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EXTENDED ABSTRACT

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**THE ROLE OF BANK LENDING IN SUSTAINABLE
DEVELOPMENT OF AGRICULTURE**

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I. GENERAL CHARACTERISTICS OF THE DISSERTATION

1. Relevance of the Topic

In the context of deepening global economic, social, and environmental challenges, sustainable development is establishing itself as a leading paradigm in contemporary public policies and scientific research. The concept of sustainable development, originally formulated in the report of the World Commission on Environment and Development "Our Common Future", places a strong emphasis on the objective necessity for a balanced combination of economic growth, social justice, and environmental protection.

Within this global context, agriculture occupies a strategic and key position. It functions simultaneously as a critical source of vital food resources, a leading factor for overall economic development, and a sector with a direct, large-scale impact on natural ecosystems. The agricultural sector is among the most vulnerable economic branches regarding the negative manifestations of climate change, market volatility, and the degradation of natural resources. At the same time, it bears the primary responsibility for ensuring long-term food security, maintaining employment and the viability of rural areas, as well as for the sustainable management of agricultural land.

This complex intertwining of factors determines the imperative need for implementing modern, sustainable production practices and green technologies. However, their practical realisation within farms requires the mobilisation of significant financial resources and long-term capital investments.

In this regard, bank credit emerges as a leading economic instrument for securing the financial resources necessary for the modernisation and transition towards sustainable development of agricultural producers. Through lending, opportunities are created for introducing innovations, increasing productivity, improving resource efficiency, and adapting to climate change. The role of the modern banking sector expands far beyond the traditional function of a passive financial intermediary. International principles for responsible and sustainable banking, actively supported by the initiatives of the United Nations Environment Programme and its Finance Initiative (UNEP FI), are coming to the forefront.

The relevance of this dissertation research is enhanced by the objective need for a more detailed and econometrically substantiated analysis of the links between bank lending and sustainability indicators in the agricultural sector. This is particularly critical in the conditions of dynamically changing regulatory requirements, the evolution of European policies (including the Green Deal), and increasing pressure for the greening of businesses. Despite the existence of a substantial volume of scientific works in the fields of banking and sustainable

development individually, pronounced gaps still exist regarding the integrated empirical analysis of lending activity as a real factor for sustainability in the agriculture of a specific European Union member state, such as Bulgaria.

The scientific and practical significance of the research stems from the need to build effective market mechanisms for the targeted channelling of credit capital towards green and sustainable agricultural practices, establishing commercial banks as active participants in the processes of sustainable transformation.

2. Aim of the Dissertation

The primary aim of the dissertation is to investigate and assess the role of bank credit as a factor for the sustainable development of agriculture by analysing lending mechanisms, their impact on the agricultural sector, and the possibilities for integrating sustainability principles into credit policy.

The achievement of this aim is linked to revealing the existing econometric relationships between the credit activity of commercial banks and the three main dimensions of agricultural sustainability – economic, social, and environmental. Based on the empirical results obtained, the study aims to identify opportunities for improving credit mechanisms and integrating the principles of responsible finance into banking policies, with a view to providing more effective support for the modernisation and ecological transformation of agricultural holdings.

3. Object and Subject of the Research

The successful achievement of the set aim and the scientific demarcation of the scope of the dissertation require a precise definition of its object and subject.

The **object** of the research is the process of bank lending as an essential element of financial intermediation and its manifestation in the agricultural sector of Bulgaria.

The **subject** of the research encompasses the functional dependencies, structural relationships, and interactions between the credit activity of commercial banks and the socio-economic and environmental parameters defining the sustainable development of the agricultural sector.

4. Research Thesis

The main research thesis formulated in the dissertation states that bank lending plays a crucial, structuring role in the transition of the agricultural sector towards sustainable development. When built upon the principles of responsible finance and ESG criteria (Environmental, Social, and Governance), bank credit ceases to be merely a source of liquidity. Instead, it transforms into an effective economic catalyst that stimulates the implementation of green technologies, increases resource efficiency, enhances the financial stability of

agricultural holdings, and ensures their long-term competitiveness. The targeted channelling of credit resources creates a synergistic effect, balancing the economic viability of farms with environmental responsibility and social equity in rural areas.

5. Research Tasks

To achieve the primary aim and to prove the formulated research thesis, the following main research tasks have been set and resolved in the dissertation:

1. To systematise and critically analyse the theoretical concepts regarding financial intermediation, bank lending, and the paradigm of sustainable development in agriculture.
2. To explore the international and European regulatory frameworks, initiatives, and standards for sustainable banking, with an emphasis on their application to the agricultural sector.
3. To develop an adequate methodological framework and a specialised system of indicators for assessing the impact of bank credit on the individual dimensions of agricultural sustainability.
4. To analyse the state, dynamics, and structural characteristics of bank lending to the agricultural sector in Bulgaria during the analysed period.
5. · To conduct an empirical, econometrically substantiated analysis of the impact of credit activity on the economic, social, and environmental indicators of sustainable development in agriculture.
6. · To identify the main barriers, risks, and challenges faced by both commercial banks and agricultural producers in the process of lending for green projects.
7. · To formulate strategic guidelines, practical recommendations, and innovative models for improving credit policies and integrating sustainability principles into the banking practice.

6. Research Methodology

To achieve the set aim, resolve the research tasks, and verify the formulated hypotheses, a comprehensive methodological framework has been developed and applied in the dissertation. It combines general scientific methods, specific economic approaches, and modern tools for quantitative econometric research.

The research methodology encompasses the following main components and stages:

• **Theoretic-deductive and inductive methods:** applied in clarifying the economic essence of credit and the concepts of agricultural sustainability. Through deduction, specific

financing principles have been derived, while through induction, the research hypotheses have been formulated based on real market processes.

- **Systemic and structural analysis:** used to study agriculture as a complex system functioning within a three-dimensional framework (economy, society, environment). The internal structure of credit portfolios and the qualitative characteristics of human capital in the sector have been analysed.

- **Comparative and dynamic analysis:** applied when investigating the trends in the Bulgarian banking market over a 15-year period (2009–2023). This approach allows for the identification of structural breaks, cyclicity, and sustainable trends in agricultural lending.

- **Index-based assessment:** the international methodological standard of the FAO has been applied to calculate the Agriculture Orientation Index (AOI) of credit.

- **Statistical and econometric toolkit:** which forms the core of the empirical research in Chapter III. It includes Pearson correlation analysis and four OLS regression models corresponding to the four research hypotheses.

The information base includes official data from the BNB, NSI, Eurostat, and the FAO for the period 2009–2023 ($n = 15$ annual observations). The selection of this time horizon is scientifically justified and not accidental. It begins immediately after the global financial and economic crisis (2008) and reflects the full integration of the Bulgarian agricultural sector into the Common Agricultural Policy (CAP) of the European Union. The period captures important structural transformations, passes through the COVID-19 pandemic crisis and geopolitical upheavals, and concludes with the current processes of implementing the requirements of the European Green Deal. This allows for the tracking of long-term trends without the distortion of short-term market anomalies.

For the purposes of international exchange, comparative analysis, and the broader context of global trends in agricultural lending, the temporal scope is expanded to cover the period from 2000 to 2022 inclusive. This 23-year horizon is fully aligned with the availability, comparability, and homogeneity of statistical information in the FAO global databases. The utilisation of this period makes it possible to capture long-term macroeconomic effects at an international level, trace the evolution of global credit flows to agriculture since the beginning of the new century, and position the Bulgarian experience within a broader geographical and historical context.

The international indicator frameworks DPSIR and IRENA have been reviewed as a theoretical reference framework but have not been directly operationalised due to the limited availability of the required data for the full study period.

II. MAIN CONTENT OF THE DISSERTATION

The dissertation is structured into an introduction, three chapters, a conclusion, and scientific-applied documentation, logically tracing the path from fundamental theory to real econometric measurements.

The introductory section outlines the scientific significance of financing the agricultural transition towards environmental sustainability, defines the parameters of the research, and formulates the research thesis regarding sector-specific distortions in the impact of credit resources.

CHAPTER I. THEORETICAL AND CONCEPTUAL FOUNDATIONS OF BANK LENDING AND THE SUSTAINABLE DEVELOPMENT OF AGRICULTURE

In the first section of the dissertation, credit is investigated as a fundamental economic category, the essence of which is closely linked to the evolution of commodity-money relations and the necessity of redistributing financial resources over time. Linguistic and etymological analysis shows that the term originates from the Latin word *credere*, meaning belief and trust, which underscores its initial socio-economic foundation. In contemporary economic reality, credit is defined as a specific relationship between a creditor and a debtor, whereby a certain value is transferred in the form of monetary funds for temporary use under conditions of maturity, remuneration, and mandatory repayment. In most cases, this movement of value is accompanied by the payment of interest as the price of the attracted financial resource.

A crucial point in clarifying this economic category is its precise terminological differentiation from related concepts such as financing and loan. The hierarchical relationship and characteristics of these three concepts can be summarised in the following Table 1:

Table 1. General characteristics of the concepts: financing – loan – credit

Criterion	Financing	Loan	Credit
Essence	Provision of financial resources	Providing funds or goods for temporary use	A specific form of a loan
Scope	Broadest	Narrower	Narrowest
Mandatory repayment	Not always	Usually yes	Yes
Interest/remuneration	Not always	May or may not apply	Usually applies
Maturity/Term	Not always	May or may not apply	Mandatorily applies
Contract/Agreement	Not always	Yes	Yes
Basis	Provision of resources	Transfer of value	Credit relationship
Examples	subsidies, grants, equity, bonds, leasing	loan between individuals	bank credit

Source: own interpretation

Financing represents the broadest category and encompasses all forms of capital provision, including non-repayable state subsidies and the internal sources of economic entities. A loan possesses a narrower legal meaning and, pursuant to the Obligations and Contracts Act, is viewed as a contractual form whereby the lender transfers money or fungible goods, which must be returned in the same quantity and quality. The analysis of the regulatory framework, including the Credit Institutions Act and Directive 2008/48/EC, proves the absence of a unified and universal definition of credit within the legal system, as legislation views it primarily through the prism of contractual facilities rather than as an independent macroeconomic category.

Based on a critical review of authoritative sources, the dissertation proposes an original author's definition of the concept of bank credit:

an economic relationship involving the temporary provision of financial capital by a credit institution to an economic entity under conditions of repayment, maturity, remuneration, and trust, through which the redistribution of financial resources is achieved, and prerequisites are created for supporting the reproduction process and sustainable economic development.

There are several advantages to such a definition. Firstly, it views credit within a broad context, defining it as an economic relationship rather than merely a simple transaction. Furthermore, it incorporates the fundamental principles that integrate classical credit theory, contemporary banking theory, and the etymological origin of the term. Secondly, the redistributive function of credit is included, which aligns with banking practice and the theory of financial intermediation. In addition, the term "sustainable" introduces a modern element that allows for a distinct focus on green finance and sustainable lending.

The second section investigates how the universal principles of lending adapt to the specific conditions of the agricultural sector, which in Bulgaria underwent a complex process of transformation following privatisation and subsequent integration into the Common Agricultural Policy of the European Union. The modernisation of farms requires substantial capital investments in non-current tangible assets, such as agricultural machinery, land, high-yield livestock, and storage infrastructure. Bank lending emerges as a leading lever for the realisation of these projects, but its effectiveness depends on a precise assessment of sector-specific risk, which is determined by highly pronounced seasonal revenues, a prolonged production cycle, and high dependence on climatic factors.

The study of contemporary practice in Bulgaria shows increasing flexibility among commercial banks, which are developing specialised products that combine traditional credit lines with the financial instruments of the Common Agricultural Policy. A key innovation in

the market is the disbursement of revolving and overdraft loans secured by future receivables and the pledging of subsidies from the State Fund "Agriculture", which provides farmers with liquidity at the very beginning of the farming campaign. Banks offer relief mechanisms such as grace periods synchronised with the revenue profile of the farmers, extensions of maturities for investment loans for land purchase of up to fifteen years, and the waiver of early repayment fees. The Fourth Industrial Revolution and digitalisation exert a major influence on operational efficiency. Online banking enables rapid, remote loan applications and real-time payments, thereby overcoming the geographical isolation of rural areas. The current conditions and parameters of the leading banking institutions in the country are presented in detail in the following Table 2.

Table 2. Specialised credit products for agricultural producers from leading commercial banks in Bulgaria

Bank	Credit Type	Maximum Financing	Maturity / Term	Interest Conditions	Fees / Collateral
UBB	Revolving credit against subsidies	Up to 100%	Up to 1 year	Contractual	Pledge over subsidies
Fibank	Revolving credit against subsidies	Up to 100%	Up to 5 years	BRR + premium	Pledge over receivables
Tokuda Bank	Revolving credit against subsidies	Up to 95%	Up to 3 years	Fixed contractual	Pledge over subsidies
iBank (Invest Agro)	Lump-sum loan against subsidy	Up to BGN 600,000	Up to 1 year	Approx. 3.85–4.50%	Registered pledge over subsidies
UniCredit	Working capital loan against subsidies	Up to 100%	According to needs	Individual contractual	Pledge over subsidies
UniCredit	Investment loan for land/machinery	Unlimited; no business plan up to BGN 150,000	According to needs	Individual plan, grace period	Collateral according to loan type
Postbank	Agro Overdraft "Navreme" (On Time)	Working capital financing	Until subsidy receipt	Accrued interest; pay only for what is used	No early repayment fee; secured by subsidies
ProCredit Bank	Revolving credit against subsidies and investments	Up to 95–100% of subsidies / as per agreed limit	Up to 5 years	Only on the drawn amount; automatic repayment	One-off pledge; no need for annual renewal

Source: Own interpretation of data from commercial banks

In the third section of the chapter, lending activity is positioned within the broad strategic framework of sustainable agricultural development, the foundations of which are rooted in international UN reports and the 2030 Global Sustainable Development Goals. In the dissertation, sustainable agriculture is defined as an integrated production system that simultaneously achieves economic efficiency and stable incomes, guarantees social justice and employment in rural communities, and minimises negative pressure on the environment. Financial resources, and bank credit in particular, emerge as a critical bridge for the realisation of these three dimensions, as they enable investments in eco-friendly technologies, precision farming, renewable energy installations, and irrigation systems that reduce the resource intensity of production.

A scientific contribution of this study is the detailed differentiation of the hierarchical structure of agricultural sustainability, which unfolds across five systemic levels – from the field, through the farm and the region, up to national and international levels. The research proves the existence of severe structural imbalances between these levels, as investment decisions and economic viability are forged at the micro-level within the individual farm, whereas environmental consequences (on water, soil, and air) and social regulations manifest and are managed at higher territorial and institutional levels. A typical example is the imbalance in the overexploitation of common-pool resources (such as pastures), known as the "tragedy of the commons", which necessitates targeted state and banking intervention through green credit policies. For the quantitative and qualitative measurement of these processes, international practice applies indicator systems such as the Eurostat DPSIR framework and the detailed FAO SAFA approach, which contains 118 indicators for assessing agricultural systems. The author's original concept of these hierarchical relationships is presented in the following Table 3.

Table 3. Hierarchical structure of agricultural sustainability

Hierarchical Level	Main Characteristics	Typical Sustainability Indicators	Interactions and Influence on Other Levels
1. Agricultural field / plot	Basic production unit; focus on land, crops, and soil	Yield, soil fertility, erosion, use of fertilisers and chemicals, biodiversity	Determines the environmental sustainability of the farm; exerts pressure on the local environment
2. Agricultural farm	Economic decision-making unit; aggregates plots and resources	Productivity, profitability, returns, social employment, sustainable practices, access to credit	The primary "carrier" of sustainability; influences the regional agricultural structure and the market

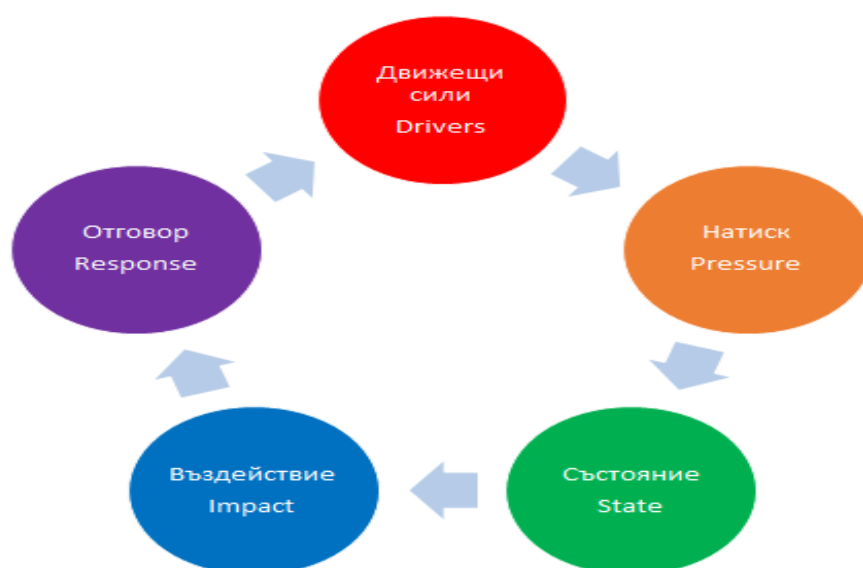
3. Region (landscape, ecosystem)	Aggregation of multiple farms; includes social, environmental, and economic systems	Employment, demographic stability, equal access to resources, water quality, landscape management	Forms the conditions for interaction between farms; influences policies and agro-ecological zones
4. Sector (national level)	Complex of institutions, policies, and entities in agriculture	Share in GDP, food security, trade balance, subsidies, institutional support	Forms the regulatory and economic framework for the sustainability of regions and farms
5. International level	Global agricultural market, trade agreements, sustainability goals	Food exports/imports, participation in agreements, carbon footprint	Determines global trends and exerts pressure on national policies and sustainable practices

Source: Own interpretation

The fourth section of the first chapter is dedicated to the operationalisation of the sustainability concept through the construction of a working system of criteria and measurable indicators capable of capturing the complex dynamic processes in the agricultural sector. Scientific literature and international practice demonstrate that, due to its multi-component nature, agricultural sustainability cannot be measured by a single isolated indicator. This necessitates the application of integrated methodological frameworks that combine qualitative and quantitative criteria to provide objective monitoring both at the microeconomic level within individual farms and at higher regional and sector-specific levels of management. Sustainability indicators function as specific analytical tools that reflect the current state, direction of development, and degree of interdependence between economic results, social transformations, and environmental impacts resulting from agricultural activity.

In the context of European and global standards, the dissertation provides a detailed analysis of two main methodological systems developed by international organisations. The first is the established analytical framework DPSIR, Figure 1, (Driving forces – Pressure – State – Impact – Response) of the European Environment Agency, which allows for the tracking of causal relationships between economic incentives and environmental pressure.

Figure 1. Graphical scheme of the DPSIR model

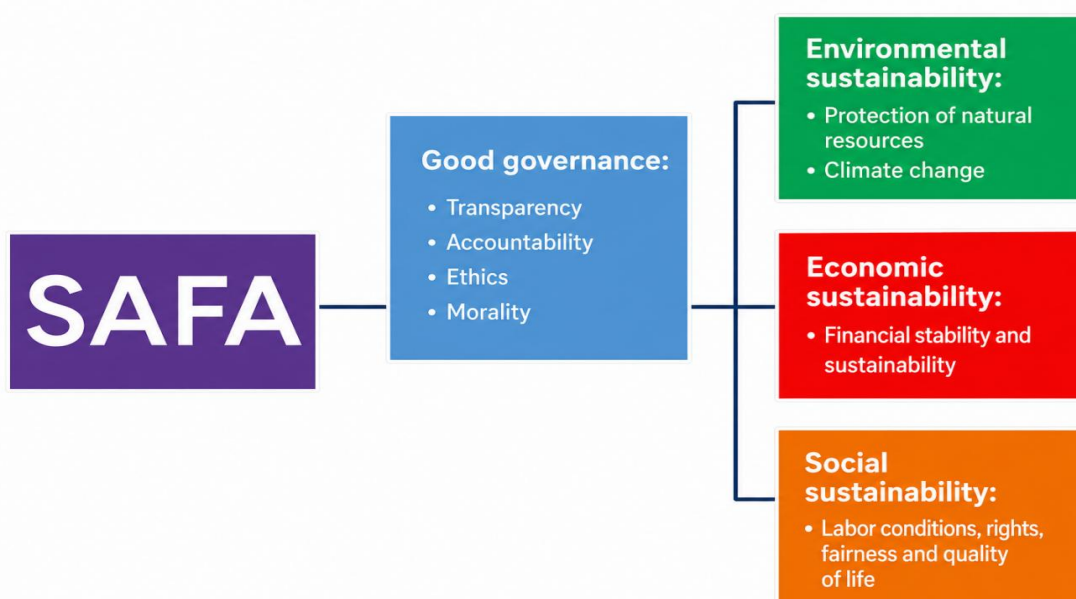


Source: Own compilation based on Eurostat indicators

It classifies indicators into five functional groups: driving force indicators (such as market demand and credit activity), pressure indicators (such as the volume of generated waste and chemical inputs), current resource state indicators, ecosystem impact indicators, and response indicators (representing state policies and banking green products).

The second methodological framework is the SAFA approach (Figure 2) of the Food and Agriculture Organisation of the United Nations (FAO), which is highly structured and encompasses a total of one hundred and eighteen indicators divided into assessment groups, allowing for a detailed scanning of the agriculture and food industry.

Figure 2. SAFA Sustainability Assessment of Food and Agriculture systems (FAO, 2013)



Source: Own figure based on data from FAO. SAFA Guidelines - Sustainability Assessment of Food and Agriculture Systems. Rome, 2013. <https://www.fao.org/nr/sustainability/sustainability-assessments-safa>

Within Bulgarian economic science, this section builds upon the holistic research conducted by the Institute of Agricultural Economics and the fundamental contributions of Prof. Hrabrin Bashev and his team. In their academic works, the traditional three-dimensional sustainability matrix is enhanced by integrating the governance pillar as a mandatory fourth pillar of agricultural sustainability. This approach proves that institutional capacity, contractual legal certainty, and the level of farm management are decisive factors in determining whether a farmer can successfully transform available financial resources into sustainable, eco-friendly practices. For the purposes of this doctoral research, the author adapts these theoretical models to the specific conditions of the Bulgarian market by constructing a matrix of key sector-specific indicators. The independent variable (the volume of bank loans granted to the sector) is juxtaposed against four representative dependent variables reflecting the economic pillar (investments in non-current tangible assets), the social pillar (employment dynamics and income levels measured by the average wage), and the environmental pillar (generated production waste).

The fifth section of the first chapter provides a profound theoretical synthesis that links the two core pillars of the dissertation – financial intermediation and the concept of agricultural sustainability. The research focuses on clarifying the causal mechanisms through which changes in the volume of credit capital impact the economic, social, and environmental status of agricultural production units. In contemporary macroeconomic theory, access to bank loans is not viewed merely as a passive instrument for overcoming temporary cash shortages, but rather as an active driving force that triggers processes of expanded reproduction and eliminates liquidity constraints for farmers. When a farm is constrained by a lack of capital, it is forced to operate within a closed cycle of low productivity, relying solely on its limited internal savings or market-inefficient informal loans. Access to formal bank lending breaks this negative spiral, enabling the realization of economies of scale and increasing the total factor productivity.

The theoretical link between credit and economic sustainability is realised through the investment function, where the attracted bank resources are transformed into non-current tangible assets. The modernisation of the machinery fleet, the acquisition of high-quality agricultural land, and the implementation of automated control systems enhance the competitiveness of the farm, making it more resilient to market shocks and price volatility. In the social dimension, the theoretical links are bi-directional and more complex. On the one

hand, increased lending and subsequent technological modernisation lead to the substitution of live labour with capital, which can trigger staff optimisation and a reduction in the total number of employed persons in the sector. On the other hand, however, this very process of capitalisation requires a qualitatively new workforce with higher qualifications and digital skills. This reflects positively on the socio-income status of employees, as increased labour productivity and expanded profit margins allow management to ensure the sustainable, long-term growth of the average wage within the enterprise.

The theoretical link between access to credit and environmental sustainability remains the most contested in the scientific literature, as the impact of bank capital is not unidirectional. Liberal market models suggest that free access to credit can stimulate production intensification, potentially leading to the excessive use of chemical inputs, soil depletion, and an increase in production waste. However, contemporary concepts of responsible banking demonstrate that under targeted regulations and green credit standards, bank credit becomes a primary catalyst for ecological transformation. Financing allows farmers to absorb the high upfront costs of precision farming systems, drip irrigation, and biomass processing, which reduce the carbon footprint and optimise the use of natural resources. In conclusion, the section draws the inference that the market impact of credit on the three pillars of sustainability is asymmetric and non-homogeneous, which necessitates an empirical verification of these theoretical relationships through econometric modelling in the context of real, large-scale data for Bulgarian agriculture.

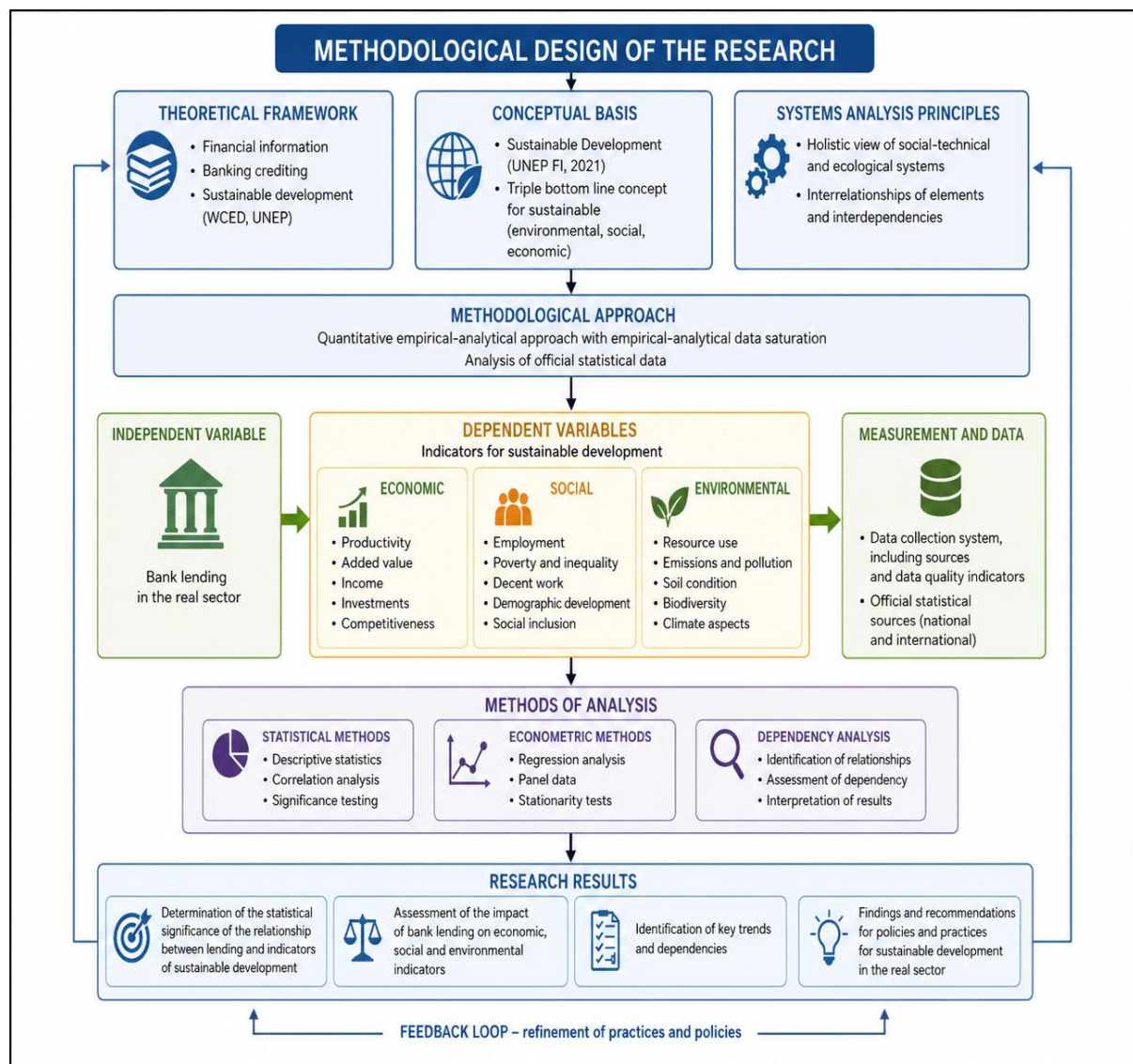
CHAPTER II. RESEARCH METHODOLOGY AND TOOLKIT

Assessing the impact of bank credit on the sustainable development of agriculture requires the construction of a comprehensive, integrated, and scientifically substantiated methodological framework. It combines an interdisciplinary approach with the precise application of quantitative empirical-analytical tools. At the core of the developed research design lies the conceptual synthesis between the theoretical tenets of financial economics and the three-pillar paradigm of sustainable development (economic, social, and environmental sustainability).

The applied methodological approach possesses a distinct empirical-analytical orientation. Its objective extends beyond the purely statistical description of observed market processes. The study is aimed at identifying statistically significant dependencies and regularities that reveal the actual transmission mechanism through which the lending activity of commercial banks impacts the individual pillars of agricultural sustainability.

The methodological architecture is based on the fundamental principles of systems analysis. It views agriculture as a complex, dynamic socio-economic and ecological system composed of multiple interdependent elements. In accordance with contemporary principles of sustainable banking developed by the United Nations Environment Programme Finance Initiative (UNEP FI), commercial banks are treated not merely as passive intermediaries in the redistribution of free monetary capital, but as active participants who, through their credit policies, channel resources and dictate the pace of sustainable transformation within the real sector. The logical sequence, structural links, investigated variables, and stages of analysis are graphically modelled and presented in Figure 3.

Figure 3. Methodological design of the research



Source: Own interpretation

For the purposes of the empirical research, a macroeconomic database has been constructed based on four official and complementary sources: the BNB, NSI, Eurostat, and the FAO. The data underwent preliminary processing and harmonisation to ensure methodological comparability.

The Bulgarian National Bank provides information on the volume and dynamics of bank lending in the "Agriculture, forestry and fisheries" sector for the period 2009–2023, with these data forming the independent variable in the models.

The National Statistical Institute provides data on the key economic, social, and environmental indicators used as dependent variables – investments in non-current tangible assets, employment, wages, and generated waste.

Eurostat serves to verify national data and to conduct a comparative analysis at the EU level, while FAOSTAT is utilised for international comparisons and for calculating the Agriculture Orientation Index (AOI).

The study focuses on Bulgaria and covers two time horizons aligned with the objectives and data availability of the analysis. For the purpose of international comparisons (the dynamics of the share of agricultural credit and the Agriculture Orientation Index), the period 2000–2022 was used based on FAO and Eurostat data. For the purpose of empirically testing the research hypotheses, the main analytical period is 2009–2023 ($n = 15$ annual observations) based on NSI and BNB data. The selection of 2009 as the starting point is determined by the availability of comparable data following the implementation of the EU Common Agricultural Policy reforms in Bulgaria, while the endpoint is determined by the currency of the latest published official data.

The analysis has been conducted at the national (macro) level. The data do not allow for disaggregation by planning regions or by farm type within the studied period; therefore, a regional comparative analysis has not been implemented in this dissertation and is outlined as a direction for future research.

The methodological toolkit of the research includes three interconnected analytical components applied sequentially in Chapter III:

Descriptive and structural analysis (Subsection 3.1): The first component analyses the dynamics and structure of bank lending in the agricultural sector for the period 2009–2023. The following are applied: a comparative analysis of the share of agricultural loans relative to total lending in Bulgaria and the EU-27; calculation and interpretation of the Agriculture Orientation Index (AOI) according to the formula:

$$AOI = (K_{ag} / K_{tot}) / (BDS_{ag} / BDS_{tot})$$

where K_{ag} is the volume of credits to the agricultural sector, K_{tot} is the total volume of credits, BDS_{ag} is the gross value added (GVA) of the agricultural sector, and BDS_{tot} is the total GVA of the economy. AOI values below 1 indicate relative underfinancing of the sector in relation to its economic contribution, while values above 1 reflect priority credit support. Furthermore, a structural analysis of loans by size classes and by type (overdraft, short-term, medium-term, long-term) is performed, allowing for the tracking of transformations in the investment orientation of farms. Within subsection 3.1, a preliminary regression $GVA \sim CREDIT$ is also conducted for the period 2000–2022 based on FAO and Eurostat data, aiming to establish the baseline relationship between lending and the economic contribution of the sector.

- **Correlation analysis (Subsection 3.3):** The second component is the correlation analysis conducted via the Pearson linear correlation coefficient for the period 2009–2023. A complete correlation matrix of the studied variables – CREDIT, TFA (Tangible Fixed Assets), employed persons, waste, average wage, and GVA – has been calculated, enabling an assessment of the degree and direction of linear dependencies between lending and each of the sustainability indicators. Additionally, correlations between lending and structural employment indicators – educational and age structures – have been calculated to achieve a more comprehensive assessment of qualitative social effects.

- **Regression analysis (Subsections 3.3 and 3.4):** The third component involves the application of four independent linear regression models (see Table 4) using the Ordinary Least Squares (OLS) method, corresponding to the four research hypotheses:

Table 4. Regression models using the Ordinary Least Squares (OLS) method

Model	Regression Equation	Hypothesis
Model 1	$TFA = \beta_0 + \beta_1 \cdot CREDIT + \varepsilon$	H1 – Economic dimension
Model 2	$EMP = \beta_0 + \beta_1 \cdot CREDIT + \varepsilon$	H2 – Social dimension (employment)
Model 3	$WST = \beta_0 + \beta_1 \cdot CREDIT + \varepsilon$	H3 – Environmental dimension
Model 4	$WAGE = \beta_0 + \beta_1 \cdot CREDIT + \varepsilon$	H4 – Social dimension (income)

Source: Own interpretation

For each model, the following parameters were estimated: the coefficient of determination (R^2) and the adjusted (R^2), the F-statistic and its significance, the regression coefficients (β_0 и β_1) along with their standard errors, t-statistics, and p-values. The criterion for statistical significance is $p < 0.05$ using a two-tailed t-test. The selection of simple linear models with a single independent variable is methodologically justified by the limited number

of observations ($n = 15$), where the inclusion of additional control variables would lead to model oversaturation and unreliable estimates. Multi-factor modelling with control variables (subsidies, interest rates, farm size) is outlined as a direction for future research utilising a richer information base. In addition to the aforementioned evaluation statistics, residual diagnostics (autocorrelation and stationarity tests) are conducted for the regression models, alongside a robustness check via re-estimation on first differences – the results of which are presented in subsection 3.3.7. To guarantee the reliability of the analysis, a data control and verification procedure was applied, encompassing: the cross-referencing of values from different official sources (NSI, BNB, Eurostat) for matching indicators; the conversion of data from Bulgarian Lev to Euro at the official fixed exchange rate (1 EUR = 1,95583 BGN) for comparability purposes; checking for the presence of outliers through visual inspection of the time series; and a manual verification of the calculated regression coefficients to ensure compliance with the economic logic of the relationships. The data from all four primary statistical sources (BNB, NSI, Eurostat, FAO) reveal no missing values for the studied period, making additional imputation procedures unnecessary.

CHAPTER III. EMPIRICAL RESEARCH ON THE IMPACT OF BANK CREDIT ON THE SUSTAINABLE DEVELOPMENT OF AGRICULTURE

The development of bank lending in agriculture represents a key factor for enhancing the production potential and competitiveness of the agricultural sector. The analysis in this chapter encompasses two interconnected aspects: the comparative dynamics of lending relative to the economic contribution of the sector, and the structure of lending in Bulgaria by volume, size, and type. These two aspects provide the contextual framework for interpreting the regression models. The analysis indicates that for the EU-27 countries, the growth in lending is accompanied by a relatively stable share of GVA, reflecting a higher degree of integration of the agricultural sector into the overall economic structure. In Bulgaria, however, despite the distinct growth in granted loans, the share of agricultural GVA shows fluctuations linked to dependence on natural conditions, the specifics of the production structure, and the limited diversification of agribusiness. Within the EU-27, the gross value added generated by agriculture remains lower than the value of the credits provided to the sector. This demonstrates a greater willingness on the part of financial institutions to disburse funds relative to the actual economic contribution of agricultural activity. It also testifies to a strategic understanding of the importance of agriculture for sustainable development, including its role in ensuring food security, environmental protection, and the preservation of rural communities. In Bulgaria, however, we observe the opposite trend. The sector forms a more significant relative share of

GVA, while the volume of granted credits is substantially lower. Only during the 2017–2018 period did the two values draw closer – a temporary alignment that was not maintained in subsequent years. The average share of loans directed towards agriculture in Bulgaria stands at 2.88%, which is lower than the EU-27 average of 3.42%. This structural weakness highlights the need for more flexible and adapted financing mechanisms that account for the specific features of agricultural production.

The theoretical foundations of bank lending examined, along with the system of indicators for sustainable agricultural development, establish the necessary baseline for transitioning to an empirical study of the links between these two key aspects. In this regard, the question arises as to what extent and in what manner the intensity of credit activity influences sustainability indicators. The answer to this question cannot be derived solely through theoretical reasoning; rather, it requires a systematic quantitative analysis. The analysis encompasses three groups of indicators corresponding to the three dimensions of sustainability. Within the economic dimension, the dynamics of Gross Value Added (GVA) and investments in Tangible Fixed Assets (TFA) are examined. Within the social dimension, employed persons, the average wage, the educational structure, and the age structure of the workforce are investigated. Within the environmental dimension, the volume of generated animal and vegetable waste is analysed as a proxy indicator for the environmental burden of the sector. The comprehensive analysis of sustainability indicators reveals a contradictory picture of the agricultural sector's development in Bulgaria for the period 2009–2023. In the economic dimension, an increase in GVA and particularly in TFA is observed, reflecting a process of capital intensification. In the social dimension, a duality is present: while the average wage has increased threefold, the number of employed persons has decreased, and the workforce is ageing. A gradual rise in the educational attainment level of the employed serves as a positive signal. In the environmental dimension, the dynamics of waste are non-linear and exhibit high variability, with no clearly defined systemic trend. This complex picture suggests that bank lending, although increasing, does not exert a unidirectional impact across all dimensions of sustainability. It is precisely this multidimensional dependency that is quantitatively investigated through correlation and regression analysis. The studied period covers 2009–2023 ($n = 15$ observations). The independent variable is the volume of bank loans granted to the "Agriculture, forestry and fisheries" sector (CREDIT, in EUR million), while the dependent variables are: Tangible Fixed Assets (TFA, in EUR million), number of employed persons (EMP, in persons), generated animal and vegetable waste (WST, in tonnes), and average annual

wage (WAGE, in BGN). All calculations have been performed using the Ordinary Least Squares (OLS) method.

The correlation analysis performed identifies two strong positive dependencies (CREDIT–TFA and CREDIT–WAGE), one moderate positive dependency (CREDIT–GVA), and two weak dependencies with opposite signs (CREDIT–EMP and CREDIT–WST). These results form the basis for the subsequent regression modelling. Regression Analysis – Model 1: Lending and Investments (TFA) The model investigates the impact of bank lending on investment activity in the agricultural sector, measured through the expenditures for the acquisition of tangible fixed assets (see Table 4). The regression equation takes the following form:

$$\text{TFA} = \beta_0 + \beta_1 \cdot \text{CREDIT}, \text{ or specifically: } \text{TFA} = 289,78 + 0,5175 \cdot \text{CREDIT}$$

Table 4. Results of the regression analysis – Model 1 (TFA ~ CREDIT)

Indicator	Value
Correlation coefficient (r)	0,7925
Coefficient of determination (R ²)	0,6280
Adjusted R ² (Adj R ²)	0,5994
F-statistic	21,951
p-value (F)	0,0004
β_1 (CREDIT)	0,5175
Standard Error (β_1)	0,1105
t Stat (β_1)	4,685
p-value (β_1)	0,0004
β_0 (Intercept)	289,78
Standard Error (β_0)	111,63
t Stat (β_0)	2,596
p-value (β_0)	0,022

Source: Own calculations based on NSI and BNB data

Interpretation. The coefficient $\beta_1 = 0,5175$ is positive and statistically significant ($t = 4,685$, $p = 0,0004$). This implies that for every EUR 1 million increase in bank lending, investments in TFA expand by an average of approximately EUR 0.52 million. The model explains 62.8% of the variation in TFA ($R^2 = 0,628$), while the adjusted ($R^2 = 0.599$) confirms the stability of the results. The F-statistic (21.951) at $p = 0.0004$ testifies to the high statistical significance of the model as a whole. The constant $\beta_0 = 289.7$ is significant $p = 0.022$ and reflects the baseline level of investments financed through own funds and European subsidies, independent of bank loans. The remaining 37.2% of the variation in TFA is determined by

factors outside the model – primarily subsidies under the Common Agricultural Policy (CAP), market conditions, and structural characteristics of the farms (Hennessy & Moran, 2015). This is expected, as bank lending is only one of the sources of investment financing in the agricultural sector. Regression Analysis – Model 2: Lending and Employment The model investigates whether the expansion of lending is linked to changes in the number of employed persons in the agricultural sector (see Table 5). The regression equation is:

$$\text{EMP} = \beta_0 + \beta_1 \cdot \text{CREDIT}, \text{ or specifically: } \text{EMP} = 70\,516,04 - 1,936 \cdot \text{CREDIT}$$

Table 5. Results of the regression analysis – Model 2 (Employed persons ~ CREDIT)

Indicator	Value
Correlation coefficient (r)	-0,2509
Coefficient of determination (R ²)	0,0630
Adjusted R ² (Adj R ²)	-0,0091
F-statistic	0,873
p-value (F)	0,367
β_1 (CREDIT)	-1,936
Standard Error (β_1)	2,071
t Stat (β_1)	-0,935
p-value (β_1)	0,367
β_0 (Intercept)	70 516,04
Standard Error (β_0)	2 093,44
t Stat (β_0)	33,684
p-value (β_0)	< 0,001

Source: Own calculations based on NSI and BNB data

Interpretation. The coefficient $\beta_1 = -1.936$ is negative but not statistically significant ($t = -0.935$, $p = 0.367$). Consequently, it cannot be assumed that bank lending exerts a systematic influence on the number of employed persons. The model explains a mere 6.3% of the variation in employment ($R^2 = 0.063$), and the adjusted R^2 is negative (-0.009) – meaning the model does not outperform a simple average. The F-statistic (0.873) at $p = 0.367$ is not significant. These results do not imply that lending is of no consequence to the agricultural labour market. Rather, they reflect that capital intensification processes – financed via credits – simultaneously lead to the substitution of low-skilled manual labour with machinery and to the retention or even expansion of the demand for specialised personnel. The two effects counterbalance each other, explaining the absence of a systematic linear dependency. Two limitations should also be considered in this interpretation. First, given the small sample size ($n = 15$), the statistical power is low; thus, the lack of significance is not equivalent to a proven absence of an effect, but

rather to an inability to establish it reliably. Second, the indicator used covers only employed persons in sector enterprises and excludes self-employed agricultural producers (see subsection 3.2.2); therefore, the negative sign may partly reflect a structural shift between these two categories rather than a response in total employment. Regression Analysis – Model 3: Lending and Environmental Burden The model investigates the relationship between credit activity and the volume of generated animal and vegetable waste as a proxy indicator for the environmental burden of the sector (see Table 6). The regression equation is:

$$WST = \beta_0 + \beta_1 \cdot CREDIT \text{ or specifically: } WST = 322,652.81 + 126.18 \cdot CREDIT$$

Table 6. Results of the regression analysis – Model 3 (Waste ~ CREDIT)

Indicator	Value
Correlation coefficient (r)	0,2829
Coefficient of determination (R ²)	0,0801
Adjusted R ² (Adj R ²)	0,0093
F-statistic	1,131
p-value (F)	0,307
β_1 (CREDIT)	126,18
Standard Error (β_1)	118,64
t Stat (β_1)	1,064
p-value (β_1)	0,307
β_0 (Intercept)	322 652,81
Standard Error (β_0)	119 898,74
t Stat (β_0)	2,691
p-value (β_0)	0,018

Source: Own calculations based on NSI and BNB data

Interpretation. The coefficient $\beta_1 = 126.18$ is positive – for every EUR 1 million increase in credits, waste expands by an average of approximately 126 tonnes. Nevertheless, the coefficient is not statistically significant ($t = 1.064$, $p = 0.307$). The model explains only 8.0% of the variation in waste ($R^2 = 0.080$), and the F-statistic (1.131) at $p = 0.307$ does not confirm the overall adequacy of the model. These results correspond to the correlation analysis and indicate that the dynamics of waste are determined primarily by production and climatic factors rather than by the level of lending. The significant constant ($\beta_0 = 322,653$, $p = 0.018$) shows that a baseline level of generated waste exists, independent of lending. An inference regarding the environmental dimension is that the growth in bank financing is not accompanied by a systematic deterioration of environmental indicators; however, a mechanism for their

improvement has also not been proven. Consequently, the channelling of credits towards eco-friendly technologies remains an optional rather than a systemic phenomenon during the studied period. As with the employment model, the non-significant result given $n = 15$ must be viewed with the caveat of low statistical power: the positive but non-significant coefficient does not rule out the presence of a weak relationship that a larger sample size might be able to establish. Regression Analysis – Model 4: Lending and Average Wage The model investigates the dependency between bank lending and the average annual wage in the agricultural sector (see Table 7). The regression equation is: $WAGE = \beta_0 + \beta_1 \cdot CREDIT$ or specifically:

$$WAGE = -1,127.65 + 11.4472 \cdot CREDIT$$

Table 7. Results of the regression analysis – Model 4 (Average WAGE ~ CREDIT)

Indicator	Value
Correlation coefficient (r)	0,9821
Coefficient of determination (R^2)	0,9646
Adjusted R^2 (Adj R^2)	0,9619
F-statistic	354,007
p-value (F)	< 0,0001
β_1 (CREDIT)	11,4472
Standard Error (β_1)	0,6084
t Stat (β_1)	18,815
p-value (β_1)	< 0,0001
β_0 (Intercept)	-1 127,65
Standard Error (β_0)	614,86
t Stat (β_0)	-1,834
p-value (β_0)	0,089

Source: Own calculations based on NSI and BNB data

Interpretation. The model demonstrates an exceptionally high explanatory power – $R^2 = 0.9646$ implies that 96.46% of the variation in the average wage is explained by the dynamics of lending. The coefficient $\beta_1 = 11.4472$ is positive and highly significant ($t = 18.815$, $p < 0.0001$); for every EUR 1 million increase in bank lending, the average annual wage expands by an average of approximately BGN 11.45. The F-statistic (354.007) at $p < 0.0001$ confirms the overall adequacy of the model. The constant is not statistically significant ($p = 0.089$), which is acceptable given the lending values within the observed range. It is important to emphasise that this exceptionally strong statistical dependency reflects the co-movement of both indicators under conditions of overall macroeconomic growth, inflationary pressure, and statutory increases in the minimum wage. Nevertheless, the results convincingly demonstrate

that more active lending to the sector is systematically linked to higher labour incomes for its employees. This caveat requires an explicit quantitative verification: with a Durbin-Watson statistic of 0.63, the model exhibits strong positive autocorrelation in the residuals – a typical symptom in a regression between two ascending (non-stationary) time series, suggesting that the high coefficient of determination is partly a reflection of a shared time trend. The robustness check on first differences (subsection 3.3.7) confirms that the dependency is maintained even in a more conservative specification, albeit with a significantly more moderate magnitude.

Summary Evaluation of the Regression Models

Table 8. Comparative characteristics of the regression models

Model	Dependent variable	r	R²	β_1	p(β_1)	Significance
Model 1	TFA (EUR million)	0,7925	0,628	0,5175	0,0004	Yes
Model 2	Employed persons (persons)	-0,2509	0,063	-1,936	0,367	No
Model 3	Waste (tonnes)	0,2829	0,080	126,18	0,307	No
Model 4	Average WAGE (BGN)	0,9821	0,965	11,4472	< 0,0001	Yes

Source: Own calculations based on NSI and BNB data

The comparison of the four regression models reveals a differentiated impact of bank lending across the various dimensions of sustainability (see Table 8). Two of the models are statistically significant and possess high explanatory power – Model 1 (TFA, $R^2 = 0.628$) and Model 4 (average WAGE, $R^2 = 0.965$), – whereas Model 2 (employment) and Model 3 (waste) do not reveal statistically significant dependencies. In the economic dimension, lending functions as a significant factor for investment activity – each additional lev of financing generates approximately 52 stotinki of investment in tangible fixed assets. In the social dimension, the picture is two-sided: lending does not influence the number of employed persons, but it is strongly associated with the growth of their incomes. In the environmental dimension, the dependency is statistically non-significant, meaning that lending in itself is neither a driver nor a brake on environmental burden. These results carry direct methodological significance for the verification of the research hypotheses. They underscore that the impact of bank lending on sustainability is multidimensional and heterogeneous – strong in the economic and income aspects, yet non-significant in the aspects of employment and environmental burden. This gives rise to the need for targeted policies where financial incentives are linked to specific sustainable outcomes. The results of the correlation and regression analysis presented in subsection 3.3 are juxtaposed with the formulations of the research hypotheses.

The objective is to draw a well-founded conclusion regarding the confirmation or rejection of each hypothesis based on statistical data rather than theoretical assumptions. The verification encompasses four hypotheses structured around the three dimensions of sustainability – economic, social, and environmental – with the social dimension examined in an expanded version through two independent hypotheses.

Verification of Hypothesis 1 (Economic Dimension)

Formulation: Access to bank credit stimulates investments in machinery, technologies, and production modernisation, leading to increased productivity and higher incomes for agricultural holdings.

Data and Model Used: Dependent variable – expenditures on tangible fixed assets (TFA, EUR million); independent variable – volume of bank loans to the agricultural sector (CREDIT, EUR million); period 2009–2023 (n = 15), see Table 9:

Table 9. Summary of results – Hypothesis 1

Indicator	Value
Correlation coefficient (r)	0,7925
Coefficient of determination (R^2)	0,6280
Adjusted R^2	0,5994
F-statistic/ p-value	21,951 / 0,0004
β_1 (CREDIT) / p-value	0,5175 / 0,0004
Regression equation	$TFA = 289,78 + 0,5175 \cdot CREDIT$

Source: Own calculations based on NSI and BNB data

Verification: The coefficient $\beta_1 = 0.5175$ is positive and statistically significant at $\alpha = 0.001$ ($p = 0.0004$). With an increase in lending of EUR 1 million, investments in TFA expand by an average of EUR 0.52 million. $R^2 = 0.628$ indicates that the model explains nearly two-thirds of the variation in investment activity. The F-test confirms the overall adequacy of the model.

Conclusion: Hypothesis 1 is confirmed. Bank lending exerts a positive and statistically significant influence on investments in TFA as a primary indicator of technological modernisation and economic sustainability in the agricultural sector. The role of banks as financial intermediaries facilitating capital renewal is empirically proven for the period under review. The moderate value of the coefficient of determination indicates that investment activity is also determined by additional factors – CAP subsidies, farms' own funds, and market conditions – which necessitates an integrated approach when developing investment policies.

Verification of Hypothesis 2 (Social Dimension – Employment)

Formulation: Access to bank credit contributes to improving the social sustainability of agriculture by increasing employment in the sector. Data and Model Used: Dependent variable – number of employed persons in the agricultural sector (EMP, persons); independent variable – CREDIT (EUR million); period 2009–2023 (n = 15), see Table 10. Additionally, a correlation analysis of the educational and age structures of the workforce was performed.

Table 10. Summary of results – Hypothesis 2

Indicator	Value
Correlation coefficient (r)	-0,2509
Coefficient of determination (R ²)	0,0630
AdjustedR ²	-0,0091
F-statistic/ p-value	0,873 / 0,367
β_1 (CREDIT) / p-value	-1,936 / 0,367
Regression equation	HJI = 70 516,04 - 1,936 · KPEД
r(CREDIT, share of higher education)	0,9312
r(CREDIT, share of primary and lower education)	-0,7981
r(CREDIT, share of 15–24 years old)	-0,6402
r(CREDIT, share of 55+ years old)	0,4959

Source: Own calculations based on NSI and BNB data

Verification: The regression analysis does not establish a statistically significant dependency between the volume of lending and the number of employed persons ($\beta_1 = -1.936$, $p = 0.367$). $R^2 = 0.063$ and the adjusted $R^2 = -0.009$ indicate that lending practically fails to explain the variation in employment. Employment in the agricultural sector is determined primarily by demographic processes, structural shifts, and rural development policies [Hennessy & Moran, 2015].

Expanded Structural Analysis: Despite the non-significant impact on the total number of employed persons, the correlation analysis of structural characteristics reveals important qualitative changes. The share of employees with higher education expands steadily alongside lending ($r = 0.93$), while the share of low-educated personnel decreases ($r = -0.80$). However, the outflow of young personnel ($r = -0.64$) and the ageing of the workforce ($r = 0.50$ for the 55+ age group) represent structural risks to long-term social sustainability.

Conclusion: Hypothesis 2 is not confirmed in its primary formulation. Bank lending does not exert a statistically significant direct influence on the volume of employment. Nonetheless, the expanded analysis demonstrates that lending is linked to a qualitative transformation of the workforce – namely, an increase in educational attainment levels, – which

represents an indirect positive effect on social sustainability. Coupled with the rising ageing of employees, these trends underscore the necessity for targeted policies aimed at attracting young specialists to agriculture.

Verification of Hypothesis 3 (Environmental Dimension)

Formulation: Access to bank credit exerts an impact on the environmental sustainability of agriculture, measured through the volume of generated animal and vegetable waste.

Data and Model Used: Dependent variable – animal and vegetable waste (WST, tonnes); independent variable – CREDIT (EUR million); period 2009–2023 (n = 15), see Table 11:

Table 11. Summary of results – Hypothesis 3

Indicator	Value
Correlation coefficient (r)	0,2829
Coefficient of determination (R ²)	0,0801
Adjusted R ²	0,0093
F-statistic/ p-value	1,131 / 0,307
β_1 (CREDIT) / p-value	126,18 / 0,307
Regression equation	WST= 322 652,81 + 126,18 · CREDIT

Source: Own calculations based on NSI and BNB data

Verification: Neither the correlation analysis ($r = 0.28$) nor the regression model ($\beta_1 = 126.18$, $p = 0.307$) reveals a statistically significant dependency between the volume of lending and the generated waste. $R^2 = 0.080$ implies that lending explains less than 10% of the variation in the environmental indicator. The considerable variability of waste (min 261,090 tonnes, max 709,099 tonnes) demonstrates that its dynamics are primarily a function of production cycles, climatic conditions, and the structure of livestock farming.

Conclusion: Hypothesis 3 is not confirmed. Bank lending does not exert a statistically significant influence on the environmental burden of the agricultural sector, as measured through waste. The weak positive trend ($r = 0.28$) indicates that as credits grow, production expands, but without a systematic deterioration of environmental indicators. The absence of a significant effect is two-sided: lending does not worsen, but neither does it improve environmental sustainability by itself. This underscores the necessity of linking credit products to explicit environmental requirements and incentives within the framework of "green" finance.

Verification of Hypothesis 4 (Social Dimension – Income)

Formulation: Access to bank credit exerts a positive and statistically significant influence on the average wage in agriculture, measured as an indicator of incomes and labour quality in the sector.

Data and Model Used: Dependent variable – average annual wage in the agricultural sector (WAGE, BGN); independent variable – CREDIT (EUR million); period 2009–2023 (n = 15), see Table 12:

Table 12. Summary of results – Hypothesis 4

Indicator	Value
Correlation coefficient (r)	0,9821
Coefficient of determination (R^2)	0,9646
Adjusted R^2	0,9619
F-statistic / p-value	354,007 / < 0,0001
β_1 (CREDIT) / p-value	11,4472 / < 0,0001
Regression equation	WAGE= -1 127,65 + 11,4472 · CREDIT

Source: Own calculations based on NSI and BNB data

Verification: The model demonstrates an exceptionally high explanatory power – $R^2 = 0.9646$, Adj $R^2 = 0.9619$. The coefficient $\beta_1 = 11.4472$ is positive and highly statistically significant ($t = 18.815$, $p < 0.0001$): with every EUR 1 million increase in lending, the average annual wage expands by an average of approximately BGN 11.45. The F-statistic (354.007) at $p < 0.0001$ confirms the overall adequacy of the model. This is the model with the highest explanatory power among all those investigated in the dissertation.

Conclusion: Hypothesis 4 is confirmed. Bank lending exerts a positive and statistically significant influence on the average wage in the agricultural sector. The results reflect the process of capital intensification, where more accessible financing stimulates labour productivity, which in turn translates into higher labour incomes. This strong statistical dependency should be interpreted with caution – as both indicators expand under conditions of general macroeconomic growth – but it unambiguously demonstrates that more actively credited sectors are systematically associated with better incomes for their employees.

Summary Table for Hypothesis Verification

Table 13. Results of the research hypothesis verification

Hypothesis	Dimension	Indicator	r	R^2	$p(\beta_1)$	Result
H1	Economic	FTA (million EUR)TFA	0,793	0,628	0,0004	✓ Confirmed

		(EUR million)				
H2	Social	Employed persons (persons)	-0,251	0,063	0,367	✗ Not confirmed
H3	Environmental	Waste (tonnes)	0,283	0,080	0,307	✗ Not confirmed
H4	Social	Average WAGE (BGN)	0,982	0,965	< 0,0001	✓ Confirmed

Source: Own calculations based on NSI and BNB data

The results of the verification of the four hypotheses (see Table 13) outline a clear differentiation in the role of bank lending as a factor for the sustainable development of the agricultural sector. In the economic dimension (H1), lending functions as a significant stimulus for investment activity and modernisation. In the social dimension, the impact is two-sided – lending does not influence the number of employed persons (H2 is not confirmed), but it is strongly associated with the growth of labour incomes (H4 is confirmed with high explanatory power). In the environmental dimension (H3), a statistically significant dependency is not established, which implies that the environmental effects of lending are neither systematically positive nor negative. This picture is aligned with the theoretical propositions regarding the multidimensional nature of sustainable development. It demonstrates that bank lending by itself is not a sufficient instrument for achieving balanced sustainability. Its combination with targeted policies is necessary – namely, the channelling of credits towards eco-friendly technologies, programmes aimed at attracting young specialists to agriculture, and differentiated credit products linked to sustainable outcomes. These guidelines are precisely the subject of investigation in the dissertation. The formulated guidelines and recommendations can be systematised into a summary matrix linking each recommendation with a specific empirical finding from the research (see Table 14).

Table 14. Recommendation matrix – linking with empirical results

Recommendation	Target Audience	Empirical Basis	Priority
Investment loans with grace periods and sustainability features	Banks	H1: $\beta_1 = 0.52$; $R^2 = 0.628$	High
Introduction of ESG criteria in credit assessment	Banks / Regulator	H3: $p = 0.307$ (non-significant)	High

Improvement of credit scoring models	Banks	$r(\text{CREDIT-education}) = 0.93$	Medium
Advisory and consulting role of banks	Banks	H4: $R^2 = 0.965$	Medium
Focusing on long-term investments	Farmers	H1 confirmed; $\text{AOI} < 1$	High
Enhancing financial literacy	Farmers	H2: $R^2 = 0.063$ (multiple factors)	Medium
Combining with public financing	Farmers	$\beta_0 = 289.78$ ($p = 0.022$)	Medium
Programmes for young personnel	Farmers / State	Share of 15–24 age group drops from 6.6% to 3.7%	High
Expanding guarantee mechanisms	State	$\text{AOI} < 1$ (2009–2017, 2021–2023)	High
Linking credit to environmental standards	State / Regulator	H3 not confirmed	High
National indicator system	State / NSI	Data limitations	Medium

Source: Own development

The presented matrix demonstrates that most high-priority recommendations are directed towards systemic institutional changes – namely, the introduction of environmental criteria in lending, the expansion of guarantee mechanisms, and policies targeting young personnel. These measures address precisely those dimensions of sustainability where the research identified a lack of statistically significant dependencies with lending, implying that market mechanisms alone are insufficient and active regulatory intervention is required. In summary, improving the effectiveness of bank lending as an instrument for the sustainable development of the agricultural sector requires coordinated actions at three levels – financial (banks), production (agricultural farms), and institutional (state authorities and regulators). Only through the simultaneous implementation of measures across all three levels is it possible to achieve balanced development, wherein economic efficiency, social stability, and environmental sustainability complement each other rather than being mutually exclusive.

CONCLUSION

This dissertation has investigated the role of bank lending as a factor for the sustainable development of agriculture in Bulgaria for the period 2009–2023. The research is based on official data from the BNB, NSI, Eurostat, and the FAO. Through the application of correlation and regression analysis, four research hypotheses encompassing the economic, social, and environmental dimensions of sustainability were verified. The results make it possible not only

to outline empirical dependencies but also to derive a broader understanding of the role of financial mechanisms within the process of sustainable development.

Firstly, the analysis of lending dynamics shows a clearly pronounced upward trend, both in absolute terms and as a relative share of lending to non-financial corporations. Nevertheless, agriculture continues to be structurally underfinanced relative to its contribution to the economy. This result calls into question the effectiveness of existing financial channels and points to the presence of systemic constraints – namely, the high-risk nature of the sector, dependence on external factors, and limited access to collateral. Parallel to this, a shift in the structure of loans is observed – an increase in the share of larger exposures and overdrafts, indicating a transition from traditional financing towards more flexible, yet more short-term, forms of lending.

Secondly, the empirical results confirm the presence of a statistically significant positive dependency between bank lending and gross value added in agriculture. Credit performs the function of a catalyst for economic activity by supporting investments and production growth. At the same time, the explanatory power of this factor remains limited, demonstrating that the development of the sector is the result of the interaction of multiple factors – price cycles, climatic conditions, and support mechanisms. This confirms the thesis that credit is a necessary but not a sufficient factor for development.

Thirdly, the analysis reveals a clearly pronounced asymmetry in the impact of lending across the different dimensions of sustainability [Hennessy & Moran, 2015]. In the economic dimension, the effect is consistently positive – an intensification of investment activity, modernisation of the production base, and an increase in productivity are observed. In the social dimension, the results are contradictory – incomes rise, but employment remains relatively stable or even decreases, pointing towards processes of capital-labour substitution. This implies that credit supports efficiency, but not necessarily social sustainability. In the environmental dimension, a sustainable dependency is absent, demonstrating that investments financed through credit are not systematically directed towards environmental goals.

This asymmetry carries important theoretical significance. It demonstrates that financial instruments are by nature "economically oriented", and their impact on social and environmental outcomes is indirect and dependent on the institutional framework. In other words, without targeted policies, credit does not automatically lead to balanced sustainable development.

Fourthly, the structural analysis of human capital reveals a dual trend – a rising educational attainment level among the employed, coupled with a significant ageing of the

workforce. This result raises questions regarding the long-term sustainability of the sector, as higher qualifications do not fully compensate for demographic constraints. In this context, credit can support technological adaptation but cannot resolve the structural issues related to the reproduction of labour resources.

The results of the study allow for a broader conclusion to be formulated: bank lending plays a clearly defined role in the economic dynamics of agriculture, but its contribution to sustainability is selective and limited.

This conclusion leads to the formulation of the main thesis of the dissertation in a more generalised form: financial funding supports growth, but sustainability requires an institutional and structural framework that guides this growth.

III. DIRECTIONS FOR FUTURE RESEARCH ON THE TOPIC OF THE DISSERTATION

Based on the analysis performed regarding the role of bank lending in the sustainable development of agriculture, a number of directions for future scientific research can be formulated, aimed at deepening and expanding the investigated issues.

Firstly, there is a necessity for a more detailed investigation into the link between access to credit resources and the sustainability of agricultural holdings, emphasizing the differences between small, medium, and large agricultural enterprises. In this context, future research could analyse the impact of credit conditions on economic, environmental, and social sustainability.

Secondly, analyses should be deepened regarding the effectiveness of various types of bank loans and financial instruments, including subsidised credits, guarantee schemes, and public-private partnerships, in supporting the agricultural sector. Of particular interest is the assessment of their impact on investment activity and innovation in agriculture.

A third direction for future research is linked to the integration of sustainable finance principles into banking practice. This includes analysing the application of ESG criteria (environmental, social, and governance factors) in lending to agricultural producers, and assessing their impact on credit risk and long-term financial stability.

Fourthly, a promising area for scientific research is represented by the digitalisation of banking services and its reflection on access to finance in rural areas. Research could encompass the role of fintech solutions, digital platforms, and alternative sources of financing in improving the financial inclusion of agricultural producers.

Additionally, future research could focus on a comparative analysis between Bulgaria and other European Union member states regarding credit support for agriculture, with the aim of identifying good practices and opportunities for their adaptation to the national environment.

In conclusion, expanding scientific research in these specified directions will contribute to a better understanding of credit support mechanisms and their role in achieving the sustainable development of the agricultural sector.

IV. REPORT ON THE SCIENTIFIC AND SCIENTIFIC-APPLIED CONTRIBUTIONS OF THE DISSERTATION

Based on the theoretical research conducted, the developed methodological design, and the empirical results obtained from the econometric modelling, the scientific and scientific-applied contributions of the dissertation can be systematised into the following main directions:

1. Scientific Contributions

First: The theoretical concept regarding the role of bank lending as a factor for the sustainable development of agriculture has been further developed by integrating financial aspects with the economic, social, and environmental dimensions of sustainability.

Second: An original author's definition of the concept of bank credit has been proposed based on the critical analysis performed, which simultaneously combines the fundamental principles of credit and its redistributive function, while focusing distinct attention on green finance and sustainable lending.

Third: An integrated analytical model has been developed, which unifies economic, social, and environmental indicators, thereby enabling a comprehensive assessment of sustainability.

Fourth: The regularities and specifics of the impact of bank lending on the individual dimensions of sustainable development have been established, proving its differentiated role in relation to investment activity, incomes, employment, and the environmental characteristics of the agricultural sector.

2. Scientific-Applied Contributions

First: A methodological framework has been developed to assess the impact of bank lending on the sustainable development of agriculture, which is applicable to future research and the monitoring of the agricultural sector.

Second: The main trends and structural characteristics of bank lending in Bulgarian agriculture have been derived, which can be utilised in the formulation of sector-specific financial policies and sustainable development strategies.

Third: Practical guidelines and recommendations have been formulated to improve the credit policies of banking institutions, aimed at stimulating investment and the sustainable development of agricultural holdings.

Fourth: Measures have been proposed to enhance the interaction between the banking sector, agricultural producers, and public institutions, with the objective of increasing the effectiveness of financial support for the sustainable development of the agricultural sector.

V. STATEMENT OF COMPLIANCE WITH NATIONAL REQUIREMENTS UNDER THE REGULATIONS FOR APPLICATION OF THE DEVELOPMENT OF ACADEMIC STAFF IN THE REPUBLIC OF BULGARIA ACT (ZRASRB)

This dissertation fully complies with the provisions and requirements set forth in the Development of Academic Staff in the Republic of Bulgaria Act (ZRASRB), as well as the Regulations for its application, which govern the procedure for awarding the educational and scientific degree of "Doctor" (PhD). In terms of content and methodology, the work meets the criteria under Art. 2, para. 1 of the Ordinance – through the formulation of a highly relevant scientific problem, independent theoretical justification, a clearly defined thesis, contributing results, and a corresponding structure of the exposition. Compliance encompasses not only the formal aspects of volume, structure, and published materials, but also the essential academic criteria – originality of contribution, scientific novelty, methodological soundness, and the significance of the results for both practice and theory.

1. Compliance Regarding the Volume and Content of the Dissertation

The dissertation has a volume of over 215 standard pages, containing a fully structured academic exposition substantiated by more than 140 bibliographic sources, including international scientific literature, official EU documents, statistical databases, and national policies. The content of the dissertation encompasses all mandatory components: introduction, theoretical review, methodology, empirical analysis, contribution section, conclusions, list of references, and appendices.

2. Compliance with the Requirements for Independence and Originality

The dissertation has been developed independently by the PhD student Hristo Kostov within a full-time form of study at an accredited higher education institution. The text is entirely free of plagiarism, unlawfully borrowed passages, or intertextual violations of scientific ethics. Pursuant to Art. 7 of the Regulations for Application of ZRASRB, the work is accompanied by

a declaration of originality and independence of the research, as well as a list of publications reflecting a portion of the results.

3. Compliance with the Criteria for Scientific Publications

Scientific Articles (3 papers):

1. Kostov, H., Blagoeva, N., & Georgieva, V. (2025). Credit support for the agricultural sector in Bulgaria: Structural analysis and economic dimensions. *Scientific Papers Series: Management, Economic Engineering in Agriculture and Rural Development*, v.25, issue 1, 549-558, PRINT ISSN 2284-7995, E-ISSN 2285-3952. (10т.)

2. Kostov, H. (2025). *Impact of agricultural loans in Bulgaria on the sustainability of agribusiness companies*, Scientific Works of the Agricultural University – Plovdiv, v. LXVII, issue 4, ISSN 1312-6318 (print), 2367-5845 (online). (10т.)

3. Kostov, H. (2026). Bank Lending and the Dynamics of Human Capital in Bulgarian Agriculture: Relationship with the Level and Structure of Employment (2009–2023). *E-Journal VFU*, 25, 866–878. ISSN: 1313-7514. <https://ejournal.vfu.bg/index.php/vfu/article/view/326> (10т.)

Against a minimum requirement of 30 points and 2 scientific publications, the total points accumulated by the PhD student amount to **30 points and 3 scientific publications**.

4. Compliance with the Criteria for Contributing Character

The dissertation work complies with Art. 8, para. 1 of the Regulations for Application of ZRASRB, which requires it to contain new scientific results with provable originality and significance for the respective scientific field.

5. Compliance Regarding the Structure of the Extended Abstract

This extended abstract has been prepared in accordance with the requirements of Art. 13 of the Regulations for Application of ZRASRB – as a summary of the main elements of the dissertation work, including: general characteristics, content, results and contributions. The volume of the extended abstract exceeds the minimum required 10 standard pages and accurately reflects the actual content of the research, while maintaining its logical sequence, scientific vocabulary, and formal academic style.

VI. DECLARATION OF ORIGINALITY OF THE DISSERTATION

The content of the dissertation complies with Art. 13, para. 1 of the ZRASRB and with Art. 2, para. 1 and 2 of the Ordinance on the Development of Academic Staff. The author has demonstrated skills for the independent formulation of a scientific problem, justification of aims and objectives, methodological consistency, and critical analysis. The results demonstrate

an original contribution to the theoretical and applied aspects of sustainability in the agricultural sector. Scientific theses are presented, supported by reasoned logic, an analytical apparatus, and empirical evidence. I hereby declare that this dissertation is entirely the result of my own independent research activity. In the process of its preparation, all requirements for academic integrity, citation of used sources, and originality of the presented ideas and formulations have been strictly observed. By means of this work, I certify that:

- The entire research, including methodology, empirical analysis, theoretical conclusions, and formulations, is the result of my own independent scientific activity;
- In the compilation of the dissertation, exclusively reliable academic sources have been used, which are correctly cited in accordance with international academic standards;
- No third-party materials that violate the provisions of the Copyright and Related Rights Act have been used in the text;
- The dissertation has not been submitted in other procedures for the acquisition of the educational and scientific degree of "Doctor" (PhD) in the Republic of Bulgaria or in any other country;
- The research has not been published in any other form and has not been utilised for the acquisition of an academic position or rank;
- This declaration is made in good faith, and full responsibility is assumed for its content and the consequences of any potential violations.

This declaration is an integral part of the extended abstract and the defence dossier, and is subject to verification by the Scientific Jury, the Academic Ethics Committee, and other competent authorities within the framework of the degree-awarding procedure.