 0.17$). A post-hoc analysis using Dunn's test with Bonferroni correction confirmed statistically significant differences between all pairs of agricultural production areas. The results thus clearly indicate a strong differentiation in the intensity of ANC support across individual production areas.

Visualization using a violin plot (Fig. 28) also clearly shows an increasing trend in support intensity from the corn-growing region through the beet-growing and potato-growing regions to the mountainous production region, with the highest support values concentrated precisely in the mountainous regions. This pattern corresponds to the spatial distribution of agricultural production areas in the Czech Republic, where mountainous areas are concentrated primarily in border mountain ranges with less favorable climatic and production conditions for agriculture. The result thus clearly confirms the expected design of this Common Agricultural Policy instrument, which is specifically aimed at compensating for farming in areas with climatic and natural disadvantages.

Fig. 28: ANC – Agricultural production areas



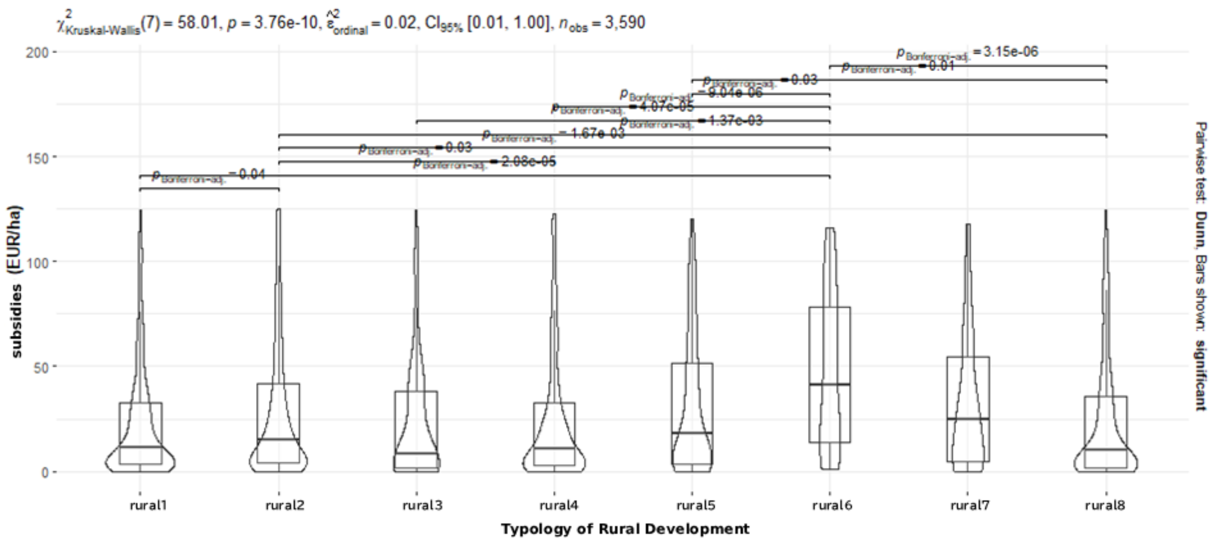
Source: Own processing

In the rural development typology, the correlation between ANC support and rural development is weaker than in the analysis based on agricultural production areas; nevertheless, the differences between rural categories are statistically significant ($\chi^2(7) = 58.01$; $p = 3.76 \times 10^{-10}$), although the effect size remains relatively low ($\varepsilon^2 \approx 0.02$).

Visualization using a violin plot (Fig. 29) shows that the relatively highest values of support appear primarily in intensive recreational areas (rural6) and, to some extent, also in problematic recreational rural areas (rural5). According to the rural development typology map, these rural categories are concentrated primarily in the mountainous and foothill regions of the Czech Republic. Conversely, lower support values are evident, for example, in developing rural areas (rural1) and in non-profiled rural areas (rural8), which, according to the map, are located predominantly in lowland areas more favorable for production outside the main disadvantaged zones.

This spatial distribution is consistent with the results of the analysis by agricultural production areas, where the highest intensity of support was identified in the mountainous production area, and conversely, the lowest values in the more productive lowland regions. The results thus confirm the expected structure of ANC support, which is aimed at compensating for farming in areas with natural and climatic disadvantages.

Fig. 29: ANC – Typology of Rural Development



Source: Own processing

The ANC results also serve as a validation test of the dataset used. The observed spatial distribution corresponds to the expected reality of subsidy allocation, with the highest intensity of support concentrated in mountainous and otherwise disadvantaged areas. This result supports the conclusion that the data adjustments made are methodologically sound and that the analyzed dataset is internally consistent and factually valid.

3.2 Spatial Analysis

The second analysis examined whether the intensity of subsidy support exhibits spatial autocorrelation at the district level—that is, whether high (or low) values cluster in a statistically significant manner in neighboring areas. The interpretation is based on the Global Moran's I index, which, in the case of a statistically insignificant result (higher p-value), indicates that the observed spatial distribution does not differ from a random pattern. Conversely, a positive and statistically significant Moran's I indicates spatial clustering (high–high / low–low), while a negative value would suggest a "checkerboard" pattern (dispersion).

3.2.1 Aggregated Subsidy Categories

National Subsidies (Czech Republic)

For national subsidies, a Moran's index of I = 0.012 was found, with Z = 0.646 and p = 0.519; thus, the result is statistically insignificant. This means that, at the district level, national subsidies do not exhibit a clustering tendency, and their spatial distribution can be interpreted as random. In practical terms, this implies that any differences between districts are not linked to contiguous regional blocks (clusters), but rather follow a dispersed pattern related to the local structure of recipients, the size of enterprises, or the administrative location of settlements.

EU subsidies

Similarly, EU subsidies as a whole yield I = −0.050 at Z = −1.048 and p = 0.295, which is again statistically insignificant. Although the index takes on a negative value, it cannot be interpreted as demonstrably dispersed; on the contrary, the result shows that EU subsidies at the district level do not form statistically significant clusters. From an interpretive standpoint, this suggests that even though EU support was clearly linked to the type of agricultural area (e.g., mountainous ANC) in the initial analysis, this spatial logic “dissolves” at the aggregated district level and does not manifest as compact regional clusters.

3.2.2 Environmental and Area Payments

Agri-environmental and Climate Measures

No spatial autocorrelation was detected in the AECM (I = −0.055, Z = −0.907, p = 0.364). The distribution of support is therefore statistically random at the district level. This interpretation is consistent with the nature of the measures, which may be influenced by a mosaic of protected areas, specific types of commitments, and local supply/willingness to participate in the measures, which may not form contiguous district-level blocks.

Organic Farming

Organic farming yields the values I = −0.018, Z = −0.116, p = 0.907, which is clearly a non-significant result. Thus, at the district level, there is no clustering pattern for organic farming, which supports the interpretation that the spread of organic farming is the result of local production systems (pastures vs. arable land), farm structures, and individual management strategies, rather than a homogeneous regional distribution across districts.

SAPS a Greening

For area-based payments, the lack of significance is expected and empirically confirmed: SAPS (I = 0.005; p = 0.610) and Greening (I = 0.006; p = 0.604) do not show spatial clustering. This result is consistent with their design as standardized area-based payments, which, when converted to comparable intensity, are not intended to result in significant regional concentration.

3.2.3 Titles without a demonstrable spatial structure

VCS, FDR , LEADER, ITA, Afforestation

No statistically significant spatial autocorrelation was found for VCS (p = 0.271), FDR (p = 0.655), LEADER (p = 0.505), IHM (p = 0.150), or afforestation (p = 0.325). Although some indices are slightly positive (particularly IHM), the results do not allow us to conclude that subsidies create stable district clusters. From a substantive perspective, this indicates that these subsidies are likely influenced by project and enterprise-specific logic (who applies, what capacities and intentions they have), which may be spatially dispersed and may not respect the contiguity of districts.

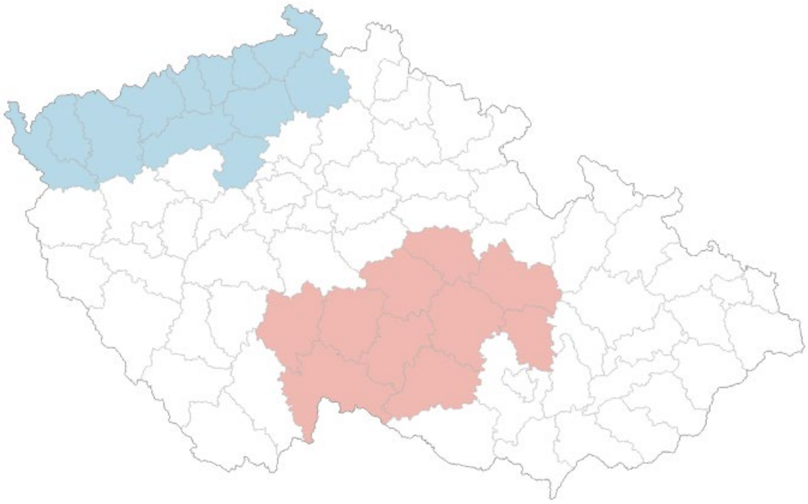
3.2.4 Titles with statistically significant clustering

Animal welfare

Animal welfare presents a completely different case. Global Moran's I yields I = 0.380, Z = 7,710 and $p \approx 0$, indicating strong, highly statistically significant spatial autocorrelation. In other words, the intensity of this support exhibits a pronounced clustering pattern at the district level—districts with high values tend to be adjacent to districts with high values (and similarly for low values). This result indicates that "location" is a key determinant for AW and that there are spatially contiguous regions where support is systematically drawn at above-average or, conversely, below-average rates. A local analysis using Anselin's Local Moran's I substantiates this conclusion by identifying statistically significant high–high and low–low clusters. High–high (red), i.e., districts with above-average AW intensity surrounded by districts also with above-average intensity, were identified in a contiguous belt comprising the districts of Jindřichův Hradec, Tábor, Pelhřimov, Havlíčkův Brod, Jihlava, Třebíč, Žďár nad Sázavou, Chrudim, Svitavy, and Blansko. This spatial pattern points to the existence of a regional core where AW is systematically utilized at above-average levels, which can be interpreted as a manifestation of region-specific production structures (e.g., higher concentrations of relevant livestock operations and technological systems) and simultaneously as an indication that decisions regarding entry into AW schemes are not purely individual, but exhibits signs of spatial diffusion (shared know-how, advisory support, similar economic conditions in neighboring districts).

Conversely, low–low (blue) districts—i.e., those with below-average AW intensity surrounded by districts also with below-average intensity—are concentrated in a distinct cluster in the northwestern part of the Czech Republic: Cheb, Sokolov, Karlovy Vary, Chomutov, Louny, Most, Teplice, Litoměřice, Kladno, Ústí nad Labem, Děčín, and Česká Lípa. This compact, low-intensity block indicates a stable regional deficit in AW utilization, which may be related to the structure of agriculture in the given macroregion (a lower share of relevant livestock operations or different production specializations), or to institutional and capacity factors influencing participation in the program. It is important to note that this is a spatially contiguous unit, which distinguishes AW from most other programs, where clustering at the district level has not been demonstrated.

Fig. 30: AW - Anselin Local Moran's I



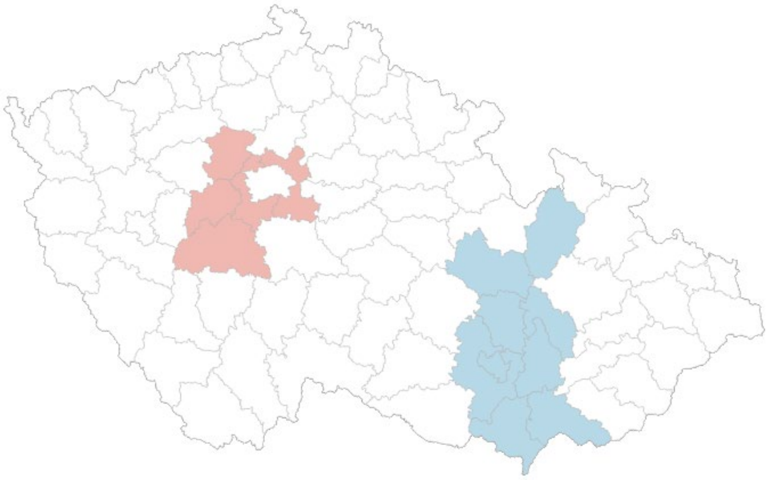
Source: Own processing

Payment for young farmers

For payments to young farmers, a weaker but statistically significant positive spatial autocorrelation was observed at the district level (Global Moran's I = 0.065924; Z = 2.09582; p = 0.036098). The result thus suggests that the intensity of this support tends to create spatial clusters, although the effect is not as pronounced as in the case of schemes with explicit territorial targeting (e.g., ANC).

Anselin's Local Moran's I analysis identifies two spatially distinct cores. High–high (red), i.e., districts with above-average funding intensity surrounded by districts also with high values, are concentrated in the metropolitan hinterland: Prague-East, Prague-West, Kladno, Beroun, and Příbram. This cluster points to a regional concentration of higher support intensity in the metropolitan hinterland, which can be interpreted as a combination of higher institutional and informational capacity, greater generational turnover dynamics, or distinct business strategies in agriculture around a major urban center. Conversely, the low–low (blue) category—districts with below-average support intensity surrounded by similarly low values—is found in the South Moravian and North Moravian regions: Břeclav, Hodonín, Vyškov, Brno-countryside, Brno-city, Blansko, Svitavy, and Šumperk. This low-intensity cluster indicates a more stable regional deficit in the uptake of support by young farmers, which may be related to the structure of agricultural enterprises, a different model of generational continuity, or a lower rate of new entrants into the sector.

Fig. 31: Payment for young farmers– Anselin Local Moran's I



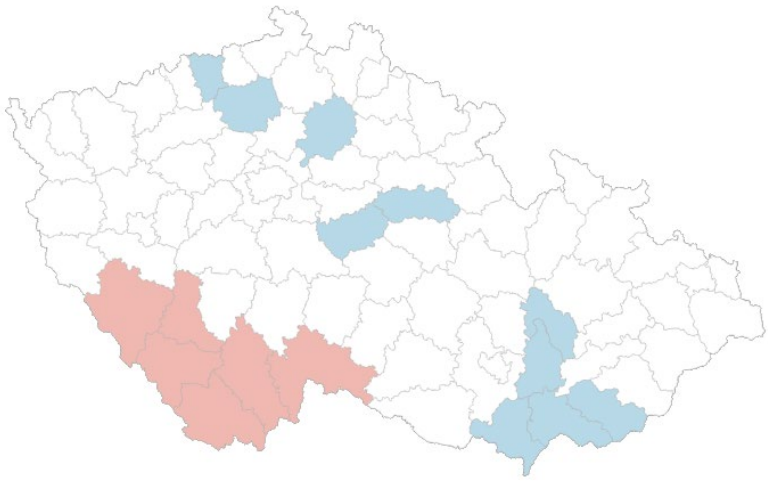
Source: Own processing

Areas with Natural Constraints

Statistically significant positive spatial autocorrelation was demonstrated for ANC support at the district level (Global Moran's I = 0.140843; Z = 3.100432; p = 0.001932). The distribution of support is therefore not random but exhibits a clustered pattern, which is to be expected given that ANC is designed as a compensatory payment for mountainous and climatically disadvantaged areas that are spatially contiguous.

Anselin's Local Moran's I analysis identifies specific cluster cores. High–high (red), i.e., districts with above-average ANC intensity surrounded by similarly high values, are concentrated in the southwestern block comprising the districts of Klatovy, Prachatice, Český Krumlov, České Budějovice, Jindřichův Hradec, and Strakonice. This pattern corresponds to spatially contiguous areas with a higher proportion of disadvantaged conditions and confirms the territorial targeting of support. Conversely, low–low (blue) areas—that is, districts with below-average ANC intensity in the vicinity of similarly low values—were identified in the districts of Teplice, Litoměřice, Mladá Boleslav, Kutná Hora, Pardubice, Prostějov, Vyškov, Břeclav, Hodonín, and Uherské Hradiště—that is, predominantly in lowland or more productive regions where a smaller proportion of areas meeting the ANC criteria naturally occurs.

Fig. 32: ANC – Anselin Local Moran's I



Source: Own processing

3.3 Limitations and Robustness of the Results

Several limitations of the analysis should be acknowledged when interpreting the results. First, the study is based on aggregated national time-series data, which may partially obscure differences between individual farms, production systems, and regional conditions. The relatively limited length of the analyzed time series may also reduce the statistical power of some causality tests and affect the stability of lag structures.

In addition, agricultural production is influenced by a wide range of external factors that could not be fully incorporated into the models. These include commodity price fluctuations, climatic variability, energy prices, international trade developments, technological change, and broader political or regulatory interventions. Consequently, the identified relationships should not be interpreted as purely deterministic effects of subsidies alone.

The robustness of the results was supported by the consistency of several findings across different model specifications and causality testing approaches. In particular, the relationship between subsidies and livestock production remained relatively stable across alternative lag structures. Nevertheless, some relationships were sensitive to model specification and the statistical properties of the analyzed series, particularly in cases characterized by autocorrelation or lower data variability.

Future research could therefore benefit from the use of farm-level panel data, longer time series, and models incorporating additional explanatory variables to better capture the complex interactions between subsidy mechanisms, market conditions, and agricultural production dynamics.

4. Conclusion

The main objective of this article was (C1) to determine whether changes in the application of agricultural policy instruments affect the structure and volume of agricultural production in the Czech Republic, and (C2) to verify the existence of spatial disparities in subsidy and payment receipts. These objectives were met. The results show that the impacts of subsidy instruments are not homogeneous within the sector but have a selective structural character and, in some cases, a distinct spatial dimension, which is conditioned by the design of specific programs as well as the production and regional context. These findings suggest that agricultural subsidies should not be interpreted as universally production-enhancing instruments, but rather as mechanisms whose effects differ across production segments and territorial contexts.

The hypotheses were tested using statistical and spatial analyses. Hypothesis H1.1, which posits that trends in agricultural subsidies are reflected in quantitative indicators of agriculture in the Czech Republic, was confirmed only partially. No statistically significant link was found between the total volume of subsidies and aggregated indicators of the sector's performance or its economic results. In contrast, a clear and highly statistically significant association was found between the development of subsidy support and livestock production, with a time lag of approximately five years. This effect is particularly evident in cattle and pig farming, as well as in the production of animal products, especially milk. The results thus suggest that the impact of subsidies materializes primarily in capital-intensive and structurally more complex segments, whereas no statistically significant link was identified for crop production. This finding contributes to the existing literature by indicating that subsidy effects are more pronounced in sectors characterized by higher investment intensity, longer production cycles, and greater exposure to market volatility.

Hypothesis H1.2, testing the relationship between commodity-specific subsidies and the production of selected commodities, was not confirmed. In most of the cases analyzed, no causality was demonstrated between subsidies and subsequent production trends. The exception was hops, where an inverse relationship was identified, meaning that changes in production precede changes in subsidy allocation. The results thus show that commodity-specific subsidies do not act as an immediate determinant of production volume in the short term. At the same time, however, their broader structural significance cannot be ruled out, which may manifest itself at the aggregate level of production segments rather than at the level of individual commodities. The results therefore support the assumption that the effects of agricultural policy instruments are more likely to operate through long-term structural stabilization than through immediate short-term changes in commodity production volumes.

Hypothesis H2.1 was partially confirmed. Although most subsidy programs do not exhibit statistically significant spatial autocorrelation at the district level, there are clear differences in their spatial distribution. National subsidies tend to flow into areas more favorable for production, particularly the sugar beet production region, while EU subsidies as a whole show higher intensity in mountainous and disadvantaged regions. Significant and statistically significant spatial autocorrelation was demonstrated for animal welfare support and for payments to areas with natural or other specific constraints, which is consistent with their design logic. Weaker, yet statistically significant autocorrelation was also found in payments for young farmers, where regional clusters of higher and lower drawdown intensities were identified. Conversely, area-based payments and most project-oriented schemes do not form stable district clusters, which is consistent with their standardized nature and administrative design. These findings support theoretical assumptions that the territorial effects of agricultural subsidies are conditioned not only by policy design itself but also by pre-existing regional production structures, natural conditions, and institutional capacities.

The main contribution of this article lies in linking two analytical levels: testing temporal relationships between subsidies and production and conducting a spatial analysis of support distribution within the context of Czech agriculture. Compared with existing studies, which often focus either on aggregate economic effects or on regional subsidy distribution separately, this study combines time-series causality analysis with spatial analytical approaches in order to capture both sectoral and territorial dimensions of agricultural policy impacts. The results confirm that agricultural policy instruments are neither production-neutral nor spatially neutral. At the same time, the findings demonstrate that subsidy impacts are highly differentiated and depend on the interaction between production specialization, institutional settings, and regional conditions. The structural effect of subsidies is concentrated primarily in the livestock sector, and their spatial distribution reflects a combination of agricultural production conditions, the design of individual subsidy programs, and the institutional capacity of recipients. The added value of the study therefore lies not only in confirming the selective and spatially differentiated effects of agricultural subsidies, but especially in identifying the specific production segment in which this effect is most evident, namely livestock production, and in showing that this relationship appears with a time lag rather than as an immediate response.

Based on these findings, it is recommended that evaluations of agricultural policy effectiveness better reflect the heterogeneity of production segments as well as regional differentiation. Aggregated sectoral indicators may obscure segment-specific effects, particularly in the case of livestock production, where the impact of support manifests itself with a time lag. At the same time, it is advisable to pay increased attention to regions with a long-term low uptake of selected programs, where structural or institutional barriers may exist that limit the full utilization of available support instruments. At the same time, the results should be interpreted with caution, as agricultural production is simultaneously influenced by a broader range of economic, climatic, market, and political factors that could not be fully incorporated into the analytical models.

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