CLUSTERING THE FARMS MANAGED BY YOUNG FARMERS: INFLUENCE OF FARM CHARACTERISTICS ON SUBSIDIES TAKES UP

Marie Šimpachová Pechrová – Ondřej Šimpach

Abstract

The aim of the paper is to characterize the farms managed by young farmers that obtain subsidies from Common Agricultural Policy (CAP), particularly basic income support for sustainability (BISS), complementary income support for young farmers (CISYF), and investment support for start-up of young farmers (IYF), to better understand the heterogeneity of young farmers benefiting from CAP support. An agglomerative hierarchical cluster analysis, Ward's method, and Gower distance were chosen to create 3 cluster from the primary survey data. The first cluster was characterized by the lowest share of farms that obtain BISS, CISYF or IYF subsidies. The farms were aimed mainly at crop production and managed by the oldest farmers and were functioning the longest. On the other hand, second group had the highest share of firms with BISS subsidy and IYF. They had mainly mixed production with the highest acreage and number of employees. Third group was characterized by the highest uptake of CISYF subsidies, focus on livestock and organic production. The farms here were the smallest. The highest share of managers had university degree. This typological approach allows us to identify distinct farmer profiles and link them to policy effectiveness and future support design.

Key words: hierarchical clustering, gower distance, subsidies, young farmer, Ward's method

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Introduction

Generational renewal is considered by scientists and policymakers as a key driver of innovation and modernization in agriculture (Bertolozzi-Caredio, 2024). Despite that Villan, Villamayor-Tomás and Corbera (2025) found out that farm succession does not necessary lead to more sustainable farming. To address farmers ageing and to support agricultural succession, the European Union (EU) has implemented targeted support mechanisms for young farmers within the Common Agricultural Policy (CAP) framework. Young farmer support schemes have become central instruments in addressing structural decline by encouraging generational renewal, investment capacity, and the continuity of family farms (Chereji et al., 2026).

The EU defines young farmers as managers up to 40 years and supports them through several instruments for many years. In the CAP 2023-2027 programming period, Basic Income Support for Sustainability (BISS) provides direct payments not only to young farmers to stabilize farm income, while Complementary Income Support for Young Farmers (CISYF) offers supplementary income to improve the economic situation of eligible young farmers during their setting-up phase (European Commission (EC), 2021). Additionally, investment subsidies for young farmers – Investment Support for Installation of Young Farmers (IYF), aim to facilitate entry and establishment in the agricultural sector by supporting capital investments in farm equipment, buildings, and infrastructure (EC, 2025). Support for young farmers is a subject of many studies.

It was for example found out that direct payments alone do not guarantee young farmers will remain in the sector; they must be complemented with strategies addressing structural and motivational barriers such as enabling market access, improving infrastructure, and promoting innovation (May et al., 2019). Understanding the effectiveness and uptake of these instruments across different farm types and Member States is crucial for evaluating CAP policy outcomes and designing future support mechanisms that adequately address the heterogeneous needs of young agricultural entrepreneurs. "Effective policy interventions that will be in line with the actual needs of young farmers could contribute to the direction of the enhancement of the vitality and resilience of the rural systems and also act towards the prevention of the abandonment process, providing vibrance in rural areas and benefits for the whole economy and society, as well as the ecosystems." (Mattas et al., 2024)

The objective of May et al. (2019) was to determine, by means of a behavioural approach, how Young Farmer Payment which provides an additional payment on top of the average basic payment influenced the incentives of young farmers to stay in the farm. They found out that the payment affected young farmers' willingness to stay through its influence on non-economic motivational goals." They stress the role of other factors that can be even more influential, such as pessimism about farming, community and family integration, participation in decision making, and the opinion of neighbours.

Gilabert and Pla-Julian (2021) studied the impact of subsidies funding for young farmers to start up an agricultural holding on a case study of a first-time farm set up by a young female farmer in Spain and the Valencian Region.

Castillo-Quero and Guerrero-Baena (2019) analysed structural, productive and economic-financial characteristics of the farms in Andalusia in order to highlight the differences according to the age of the farmers by regression analysis and principal component analysis.

Their results showed that "young people are more educated and obtain higher levels of productivity, as well as higher profitability ratios; they are less dependent on the aid from the CAP." Hadelan et al. (2022) concluded that to increase the productivity of small farmers in Croatia, it is necessary to redefine the criteria for approving applications in investment sub-measure of Rural Development Programme in a way that preference is given to farmers committing to activities that will increase their production capacity and Standard Output.

1 Materials and methods

To better understand the heterogeneity of young farmers benefiting from CAP support we conducted cluster analysis based on farm and managers attributes (size, production type, organic certification, sex, age, education). The aim is to characterize the farms managed by young farmers that obtain BISS, CISYF, and IYF. This typological approach allows us to identify distinct farmer profiles and link them to policy effectiveness and future support design.

The data were from the primary survey among young farmers (farmers up to 40 years) that took place in 2025. There were 369 answers obtained, mainly from male managers (81.0%), with average age 32.2 years. They mostly graduated from high school with degree (41.2%) and university (33.3%), 19.5% had high school without degree. Variables that are further used were: legal type of the subject, type of production, whether the farm is organic, whether the farm is small (less or equal to 10 ha), average acreage, length of operation of the farm, number of employees, age and sex, and education. Statistical description of the sample is in Table 1.

An agglomerative hierarchical cluster analysis (CA) was chosen to group similar data points into a tree-like hierarchy of clusters. After trying out of several clustering methods such as single, average and centroid linkage, Ward's method was chosen. According to Halkidi (2002), "it cannot be a priori said which method is the best for a given problem. Usually, the method of the nearest neighbour is the least suitable and method of average distance or Ward's method suits in many cases the best".

Ward's method tends to create clusters with a more even number of members (farms in our case) which makes it highly effective for segmenting data into distinct, easy-to-interpret groups. Ward's method solves the clustering procedure in a way that it minimises the heterogeneity of clusters, i.e. maximizes the intragroup homogeneity. Measure of homogeneity is Ward's criterion that is calculated as an intragroup sum of squares of the deviations of values from the average of the clusters. Criterion for linking the clusters is based on the idea that in each step of clustering there is minimal increment of Ward's criterion. (Löster, 2017)

Given that the characteristics of farms and of managers are of a mixed nature (continuous and binary variables), it was necessary to choose a distance calculation that respects the nature of the data. Specifically, the Gower distance was chosen because of its flexibility. An extensive survey of binary similarity and distance measures was done by Choi, Cha and Tappert (2010). They presented the formula for Gower distance measure for binary data as:

$$S_{Gower} = \frac{a+d}{\sqrt{(a+b)(a+c)(b+d)(c+d)}}\ , \qquad (1)$$

where a is the number of combinations where both binary vector variables i and j have value 1 (or presence) in the same observation meaning "positive matches", b is the number of features (attributes) where the value of i and j is (0,1), meaning "i absence mismatches", c is the number of features (attributes) where the value of i and j is (1,0), meaning "j absence mismatches", and d is the number of attributes where both i and j have 0 (or absence), meaning "negative matches".

The distance at which the clustering process stopped was chosen to produce 3 clusters. Each was described by description statistics. It was further tested whether the individual clusters differed statistically significantly in a specific variable. We assumed normality of the continuous variables, so we chose ANOVA method. Differences in binary variables were tested in contingency tables. Calculations were done in Stata 15 and in MS Excel.

2 Results and Discussion

Characteristics of the farms (not the subsidies) were included into hierarchical CA, which dendrogram is displayed in Figure 1. The cut was done at height 8.5 to create 3 clusters. The first one is the smallest with 78 members, second is the largest with 175 farms. The third has 116 members. The characteristics of each cluster are displayed in Table 1. Maximal values are highlighted in bold.

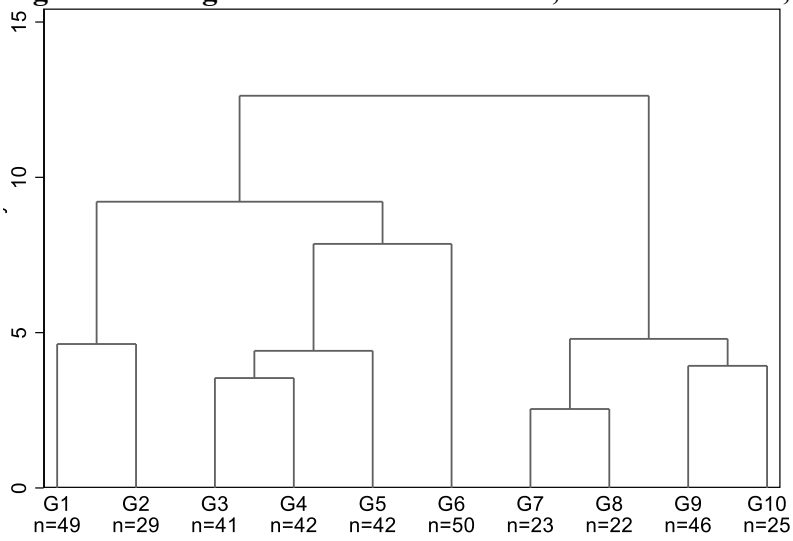
The first cluster was characterized by the lowest share of farms that obtain BISS, CISYF or IYF subsidies. The farms were aimed mainly at crop production and managed by the oldest farmers and were functioning the longest. It is paradoxical that the oldest farmers and the longest-running farms (i.e. the most experienced farmers) use the least subsidies. Possible reasons may be administrative obstacles, lack of knowledge or inappropriateness of subsidies for a given type of farm. A long-standing enterprise can be stable even without subsidies. In the case of CISYF, it is possible that the farmers have already received subsidy before and was no longer entitled to them at the time of the primary survey.

On the other hand, second group had the highest share of firms with BISS subsidy and IYF. There were mainly mixed production farms with the highest acreage and number of employees. The manager was mainly male. There was the lowest share of small farms. It is very probable that the farmers have already obtain CISYF before, so now they focus on investments and therefore draw IYF subsidies.

Third group was characterized by the highest uptake of CISYF subsidies. Farms there focused on livestock and organic production. Their size was the smallest. There was the highest share of managers had university degree. It can be hypothesized that educated farmers have positive relationship to organic production. Also, it is possible to have smaller farm, when farming organically, because the added value and price of the products is the highest. Lower share of IYF subsidies can be due to lower capacity for investments because the farms are small.

The implication for the policy makers is that some farmers (first group) need probably administrative support for higher uptake of subsidies, or simpler application forms. Results of the research done by Mattas et al. (2024) indicated that the current young farmers' scheme acts as a helpful instrument for a considerable percentage of young farmers. In our case they were utilized the most by the farmers in third group. However, they still need further streamlining is required to provide incentives, especially to new entrants, to be engaged in the farming profession. (Mattas et al., 2024).

Fig. 1: Dendrogram for hierarchical CA, Ward's method, Gower dissimilarity measure



Source: own elaboration

It was tested by ANOVA whether there are statistically significant differences between clusters in continuous variables and in contingency table if there are differences in binary variables. The results are shown it Table 2.

Tab. 1: Statistical description of the sample and clusters

Cluster	none	1	2	3	Cluster	none	1	2	3
Number of farms	369	78	175	116	Organic farming	33.9%	29.5%	34.3%	**36.2%**
Obtain BISS (1-yes)	87.8%	82.1%	**92.0%**	85.3%	Conventional farming	66.1%	**70.5%**	65.7%	63.8%
(0-no)	12.2%	17.9%	8.0%	14.7%	Small (≤ 10 ha)	28.7%	26.9%	25.7%	**34.5%**
Obrain CISYF (1-yes)	53.9%	47.4%	54.3%	**57.8%**	Large (> 10 ha)	71.3%	73.1%	**74.3%**	65.5%
(0-no)	46.1%	52.6%	45.7%	42.2%	Average acreage	46.68	46.76	**53.73**	35.98
Obrain INV (1-yes)	30.4%	25.6%	**33.7%**	28.4%	Operating time (years)	5.92	**6.45**	5.84	5.68
(0-no)	69.6%	74.4%	66.3%	71.6%	Employees	2.13	2.09	**2.20**	2.05
Physical person	98.9%	97.4%	**99.4%**	99.1%	Age	32.17	**32.82**	31.75	32.36
Legal person	1.1%	2.6%	0.6%	0.9%	Men	81.0%	83.3%	**83.4%**	75.9%
Livestock production	29.3%	28.2%	22.9%	**39.7%**	Women	19.0%	16.7%	16.6%	**24.1%**
Crop production	30.4%	**37.2%**	31.4%	24.1%	University degree (1-yes)	33.3%	34.6%	29.7%	**37.9%**
Mixed production	40.4%	34.6%	**45.7%**	36.2%	(0-no)	66.7%	65.4%	**70.3%**	62.1%

Source: own elaboration based on data from primary survey in 2025

There were differences among clusters only in acreage, type of production and whether the farms obtain BISS or not. The farms do not differ significantly in other variables. It is in contrast for example with the research of Unay-Gailhard and Bojnec (2021) who found gender differences in Agri-Environment-Climate Measures (AECMs) adoption behaviour in favour for women fully employed at farm.

Tab. 2: ANOVA and test in contingency table

ANOVA	F-value	p-value	Stat. sign.	Contingency table	G-value	p-value	Stat. sign.
Acreage	3.3888	0.0348	**	BISS	5.9432	0.0512	*
Operating time (years)	0.5682	0.5670		CISYF	2.0173	0.3647	
Employees	0.5313	0.5883		INV	1.9536	0.3765	
Age	0.9672	0.3811		Livestock / crop / mixed production	11.8796	0.0183	**
				Organic /conventional	0.9652	0.6172	
				Small / large	2.7767	0.2495	
				Sex	2.9397	0.2300	
				University or not	2.1926	0.3341	

Source: own elaboration based on data from primary survey in 2025

3 clusters represent distinct agricultural strategies. Cluster 1 demonstrates a traditional approach with less subsidy obtaining, despite long operational history. This may indicate either satisfaction with current operations or barriers to subsidy access. Cluster 2 represents an investment-oriented strategy, because the farms take advantage of income support (BISS) and infrastructure development (IYF). Cluster 3 reveals the emergence of educated, innovation-focused farmers entering the sector, utilizing complementary income support for young farmers (CISYF) while taking into account environmental aspect (high share of organic farms).

Conclusion

The aim of the paper was to characterize the farms managed by young farmers that obtain BISS, CISYF, and IYF subsidies to better understand the heterogeneity of young farmers benefiting from CAP support. The subsidy uptake patterns were examined in each group.

An agglomerative hierarchical cluster analysis applying Ward's method was chosen to create clusters with more or less even number of members (farms). Clustered variables were farm characteristics (legal form, production type, organic certification, size in acreage and number of employees, length of functioning) and farm manager features (sex, age, university degree). Given that the characteristics of farms and business managers are continuous and binary variables, it was necessary to choose Gower distance that respects the nature of the data.

The sample was divided to 3 groups where the first was characterized by the lowest share of farms that obtain BISS, CISYF or IYF subsidies. The farms were aimed mainly at crop production and managed by the oldest farmers and were functioning the longest. On the other hand, second group had the highest share of firms with BISS subsidy and IYF. There were mainly mixed production farms with the highest acreage and number of employees. The managers were mainly males. Third group was characterized by the highest uptake of CISYF subsidies, focus on livestock and organic production. The farms here were the smallest. The highest share of managers had university degree. However, the statistically significant differences were found only in attributes acreage, type of production (livestock / crop / mixed) and in the BISS subsidies up-take.

Nevertheless, this typological approach allows us to identify distinct farmer profiles and link them to policy effectiveness and future support design. Cluster 1 farmers probably require simplified administrative, while cluster 2 represents successful used of potential of the subsidies. Cluster 3 farmers benefit from CISYF the most, but also very probably from subsidies on organic farming. The heterogeneity observed across clusters suggests that one-size-fits-all

subsidy design may not be optimal. Future policy design should explicitly account for these heterogeneous farmer types rather than assuming uniform needs. Besides, May et al. (2019) concluded that agricultural policies would be more effective in addressing ageing of farmers if they are accompanied with complementary strategies aimed to deal with the social and psychological factors.

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Contact

Marie Šimpachová Pechrová
Institute of Agricultural Economics and Information
Mánesova 1453/75, 120 00 Prague 2, Czech Republic
simpachova.marie@uzei.cz

Ondřej Šimpach
Institute of Agricultural Economics and Information
Mánesova 1453/75, 120 00 Prague 2, Czech Republic
simpach.ondrej@uzei.cz