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ECONOMIC DETERMINANTS OF GROWTH IN AGRICULTURE – THE IMPACT OF INVESTMENTS, CREDITING AND ENTREPRENEURIAL INCOME

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Abstract

The focus of this study is to evaluate the effects of fixed capital investments, credit availability, and net entrepreneurial income on the gross value added of Bulgaria's agricultural sector during the years 2004 to 2022. The primary goal of this research is to investigate the development of gross value added in Bulgaria's agriculture, focusing on the effects of fixed asset investments, the influence of agricultural sector financing and the relevance of net entrepreneurial income. This investigation involved the creation and testing of three distinct hypotheses. Multiple regression analysis is utilized to explore how the sector's gross value added, investment activities, credit resources, and entrepreneurial income are interrelated in terms of both direction and strength. Data from Eurostat, FAOSTAT, and the Bulgarian National Bank (BNB) are used for the study. The results allow us to conclude that these three indicators strongly correlate with gross value added and explain a significant part of its dynamics. It has been established that investments in fixed capital in agriculture and net entrepreneurial income have a strong positive impact on gross value-added growth. A positive effect has also been demonstrated regarding credit but with statistical significance at a higher confidence interval. As a result, the study suggests broadening the range of financial tools available for agricultural lending, encouraging capital investment in agriculture, implementing tax relief measures, and easing administrative procedures for small and medium-sized enterprises to foster entrepreneurship. Collectively, these actions would support the sustainable growth of the agricultural sector while improving its productivity and global competitiveness.

Key words**:** *gross value added, agriculture sustainability, credit, fixed asset investments, net entrepreneurial income*

INTRODUCTION

Agriculture is a traditional sector in Bulgaria that is strategically important because it ensures food security for the population and provides employment and income for a large part of the rural population. At the same time, agriculture is among the most complex, dynamic, and fast-evolving sectors, demanding ongoing modernisation and digital transformation. Furthermore, it plays a central role in the circular economy, facing multiple challenges in the pursuit of sustainability and enhanced competitiveness.

All these factors necessitate government support and intervention to increase investments and provide more accessible credit options to ease the financial burden on agricultural producers. The interplay between investments in fixed capital and the enhancement of external financing options for farmers fosters an enabling environment for greater productivity and long-term sustainability in agriculture.

Research has shown that growth in Gross Fixed Capital Formation (GFCF) lead to notable enhancements in agricultural productivity over time, demonstrating a positive correlation between these indicators [1, 3, 10, 23]. Examining the relationship between fixed capital investments and agricultural gross value added is crucial for understanding agricultural productivity and development [19]. The interaction between these factors highlights the importance of capital investments in boosting productivity and growth. For example, Kusz found that the effective use of technical equipment and assets per hectare could significantly improve agricultural output, suggesting that well-planned capital formation strategies are essential for maximising the impact of investments on agricultural productivity [13].

Similarly, Dossa et al. emphasised that capital formation provides critical infrastructure for agricultural development, ultimately contributing to increased productivity [6].

Understanding the relationship between credit availability and agricultural gross value added is essential for analysing how financial resources influence agricultural productivity and economic development.

Agricultural credit provides farmers the necessary financial resources to invest in their activities, affecting their productivity and profitability. Existing research [5, 15, 16] confirms the positive relationship between agricultural credit and productivity. Nevertheless, several factors can deter farmers from seeking credit, with financial risk being a primary concern [11].

Existing research [21, 22, 24] generally indicates a positive relationship between access to bank financing, public agricultural spending, and increased productivity in the sector.

The relationship between agricultural gross value added and net entrepreneurial income is also crucial for understanding agricultural enterprises' economic resilience and revenue-generating capacity.

Studies confirm that increased agricultural gross value-added correlates positively with net entrepreneurial income [4, 14, 20].

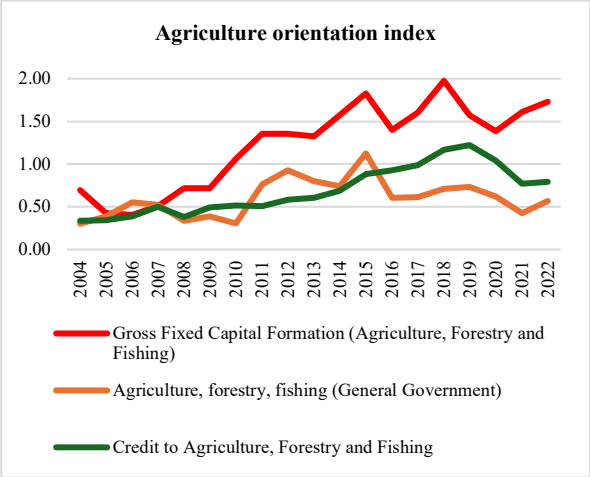

Fig.1. Agriculture orientation index in Bulgaria 2004-2022
Source: Faostat [9].

The effectiveness of this relationship is further reinforced by investments in technology, market access, and relevant agricultural policies [12, 18].

The significance of the agricultural sector in Bulgaria can be analysed using the Agricultural Orientation Index (AOI). This index can be evaluated separately regarding government expenditures, fixed capital investments, and agricultural credit. Its values for Bulgaria are presented in Figure 1.

According to FAO [8], the AOI for public expenditures in agriculture, forestry, and fisheries is an indicator that measures the extent to which public spending in this sector corresponds to its economic contribution to the overall economy. It is calculated as the ratio between government expenditures for the sector relative to total public expenditures and the gross value added (GVA) relative to the total GVA. Its values can be above or below one:

-When AOI > 1, government expenditures on agriculture are higher compared to its economic share, suggesting that the sector is regarded as a priority in terms of public investment.

-When AOI = 1, expenditures on the agricultural sector fully correspond to its significance in the economy.

-When AOI < 1, the government invests less than what the sector contributes to the economy, signalling an underestimation of the sector.

The values shown in Figure1 indicate that the government invests less in the sector than it contributes to the overall economy in Bulgaria. The index has consistently remained below 1, with 2015 being the only year the threshold of 1 is exceeded.

Consequently, agriculture in Bulgaria does not receive sufficient public investments relative to its economic contribution. This leads to low productivity, a lack of innovation, and slow growth.

The AOI for credit in agriculture, forestry, and fisheries measures the proportion of total credit in the country allocated to the agricultural sector. It is calculated as the ratio between credit extended to the sector relative to total credit and the GVA of the sector relative to total GVA. Its values can also be above or below one:

-When AOI > 1, agriculture receives more credit resources than its economic share, indicating that financial institutions prioritise the sector.
-When AOI = 1, credit for the agricultural sector is proportional to its share in the economy.
-When AOI < 1, the agricultural sector receives less credit relative to its economic importance, which may indicate lower attractiveness for banks or higher risks.
The values in Figure1 show that the index has remained consistently below 1, with the only exception being 2018-2020, when the threshold is slightly exceeded. Since 2016, credit to the sector has consistently exceeded government expenditures, indicating that the private sector compensates for the lack of public support.
This suggests insufficient access to credit, with evident difficulties in securing external funding for agricultural activities. This signals the need for more active support and attention to the agricultural sector in Bulgaria.
The AOI for investments in fixed assets in agriculture, forestry, and fisheries reflects the degree to whichi nvestments in this sector correspond to its economic contribution to the overall economy. It is calculated as the ratio between investments in fixed capital for the sector relative to total investments and the GVA of the sector relative to total GVA. Its values can also be above or below one:
-When AOI > 1, investments in agriculture are higher compared to its share in the economy, indicating that the sector is a priority for investment.
-When AOI = 1, investments in agriculture fully correspond to its share in the economy.
-When AOI < 1, investments in agriculture are lower relative to its share in the economy, meaning the sector remains underfunded.
As seen in Figure 1, since 2010, the index values for investment in fixed assets in Bulgaria have consistently remained above 1, reaching their highest point in 2018. This trend reflects a sustained increase in investments in agricultural fixed assets, indicating ongoing growth and modernisation within the sector. However, public expenditures on agriculture have remained limited and have not kept pace with the broader trends in economic investment. While investments in fixed assets serve as a key engine of growth, their long-term impact may be fragile in the absence of adequate government support.
At the same time, credit to the sector shows a positive trend, indicating increased confidence from financial institutions in agribusiness.
Despite the observed trends, the agricultural sector in Bulgaria remains underfunded.
The primary objective of this study is to evaluate the formation of gross value added (GVA) in the country's agricultural sector by examining the influence of key economic factors. Specifically, the study aims to:
(i) analyse the impact of investments in fixed assets on the formation of GVA in Bulgaria's agricultural sector;
(ii) assess the effect of agricultural lending on the generation of GVA;
(iii) examine the role of net entrepreneurial income in contributing to value added in agriculture.
To achieve these objectives, the following research hypotheses are formulated and subject to empirical testing:
H01: Investments in fixed assets have no significant impact on the gross value added of the agricultural sector.
H02: Loans granted to the agricultural sector do not significantly influence its gross value added.
H03: Net entrepreneurial income does not significantly affect the gross value added generated by the sector.

MATERIALS AND METHODS

The article employs descriptive and analytical methods to process and analyse the data and individual dependencies. The descriptive methods include the historical method, chronological analysis, comparative and content analysis, and graphical methods.
The analytical methods involve inductive and deductive approaches, quantitative analysis of dependencies, and critical analysis. Correlation and multiple regression analysis are applied to establish cause-and-effect relationships and dependencies and test hypotheses.

The study is based on data from Bulgaria covering 19 years from 2004 to 2022. The objective is to determine which factors influence the agricultural sector's gross value added (GVA).

The analysis employs four key economic indicators.

-Gross Value Added (GVA) serves as dependent variable,

The independent variables include:

- Gross Fixed Capital Formation (GFCF), excluding deductible VAT,

-Credit to Agriculture, and

-Net Entrepreneurial Income (NEInc)

Data on Gross Value Added at current prices are sourced from Eurostat and are expressed in million euros, covering the sectors of agriculture, forestry, and fishing. This indicator measures the value created by agricultural enterprises over a year and is a key element reflecting the sector's productivity. An increase in GVA indicates that the sector contributes more to the country's economy. A decrease in GVA suggests lower productivity and a declining economic role of the sector.

For Gross Fixed Capital Formation (GFCF), data from Eurostat in million euros are used. This is a key economic indicator that measures investments in fixed assets in agriculture. This metric is derived by removing the value of assets that have been sold or taken out of service from the value of assets that have been newly acquired. Investments in fixed assets include buildings, infrastructure, machinery, equipment, perennial crops, and information and communication technologies.

GFCF reflects the degree of renewal and expansion of production capacity in the agricultural sector. An increase in GFCF shows that farmers invest more in modernisation and business expansion, improving productivity, efficiency, and overall sectoral growth.

For Credit to Agriculture, Forestry, and Fishing (CAFF), data from FAOSTAT in million euros are used. This critical indicator measuring the sector's access to financing is essential for its efficiency and development. Higher credit availability indicates easier access to external funding for business expansion.

An increase in credit values suggests greater investments, more mechanisation, and modern technologies, which enhance productivity. Low credit availability signals insufficient support, including governmental assistance, highlighting the need for state policy changes and additional subsidies [2]. Thus, CAFF significantly impacts sectoral development, mechanisation, and competitiveness.

For Net Entrepreneurial Income (NEInc), data from the National Statistical Institute (NSI) in million euros are used. This is an important economic indicator of profitability and financial stability in agricultural enterprises. It assesses the net income of farmers after deducting operational costs, including employee wages, interest on loans, land rents, etc. It measures the compensation for unpaid labour, returns on owned land, and capital usage income.

It is calculated as the sum of net operating surplus/mixed income plus interest received by enterprises, minus interest and rent paid. Higher NEInc values indicate effective management, high profitability, and financial stability.

Research Model Specification

Based on the presented criteria, the research model is functionally specified as follows:

$$GVA=f(GFCF,CAFF,NEInc) \quad (1)$$

where:

-GVA – Gross Value Added (million euros)

-GFCF – Gross Fixed Capital Formation, excluding deductible VAT (million euros)

-CAFF – Credit to Agriculture, Forestry, and Fishing (million euros)

-NEInc – Net Entrepreneurial Income (million euros)

To evaluate the above model, the following regression equation is formulated:

$$GVA = a_0 + a_1GFGC + a_2CAFF + a_3NEInc \quad (2)$$

where:

- GVA – dependent variable
- GFCF, CAFF, NEInc – independent variables
- a_0 – Intercept of the model

- a_1, a_2, a_3 – regression equation parameters

The expected signs associated with the parameters of the regression model are outlined as follows:
$a_1 > 0$, $a_2 > 0$, $a_3 > 0$

RESULTS AND DISCUSSIONS

Analysis of the Dynamics of Selected Macroeconomic Indicators

We may observe the dynamics of GVA and investments in fixed assets (in million euros) in Figure 2.

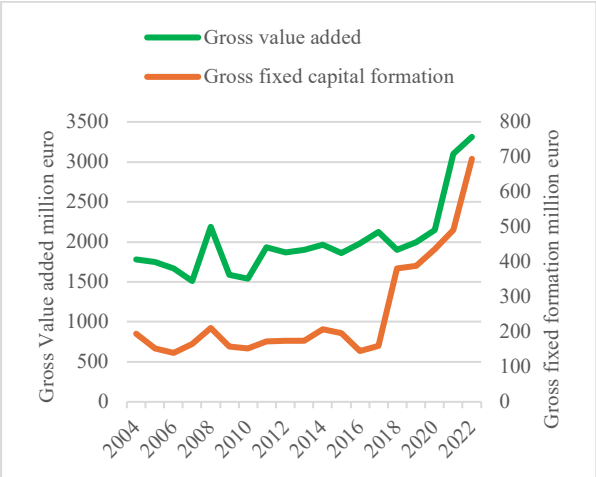

Fig.2. Gross Value Added and Gross Fixed Capital Formation in Bulgaria 2004-2022 (million euro)
Source: Eurostat [7].

The value added from agriculture in Bulgaria exhibits an upward trend. Starting at approximately 1,700 million euros, there is a slight decline in 2017, followed by a stabilisation period with a moderate upward dynamic until 2018. After that, the indicator rises sharply, reaching around 3,300 million euros in 2022, almost doubling its initial value.
The dynamics of investments in fixed assets are also notable.
Despite minor fluctuations, their value triples over the entire period, starting at 195 million euros and reaching 695 million euros in 2022. A significant increase is observed after 2018.
An interesting observation is that the trends of both indicators closely align and run almost parallel, suggesting a potential relationship between them. This implies that investments in fixed assets may positively affect productivity, serving as a key driver of growth. With the help of the regression analysis, we will further explore this relationship
Figure 3 shows the trends in agricultural credit, which could also influence the sector's productivity.

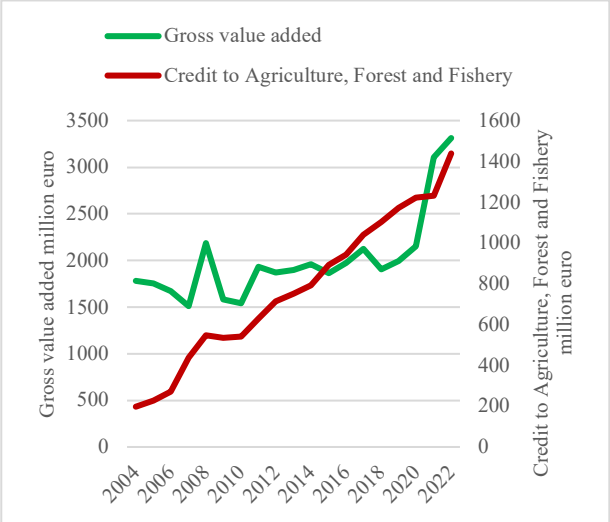

Fig.3. Gross Value Added and Credit to Agriculture, Forest and Fishery, million euro in Bulgaria 2004-2022
Source: Eurostat [7].

The rapid upward trend in credit values is particularly noteworthy. Throughout the entire period, there has been only one year—2009—in which a slight decrease in credit value has been observed.
In all other years, the trend remains consistently positive. Starting at 197 million euros, the credit volume reaches 1,439 million euros by the end of the period, marking a sevenfold increase. This growth is linked, among other factors, to Bulgaria's stimulative credit policies during the period analysed.
Distinct periods can be identified by examining credit and gross value-added relationships. For example, after 2018, the sharp increase in gross value added coincides with a rise in credit volume. This suggests that improved access to financing may have contributed to enhanced productivity and efficiency in the sector.
On the other hand, periods such as 2009–2012 show that while credit continues to rise, gross value added remains stable. This could indicate that some investments may have been inefficiently allocated or that external factors—such as climate conditions, economic crises, etc.—may have hindered the sector's growth. This highlights the need for further

research into the relationship between these indicators.

The dynamics of net entrepreneurial income is revealed in Figure 4, which supports additiona l analysis.

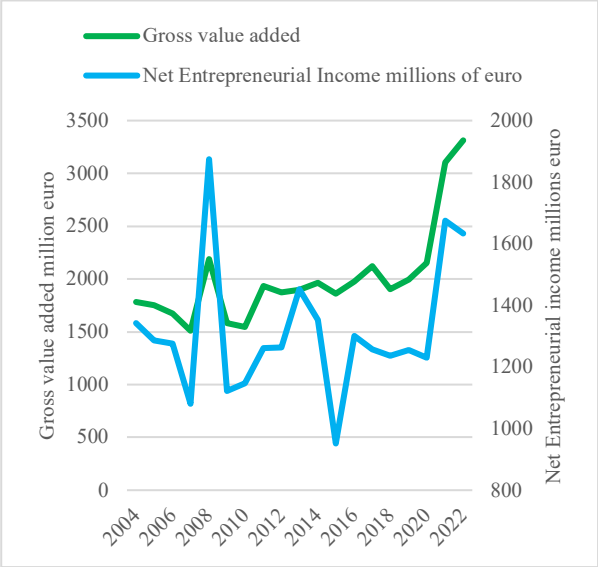

Fig.4. Gross Value Added and Net Entrepreneurial Income in Bulgaria 2004-2022 (million euro)
Source: Eurostat, NSI [7, 17].

Unlike GVA, net entrepreneurial income is significantly more volatile. It reaches its peak in 2008, followed by a sharp decline in 2009. This drop can be partially linked to the financial crisis, negatively impacting profitability.

Another decline is observed in 2015, marking the lowest value of net entrepreneurial income within the analysed period. After this, a partial recovery follows, and from 2020 onward, an upward trend emerges, with a second peak in 2021. During these years, both indicators (GVA and net entrepreneurial income) increase, which could signal sector stabilisation and improved profitability. Although these two indicators follow relatively similar trends over the analysed period, net entrepreneurial income exhibits stronger fluctuations. This suggests that it is more sensitive to market and economic factors. The impact of individual indicators on GVA dynamics will be further analysed using multiple regression analysis.

Multiple Regression Analysis of Gross Value Added in Bulgaria

As result we obtain following regression equation:

GVA = 143.74+ 1.2987*GFGC +0.3759*CAFF +0.9454*NEInc

The empirical results of the study are presented in Table 1.

Table 1. The empirical result of the regressions

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	143.7385	297.3905	0.4833	0.6358	-490.1343	777.6113
GFCF	1.2987	0.5034	2.5796	0.0209	0.2256	2.3717
CAFF	0.3759	0.1938	1.9395	0.0715	-0.0372	0.7890
NEInc	0.9454	0.2292	4.1253	0.0009	0.4569	1.4339
Multiple R	0.9311	R Square	0.8670	Adjusted R Square		0.8404

Source: Own calculation based on data from Eurostat and NSI [7, 17].

The multiple correlation coefficient is 0.9311, indicating a strong positive correlation between the dependent variable – GVA - and the independent variables: investments, credits, and net entrepreneurial income. With a coefficient of determination (R^2) of 0.8670, it can be concluded that these independent variables account for 86.70% of the fluctuations observed in the dependent variable. The Adjusted R^2, which accounts for the number of variables and dataset size, is 0.8404, suggesting that the model contains few irrelevant variables and accurately describes the relationship between them.

The high F-statistic (32.60) and the very low Significance F value (8.17127E-07) indicate that the model is statistically significant, confirming that at least one independent variable impacts the dependent variable.

The intercept, representing the agricultural sector's GVA when all independent variables are zero, is 143.74. However, it is not statistically significant (p-value > 0.05), meaning that the baseline level of the dependent variable without the influence of other factors is not meaningful.

The regression coefficient for the independent variable GFGC is positive, aligning with the theoretical assumption regarding the sign of the regression coefficients. The results show that a one-unit increase in investments leads to a 1.2987-unit increase in Gross Value Added. This result is statistically significant at the 5% level, as the p-value is 0.0209, meaning that the effect is not random. Consequently, the null hypothesis **(H01):**

"Investments in fixed capital have no significant impact on Gross Value Added"

is rejected, and the alternative hypothesis is accepted.

The confidence interval boundaries are entirely positive, ranging from 0.2256 to 2.3717, meaning that with 95% confidence, the strong positive effect of investments on GVA is confirmed.

Thus, we can conclude that investments in fixed assets in the agricultural sector significantly contribute to the sector's Gross Value Added. They play a key role in ensuring sustainable growth in agriculture. The development of modern infrastructure and technology improves the quality and quantity of agricultural production, leading to lower costs, higher efficiency, and increased contribution to GVA.

The regression coefficient for CAFF is positive (0.3759), supporting the initial theoretical assumption about the coefficient signs. This means that a one-unit increase in agricultural credit leads to a 0.3759-unit increase in GVA.The result is marginally significant at the 10% level, as the p-value is 0.0715. Therefore, the null hypothesis **(H02):**"Agricultural sector credit has no significant impact on Gross Value Added" is rejected, but with weaker evidence, as the p-value is greater than 0.05 but less than 0.1.

The confidence interval ranges from -0.0372 (negative) to 0.7890 (positive), indicating that the actual effect of credits could vary from slightly negative to strongly positive.

In summary, credit financing has a weaker but potentially significant effect on GVA. It enables farmers to invest in modernisation and technology, enhancing productivity. Additionally, improving liquidity reduces financial stress related to cash flow timing mismatches, helping farmers expand their operations.

However, the weaker statistical significance at 10% (instead of the conventional 5%) suggests possible reasons, such as:

-inefficient use of loans – for example, covering operational costs instead of investments

-influence of government subsidies, which reduce the relative effect of credit financing

-challenges in loan repayment, which may limit long-term positive effects.

This calls for further investigation, which will be part of the author's future research.

The regression coefficient for NEInc is positive (0.9454), consistent with the theoretical assumption regarding the coefficient sign. This means that a one-unit increase in NEInc leads to a 0.9454-unit increase in GVA.

The result is highly statistically significant, as the p-value is 0.0009. Therefore, the null hypothesis **(H03):**"Net Entrepreneurial Income has no significant impact on Gross Value Added" is rejected, and the alternative hypothesis is accepted.

The confidence interval boundaries are entirely positive, ranging from 0.4569 to 1.4339, meaning that with 95% confidence, the impact of NEIncis definitively positive, ruling out the possibility of a zero or negative effect.

Higher NEIncfor farmers translates into greater available income for investments in modernisation and innovation, which in turn enhances productivity and efficiency, leading to an increase in GVA.

The model can be further expanded and refined by incorporating additional independent

variables, which will be the subject of future research by the author

CONCLUSIONS

Drawing upon the analysis of the dynamics of the specified indicators and the regression analysis concerning the influence of investments, loans, and net entrepreneurial income on the gross value added in Bulgaria's agriculture between 2004 and 2022, the following conclusions can be outlined:

-The gross value added to agriculture in Bulgaria has shown an upward trend over the past two decades, almost doubling its value over the entire period

-In terms of credit, there is a sharp upward trend, resulting in a sevenfold increase in the indicator

-Net entrepreneurial income is more volatile compared to other indicators, experiencing sharp declines and rises, but in the last three years, its dynamics have gradually stabilised

-The positive and statistically significant regression coefficient for investments in fixed assets in agriculture indicates that increased investment contributes to greater value added in the sector

-The positive and statistically significant coefficient for credits—though at a higher confidence threshold—suggests that loans exert a weaker but potentially meaningful impact on gross value added

-The positive and statistically significant coefficient for net entrepreneurial income implies that as entrepreneurial income rises, so does the productivity of the agricultural sector.

As a result of the above conclusions, several specific recommendations can be made:

-Encouraging investments in fixed assets in agriculture. It is important to stimulate investments in modern technologies, infrastructure, and mechanisation to enhance productivity and efficiency in the agricultural sector.

-Providing better credit conditions, including longer repayment periods and lower interest rates for investment loans in the agricultural sector. High interest rates can limit farmers' investment activities. Therefore, approaches to reducing interest rates on loans for agricultural enterprises should be considered, such as state support or subsidies.

-Introducing lower interest rates for loans used for investments in sustainable and innovative agricultural practices, such as "green" loans that promote sustainable farming and reduce the environmental footprint of agricultural production.

-Implementing tax relief and reducing administrative burdens for small and medium-sized enterprises to stimulate entrepreneurship.

All these measures will contribute to the sustainable development of the agricultural sector and enhance its efficiency and competitiveness.

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