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# Implementation of quality improvements and innovations in agricultural enterprises

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**Abstract:** This article deals with the implementation of innovations and quality improvements into operations of mainly small and medium-sized enterprises and family farms in the Czech Republic. The aim is to improve the competitiveness of production in internal, European, and global markets, as well as in the context of optimising the settings and recommendations for new subsidies within the Common Agricultural Policy for the forthcoming programming period. The dependence of the use of various forms of innovation in relation to financial crises was investigated, as well as the general (proactive *vs.* reactive) attitude to innovation, and also mutual operation with Local Action Groups (LAGs) as another source of support. Due to the structure of the obtained data, a general linear model (GLM) was used for the evaluation. Using the methods of advanced statistical testing, the two most important aspects of the implementation of innovations in agriculture enterprises were identified from the obtained data. These two key aspects are: cooperation with the LAG and the use of consultants for processing project applications. Thus, other factors, the size of the farm, the existence of financial problems and the length of farming are not statistically significant. This contribution is intended to help public administration bodies that have a power to set the support conditions for the Rural Development Programme.

**Keywords:** agribusiness; consultants; farming; Local Action Groups; new approaches

Farming and agriculture, in general, can be seen as a complex, unpredictable, but also an individual, business. Still, agriculture remains essential for the global food security (Foley et al. 2011) as well as being a key supplier of raw materials for other industries. Nowadays, farmers face increasing challenges including climate change, soil erosion and biodiversity loss, as well as having to manage changing consumer expectations and views on agricultural technologies. The tools to support and develop this sector are investments aimed not only at renewal and systematic modernisation but, above all, at innovation. It is suggested that the impact of technological innovation will be reflected in several areas, for example in the volume and quality of the production, in increasing the market size, and consequently in the export share as well. Technologies in agriculture can be considered multidisciplinary; the reason for this is that it involves the management of several conditions – physical, chemical, and biological ones as well as the effects of their interactions with one another and with the environment. Aspects like changes in the soil properties, the climate or the functioning of individual organisms represent modern challenges that farmers have to face. If they are to be, at least, partially successful in this 'fight' so that they can remain competitive in both internal and global markets, innovation should be implemented

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in a company's operations. Both in terms of new technologies associated with robotisation and, for example, quality management systems or digitisation. Across the centuries, innovation in agriculture has been mostly associated with technology, aimed at achieving economic goals related to productivity (Andrade et al. 2020). Thus, from the point of view of national economies, innovation is an important driver of growth and development in the agricultural sector.

**Innovation and quality implementation in the agricultural sector.** Today, globalisation, the advancement of technology, the shortening of product cycles, increasingly sophisticated consumers, and increasing labour costs and volatility in input prices have created an environment where manufacturers must be flexible, adaptive, responsive, and innovative (Su et al. 2009). Such reasons cause businesses to increasingly struggle and the diversity of identical products in the same price segment force agricultural enterprises to search for ways to improve a product's quality, create additional competitive advantages to win customer loyalty with a focus on their requirements, not only while releasing food products, but also while planning and organising production (Mizanbekova et al. 2017).

Innovation, in general, and particularly in agriculture, is the central driving force for achieving a world free from hunger and malnutrition. The definition of agricultural innovation is as follows: agricultural innovation is the process whereby individuals or organisations bring new or existing products, processes or ways of the organisation into use for the first time in a specific context, to increase the effectiveness, competitiveness and resilience, with the goal of solving a problem. Digital agriculture innovation is both knowledge- and skill-intensive because agricultural production systems are complex and multifaceted and solutions require knowledge ranging from broad to specific (Van Es and Woodard 2017). According to the findings of literature study results of Coca (2017), the general purpose of innovation in agriculture is to reduce the environmental impact (especially processes which involve a decrease in the consumption of resources, such as technological innovations of soil conservation and precision innovations), followed by the purpose of reducing costs. The importance of innovation in agriculture is supported by the effects that innovation has on the performance improvement of the economic entities in this field, in relation to the efforts. An organisation's decision to engage in innovation or to use the innovation results is influenced by the perception that the company has a net benefit generated by such an approach (Coca 2017).

**Agricultural innovation in the Czech Republic.** Agriculture is still under-technicalised in the Czech Republic and, moreover, not all ideas and changes can be implemented in this sector. However, now there is an advantage of a generational change – when, on one hand, there are 'old' agronomists, who used to go to the fields and make decisions according to what they see there and, on the other hand, there are recent graduates in the agricultural sector who see new technologies as a chance for improvement because they work well in the online environment and they can use smartphones and other electronic devices in a sophisticated way as well as the Internet of Things not being a problem for them. The current situation shows that Czech farmers are unable to find workers for many activities, so they are even forced to address the shortage of workers by purchasing more efficient technologies which are less demanding for human labour. Therefore, they are primarily modernising operations with high demands on human labour. In the case of animal production, milking robots can be most often found; in the case of crop production, a rising number of autopilots can be seen, guiding agricultural machinery to the right track in the field during soil preparation, sowing fertilisation and other agrotechnical operations.

However, progress and innovation are not only concerned with 'production processes' and the optimisation and streamlining of specific activities, but also the evaluation itself. This applies both to the evaluation of the impacts of the implementation of specific measures and to the collection of data aimed at evaluating the quality or in setting and managing the quality of the agricultural production. Specifically, food quality control in areas where agricultural production tends to be dominated by smallholder farmers presents particular challenges (Saak 2016). Modern technology provides the solution for the quality management of agricultural products, it helps to improve time management, decreases human inspection errors and positively influences other agricultural production processes and their inspection and optimisation.

Quality improvement is not one of the activity areas of these enterprises, but a continuous process, related to all the functions of the managerial apparatus; it does not interfere but helps to reduce production costs, requiring new techniques and technologies. Quality has to be managed just as directly and efficiently as production, equipment and money are. The release of high-quality food products provides a triple benefit in the form of lower production costs, higher net revenues and greater market share (Mizanbekova et al. 2017).

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On the other hand, the issue of implementing innovations and introducing quality improvements into the operation of small and medium-sized enterprises is exposed to problems associated with the high costs of implementing quality management systems or quality management standards. Zimon (2015), for example, researched this issue in his study and according to his results, these costs are so high that, in consequence, they could negatively affect the economic health of the enterprise and, in addition, the costs of certification and maintenance of the systems are much higher than the savings achieved from its implementation. These statements confirm that it is a large burden on small and medium-sized companies.

**Local Action Groups (LAGs).** A change in the understanding of the importance of supporting integrated rural development in Europe with a strong emphasis on local solutions to local problems associated with the period from the late 1990s has led to the formation of partnerships that see cooperation between the public and private sectors so that they can contribute to the implementation of rural development policies at various levels, supplementing decisions taken by national parliaments and local elected councils (Gargano 2021). Thus, the foundations for the establishment of the Local Action Groups (LAGs) were laid.

LAG is a non-profit group, made up of representatives of the local community (such as trade unions, business associations, and municipalities of the territory managed by the LAG) (Menconi et al. 2018). These groups are based on the principle of partnership and cooperation between public, private and non-government organisations. It is, therefore, a certain form of an institutionalised public-private partnership. The main LAG activity is creating territorial development strategies through a combination of expert and the community methods, which harmoniously combine the interests of all players involved into the development of rural areas: inhabitants, organisations, professional unions, local politicians, environmental associations, cultural and community service providers, mass-media, etc. (Albu and Chitu 2014). For this reason, LAGs can apply for financial assistance in the form of grants and subsidies from the EU budget as well as national programmes, and deliver support to the territory through the implementation of small-scale projects. Through this approach, LAGs can better target the particular needs and priorities of their territory since they are part of the territory itself. The involvement of LAGs into the decision-making process in respect to the future of rural regions ensures the premise of sustainable development within the rural area, providing consistency in its three dimensions: economic, social and environmental (Albu and Chitu 2014). Today, there are about 180 LAGs in the Czech Republic. An interconnected network of LAGs also operates at the European level – European Network for Rural Development (ENRD). The ENRD LAG database allows LAGs to get in touch, network, and mutually cooperate.

Technology and science innovations are the core power of economic growth because the input of these factors leads to the multiplier effect of economic development (Cheng and Wang 2019). The multiplier effect, in relation to the financing of development and innovation in the region within the LAGs, is strengthened through the principle of subsidiarity. The subsidiarity principle aims to ensure that decisions are taken as closely as possible to the citizen. Except in cases where the EU has exclusive competence, action at the European level should not be taken unless it is more effective than an action taken at the national, regional, or local level. At the same time, it emphasises greater consultation with these lower levels when drafting legislative proposals, specifically closer communication with national parliaments during the legislative process. Thus, the importance of LAGs in rural areas is enormous. There is a significant multiplier effect in the territory of the appreciation of financial resources (originating from local, regional, national, and international levels) through the LAG that flow to agricultural enterprises in the context of the development of the territory. Generally speaking, the agricultural multiplier effect happens when investing leads to larger-reaching benefits for the farmers and local organisations. The idea of multipliers is based on the difference between the initial and the total effects of a specific change (Miller and Blair 2009) caused by direct, indirect, and induced effects (Martinez 2010). Direct effects quantify the value of new outputs and the additional employment and income generated. The indirect effects are the total value of the inputs created by the local suppliers of the focal sector (e.g. machinery, fertiliser, financial services, etc.). Induced effects measure the impact of workers in the direct and input supply sectors who spend their earnings within a region (Benedek et al. 2020).

The starting point of the LAG's operation and, thus, the possibility to draw financial resources from the Rural Development Programme, specifically the LEADER axis, is the fulfillment of the condition that all activities are implemented in a certain local area, bringing greater interest of the inhabitants and the local population for the development of the local area. All the economic and

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other activities implemented in a certain local area multiply its effects, which means that the local resources are being used by local actors and stay inside the local area, as well as being oriented towards the support of the skills, knowledge, cooperation, and development capabilities of the local actors. This brings the opportunity to actively participate in the sustainable development of the local area (Volk and Bojnec 2014). Within this cooperation, value is being added to the local products, in particular by facilitating access to markets for small production units through collective actions. Linking and supporting all these activities has a multiplier effect. Likewise, the multiplier effect is supported through active cooperation with other LAGs at the national level and cooperation with key entities in the territories (Kostalova and Vavra 2021).

One of the financial resources intended for the support and development of rural development is the LEADER approach, which is specifically focused on supporting the development of partnerships in LAGs. The LEADER programme can bring a new innovative theme to rural development in the way how to develop the countryside with regard to the agricultural and forestry sector, and the environment and quality of living in the countryside (Hudečková and Lošťák 2008). Delin (2012), as the basic assumption of the LEADER approach, sees that local development potentials exist, and they can be strengthened through local initiatives such as the LAGs.

Some Czech authors have dealt with the issue of farmers' participation in LAGs in the Czech Republic in their research. In the context of participation of farmers and the farming-related actors in the LEADER approach in the Czech Republic, Hudečková and Lošťák (2008) found that roughly 35–45% of all Czech LAGs are those where farmers and farming related actors participate, while the most often stated reason for why they want to participate in the LAG is to obtain investments for the machinery and business facilities. Participation in LAGs is, thus, a significant help for farmers as it represents an opportunity for them to implement various sorts of innovations more easily into their business activities. Other research focused on the Czech LAGs was carried out by Delin (2012), which focused on the issue of the position of farmers in LAG groups. The author sees farmers and agricultural entrepreneurs as a specific social group. The results of his study found that the situation in the LAGs is not bad in terms of the external social exclusion of farmers and that there is a continuous increase in the number of farmers participating in the LAGs. As mentioned above, the multiplier effect of investment in agriculture is one of the most effective ways not only in rural development but also in reducing poverty. Therefore, to maximise the multiplier effect, it is necessary to ensure the principle of subsidiarity which will allow for the approval and redistribution of funds at the local level and thus ensure the optimal use and distribution of money with regard to the current situation in the area. From the point of view of farmers and farming related actors, the trend of the increasing number of farmers involved in the LAGs is crucial and proof that farmers themselves are interested in participating in the LAGs because it brings benefits to them in the form of better access to financial resources and, thus, the implementation of innovations, plus they also have the opportunity to participate in decision-making.

## MATERIAL AND METHODS

The aim of this paper was to find out the farmers' attitude to the implementation of innovations and to evaluate the forms of support that farmers most often use in relation to the implementation of innovation into their businesses – with a special focus on the cooperation with LAGs and on consultants' services. For this purpose, a survey was conducted with 93 respondents from selected regions of the Czech Republic (most often in South Bohemia, and in the Pilsen and the Vysocina Regions). These were mostly family farms (59 cases) or small and medium-sized agricultural holdings with a maximum of 50 employees (25 cases). There were only 6 cases of companies with 50–100 employees and 3 cases of companies with 101–250 employees.

The selection of organisations for the research was carried out in such a way that students working within the interfaculty cooperation were asked to address all the agricultural holdings in their permanent residence areas. This approach ensured that all 'forms' of agricultural business were included in the research. No other specific selection criteria was set.

The method of a questionnaire survey was chosen as the form of research, where representatives of individual companies answered a total of 13 research questions within the questionnaire. The respondents' relationship to innovation was primarily surveyed (such as stagnation prevention, response to external impulses or, at least, the minimal innovation, etc.). In addition, the respondents expressed their experiences and attitudes related to the implementation of innovation in relation to 'past' financial problems, including how financial crises have changed the respondents' attitudes

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to innovation. The research also determined the size of the farm, the cultivated land area (of which is leased), the size of the farm, as well as the time in which the agricultural activity is carried out. Special attention was also paid to identifying strategies in the event of threats to the future – such as a future lack of funds, a problem with succession on the farm, etc.

Data were collected on the Internet (online) in the period 2.–9. 5. 2017. Following this procedure, the respondents did not receive feedback on the answers, nor did the respondents ask any additional questions to the interviewers.

The obtained data were processed in the software Statistica 12. The licence holder was the University of South Bohemia. Several statistical analysis methods and models were used. First, the general linear model (GLM) was used to analyse the respondents' relationship to innovation with respect to the explanatory factors. The GLM is a flexible generalisation of ordinary linear regression. It is a useful framework for comparing how the chosen variables affect different continuous variables. It is the foundation for several statistical tests. Then the assumption of homoscedasticity was checked through Bartlett's test for all the explanatory factors. Homoscedasticity is the assumption of equal (or similar) variances in different groups being compared. Bartlett's test is used to test homoscedasticity, to test if the $k$ samples have equal variances. One-dimensional significance tests and a quantile-quantile (Q-Q) plot were also used. The one-dimensional significance test is a formal procedure for comparing the observed data with a hypothesis, the truth of which is being assessed. The Q-Q plot is a tool to help assess if a set of data plausibly came from some theoretical distribution.

For the purpose of the research, all the respondents were specifically classified on the basis of their answers (in the case of categorical variables – answer 'yes' or 'no'), in the case of continuous variables, there were several sets in which the respondents were classified according to the size of the farm, or according to the period of time in the case of the length of farming.

At the beginning of the questionnaire, the respondents' relationship to innovation was ascertained. The answer could be chosen among four options. The evaluation of this question is evident in Figure 1.

Figure 1 shows that a proactive approach to the implementation of innovations and, thus, the quality improvements in the company's processes, is relatively unique, as only 3 respondents out of a total of 93 respondents actively implemented innovations. The reactive approach was used by 25 respondents, and the minimum

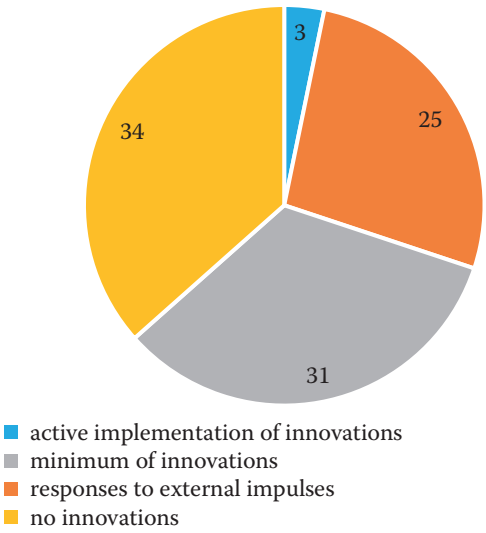


Figure 1. Relation to the implementation of innovations into the operation of farms ($n$ = 93)

Source: Authors' own elaboration

amount of innovation was introduced by 31 respondents. The remaining 34 respondents did not implement innovation into their agricultural activities at all.

The next question was focused on past financial crises and access to innovation, in the context of these crises. Out of a total of 93 respondents, 25 of them never had financial problems, the remaining 68 respondents have had financial problems in the past – 25 of them several times in the history of the farm and 43 respondents reported problems only once in their history. The impact of these financial difficulties on the change of the respondents' approach to the introduction of innovations on the farm is evident in Figure 2.

The next question relates to the choice of strategy in the event of a crisis situation in the future. In the case of this question, it was possible to choose several answers, i.e. several variants of strategies. The structure of the selected strategies is shown in Figure 3.

Figure 3 shows the answers to the question: 'In the event of a threat to the future – such as a future lack of funds, a problem with succession on the farm, etc.' The answers 'change in economic structure' and 'the effort to get additional subsidies' were most often chosen in the same way in 43 cases, the next most common answer 'expansion of business activities – in the sense of expanding activities to more lucrative activities, such as diversification in the form of services' was chosen by 32 respondents. Other strategies were chosen significantly less often as the best strategy option in the case of future financial difficulties.

Advanced statistical testing was also performed as part of the research. First, GLM was used in order to analyse

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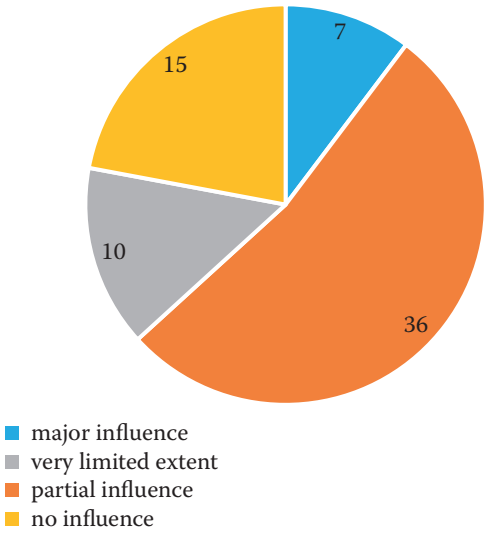


Figure 2. The impact of the financial crisis on the implementation of innovation in the farm, agricultural enterprise ($n$ = 68)

Source: Authors' own elaboration

the respondents' relationship to innovation with respect to the explanatory factors, which are specific measures arising from the need to implement innovations (especially cooperation with LAGs, the use and assistance of consultants, the choice of strategy in case of a crisis, etc.). The GLM model was chosen with respect to the structure of the evaluated data.

This advanced testing was related to another part of the questionnaire focused on the cooperation among farms and LAGs. When asked about cooperation with the LAG, it was discovered that out of a total of 93 respondents, 40 of them cooperated with the LAG, of which 10 respondents reported regular cooperation, 28 respondents sometimes used the cooperation and 2 respondents stated that they had cooperated with LAG only once. Thus, 53 respondents did not cooperate with the LAG within their agricultural activities.

The last set of questions in the questionnaire was related to the use of consultants for processing project applications, grant applications, etc. Of all the respondents, a total of 26 did not use the services of consultants while the remaining 67 interviewed respondents had used consultant services, where 31 of them regularly used consultants, 31 respondents used consultants only sometimes and 5 respondents used consultants only once (Figure 4).

At the same time, the experience with these consultants was ascertained: 6 respondents had an excellent experience, 32 of them had a very good experience, 28 respondents had an average experience, and 1 respondent had a bad experience.

Innovation was treated as an ordinal variable due to the lack of data in the different categories when treating innovation as a categorical one. Due to the amount of data and the resulting Q-Q plot, the normality of the data is an acceptable assumption. The assumption of homoscedasticity was checked separately for every explanatory factor by Bartlett's test.

The main effect GLM was applied first, including the verification of both assumptions of the model. Then by the step-by-step backward elimination of the explanatory variables, two explanatory variables were identified as being significant – the mutual cooperation with the LAGs and the cooperation with consultants. Finally, for these two explanatory variables, we performed a factorial GLM in order to study the multiplicative effects of these variables.

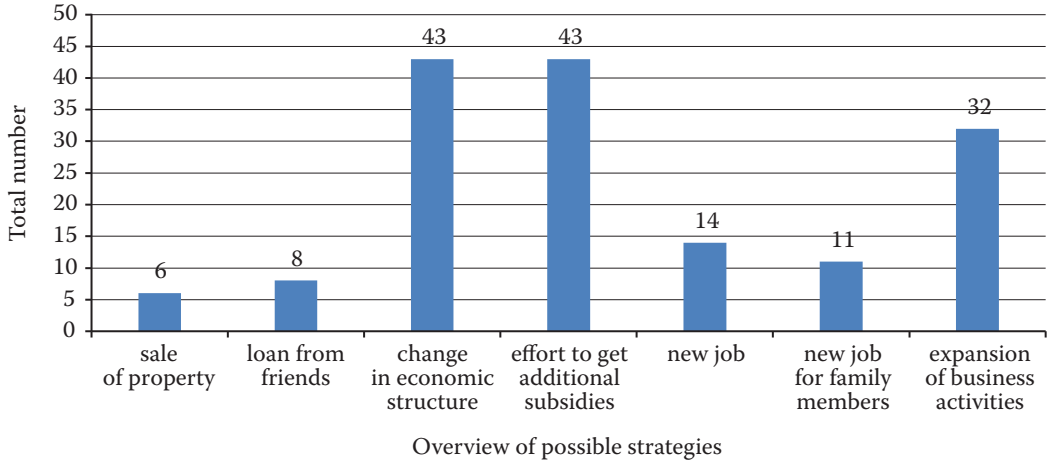


Figure 3. The choice of strategy in case of future crisis

Source: Authors' own elaboration

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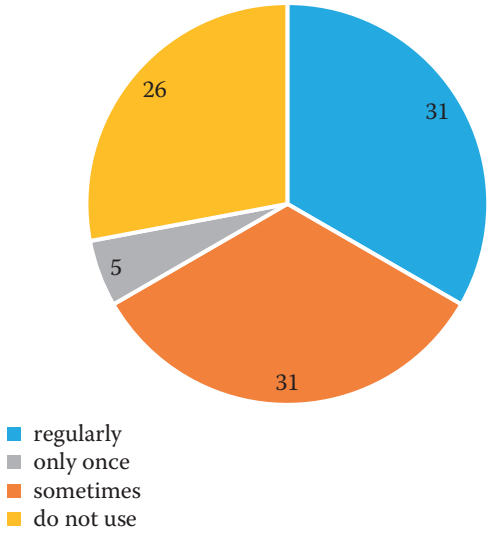


Figure 4. Cooperation with consultants for project and grant applications ($n$ = 93)

Source: Authors' own elaboration

The results of the performed testing can be seen in following figures and tables.

GLM of dependencies was used to evaluate the obtained data. Table 1 shows the entire GLM model, which contains all the explanatory variables. Specifically, it models the dependence of 'relationship to innovation' of five explanatory factors, where the variables 'farm size', 'use of consultants for processing project applications, etc.', 'previous financial problems' and 'cooperation with the LAG' are categorical variables, the factor 'farming since' is a continuous variable. This model contains all the explanatory factors.

The test revealed two significant factors (i.e. $P$-value less than 0.05), namely, 'use of consultants for processing project applications, etc.' and the factor 'cooperation with the LAG'. A graphical representation was also compiled for the mentioned significant factors (Figures 5, 6). It is clear from the figures that, assuming the 'use of a consultant to process project applications' ('yes'), the 'relationship to innovation' is greater than if the services of the consultants are not used ('no'). By analogy, also in Figure 6, following the 'relationship to innovations' in connection with 'cooperation with the LAG'. Here, too, in the case of 'cooperation with the LAG' ('yes'), the 'relationship to innovations' is greater than in the case of non-cooperation ('no').

Next, the first verification of the GLM model was performed. For this purpose, a Q-Q plot was compiled. This $P$-graph verifies the normality of the residues. We decided to verify the normality of the residues due to the lack of data in the different categories. The performed $P$-graph shows that the normality of the data is an acceptable assumption (Figure 7).

Subsequently, the second assumption of the GLM was verified – the test of homogeneity of variances.

Table 1. Results of general linear model (GLM) – main effects (one-dimensional tests of significance, effect size, and strength for 'relation to innovations': sigma-constrained parameterisation decomposition of an effective hypothesis)

| Effect | Sum of squares | Degrees of freedom | Mean square | $F$-value | $P$-value | Partial eta-squared | Excentricity | Observation strength (α = 0.05) |
|---|---|---|---|---|---|---|---|---|
| Intercept | **22.73559** | **1** | **22.73559** | **33.85661** | **0.000000** | **0.287269** | **33.85661** | **0.999925** |
| Farming since | 0.80163 | 1 | 0.80163 | 1.19374 | 0.277700 | 0.014012 | 1.19374 | 0.190655 |
| Farm size | 1.30272 | 4 | 0.32568 | 0.48498 | 0.746696 | 0.022573 | 1.93994 | 0.160013 |
| Use of consultants for processing project applications, grant applications, etc.: 'yes' | **3.58785** | **1** | **3.58785** | **5.34284** | **0.023257** | **0.059802** | **5.34284** | **0.627423** |
| Previous financial problems: 'yes' | 0.58631 | 1 | 0.58631 | 0.87310 | 0.352776 | 0.010287 | 0.87310 | 0.152015 |
| Cooperation with LAG: 'yes' | **4.91893** | **1** | **4.91893** | **7.32500** | **0.008235** | **0.080208** | **7.32500** | **0.762836** |
| Error | 56.40818 | 84 | 0.67153 | – | – | – | – | – |

LAG – Local Action Group; variables that proved to be significant are written in bold ($P$ < 0.05)

Source: Authors' own elaboration

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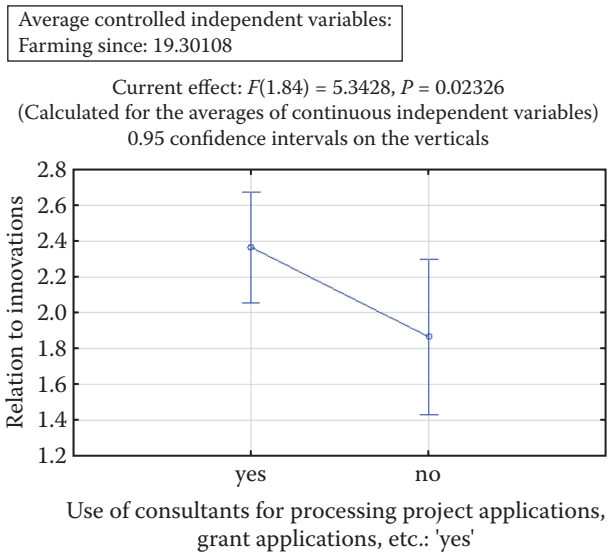


Figure 5. Results of general linear model (GLM), 'relation to innovations' related with the 'use of consultants for the processing or project applications, etc.'

Source: Authors' own elaboration

For this purpose, Bartlett's homogeneity test of variance was performed for all the categorical variables. The aim of this testing was to verify whether the 'relationship to innovation' is homoscedastic within the solved categorical variables. From Tables 2–5, we managed to verify that Bartlett's test does not show heteroscedasticity in any of the solved variables.

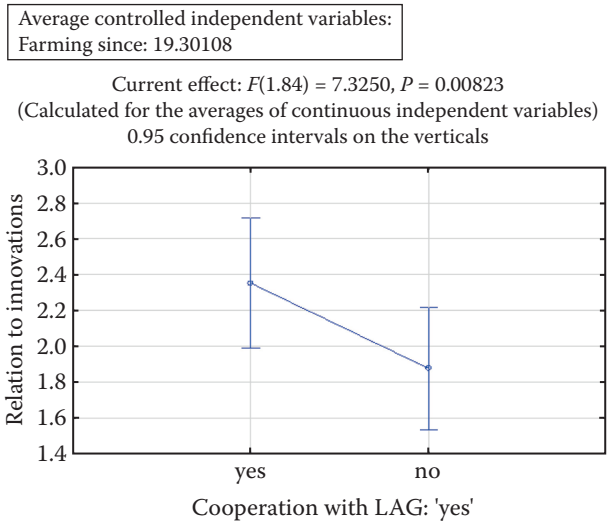


Figure 6. Results of general linear model (GLM), 'relation to innovations' related to the 'cooperation with the LAG'

LAG – Local Action Group

Source: Authors' own elaboration

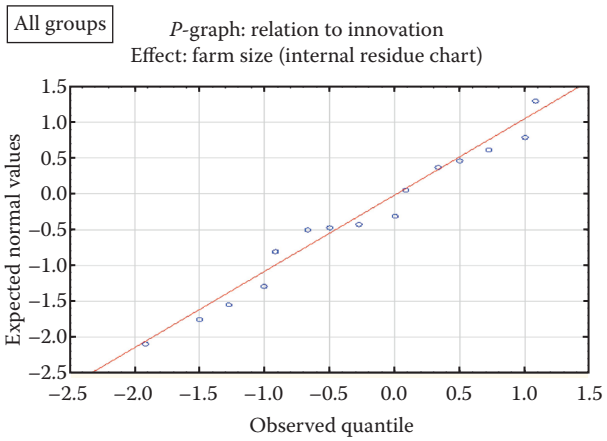


Figure 7. *P*-graph for verification the normality of residues

Source: Authors' own elaboration

We also wanted to verify the existence of the interaction between the selected factors. The main effect GLM was applied first. Then, by the step-by-step backward elimination of the explanatory variables, two explanatory variables were identified as being significant (Table 6). In order to identify the interaction between these significant variables (i.e. between the variable 'use of consultants for processing project applications, etc.' and the variable 'cooperation with the LAG'), a factorial GLM was performed. No mutual interactions are apparent from the expression of the value used, as well as from the graphical expression (Figure 8); which, in this case, means that the 'use of consultants for processing project applications, etc.' has no effect on the different values of the second variable ('cooperation with the LAG'). In other words, the effect of the consultant is the same whether respondents cooperate with the LAG or if they do not.

The implementation of innovations and new technologies and the introduction of quality improvements as principles of smart agriculture represent a great hope for the future. They can bring increased efficiency and production, moreover, with much less impact on the environment, and they contribute to sustainability which is very important because it defines the principles for ensuring the stability of the social system through its internal balance and coherence with the external environment (Atkociuniene et al. 2021). In the current competitive environment, especially regarding quality as well as time, cost and knowledge, innovation is one of the key factors in the long-term success of companies. On the other hand, in relation to the implementation of new technologies, it turns out that sophisticated machines and systems can save

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Table 2. Test of homogeneity of variances effect: use of consultants for processing project applications, grant applications, etc: 'yes'

| Researched phenomenon | Hartley's (*F*-max) | Cochran's (*C*) | Bartlett (Chi-squared) | df | *P*-value |
|---|---|---|---|---|---|
| Relation to innovation | 1.794450 | 0.642148 | 3.299182 | 1 | 0.069314 |

df – degree of freedom
Source: Authors' own elaboration

Table 3. Test of homogeneity of variances effect: cooperation with LAG: 'yes'

| Researched phenomenon | Hartley's (*F*-max) | Cochran's (*C*) | Bartlett (Chi-squared) | df | *P*-value |
|---|---|---|---|---|---|
| Relation to innovation | 1.333210 | 0.571406 | 0.887887 | 1 | 0.346051 |

LAG – Local Action Group; df – degree of freedom
Source: Authors' own elaboration

Table 4. Test of homogeneity of variances effect: previous financial problems: 'yes'

| Researched phenomenon | Hartley's (*F*-max) | Cochran's (*C*) | Bartlett (Chi-squared) | df | *P*-value |
|---|---|---|---|---|---|
| Relation to innovation | 1.823442 | 0.645822 | 3.414874 | 1 | 0.064611 |

df – degree of freedom
Source: Authors' own elaboration

Table 5. Test of homogeneity of variances effect: farm size

| Researched phenomenon | Hartley's (*F*-max) | Cochran's (*C*) | Bartlett (Chi-squared) | df | *P*-value |
|---|---|---|---|---|---|
| Relation to innovation | 2.454545 | 0.250213 | 0.866029 | 4 | 0.929383 |

df – degree of freedom
Source: Authors' own elaboration

Table 6. Factorial GLM (one-dimensional significance tests for relation to innovation: sigma-constrained parameterisation decomposition of an effective hypothesis)

| Effect | Sum of squares | Degree of freedom | Mean square | *F*-value | *P*-value |
|---|---|---|---|---|---|
| Intercept | **252.8013** | **1** | **252.8013** | **374.8347** | **0.000000** |
| Use of consultants for processing project applications, grant applications, etc: 'yes' | **4.5723** | **1** | **4.5723** | **6.7795** | **0.010804** |
| Cooperation with LAG: 'yes' | **3.0341** | **1** | **3.0341** | **4.4988** | **0.036700** |
| Use of consultants for processing project applications, grant applications, etc: 'yes' and cooperation with LAG: 'yes' | 0.0453 | 1 | 0.0453 | 0.0672 | 0.796118 |
| Error | 60.0246 | 89 | 0.6744 | – | – |

GLM – general linear model; LAG – Local Action Group; variables that proved to be significant are written in bold ($P < 0.05$)
Source: Authors' own elaboration

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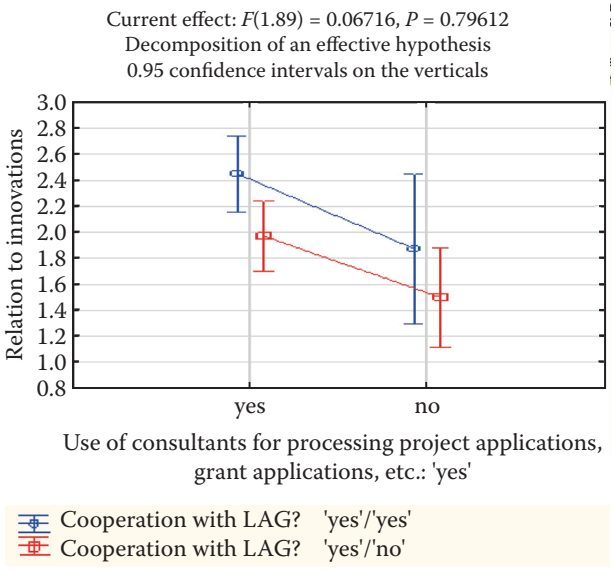


Figure 8. Factor general linear model (GLM) to verify interactions between variables

LAG – Local Action Group
Source: Authors' own elaboration

labour, eliminate human errors, and increase the quality not only in operations, but also in the quality of the output product, and, in the near future, possibly fully replace the work of man himself. In addition, contemporary studies refer to findings that the innovation space in agriculture is migrating from an emphasis on technology which aims to achieve economic goals related to productivity, to an emphasis on the relationship of humankind and nature which aims for a greater balance between social, economic and environmental goals (Andrade et al. 2020).

LAGs have become a major tool for competitiveness worldwide with increasing importance being attached to new knowledge which, together with continuous learning, is an essential attribute of creating innovation. In relation to LAGs, it is possible to rely on research conducted in the Czech Republic during the 2014–2020 programming period (Svobodová 2015) which showed, among other things, that support in this period shifted mainly from support for education, employment and environmental care, to support for the introduction of innovation, i.e. it moved to so-called 'soft' projects. This confirms the approach of farmers to drawing subsidies and support in connection with the introduction of innovations which was identified in our research.

The novelty of this article lies in the identification of key factors in the introduction of innovations in agricultural enterprises. Support for cooperation with LAGs has a clear positive impact on the development of agriculture and, thus, the development of regions, as LAGs significantly multiply the effect of the appreciation of financial resources flowing into the agricultural enterprises in the area. Furthermore, it can be stated that consulting increases the probability of project success and becomes an integral part of the innovation processes in agriculture, and in the intentions of Agriculture 4.0 which brings pressure with it for professionalisation and for the preparatory phase of projects.

## CONCLUSION

This article deals with the relationship to innovations in small and medium-sized agricultural holdings. The use of innovations in agricultural enterprises and farms in the Czech Republic has shown that implementing innovation in a proactive approach is not very common. Innovations are implemented by companies to a minimal extent and, moreover, usually in response to external stimuli, such as financial crises, which have a major or, at least, a significant impact on implementing innovation. Due to the implementation of innovations, farmers have a promised form of stabilisation and a kind of guarantee that will protect them from possible future crises and, thus, ensure their long-term stability and prosperity. In the event of recurring financial difficulties, farmers would most often choose a strategy of changing the economic structure or focusing on the development and diversification of their services, or they would try to obtain additional subsidies.

The questionnaire survey also identified the significant impact of cooperation with LAGs and the use of consultants as possible forms of innovation. Almost half of the respondents declared their cooperation with LAGs, and, in many cases, it is regular or recurring cooperation. This form of cooperation is beneficial not only for the farmers themselves, but thanks to the subsidiarity and multiplier effect, it is positive for the whole territory. More than two-thirds of respondents use the services of consultants, almost all of them repeatedly.

The goal of this paper was to evaluate the forms of support that farmers most often use in relation to innovation at the time of the survey (in the 2014–2020 Common Agricultural Policy programming period). 'Use of consultants for processing project applications' and 'cooperation with the LAG' were identified as statistically significant factors. These factors point to the direction that should be supported by appropriate measures and where the attention should be focused in the context of assistance and support of small

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and medium-sized agricultural enterprises in the Czech Republic. In relation to the use of consultants, two options can be the solution – either simplifying grant applications, optimally so that filling in the form is manageable and farmers do not have to use consultants or, conversely, focus on using consultants and simplify and facilitate the farmers' access to their assistance. We consider all these findings to be key and extremely beneficial points, and it would be appropriate to use them in the form of recommendations in the forthcoming programming period of the Common Agricultural Policy. This contribution is intended to help public administration bodies with setting the conditions for support from the Rural Development Programme and taking these recommendations into account will ensure that the conditions for financially supporting farmers from the National Operational Programmes are optimally set and in line with the actual use by farmers. For example, they could constitute specific recommendations for public administrations mediating the provision of subsidies to agricultural entities (such as The State Agricultural Intervention Fund). Or, for example, to set individual measures for drawing subsidies through operational programmes so as to purposefully support cooperation with LAGs.

It can be stated that these are relatively powerful tools that are often used in practice. The detailed research will be the subject of future research.

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