MODERN DECISION-MAKING MECHANISM IN THE PROCESS OF DEVELOPMENT OF SMALL FARMS

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ABSTRACT

The use of multi-criteria decision-making methods can contribute to finding the most rational solution more easily and efficiently. The purpose of the research is to investigate the applicability of the PROMETHEE and TOPSIS methods at the level of family farms and their comparative analysis in the case of the purchase of agricultural mechanization. Both methods start from a set of criteria established based on the subjective expectations of 48 farmers (decision makers) who were asked to choose the decision criteria. Then, mathematical models are used to determine the most suitable choice for the farm. Based on the research findings, it can be concluded that applying both methods in parallel leads to similar outcomes. Although decision support systems can be instrumental in making the right decisions, their usage is still not widely adopted in family farms due to the challenges of introducing new solutions in a production setting.

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Introduction

Agriculture is characterized by multi-criteria decision-making in planning, strategic management and production, and decision-making mainly consists in evaluating a set of possible alternatives and solutions in relation to a defined set of criteria. In the agricultural sector, decision-making problems are usually poorly structured, and the possible decisions are insufficiently defined. It can be concluded that agriculture is a very risky activity in which the risk must be studied every day, and the right decisions must be made. For this reason, the use of multi-criteria decision-making methods can be a powerful tool when making decisions. The optimization problem of plans has to be in the system of modernization agriculture (Bešić, et al., 2022). The goals of the research are what the way of modernity is and, on the other, what the relationship is between modernization and the decision-making process.

Modern production methods require the use of agricultural mechanization, without which efficient and economical agricultural production would not be conceivable today. Agricultural mechanization is a significant symbol of the transformation from traditional agriculture to modern agriculture. The choice of agricultural machinery plays an important role in the management of agricultural mechanization production and directly affects economic benefits (Lu et al., 2022). Mechanization is one of the most important conditions for good and high-quality cultivation of agricultural land. The absence of mechanization, inadequate application, or its poor quality can cause huge negative consequences. Frequent consequences are increased soil compaction, poor execution of processing, sowing and care, mechanical damage to plants and fruits of plants, increased losses during harvesting, performing agrotechnical operations outside of optimal terms, and “pollution” of soil, water, and air with harmful substances from exhaust gases or chemical protection. Excessive soil compaction caused by the mechanical action of the wheel and the working units of agricultural machines disrupts the ratio of air and water in the soil. At the same time, it increases the resistance to the development of the root system of plants and creates very unfavourable conditions for the development of microbiological activity, which has a negative effect on the provision of soil fertility elements: food, water, oxygen, heat, and others. Research has shown that this phenomenon can be alleviated by the application of technical and agrobiological measures, followed by the controlled movement of machinery and reduction of the number of passes. Low-quality and inadequate tillage can reduce yields by 15-25%, while poorly executed sowing can cause a decrease of 10-15%. On the other hand, low-quality mechanization can lead to yields that are half as much. When picking fruits, losses can also be high as a result of machine imperfections or poor operating modes. Losses in wheat can reach 5%, seed corn 7%, sugar beet 8%, and in some vegetable crops, even 20% (Radivojević, 2012).

The market for modern agricultural machinery is extensive and varied, with countless manufacturers, machine types, and varieties. At the same time, the supply of agricultural mechanization, accessories, irrigation systems, and other machinery is continuously expanding. In these circumstances, the following question arises: what is the most appropriate choice to meet one's needs? Selecting a rational choice can contribute to the best, above-average result. Conversely, choosing a less appropriate option can cause serious negative financial consequences for the agricultural holding. The development of agricultural mechanization not only has an important impact on improving agricultural productivity but also plays a vital role in enhancing crop yield and farmers' quality of life (Fu, Dan, 2014).

Decision support systems can play a crucial role in making the right decision. These procedures allow the decision-maker to find a satisfactory, rational solution. The need for modern management and decision-making mechanisms, however, requires much more than possessing the appropriate data. Of course, we need to know what the situation is, but even more, we need to know what to do. Once modern computers are available - hopefully in the near future - we can solve not only generating, handling, and processing data but also multivariable planning and optimization of planning in a contemporary manner (Cvijanović, Sedlak & Vojinović, 2018; Pantić et al., 2022). We can surely state that exact and comprehensive analysis is inconceivable without such information provided by a model that solves a number of decision types: optimal production structure, gains, technologies, use of resources, shadow prices, sensitivity analysis, assumptions, simulating, and analyzing "what if…" situations, etc. The relationship between optimization and economical regulation in the decision-making mechanism also deserves our attention (Janković et al., 2022; Prdić & Kostić, 2022). Sedlak et al., 2016).

Companies worldwide are focused on two topics: how to modernize their production process and how to modernize the company's decision-making mechanism. These two issues are tightly linked. To have modern management in place, not only must the means of production and the technical level of manufacture be developed, but the decision-making system as well. It should be considered an axiom that modern development can be achieved only through modern decision-making, and this includes modern analysis, flow and processing of information, multivariate planning, and deciding on the optimal version (Ciric et al., 2019).

Multi-Criteria Decision Making is a well-known branch of operations research models that deals with decision problems when several decision criteria exist (Tzeng *et al*., 2007). Nowadays, there are many methods in the field of *MCDM* methods, among which the *PROMETHEE, TOPSIS, ELECTRE* and *AHP* methods can be highlighted (Nedeljković, Puška & Krstić, 2022). All that applies to agricultural production.

Materials and methods

MCDM has a relatively short history; the basics of modern *MCDM* were laid in the 1950s and 1960s (Zavadskas, Turskis & Kildiene, 2014). The rapid growth of this field has been recorded since 1980 (Dyer et al., 1992). *MCDM* involves situations in which the decision-maker needs to choose one alternative from a set of alternatives, which are evaluated based on several criteria. *MCDM* is a decision-making process when there is a large number of criteria that are usually opposed to each other. This fact is an extremely important step towards the types of problems that should be solved by different methods of multi-criteria decision making. *MCDM* is one of the most important areas of decision-making theory, which is widely applied in solving real-life problems (Bobar, 2014). Furthermore, two methods of multi-criteria decision-making will be presented, as well as their application in solving real problems in terms of buying agricultural machinery.

The basis of the *TOPSIS* (Technique for Order Preference by Similarity to Ideal Solution) method is the definition of ideal and anti-ideal solutions. The method is based on the concept that the chosen alternative should have the shortest distance from the ideal solution and the longest from the anti-ideal one. The ideal solution minimizes the price criteria and maximizes the profit criteria; the reverse situation applies to the minimum ideal solution. The ideal solution is defined by the best rating values of the alternatives for each criterion, and the negative ideal solution implies the worst rating values of the alternatives. The terms ‘best’ and ‘worst’ are considered for each criterion separately, depending on whether the criterion is a maximization or minimization one. The optimal alternative is defined as the alternative that is geographically closest to the ideal solution, that is, the one that is farthest from the anti-ideal solution. The ranking of alternatives is done on the basis of the ‘relative similarity to the ideal solution,’ which avoids the situation of simultaneous similarity of the alternative to the ideal and anti-ideal solution (Chang, Lin, Linz & Chiang, 2010).

PROMETHEE methods (Preference Ranking Organization METHODS for Evaluation) are multi-criteria decision-making methods used to rank a finite number of alternatives. *PROMETHEE* methods were introduced by Professor Jean-Pierre Brans in 1982. The methods are intended for processing quantitative and qualitative data, as well as for treating different scales (Szántó, 2012).

Today there are four types of these methods:

1. *PROMETHEE I,* which results in a partial ranking of alternatives;
2. *PROMETHEE II,* which provides a complete ranking of alternatives;
3. *PROMETHEE III,* which gives an interval order of the alternatives;
4. *PROMETHEE IV,* which is an extension for continuous sets of alternatives (Stanimirović, Stojković & Petković, 2007).

The basis of the *PROMETHEE* method is the use of the criterion function P for all alternatives that have been evaluated using criterion functions. One alternative, for example alternative a_1, is considered better than alternative a_2 based on the function f if the following is true: $f(a_1)>f(a_2)$.

The preference function refers to a single-criterium comparison of alternatives. Based on this function, a multi-criteria index of preference of alternative a_1 over alternative $a_2$is defined.

It is essential to determine the positive and negative flow of some alternative, from which net-flow defines and on the basis of which multi-criteria ranking of alternatives is performed. If an alternative a_1 has a higher net flow, this alternative is considered "better" than alternative a_2. (Brans & Mareschal, 2005)

The multicriteria problem represents as follows: max $\{g_1(a), g_2(a), ..., g_j(a), ..., g_k(a), a \in A\}$, where A is the set of possible alternatives $\{a_1, a_2, \ldots, a_i, \ldots, a_n\}$ and $\{g_1(\cdot), g_2(\cdot), ..., g_j(\cdot), ..., g_k(\cdot)\}$ is the set of criteria.

As with the previous method, every criterion in decision matrix needs to be assigned the appropriate weight w_j. Theset of criterion weights defines the relative importance of the criterion during decision-making.

PROMETHEE methods are based on comparing each pair of alternatives for each of the selected criteria. In this way, the decision-maker has the opportunity to assign a preference to one of the alternatives. Preferences can have a value in the interval of 0 to 1. The greater the value, the higher the preference. This specifically implies that the decision-maker analyzes a certain function of preference for each criterion.

The application of the *PROMETHEE* method consists of two basic steps:

1. construction of the relation of preference in the set of alternatives *A;*
2. incorporating that relation to respond to the problem.

In the first step, a complex relation of preference is determined (to emphasize the fact that this relationship is based on applying more criteria, this routing is called outranking relation. The preference index is defined and the complex relation of preference is formed, which is displayed using the preference chart. The aim of the first step is for the decision-maker to show their preferences between two alternatives, according to each of the criteria, based on the difference in the value of the alternatives they want to compare. The formed relation of preference is used in that way to calculate the input and output flow in the chart for each alternative. In order for the method to function, it is necessary to determine the general type of criteria for each individual criterion.

Results and Discussion

In this paper, it is assumed that the agricultural farm wants to expand its production, therefore the primary goal is to choose the appropriate and the best mechanization based on criteria (Table 2.).

In addition to defining alternatives, it is necessary to determine criteria on the basis of which the best alternative will be selected. After researching the market and collecting the necessary data, 48 farmers, decision makers, were asked to choose the decision criteria (10 out of 32). Regarding the importance of certain characteristics of mechanization, decision makers assigned scores on a Likert scale from 1 (least importance) to 10 (highest degree of importance) for each criterion. The general average rating of all decision makers according to all criteria was 7.54. When looking at the surveyed experts individually, the lowest overall score was 3.41, and the highest was 9.80. The distribution of general average scores of 48 decision makers does not deviate significantly from normal flatness (flatness measure K=3.11) but is significantly negatively asymmetric (asymmetry measure S= -0.95), so it does not follow a normal distribution (Jarque-Bera statistic is JB=12.66, p=0.002). Due to the deviation from the normal schedule, finding the extreme value in the general average ratings of individual decision-makers was performed with a non-parametric test, i.e. IQR (Interquartile Range). The lower limit for the extreme value was 3.26, and the upper limit was 12.01. Since the minimum and maximum value shown above belong to this interval, it follows that no extreme value was detected, the average rating of any decision-maker does not deviate significantly downwards or upwards from the others, so it was not necessary to exclude the answers of individual respondents from further data processing. The internal consistency of the survey was checked using Cronbach's α coefficient. It was concluded that the ratings assigned in the survey meet the condition of consistency and are a suitable basis for analysis and application in further research. A higher α value indicates a higher degree of internal consistency, an acceptable level is greater than or equal to 0.6, values greater than or equal to 0.8 are considered good, while values greater than or equal to 0.9 reflect excellent internal consistency of the survey. α-coefficients on the criteria are shown in *Table 1*.

Table 1. Values of α

Criteria	**α**	**Degree of internal consistency**
Market price (EUR)	0.94	excellent
Engine power (kW)	0.86	good
Manufacturer's reliability	0.88	good
Euro standard	0.88	good
Delivery time (days)	0.82	good
Max speed (km/h)	0.90	excellent
Pump capacity (l/min)	0.87	good
Lifting power (kg)	0.87	good
Front weights (kg)	0.86	good
Soil-protecting and environmentally friendly	0.90	excellent

Source: Authors' calculations based on data obtained from the decision makers

Table 2. Initial data for application of TOPSIS i PROMETHEE method

	Market price (EUR) MIN	Engine power (kW) MAX	Manufacturer's reliability MAX	Euro standard MAX	Delivery time (days) MIN	Max speed (km/h) MAX	Pump capacity (l/min) MAX	Lifting power (kg) MAX	Front weights (kg) MAX	Soil-protecting and environmentally friendly MAX
Mechanization 1	21588	42.3	5	3	14	29	48.5	2.200	80	very low
Mechanization 2	29988	54	5	3	14	30.41	48.5	2600	300	high
Mechanization 3	23990	57.8	4	4	0	33.4	45	3500	900	average
Mechanization 4	25190	60	4	4	0	33.4	45	3200	360	high
Mechanization 5	24590	60	4	4	0	33.4	45	3200	200	low
Mechanization 6	45600	65	3	3	14	40	48	2500	160	very high
Mechanization 7	29940	58.8	2	3	0	40	35.2	2610	300	high
Mechanization 8	32340	66.5	2	3	60	40	35.2	3200	300	high

Source: Authors' calculations based on data obtained from the decision makers

One of the criteria that is very important for the author is soil-protecting and environmentally friendly tillage systems, as it contains elements of the circular economy. They are as follows:

- Central loosening system: It can be used to improve the condition of deeper soil layers, mitigate cultivation errors and environmental damage. Its economic benefit is the improvement of the safety of crop cultivation, and the reduction of quantitative and qualitative losses related to the effect of drought due to the elimination of the compact state. The first element of the system is shallow, mulch-free stubble stripping that reduces moisture loss. Thus, the soil does not dry out even in the dry season, and loosening can be carried out to the planned depth;
- Cultivator system: The agronomic and indirect economic benefit of the system is the preservation of the soil structure, which can be fully utilized if the condition of the root zone is not compacted. An essential element is mulching, which helps prevent the soil from drying out and improves its workability. It is suitable for maintaining the favorable condition in the year following relaxation. Dusting and mixing elements are built-in front of, behind, or between the rows of harrows of modern cultivators. The advantage of the cultivator system is that the number of passes can be made independent of the moisture content of the soil. Cultivation that leaves mulch and reduces moisture loss is more important on dry and moist soil. Damage to the structure can be safely prevented even on wet – even arable – soil;
- Disc system: Its application risk can be reduced by adapting to the condition of the soil. In the gentle cultivation system, the function of the disc is stubble stripping and basic cultivation, in both cases combined with cultivation. The sparing of

the soil structure of the flat disc dusters is similar to that of the cultivators. Due to the dusting, the traditional discs with spherical glass plates do not meet the requirements for structural protection. It is definitely recommended to use a roller in the same pass as dialing to seal the dialed area;

- Streamlined plowing systems: The purpose of these systems is to maintain plowing, the method favored by farmers, to prevent typical errors, and to reduce cultivation and environmental risks. Plowing must not increase erosion, deflation, soil compaction, lumpiness, and dustiness. The emission of carbon dioxide, the reduction of organic matter, and the disturbance of the habitat of earthworms can also be controlled in plowing systems. A plowing system can be rationalized by reducing the frequency, rotation damage, risk associated with its time, the number of processes between plowing and sowing without loss of quality, and the total number of passes.

In addition to the soil- and environment-friendly cultivation methods, the least expensive yet effective agrotechnical element, the reasonable, professionally thought-out crop rotation, should definitely be mentioned. Even before we start cultivating our soils with one of the above-mentioned technologies, we should think about the range of plant species we want to grow and their succession in the same area (Fazekaš, Bobera, & Ćirić, 2017).

In application of ***TOPSIS*** method the first step in solving a given problem is to define the criteria for the selection of agricultural mechanization (as shown in *Table 1.*).

The next step is to transform qualitative indicators into quantitative ones using a measurement scale from 1 to 5 (*Table 3.*).

Table 3. Data evaluation in the application of TOPSIS method- mechanization

Criteria	Initial data	Weight	Value	Detailed data
(C1) Market price (EUR)	Very high	Very low	1	≥ 45.000
	High	Low	2	30.000 ≤ x < 45.000
	Average	Average	3	25.000 ≤ x <30.000
	Low	High	4	22.000 ≤ x < 25.000
	Very low	Very high	5	<22.000
(C2) Engine power (kW)	Very low	Very low	1	<50
	Low	Low	2	50 ≤ x < 55
	Average	Average	3	55 ≤ x < 60
	High	High	4	60 ≤ x < 65
	Very high	Very high	5	≥ 65
(C3) Manufacturer's reliability	Not reliable	Very low	1	1
	Under-average reliable	Low	2	2
	Average reliable	Average	3	3
	Reliable	High	4	4
	Very reliable	Very high	5	5

Criteria	Initial data	Weight	Value	Detailed data
(C4) Euro standard	Very low	Very low	1	1
	Low	Low	2	2
	Average	Average	3	3
	High	High	4	4
	Very high	Very high	5	5
(C5) Delivery time (days)	More than one year	Very low	1	182 <
	Several months	Low	2	30 < x ≤ 182
	Several weeks	Average	3	14 < x ≤ 30
	Several days	High	4	0 < x ≤ 14
	No waiting	Very high	5	0
(C6) Max speed (km/h)	Very small	Very low	1	<25
	Small	Low	2	25 ≤ x < 30
	Average	Average	3	30 ≤ x < 35
	Big	High	4	35 ≤ x < 40
	Very big	Very high	5	≥ 40
(C7) Pump capacity (l/min)	Very small	Very low	1	<35
	Small	Low	2	35 ≤ x < 42
	Average	Average	3	42 ≤ x < 45
	Big	High	4	45 ≤ x < 48
	Very big	Very high	5	≥ 48
(C8) Lifting power (kg)	Very small	Very low	1	<2300
	Small	Low	2	2300 ≤ x < 2600
	Average	Average	3	2600 ≤ x < 3200
	Big	High	4	3200 ≤ x < 3500
	Very big	Very high	5	≥ 3500
(C9) Front weights (kg)	Very small	Very low	1	<100
	Small	Low	2	100 ≤ x < 200
Criteria	**Initial data**	**Weight**	**Value**	**Detailed data**
(C9) Front weights (kg)	Average	Average	3	200 ≤ x < 300
	Big	High	4	300 ≤ x < 400
	Very big	Very high	5	≥ 400
(C10) Soil-protecting and environmentally friendly	Very low	Very low	1	1
	Low	Low	2	2
	Average	Average	3	3
	High	High	4	4
	Very high	Very high	5	5

Source: Authors' calculations

The third step is to determine the weight of each criterion (*Table 4.*).

Table 4. Presentation of weights of criterion in the TOPSIS method - mechanization

Criteria	Weights of criterion
C1	0.18
C2	0.1
C3	0.13
C4	0.14
C5	0.05
C6	0.08
C7	0.05
C8	0.07
C9	0.05
C10	0.15

Source: Authors' calculations

The next step is to normalize the decision matrix to obtain a normalized matrix *a* as $R=[r_{ij}]_{mxn.}$ After that have to multiply the normalized matrix by weight coefficients. This step is realized through the formula: $v=w_j\times r_{ij}$; $i = 1, ..., m, j = 1, ..., n$. The sixth step is to determine the ideal A^+ and ideal negative A^- solutions. The next step is to calculate the distance of all alternatives from the ideal and anti-ideal solution. The eighth step is to determine the relative closeness of the alternatives to the ideal solution (*Table 5.*).

Table 5. Display of the relative closeness of individual alternatives to the ideal solution – mechanization

Alternatives	RC
Mechanization 1	0.631
Mechanization 2	0.559
Mechanization 3	0.715
Mechanization 4	0.537
Mechanization 5	0.638
Mechanization 6	0.388
Mechanization 7	0.492
Mechanization 8	0.447

Source: Authors' calculations

The last step is to rank the alternatives using the *TOPSIS* method. Based on the calculated values of the relative closeness of alternatives to the ideal solution, the best alternative can be determined. According to the presented table and the performed analysis, the tractor with the highest value, i.e., **Mechanization 3**, achieved the best result, followed by **Mechanization 5** in second place and **Mechanization 1** in third place. **Mechanization 6** occupied the last place.

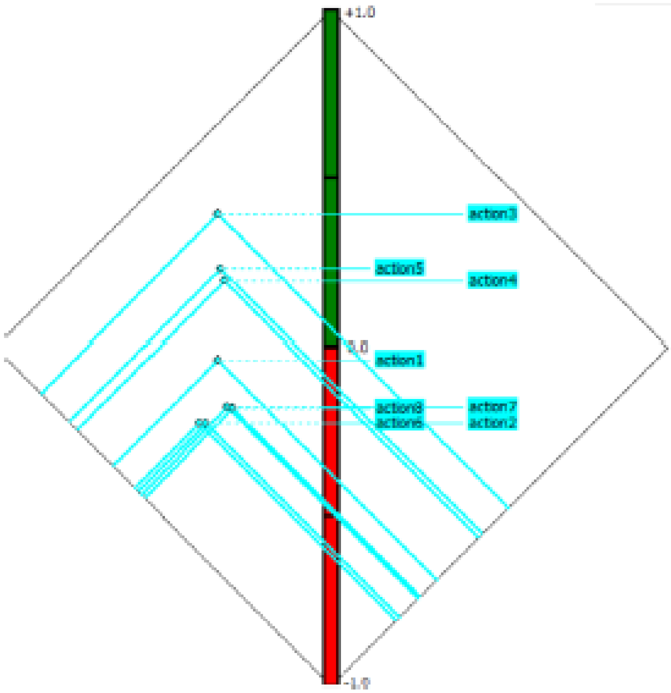
PROMETHEE method is applied using softwer Visual Promethee (Promethee & Gaia Software, 2020). In the application of *PROMETHEE* method four types of criteria are used: normal, level, linear, and criterion of shape V.

The *normal* criterion was applied to the criteria “Market price”, “Engine power”, “Euro Standard” and “Delivery time” because the agricultural economy strictly prefers the lowest possible price and delivery time, as well as the highest engine power and the highest level of the Euro standard. The criterion *level* was applied to the criteria “Manufacturer’s reliability” and “Soil-protecting and environmentally friendly”, because the data were ranked from 1-5. The *linear* criterion was applied in the case of the criteria “Pump capacity”, “Lifting power” and “Front weights” because there are both preference and indifference thresholds in this case. The *criterion of shape V* was applied to the „Max speed” criterion. In this case, there is a preference threshold of 5 units of measure, which implies that if the difference between the alternatives becomes greater than that value, the farm will strictly prefer that alternative.

After selecting the preference and indifference threshold for individual criteria, the weights of the criteria are determined. In this case the same weights were taken as when applying the *TOPSIS* method, i.e., 0.20; 0.10; 0.15; 0.15; 0.05; 0.08; 0.05; 0.07; 0.05 and 0.1. As the last step, it should be determined whether it is a *MAX* or *MIN* criterion. Of course, agriculture prefers the minimum possible price and delivery time, while for other criteria it wants to get the highest possible value.

Then the program calculates and obtains the most rational possible alternative. The results obtained can be presented in the Figure 1.

Figure 1. Solution of the problem in Visual Promethee, diamond – mechanization



Source: Author in software Visual Promethee

The closer the action is to unity, the more desirable it is. Based on the solution, it can be concluded that the best alternative is alternative number 3, followed by alternative number 5, then alternative number 4, i.e. **Mechanization 3**, **Mechanization 5** and **Mechanization 4**. The last place is occupied by **Mechanization 6** when applying this method.

After detailed analyzes and explanations of the *TOPSIS* and *PROMETHEE* methods in the previous two chapters, it is necessary to summarize their results and the decisions that should be made based on them.

The *TOPSIS* and *PROMETHEE* methods are applicable for analysis sets of elements and ranking alternatives. They assume the existence of multiple attributes that are used as criteria. Both methods enable the aggregation of qualitative and quantitative criteria of different importance. However, an important difference is that for the *PROMETHEE* method to work, it is necessary to select the types of general criteria, whereas with *TOPSIS*, there is only one type of criterion, and there is no choice of criterion type.

This is the main reason why these two methods do not necessarily give the same solutions. It is possible to obtain one alternative as preferable with one method and another alternative with another. With the *PROMETHE*E method, the result largely depends on the type of general criterion that is chosen, while the *TOPSIS* result depends on the weighting coefficients and the farmer's preference of one criterion over another.

The first method selects the best possible solution from all methods. It can be concluded there is only a small deviation between individual methods due to the large number of clearly defined alternatives. Differences in ranking occur due to the existence of criteria types, preference, and indifference threshold in the *PROMETHEE* method, which were not used at all in the case of *TOPSIS.*

Conclusions

Multi-criteria decision-making is a complex process with diverse applications in all segments of human activity. One of the more significant areas of application is actually the agricultural sector, for the reason that all participants involved in the agricultural production system make different, complex decisions on a daily basis. This paper presents the application of two multi-criteria decision-making methods that represent a realistic picture of the inclusion of decision-making methods in the agricultural sector. Using the *TOPSIS* and *PROMETHEE* methods is a very important tool in solving complex decision-making problems. With the help of these methods, the most efficient and profitable solution can be found in a simple way, that is, the most adequate alternative when purchasing different agricultural machinery.

Mechanization is certainly one of the most important conditions for good and high-quality soil cultivation and for more profitable products. If there is an absence of mechanization, if it is not applied adequately, or if its quality is poor, the consequences can be significant. Versatile and high-quality mechanization is a condition for successful production on large areas. For this reason, multi-criteria analysis has become indispensable in planning their purchase.

The mechanism of spreading something "modern" is worth studying to understand how modern solutions are being implemented in agriculture. In this context, questions arise such as: How long does it take for a new and modern procedure, technique, machine, work, or production plant organization system to be implemented in our fields? If we lack resources to modernize everything at the same time, how do we choose among the possible solutions? The flow of information and orientation is vital in the mechanism of spreading modern and contemporary achievements.

Farms choose among new solutions based on their own resources. However, introducing a new solution in a production plant can be challenging. The problem lies in the fact that a novelty does not always increase profits, and it may even lead to losses. Yet, production plants still choose to introduce something new, even if it will not increase profits. This is a new mixture of necessary and free course decisions. Farms assume the introduction of a new thing against some other advantage: the farm will be granted a loan for the novelty, but also for some other things. New solutions should be tested and experimented with, and support is needed for that. This is also one possible way of support, although a bit complex. Farms assume it because of their good reputation, because they want to be proud of finding avant-garde solutions in the economy. Farms assume it because they believe that later it will be profitable.

The research work showed that by applying one of the two methods, we can significantly influence the decision maker. Often the alternative that would be chosen at first glance is not the right one. Every participant in the agricultural sector should have knowledge about some methods of multi-criteria analysis. This gives farmers, managers, agronomists and all other employees in the agricultural sector the opportunity to save time, money and energy.

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Conflict of interests

The authors declare no conflict of interest.

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