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Human potential of talents in agriculture and forestry in context of Agriculture 4.0

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Abstract: Agriculture 4.0 creates a challenge for agricultural and forest enterprises in the form of changes in the processes and strategies set up to now. The ability for flexibility, personal development, and further education will be critical in transforming agriculture and forestry organisations. The transition to Agriculture 4.0 will also affect the need for human resource management in terms of their need and competence structure. This work aims to identify a group of employees in the environment of the Slovak Republic's agricultural and forest enterprises with the prerequisites to acquire additional work competencies and the interest to develop flexibly. The mentioned group of employees, understood as progressive, will be examined from the point of view of motivational preferences and the level of satisfaction with them. The presented outputs follow searching the sample unit of 2 193 employees in agriculture and forestry organisations. Based on inferential statistics, it was confirmed that the progressive group of employees is identifiable in terms of their education and, compared to other groups, has a significantly higher perception of the importance of motivation factors with the highest difference in the case of factors related to career aspiration and social needs.

Keywords: agriculture and forestry organisation; competence change; identification of talented people; human resource management; talent motivation; retaining talented people

In recent years, agricultural and forest enterprises have faced complex challenges associated with turbulent changes due to COVID-19, the crisis related to the war in Ukraine, and, above all, in connection with the industrial revolution 4.0. The conditions of Agriculture 4.0 (also referred to as Smart Agriculture) bring about the development of economic and technological dependence between subjects of agricultural and forest enterprises and their stakeholders (European Commission 2017). These innovations bring questions related to data ownership and protection (Wiseman et al. 2019), with competence changes among workers,

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automation, and the subsequent loss of jobs of low-skilled agricultural and forestry workers (Lioutas and Charatsari 2021; Vrabcova et al. 2022). The need to create strategic plans for the transition to Agriculture 4.0 brings the need to reassess the work potential of employees not only in the context of expertise and their abilities for flexibility, independence, and further development (Garavan et al. 2021; Charatsari et al. 2022).

In the published knowledge, the attention is primarily focused on economic advantage, the introduction of new technologies, sustainability, difficult points, and the necessary competencies of agricultural advisers (as the primary mediators of innovations) in connection with Agriculture 4.0 (Pogorelskaia and Várallyai 2020; Lybaert et al. 2021; Charatsari et al. 2022; Jankelová et al. 2022; Urbancová and Vrabcová 2022). This contribution responds to the knowledge gap in the potential of workers perceiving development needs, motivated to further education in agricultural and forest enterprises, and an insight into their preferences in the employment relationship. The importance of this output supports the finding of Sirková et al. (2016) that investing in enterprise employees is approximately three times more beneficial than investing in equipment and technologies, which would be counterproductive without a quality and qualified human factor. Identifying these employees, the so-called talents, and their subsequent development is essential for every sector of the economy, and agriculture is no exception. A talent (Budhiraja et al. 2022; Sandeepanie et al. 2023) can be any employee who has the potential to contribute to the achievement of the company's goals or consistently achieves above-standard performance (Kohnová et al. 2023). Talent management enables an agricultural company to identify, recruit, develop, and retain key employees. Agricultural and forest enterprises with strong talent management have a competitive advantage (Kaliannan et al. 2023). The paper aims to identify a group of employees in the environment of the Slovak Republic's agricultural and forest enterprises with the prerequisites to acquire additional work competencies and the interest to develop flexibly. Following the published knowledge, a progressive group of workers further investigated in the paper is defined in the methodology. The results are presented and discussed in the second part of the paper.

Theoretical background. Today's agriculture, as well as the agriculture in the past, fulfils not only the production function but also other functions, among which, for example, social, environmental, and landscape operations are included. In 2021, in the structure of agriculture, forestry, and fishing employees, the Statistical Office of the Slovak Republic listed 80.46 thousand employees, of which 20.18 thousand employees (Statistical Office of the SR 2022) were in agriculture.

As a sub-field of the agricultural sector, forestry is an industry focused on cultivating forests and forest cultures, planting, harvesting wood, and primary processing. According to the statement of Forests of the Slovak Republic, Slovakia has 41% of its territory covered by forests (Statistical Office of the SR 2022). As part of digitisation, wider deployment of automation and robotisation is expected in all industrial areas (Gottwald et al. 2017; Lazarevic et al. 2020). The McKinsey Global Institute reports that reflecting the number of jobs in agriculture, forestry, and fishing, automation potential is 56%, the fourth highest automation rate by Statistical classification of economic activities in the European Community (NACE), after manufacturing (64%), transport (59%), and mining (62%). According to their findings, however, only approximately 5% of places can be fully automated without needing a human factor. Other jobs show partial automation, which will facilitate, improve, and speed up activities, while a significant change in workers' competencies will be required (Indruchová 2019; Pogorelskaia and Várallyai 2020).

The changes brought by Agriculture 4.0 have a positive but also a negative nature (European Commission 2017). Optimising production processes and changing the nature of business is positive. At the same time, this change will impact profit and cost structure (Gislam 2019). The disadvantage is the change in the number of job opportunities and the necessary retraining of employees due to the saved jobs. At this stage, we see the need for talent identification in the future, where to look for and discover such people. At the same time, define their everyday motivational needs and how they are fulfilled from this point of view. Active talent management can help agricultural and forest enterprises identify and develop new and innovative practices and can help increase productivity and work efficiency (Sommerauerová and Chocholáč 2020; Tokarcikova et al. 2020). From the perspective of Agriculture 4.0 and the ongoing transformation, a change in the structure of employee qualifications will have to be addressed (Sergi et al. 2019; Southwick et al. 2023). The key to promoting skill development is to continuously provide access to information and build a culture of continuous learning (Shevyakova et al. 2021; Kowal et al. 2022). Nasir et al. (2019) demonstrated through path analysis that the competence of agricultural workers has a direct positive effect on performance with

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a path coefficient of 62.9%, while compensations have an immediate positive impact on only 34.9% of the path coefficient. In this context, the identification of potential talents in agriculture is essential from the point of view of the change in the structure of competencies in the context of digitisation in the form of a growing need for education and personal growth, flexibility to introduce changes, digitisation, but no less important is the relationship to the workload and motivation (Michulek et al. 2023). According to Pogorelskaia and Várallyai (2020), farmers must prepare to embrace the coming digital change by increasing emphasis on increasing or acquiring new skills and abilities in the field of information and communication technologies.For talent management to be functional and practical for the enterprise, it is necessary to allow talented employees openness in communication, not to privilege them, provide them with a realistic perspective, and keep them in the company (Majerova et al. 2021; Urbancová and Vrabcová 2022). The mentioned process (Vetráková and Smerek 2019) is a fundamental problem of the primary sector due to the long-term low interest in agriculture and forestry.

MATERIAL AND METHODS

Research on employee motivation in agricultural and forest enterprises (besides fishery enterprises) of the Slovak Republic was carried out using the questionnaire from 2016–2022 on a sample unit of 2 193 respondents. The sample unit was chosen proportionally according to the economic activity of the employer, i.e. within agricultural and forestry activities (besides fishing). The questioning took place by directly addressing employees (in person and electronically in the form of an email with a link to the electronic questionnaire) in agricultural and forest enterprises selected randomly from the register of business entities. Representation within gender and age was solved by quota selection. The total response rate was 65%, while the representation of respondents in the sample unit working in agriculture and forestry was 61% and 39%, respectively. The sample unit was made up of 65.4% men; in terms of age group, it consists of 19.6% employees under 30 years old, 31.1% employees from 31 to 40 years old, 30.8% from 41 to 50 years old, and 18.6% older than 50 years. Within the sample unit, up to 55.5% were represented by blue-collar workers, 34.3% by white-collar workers, and 10.2% by managers; in terms of education, the most designated category were respondents with upper secondary education completed (up to 53.5%), the least represented with primary education completed (2.9%), respondents with lower secondary education were made up of 20.3%, and 23.3% of respondents completed higher education.

The target group represented the working population in the Slovak Republic, which was employed in agricultural and forest enterprises. Cochran's formula (Wilkinson and McElroy 1972) allows us to calculate the minimum sample size (95 % confidence interval, an accuracy of at least 5%). The critical value of the selected reliability was 1.96. The minimum range of the monitored sample unit was 322 respondents.

The questionnaire was divided into two parts. The first part dealt with socio-demographic characteristics. The second part contained 30 motivation factors relating to career aspiration (possibility of applying one's skills, job performance, competence, prestige, independent decision-making, self-actualisation, recognition, education, and personal growth), social needs (social benefits, company vision, name of the organisation, development of the region, relation of the organisation to the environment, free time), work conditions (physical effort at work, job security, workload and type of work performed, information about performance results, working hours, work environment, work processes, mental effort, stress), finances (basic salary, fringe benefits, fair appraisal system) and relationship (atmosphere in the workplace, good work team, supervisor's approach, communication in the workplace). The motivation factors were arranged in alphabetical order to avoid biasing the respondents. Respondents evaluated the importance of individual motivation factors with values. Rating 1 expressed the unimportance/unsatisfaction of/with the motivation factor for the respondent, 2 – little importance/satisfaction, 3 – neutral, 4 – importance/satisfaction, value 5 – the most significant importance/satisfaction of/with the motivation factor.

Basic descriptive statistics supplemented with inferential statistics were used to evaluate the obtained data (Hoy et al. 2011). Data processing results were obtained using SPSS 28.0 statistical software. Agriculture 4.0 transforms the needs and demands of the labour market in agriculture and forestry. Current knowledge shows the need for the so-called talents, which are not only focused on professional knowledge, but above all, it shows the need to change the structure of existing competencies with a focus not only on IT competencies, but also on the need for flexibility and continuous learning, personal development, the ability to receive and learn from constructive criticism, abilities to apply acquired knowledge and skills. K-means

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Table 1. Cluster analysis results

Preference factor	Arithmetic mean				η^2
	average workers	productive workers	progressive workers	total	
Education and personal growth	3.31	3.00	4.51	3.94	0.445
Applying skills	3.06	4.18	4.43	3.99	0.421
Feedback to performance	2.98	4.31	4.41	3.98	0.458
Individual decision making	3.27	3.33	4.44	3.94	0.369
Number of cases in each cluster	645	318	1 230	2 193	–
% of cases in each cluster	29	15	56	100	–

η^2 – measure of effect size [0.01 indicates a small effect, 0.06 a medium effect and 0.14 a large effect (Salkind 2010)]
Source: authors' own elaboration

clustering was used to determine a progressive group of employees with a high potential for further flexible education and personal growth and the ability to learn from their mistakes and apply what they know.

The cluster analysis followed the assessment results of the importance of factors: the need for education and personal growth, the possibility of using one's abilities and obtaining feedback on work results, and independent decision-making. These four motivation factors were chosen because they create a prerequisite for the development of the overall work potential of employees, such as talent, knowledge, work skills and abilities, and independent decision-making based on acquired competencies, which is essential for flexibility to changes in situations (Stacho et al. 2021; Jankelová et al. 2022). From variants 2–6 of the created clusters, variant 3 of the resulting clusters was selected after their closer analysis (Table 1).

Motivation factors were tested using Cronbach's Alpha. The internal reliability of individual scales of all analysed motivation factors was measured when Cronbach's Alpha reached $\alpha = 0.939$. The result of the Cronbach's Alpha for the selected four motivation factors (education and personal growth, the opportunity to apply one's skills and obtain feedback on work results, and independent decision-making) was 0.745, which corresponds to the required level of internal reliability (De Vaus 2002). For statistical testing, further tests were used: ANOVA, chi-square test, tree analysis using the CHAID (Chi-square Automatic Interaction Detector) method, and Games-Howell test. Based on the previous research on differences in motivation, the following research hypotheses were formulated:

H_1: We hypothesise that gender will not be a significant attribute that would play a role in identifying a group of progressive agricultural and forestry employees. This assumption is based on the fact that, despite scientifically proven different preferences in motivation, in terms of gender, employees have the same assumptions and characteristics for identifying them as potential talents, or called by us a Progressive group of employees.

H_2: We hypothesise that age will be a significant attribute that is different for determining group membership of regular employees and potential talent in agricultural and forest enterprises. This assumption is made because the interest in education and learning new things decreases with increasing age.

H_3: We hypothesise that current job classification will be a significant attribute difference for determining the group membership of regular employees and potential talents in the agricultural and forest enterprise. This assumption is not made because talents cannot be found among hierarchically lower-ranking workers but because there is an assumption of a higher correlation with education and, thus, a higher chance for their identification in the group of managers and white-collar workers.

H_4: We assume that the level of education will be an essential attribute distinguishing progressive employees from others in the environment of agricultural and forest enterprises. This assumption is based on the fact that employees who reached a higher level within formal education can now have a flexible approach to education and increase their competencies.

RESULTS AND DISCUSSION

Based on the perception of the importance of education and professional growth, use of abilities, feedback on work results, and independent decision-making, three clusters were identified using cluster analysis (Table 1). The resulting three clusters were named aver-

https://doi.org/10.17221/153/2023-AGRICECON

age employees, productive and progressive employees according to the perception of the importance of the monitored factors. Following the results of classification into three clusters, it can be seen that the majority group (up to 56%) consisted of progressive employees who internally perceive the mentioned factors predicting the ability to learn, improve, and the need to apply skills as very important and are also motivating for them. The condition of flexible adaptation to new technologies, legislative regulations, and a sustainable approach in agriculture and forestry is more than a positive fact. The cluster of employees identified as productive employees, although they have an impulse for continuous improvement in applying their skills, further education, personal growth, and increasing competencies for independent decision-making are no longer so essential for them. In the conditions of agricultural and forest enterprises, these are hardworking employees who care about their work results and can improve in a certain way. Still, they would prefer to respond more flexibly to innovations. Average employees have a neutral approach to perceiving the importance of all monitored factors. Within the ANOVA test (differences in the perception of these factors in determined clusters), the highest F value was achieved in the case of feedback to performance (926.9) and education and personal growth (877.9), which indicated that these factors were the most important in the formation of clusters. This fact was also confirmed by the result of the eta-squared value expressing the material significance of the difference between the groups, whose values above $\eta^2 = 0.14$ indicated a significant effect (Table 1).

For employers in agriculture and forestry, it is necessary to know where to look for a potential group of progressive employees, whether for their further planning in the company or their identification when selecting employees. Therefore, it is appropriate to ask whether gender, age, job position, or level of completed education are related to their belonging to the cluster of progressive employees. The structure of individual clusters and the chi-square test resulted for the given demographic attribute are presented in Table 2. Following these results, it can be stated that the classification into individual clusters is not related to gender or the age of employees at the 5% significance level. In our case, the significant connection showed the influence of education and job classification at the significance level of 1% (Table 2). Given that education likely affects the inclusion in the job category of agricultural and forest enterprises. The chi-square test results ($P < 0.001$ and Cramer's $V = 0.423$) confirmed that these are mutually influencing attributes.

Using the CHAID method for tree analysis, a model was created, presented in Figure 1. Based on the chi-square test, this model shows the potential of individual groups of employees in the environment of agricultural and forest enterprises for occurrence within individual clusters. From the drawn tree, it is clear that the lowest chance is for the employees with the most insufficient education and, conversely, the highest for employees with higher and upper secondary education working in administration and management.

Identifying a progressive group of employees in agricultural and forest enterprises motivated for further education, interested in the result of their work and its evaluation, inspired to apply their skills in practice, and interested in making decisions independently is the result of the investigation. In terms of practice, agricultural and forest enterprises as an employer are interested in the financial, relational, career, working environment, and social preferences of this group of employees due to their motivation and stabilisation. Figure 2 shows that the cluster of progressive employees, compared to the others, has a statistically significantly higher perception of the importance of all monitored groups of motivation factors, not only those related to finance. When comparing the level of fulfilment among average, productive, and progressive employees in agricultural and forest enterprises, following the ANOVA test, it can be stated that there were significant differences in the groups of motivation factors according to belonging to the cluster at the level of 1%. Their significance expressed by eta-squared is 0.209 for the motivation factors related to finance, 0.225 for those related to relationships, 0.309 for social needs, 0.377 to work conditions, and the highest – 0.518 for motivation factors related to career aspiration. The results of the Games-Howell test (for multivariate analysis of the results of the ANOVA test) determine the difference in terms of perceived importance for all motivation factors ($P < 0.001$).

The degree of fulfilment of groups of motivation factors in percentages is mentioned in Figure 3. It shows satisfaction regarding the degree of importance of the motivation factor, where a lower level of their fulfilment is visible among progressive employees. A comparison of productive and progressive employees shows that in terms of motivation factors related to finance and relationship, there was a comparable degree of fulfilment, which confirms the result of the Games-Howell test ($P = 0.052$ in the case of those related to finance and $P = 0.146$ to the relationship). It is also evident that there was a more outstanding balance in the percentage

https://doi.org/10.17221/153/2023-AGRICECON

Table 2. Structure of employee clusters of agricultural and forest enterprises

Category of workers			Cluster			Total	*P*-value χ2 (Cramer's *V*)
			average workers	productive workers	progressive workers		
Gender	men	count	434	200	801	1 435	0.379
		% gender	30.20	13.90	55.80	100.00	
	women	count	211	118	429	758	
		% gender	27.80	15.60	56.60	100.00	
Job position	manager	count	55	32	137	224	< 0.001 (0.065)
		% job position	24.60	14.30	61.20	100.00	
	blue-collar worker	count	382	199	636	1 217	
		% job position	31.40	16.40	52.30	100.00	
	white-collar worker	count	208	87	457	752	
		% job position	27.70	11.60	60.80	100.00	
Age	< 30 years	count	135	71	223	429	0.215
		% age	31.50	16.60	52.00	100.00	
	31–40 years	count	214	89	379	682	
		% age	31.40	13.00	55.60	100.00	
	41–50 years	count	190	101	384	675	
		% age	28.10	15.00	56.90	100.00	
	< 50 years	count	106	57	244	407	
		% age	26.00	14.00	60.00	100.00	
Education	primary	count	34	11	19	64	<0.001 (0.098)
		% education	53.10	17.20	29.70	100.00	
	lower secondary	count	159	68	218	445	
		% education	35.70	15.30	49.00	100.00	
	upper secondary	count	323	178	672	1173	
		% education	27.50	15.20	57.30	100.00	
	university	count	129	61	321	511	
		% education	25.20	11.90	62.80	100.00	
Total		count	645	318	1 230	2 193	
		% education	29.40	14.50	56.10	100.00	

Source: authors' own elaboration

of the fulfilment rate for factors related to relationships, career aspirations, work conditions, and social needs.

The issue of identifying a group of employees in agricultural and forest enterprises who can meet the requirements arising from the change in the structure of competencies in the context of Agriculture 4.0 is discussed in the paper. Published studies mentioned primarily the need for flexibility, the ability to continuously learn. Identifying the specific group was based on the perception of the importance and motivational effect of the chance of education and personal growth, obtaining feedback on work results, applying one's skills at work, and making independent decisions. Using these four attributes, three clusters of employees were identified by K-means cluster analysis: average, productive, and progressive. The identified clusters formed the basis for the verification of research hypotheses:

The assumption established in H_1 was confirmed because gender is not a significant attribute affecting the identification of a group of progressive employees.

The confirmation of the hypothesis is based on the results of the chi-square test ($P > 0.05$) presented in Table 2. Research hypothesis H_2 was not confirmed based on the results of the chi-square test ($P > 0.05$, Table 2).

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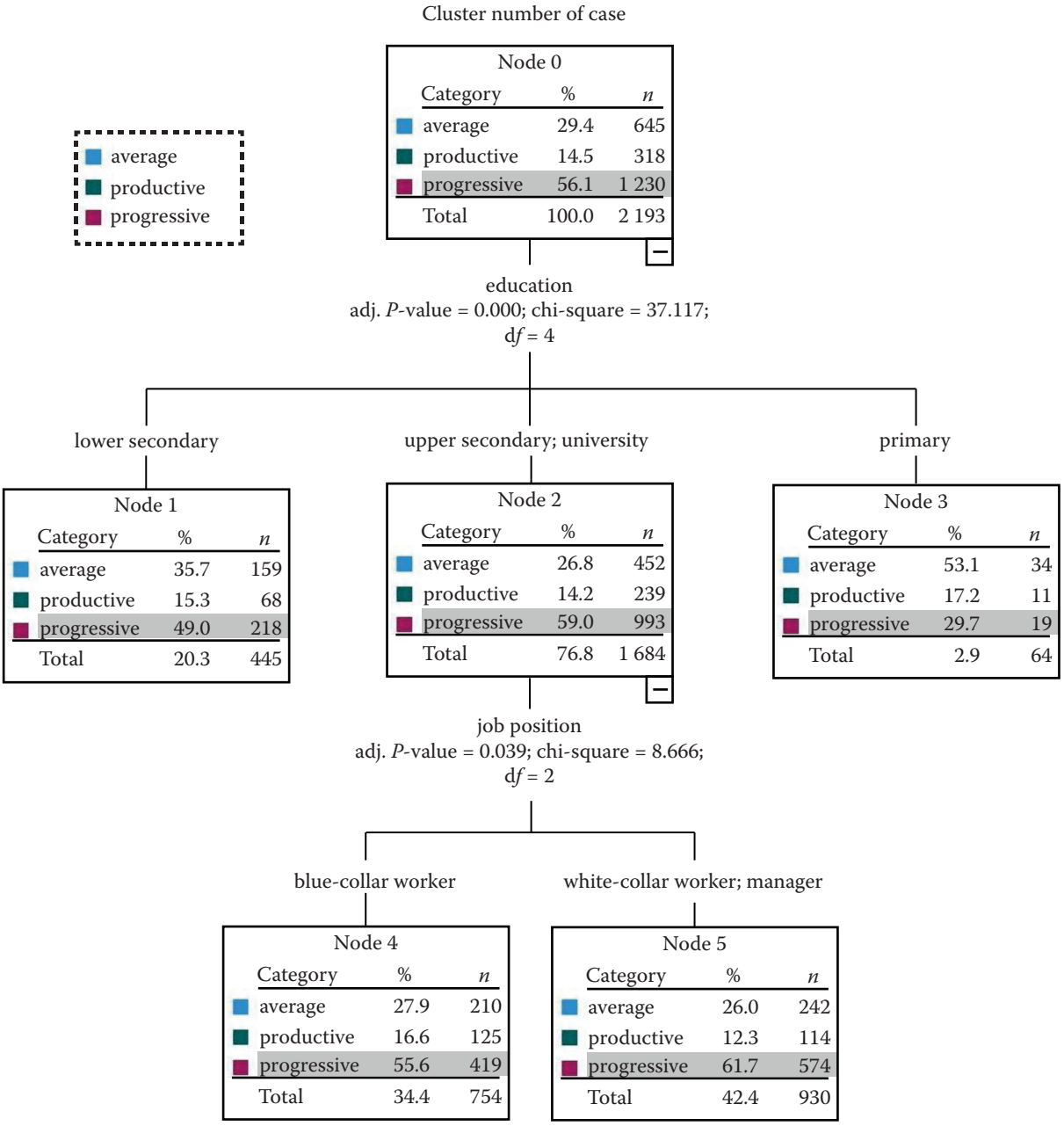

Figure 1. Employee classification model in agricultural and forest enterprises with the potential to use talent management

Source: authors' own elaboration

H_3 was confirmed. It can be concluded that the cluster of progressive employees is more significantly represented (P > 0.001, Cramer's V = 0.065) in the job positions of a manager and blue-collar worker. The expressed assumption H_4 was confirmed (P > 0.001, Cramer's V = 0.098), which is presented in Table 2.

The results show that the majority (56.1%) of agricultural and forest enterprise employees in the Slovak Republic are motivated by the possibility of further education and growth, independent decision-making, obtaining feedback on work results, and applying skills (Tables 1 and 2). This group can be determined primarily based on the education completed, while with better education, the assumption of their representation in the work teams also increases. Considering the 56% automation potential according to the number of jobs in agriculture, forestry, and fishing determined by the McKinsey Global Institute, the need for the so-

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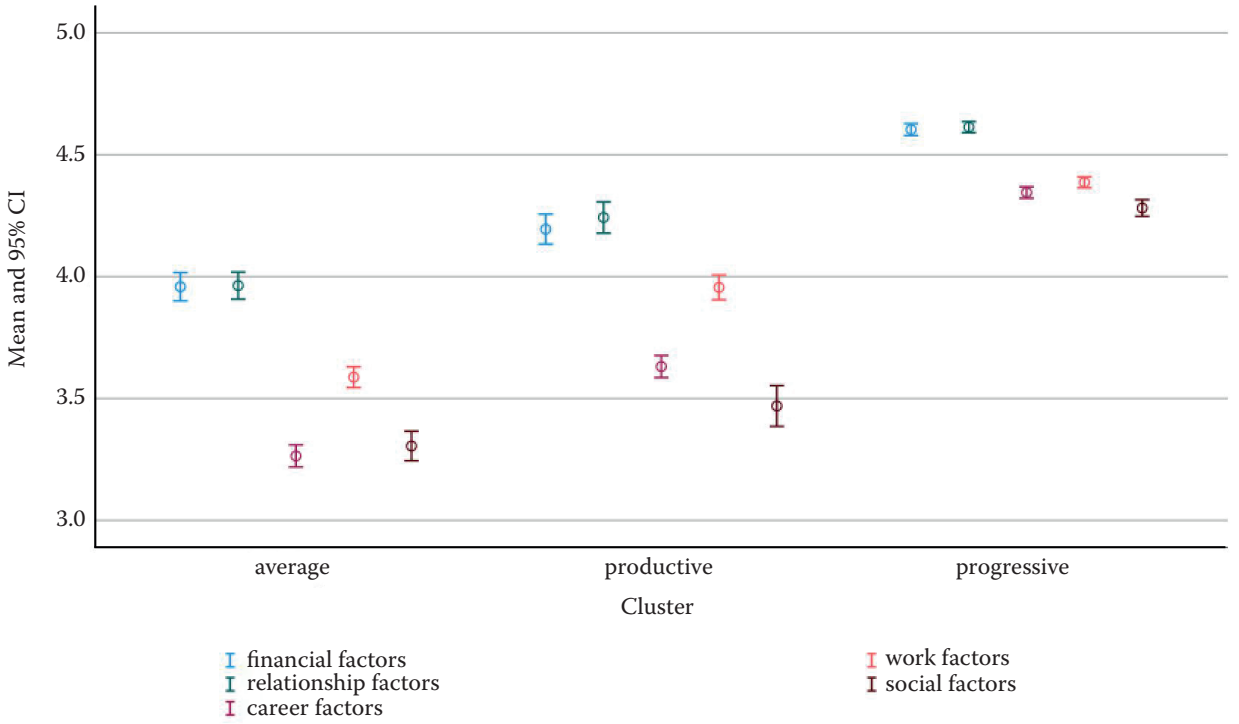

Figure 2. Importance of the group of motivation factors in terms of their cluster membership

CI – confidence interval
Source: authors' own elaboration

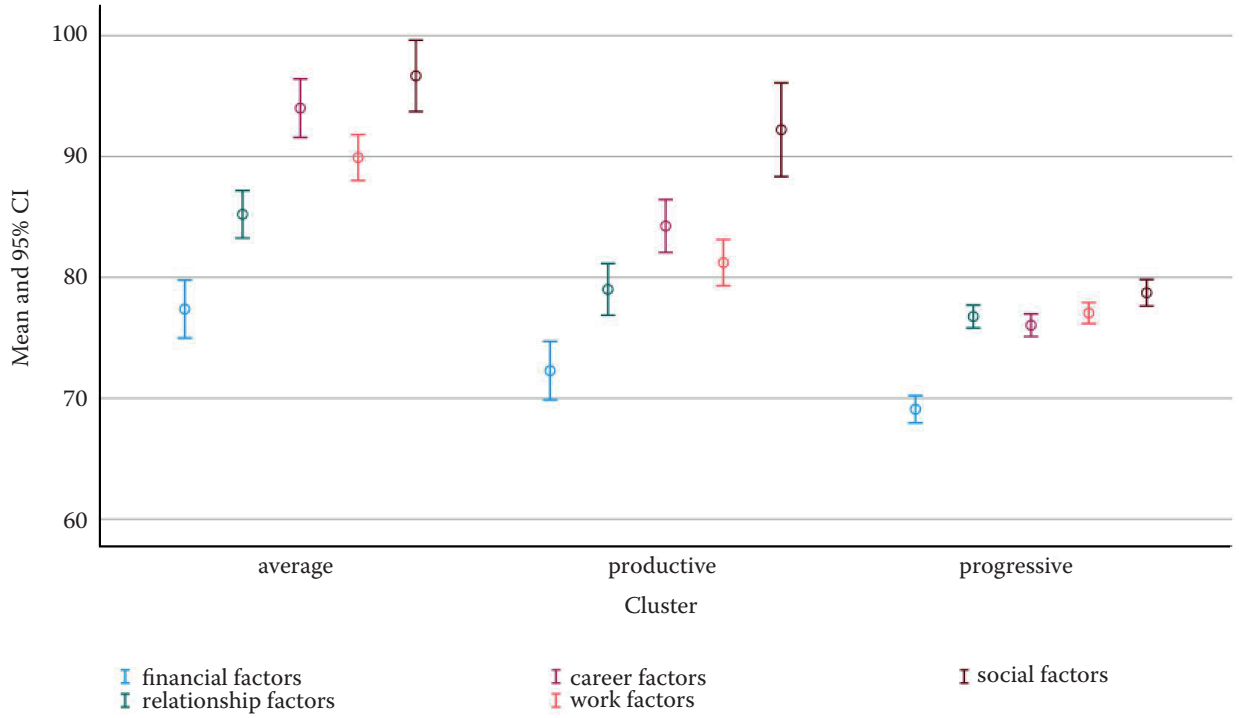

Figure 3. Degree of meeting the motivation factors according to the cluster membership

CI – confidence interval
Source: authors' own elaboration

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called progressive group of employees is high (Pogorelskaia and Várallyai 2020). According to (Issahaku 2014), a change in the structure of competencies will be necessary, while in the framework of lifelong learning and the application of new knowledge in practice, not only the acquisition of technical (primarily information-analytical) but also soft competencies will be addressed. At the same time, motivation and accepting the workload are specific to agriculture. According to studies, there is a relevant higher interest in STEM education among men than among women. On the contrary, within the fields more focused on humanities, there is a higher interest among women (Verdugo-Castro et al. 2022).

A study by Issahaku (2014) pointed out the need to acquire additional competencies in Agriculture 4.0 will be more than just technical. In our research, emphasis should have been placed on further education and applying acquired skills. Thus, the significance of gender for the identification of talents defined by us disappeared.

Nasir et al. (2019) demonstrated through path analysis that the competence of agricultural workers has a direct positive effect on performance, while compensations had an immediate positive impact. In contrast to the research presented by us, the studies of Issahaku (2014) and Nasir et al. (2019) are based only on the results for agriculture. Moreover, they are specific in terms of the cultural impact. Therefore, the conclusion that the determination of a progressive group of employees in the form of a talent pool in which the company plans to invest further and develop has strong potential can be drawn. Incorrectly setting up the purpose of talent will result in an unreturnable investment for the enterprise degrading the talent management program to a personnel process without effect (Smerek and Vetráková 2020). Following the significant lack of talent, the motivation for talent is becoming increasingly critical (Kohnová et al. 2023). A determined group of progressive employees in agriculture and forestry shows a higher perception of importance within all categories of motivation factors compared to others. The most significant differences are evident (Figure 1) in the case of those related to career aspiration and social needs, which indicates a higher degree of social responsibility (in terms of environmental sustainability, the vision of the company, and the development of the region) and the need for career growth (the need for recognition, prestige, powers). When comparing the perception of the percentage of fulfilment of the investigated factors in determined clusters, this is a group of employees that again shows a strong balance in motivation factors related to relationships, career aspiration, work conditions, and social needs. In the case of employers, the motivation must be comprehensive without a one-sided focus on the financial side, the effectiveness of which is underlined by the findings of Nasir et al. (2019).

CONCLUSION

Under the paper's aim, the employees of agricultural and forest enterprises of the Slovak Republic with a higher potential for flexible development and improvement of work competencies necessary in connection with the transition to Agriculture 4.0 were identified. Within the cluster analysis, the determined group was represented in the majority, and due to its characteristics, it was called progressive. The analyses were also solved regarding motivational preferences and the perception of meeting the motivation factors. The results are beneficial both from a theoretical point of view when they enrich the knowledge base and fill the knowledge gap. From a practical point of view, the outputs are usable for the professional public and entities hiring workers in agriculture and forestry. The research limits relate to the environment of the Slovak Republic and in limiting the field of agriculture, forestry, and fishing only to the first two areas without including fishing activities. Also, the monitoring period is not differentiated into years separately, and the dataset is analysed in the years 2016–2022. In addition, the results are presented together for agriculture and forestry, which only allows for their interpretation and comparison. Therefore, showing individual results will be desirable in the future. Further research in this field will focus on investigating the effect of corporate culture on the motivation of talented managers. The mentioned research will allow us to understand the interdependence of motivation and corporate culture in the context of human resource management.

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