

ESTIMATING THE IMPACT OF INVESTMENTS IN INNOVATION ON THE PERFORMANCE OF AGRICULTURAL ENTERPRISES: THE CASE OF THE REPUBLIC OF MOLDOVA

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Abstract

The objective of this research is to ascertain how investments in innovations impact the performance of agricultural enterprises in the Republic of Moldova. Based on this analysis, the research will then argue the significance of investments for the economic prosperity of the given branch. In order to achieve the proposed goal, the following tasks were performed: a synthesis study of research in the field of innovation management and its impact on enterprise performance; quantifying the impact of investments in innovation on the gross profit as a relevant indicator of the enterprise performance. From a methodological point of view, it was made a bibliographical study and then it was conducted an opinion survey via semi-structured thematic interviews with a sample of 66 managers and specialists from agricultural enterprises. Also, it was used mathematical modelling of the cause-and-effect relationship between the volume of investments in innovations and gross profit through the application of the linear regression method, and the processes of inference and generalisation. The research findings revealed that 92% of the survey participants have implemented innovations, with 61% of them having invested amounts exceeding LEI one million. The investments are profitable, as evidenced by the fact that each 1 LEI invested in innovations generates an increase in gross profit by 1.37 LEI. The Pearson coefficient value is 0.74 indicating a sufficiently strong correlation between the volume of investment means and the performance of agricultural enterprises.

Key words: agriculture, innovations, performance, profit, correlation.

INTRODUCTION

It is now widely acknowledged by researchers and practitioners alike that innovations in optimising the potential of enterprises are of significant importance. Consequently, the implementation of a range of innovations, including those pertaining to products and organisational structures, enables enterprises to actualise their potential, facilitate the development of new products, obtain higher income and profit [5] and provide the opportunity to enter new markets, which in turn enhances enterprise performance [9, 10, 15].

The positive impact of innovations on business performance [1, 4, 14, 3] as well as the fact that they are a key factor for the survival of enterprises in today's highly flexible environment [14] and economic growth [4] is irrefutable. This places innovation activity at the forefront of managerial responsibility, necessitating the acquisition of specific skills to overcome

existing barriers in the innovation process and ensure the economic performance and competitiveness of enterprises [8].

The rationale pertaining to the significance of innovation is pertinent to all industries and fields of activity, including agriculture, which is currently a subject of extensive debate among researchers and policymakers due to its multifaceted role in achieving sustainable development goals. It has been demonstrated that innovative practices have a beneficial impact on agricultural enterprises [12]. Furthermore, there is a positive association between innovations and the performance of such enterprises [16, 17].

The evidence presented thus far demonstrates that increased R&D costs (for innovations in new products and services) lead to increased company revenues [2] or, by another approach, that the implementation of innovations contributes to faster financial growth [11]. However, the problem of quantifying the impact of financial efforts

made in this regard remains particularly important. This provides the necessary economic arguments for justifying investment projects in innovations, as well as for choosing different project variants based on the principle of their efficiency. It is only through the acquisition of data that can be accurately measured and visualised that business managers can develop a tool that will enable them to demonstrate and calculate the contribution of innovations to business efficiency, thereby facilitating the economic case for investment decisions. In this context, however, it should be noted that measuring the effects of concrete investments in innovation is a challenging process, given that business performance indicators are influenced by a multitude of factors, both internal and external, quantifiable and non-quantifiable.

In this context, the paper aimed to assess the effect of investments in innovations on the performance of agricultural enterprises in the Republic of Moldova

MATERIALS AND METHODS

In order to achieve the research goal, the following steps were necessary:

- to investigate the role of innovations in increasing enterprise performance;
- to collect the data regarding the volume of investment in innovations and its impact on the gross profit of agricultural enterprises in the Republic of Moldova;
- to process the data using linear regression equations to quantify the dependence of gross profit on investments;
- to analyze the regression equation, to interpret the results and finally to formulate the conclusions.

At the beginning of the research, it was presented a review of the bibliography on the topic, and then it was conducted an opinion survey using the semi-structured thematic questionnaire.

In order to gather the data required for the application of the linear regression method, a survey was conducted in the period July 2023 – April 2024 on a sample of 66 enterprises. To this end, respondents were invited to

participate in a semi-structured interview, based on a series of questions designed to ascertain whether the enterprises had made investments during the period 2021-2022, the specific types of investments, the amounts allocated to each type of investment, and the gross profit cumulatively obtained during that period.

Finally, it was set up a mathematical model using the linear regression method, generalisation and inference. as the most appropriate analytical tool. This method enables the determination of the extent to which a dependent variable – in this case, the gross profit of agricultural enterprises – is influenced by one or more causal variables. The amount of investment in innovation allocated by enterprises was selected as the causal variable for analysis.

A number of scientific publications pertaining to the research topic and the results of the opinion poll were consulted as sources of information.

As a limitation of the research, the low representativeness of the sample included in the survey is highlighted.

RESULTS AND DISCUSSIONS

The results indicated that 61 enterprises (92.4%) had made investments in innovation during the period 2021-2022. The data on the volume of allocated resources are presented in Figure 1.

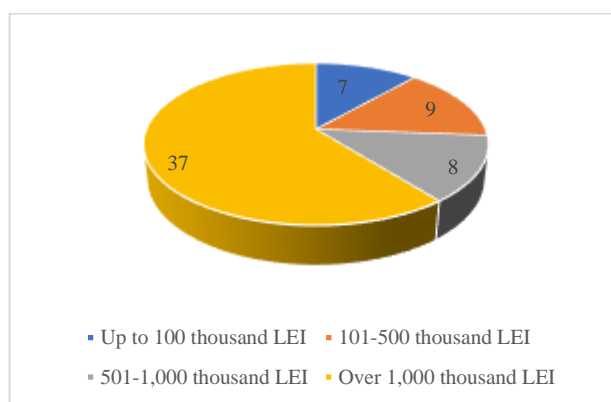


Fig. 1. Sample composition according to the amount of resources allocated to different types of innovations between 2021-2022

Source: Own determination.

As illustrated in Figure 1, most of enterprises surveyed (60.6%) have invested in innovation amounts exceeding 1 million LEI. Conversely, the fact that almost 40% of the enterprises invested less than 1 million LEI over the two-year period indicates that the level of investment in innovation is insufficient to achieve significant improvements in enterprise performance and competitiveness.

In order to ascertain the extent to which profit is dependent on the amounts allocated to various innovations, the following equation, which characterises the linear relationship between two indicators, was used:

$$Y_x = a + bx \quad (1)$$

where:

x - factor indicator;

y - outcome indicator;

a and b-the regression equation parameters to be found.

The primary data obtained from the initial processing of the survey results allowed to determine the following sizes of the variables needed for modelling:

$\sum x$ – the sum of the values of the determinant factor –212,737 thousand LEI;

$\sum y$ – the sum of the characteristic values (of the result indicators found in each observation) – 478,046 thousand LEI;

$\sum x^2$ – the sum of the squares of the assets of the determinant factor – 3,308,677,581 thousand LEI;

$\sum xy$ – the sum of the product of the factor and the characteristic value – 5,180,753,546 thousand LEI.

By solving the following system of equations and using the method of least squares, the values of the coefficients a and b were found.

$$\begin{cases} na + b \sum x = \sum y \\ a \sum x + b \sum x^2 = \sum xy \end{cases} \quad (2)$$

where:

n – the number of observations made.

Upon replacing the data in the formula, the following system of equations is obtained:

$$\begin{aligned} 61a + 212,737b &= 478,046 \\ 212,737a + 3,308,677,581b &= 5,180,753,646 \\ \dots\dots\dots(3) \end{aligned}$$

In accordance with the afore mentioned system of equations, the magnitudes of the parameters a and b were ascertained:

$$\begin{aligned} a &= 3,092.879665288459 \\ b &= 1.368874900739289 \\ \dots\dots\dots(4) \end{aligned}$$

The resulting linear regression equation is:

$$Y_x = 3,093 + 1.37x \quad (5)$$

The data obtained can be interpreted as follows:

-the evidence suggests that investments in innovations are profitable. Each LEI invested in innovations is demonstrated to generate an increase in gross profit of 1.37 LEI;

-consequently, the percentage increase in profit relative to the initial investment can be determined as follows:

$$\text{Growth percentage} = \left(\frac{0.37}{1} \right) \times 100\% = 37\% \quad (6)$$

Thus, a positive linear correlation exists between innovation costs and gross profit. In other words, an increase in investment in innovations is accompanied by a corresponding increase in gross profit for agricultural enterprises.

The subsequent step is to ascertain the correlation coefficient (r) in order to illustrate the significance of innovations in agricultural enterprises. This will enable us to ascertain the strength of the relationship between investment in innovation and the gross profit of the companies in question.

In order to achieve this, we will use the simple linear Pearson correlation coefficient, which is a commonly utilized statistical tool in a multitude of disciplines, including economics, sociology, psychology and medicine, in order to evaluate the interrelationships between the various variables under analysis [6].

The correlation coefficient can vary between 0 and 1. A value closer to 1 indicates a stronger relationship between the factors and the outcome being studied [7]. The results of the correlation coefficient calculation are interpreted as follows:

- a correlation coefficient of: $0 \leq r < 0.2$ indicates on the lack of correlation between variables;
- a coefficient of $0.2 \leq r < 0.4$ indicates a poor correlation, and a coefficient of $0.4 \leq r < 0.6$ represents a correlation of medium intensity;
- a coefficient of $0.6 \leq r < 0.8$ signifies a sufficiently strong correlation, and a coefficient of $0.8 \leq r < 1$ indicates a very strong correlation [13].

In the context of linear equations, the correlation coefficient is determined through the following process:

$$r = \frac{n\sum xy - \sum x \sum y}{\sqrt{(\sum x^2 n - (\sum x)^2)(\sum y^2 n - (\sum y)^2)}} \quad (7)$$

Upon entering the values calculated, the following equation is obtained:

$$r = \frac{61 \times 5,180,753,546 - (212,737 \times 478,046)}{\sqrt{[61 \times 3,308,677,581 - (212,737)^2][61 \times 12,518,276,524] - (478,046)^2}} \dots\dots\dots(8)$$

As a result, we obtain the correlation coefficient:

$$r = \frac{214,327,894,404}{2,894,473,779,888} = 0.74 \quad (9)$$

Because the obtained coefficient is located within the limits of $0.6 \leq r < 0.8$, we may infer that there is a sufficiently strong correlation to conclude that innovations are of significant importance for enterprises. Furthermore, once implemented, they exert a moderately strong impact on the achievement of business objectives and on profit growth.

The impact of innovations on the profitability of the agricultural enterprises under analysis can be observed in Figure 2.

This figure confirms the existence of a positive correlation between the amount invested in innovations and the gross profit obtained.

However, it should be noted that this correlation is not perfectly linear for all the data, as innovations are not the only factor influencing gross profit.

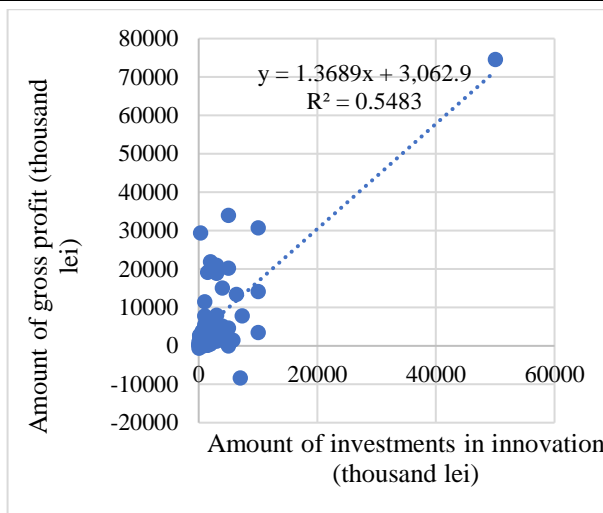


Fig. 2. Structure of the sample of agricultural enterprises according to the amount of resources allocated to various types of innovations in the period 2021-2022

Source: Own determination.

If the coefficient of correlation is squared, the resulting value is the coefficient of determination (R^2), which estimates the degree of dependence of the resulting indicator on the factor under analysis. In this case, the value of R^2 is 0.55, indicating that the gross profit of the surveyed agricultural enterprises is dependent on investment in innovation to the extent of 55%, while other factors account for the remaining 45%. The considerable impact observed can be attributed to the fact that most of the surveyed enterprises (approximately 74%) allocated resources towards process and product innovations. Consequently, by modernizing technologies, diversifying products by including crops with improved properties in their production, streamlining several processes, and so forth, the enterprises were able to achieve a notable improvement in their performance.

CONCLUSIONS

It is evident that innovations play a pivotal role in the advancement of agricultural enterprises. This is a fact that entrepreneurs are keenly aware of, as evidenced by the findings of the survey, in which 92% of managers and specialists participating in the survey indicated that they had invested in the implementation of innovations in their

respective companies during the period 2021-2022. Despite the fact that the majority of the surveyed enterprises (60.6%) have invested over one million LEI in innovations between 2021 and 2022, the observation that nearly 40% of the surveyed enterprises have invested less than one million LEI in innovations indicates that the level of investment in innovations is insufficient to achieve significant improvements in the performance and competitiveness of enterprises.

The investments made in innovations in the agricultural enterprises surveyed have yielded profitable outcomes, as evidenced by the fact that each LEI allocated has increased gross profit of 1.37 LEI.

There is a positive linear correlation between innovation costs and gross profit: as investment in innovation increases, the gross profit of agricultural enterprises increases correspondingly.

The Pearson coefficient value of 0.74 indicates a sufficiently strong correlation to conclude that innovations play a pivotal role in enterprise performance. The coefficient of determination of 0.55 suggests that profit is 55% dependent on investment in innovations of various kinds.

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