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AUTHOR'S ABSTRACT

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**ADAPTATION OF BULGARIAN
AGRICULTURE: BALANCING NATIONAL
INTERESTS AND THE EU GREEN
POLICIES**

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I. GENERAL CHARACTERISTICS OF THE DISSERTATION

1. Relevance of the Topic

The topic of the adaptation of Bulgarian agriculture to the European Green Deal and European environmental policies is of paramount importance in the context of the global

climate crisis and the reform of the Common Agricultural Policy (CAP). The agricultural sector in Bulgaria is characterized by a number of challenges - demographic collapse, institutional deficits, low competitiveness and weak technological modernization. At the same time, it is expected to undergo a rapid and profound transformation in accordance with EU environmental standards. This leads to tension between national interests (economic sustainability, social cohesion, food security) and supranational regulations. In this context, the study proposes an analytical framework for balanced adaptation, aiming to avoid both environmental formalism and economic stagnation.

The dissertation examines sustainable development in the agricultural sector through an integrated approach that combines institutional analysis, strategic planning, and assessment of applied results. The innovation is manifested in the systematic comparison of the goals, instruments, and indicators of sustainability, so as to reveal the links between national priorities and European strategic frameworks. The analysis is built on a broad theoretical foundation, including economic, social, and managerial perspectives, and is oriented towards creating practical value through formulating guidelines for improving sectoral policies. This approach ensures that the work contributes both to the academic discussion and to the process of informed decision-making at the management level.

In the context of deepening global climate change and the strengthened regulatory frameworks of the European Union, Bulgarian agriculture stands at a strategic crossroads. The entry into force of the European Green Deal and the new Common Agricultural Policy (CAP) require from member states not only technological and production changes, but also a comprehensive transformation of institutional and managerial models. This poses a complex of interconnected challenges for Bulgaria: how to ensure the economic viability of the sector without compromising environmental goals; how to integrate social priorities such as employment and demographic stabilization with the strictly formulated environmental requirements; and how to combine the national specificity of agricultural practices with supranational regulatory mechanisms.

In recent decades, Bulgarian agriculture has been characterized by a high degree of regional heterogeneity - both in terms of natural resources and climatic conditions, and in socio-economic parameters. This further complicates the adaptation process, as a single, "universal" policy can hardly cover the specific needs of the plain grain and vegetable producing regions, and those of the mountainous and semi-mountainous zones, oriented towards livestock farming and organic agriculture. In this context, the relevance of the topic transcends its academic significance - it becomes a key factor for national food security, the competitiveness of the

Bulgarian agricultural portfolio on the international market, and the long-term sustainability of rural areas.

It is precisely for these reasons that the analysis of the sector's adaptation potential vis-à-vis the Green Deal is not just timely, but imperative, as it serves as a scientific basis for developing policies that guarantee a balance between the economic, social and environmental priorities of Bulgaria.

Globally, the issue of sustainable agricultural development fits into broader normative and strategic frameworks that set the general direction for national policies. Among them, the UN Sustainable Development Goals (SDGs) are of particular importance, especially SDG 2 "Zero Hunger", SDG 12 "Responsible Consumption and Production" and SDG 13 "Climate Action". These goals emphasize the simultaneous achievement of food security, limiting the environmental footprint, and increasing social justice. The dissertation research, focused on the sustainability of Bulgarian agriculture, fits precisely into this context, offering an analytical framework through which local specifics are contrasted with global challenges.

An additional perspective is provided by the concept of "resilience", which examines the ability of agricultural systems to withstand shocks - climatic, economic or social - and at the same time transform in a way that strengthens their long-term viability. In this regard, the indices proposed in the dissertation can be viewed as quantitative tools for assessing the capacity of Bulgarian agriculture to respond and adapt in the context of dynamic global processes.

Finally, the connection with the EU's strategic framework for the bioeconomy also deserves attention, which requires a transition to production models based on the circular economy and efficient use of biological resources. Bulgaria, as a member state, is directly bound to this process, and the results of the dissertation research can serve to formulate policies that combine global goals with national specificities.

2. Aim of the Dissertation

The main goal of the dissertation is to prove that a sustainable transition of Bulgarian agriculture towards the EU's green policies is possible through adaptive strategies that integrate national economic, social and environmental interests. The work aims to propose a framework for balancing the implementation of European regulations (such as the Green Deal and the Common Agricultural Policy) with preserving the specificity of the Bulgarian agricultural sector, including its historical, cultural and structural features.

3. Object and Subject of the Research

The object of the research is Bulgarian agriculture in the context of its adaptation to the EU's green policies. **The subject** of this work is the creation of mechanisms for adapting the EU's green policies to Bulgarian agriculture, including analysis of conflicting and synergistic points between local needs and European regulations, and identification of strategic directions for overcoming structural weaknesses in the sector.

4. Research thesis and research question

The research thesis, defended in the sequential course of the research for this dissertation, states that the sustainable adaptation of Bulgarian agriculture to the Green Deal and EU policies is possible only through a balanced alignment of national interests and environmental goals via integrated policies and strategic resource management.

The main research question put forward in the research is, what adaptation mechanisms can ensure a balance between the national, economic and social interests of Bulgaria and the environmental requirements of the EU in the context of the agricultural sector. Specifically, the question is directed towards the mandatory consideration of the influence of regional differences and the Bulgarian context.

5. Research Tasks

Based on the set aims, the formulated thesis and questions, the following research tasks have been defined:

- Analysis of the historical transformations in Bulgarian agriculture in terms of sustainability, production structure and export potential;
- Assessment of the impact of the Green Deal, CAP and climate regulations on agricultural production, environmental footprint and investments;
- Identification of discrepancies between European policies and national economic and environmental priorities;
- Investigation of the socio-economic, demographic and environmental effects of implementing sustainable practices in rural areas;

- Analysis of the structure, distribution and effectiveness of subsidies and foreign investments in the sector;
- Assessment of administrative capacity and proposals for institutional improvements oriented towards climate resilience and growth;
- Investigation of the dependencies between types of crops, livestock farming and climate pressure;
- Identification of the interactions between demographic changes and the sustainability of the sector;
- Development of scenarios for the political, economic and demographic adaptation of Bulgarian agriculture to the Green Transition.

Each of the formulated tasks is linked to specific analytical approaches. Tasks 1-3 are developed through a comparative analysis of EU strategic documents and national planning documents. Tasks 4-6 are solved through an interpretative analysis of indicators contained in public monitoring databases and institutional reports. The last three tasks (7-9) use a deductive approach to validate the generalized thesis, based on a logical reconstruction of the political and normative discourse.

Table No. 1 presents the correlation between the nine research tasks and the corresponding analytical hypotheses. Each link is supported by a methodological approach and an applied indicator. This allows for tracking the logical consistency of the research. The table serves as an analytical map for navigating the argumentative structure. In addition, it emphasizes the clear measurability of the scientific thesis.

Table1. Dependency between research tasks and applied hypotheses in the investigation

Nº	Research Task	Related Hypotheses
1	Analysis of the historical transformations in Bulgarian agriculture in terms of sustainability, production structure and export potential	H2, H3, H4, H16
2	Assessment of the impact of the Green Deal, CAP and climate regulations on agricultural production, environmental footprint and investments	H5, H6, H13
3	Identification of discrepancies between European policies and national economic and environmental priorities	H9, H11, H15

4	Investigation of the socio-economic, demographic and environmental effects of implementing sustainable practices in rural areas	H4, H5, H7, H8
5	Analysis of the structure, distribution and effectiveness of subsidies and foreign investments in the sector	H1, H10, H12
6	Assessment of administrative capacity and proposals for institutional improvements oriented towards climate resilience and growth	H14, H15
7	Investigation of the dependencies between types of crops, livestock farming and climate pressure	H13, H14, H15
8	Identification of the interactions between demographic changes and the sustainability of the sector	H7, H8, H9, H10, H11, H12
9	Development of scenarios for the political adaptation of Bulgarian agriculture to the Green Transition	H1-H16

Source: Author's interpretation

6. Methodology

The analytical methods in this research are based on a systemic and holistic approach, combining qualitative and quantitative methods with the aim of objectively investigating the complex dynamics between national interests and European green policies in agriculture.

The following approaches were applied in the theoretical part:

- Literature review of leading theories on sustainability, adaptation and development in the agricultural sector, including economic, institutional and environmental paradigms;
- Comparative analysis of European and national regulatory frameworks to identify similarities, differences and potential areas of tension or synergy;
- Construction of a conceptual framework and an authorial definition for the adaptation of Bulgarian agriculture in the context of the green transition;
- Historical analysis of key stages in the development of the sector (1990-2022), with emphasis on institutional transformations, changes in ownership structure and the effects of EU membership.

In the empirical part of the research, quantitative methods were applied, aimed at an objective assessment of the influence of economic, environmental and demographic factors on the adaptation capacity of the sector:

- Correlation analysis to establish statistical dependencies between variables, including identification of the strength and direction of relationships;

- Regression analysis with the development of models testing hypotheses about the impact of specific factors on key sustainability indicators;
- Analysis of time trends and moving averages to track long-term changes in agricultural indicators and to avoid the influence of short-term fluctuations;
- Construction and use of index measures (e.g., export value index, livestock density index, resource efficiency index), serving for sub-sectoral analysis and comparison between farming models.

A substantial methodological contribution of the dissertation is the introduction of three authorial indices, which enable integrated measurement of sustainability. The first – the Agro-Ecological Footprint Index (AFI) – combines indicators for greenhouse gas emissions (CO₂, CH₄, N₂O), the share of renewable energy and land use efficiency to assess the real environmental impact of agricultural activity. The second – the Livestock Density Index (LDI) – measures the load on agro-ecosystems resulting from the concentration of livestock production on the available area, which is critical for understanding the link between intensive livestock farming and sustainable resource management. The third – the Cooperative Agro-Climatic Index (CACI) – integrates economic, environmental and social dimensions to assess the effectiveness of cooperative and business models, and their ability to combine production profitability with environmental responsibility.

Methodologically, the three indices are not used in isolation, but within a multi-stage index analysis, which tracks both their individual behavior and the interrelationships between them. This achieves high analytical accuracy and minimizes the risk of partial or fragmented conclusions. Furthermore, the indices can also be applied in a monitoring context, allowing for current assessment of progress towards strategic goals and timely policy correction.

Such an integrated approach is rare in previous studies of Bulgarian agriculture, which underscores the innovative nature of the methodology and its applicability in both the scientific and practical spheres of policy.

Methodologically, the dissertation is based on analysis of data through critical discourse, and information from normative and strategic documents, used to identify conceptual tensions between externally imposed policies and internal legitimacy. The analytical framework combines approaches from institutional theory and political constructivism. One of the innovative aspects of the dissertation is that through such a methodological perspective, it examines how, during the studied period, regulatory goals and linguistic formulations shape sustainability as a form of institutional conformism, rather than as a result of local needs and practices.

7. Scope of the Research

The chronological scope includes the period 1990-2022. Territorially, the research has a national character, but the recommendations are synthesized for application on regional, even local municipality levels as well (especially in highly vulnerable areas like Northwestern Bulgaria, Strandzha, the Rhodopes).

Sectorally, the following are considered: land use, livestock farming, productivity, emissions, institutional coordination and demography.

The specified research period was chosen not by chance, but in view of the significant socio-economic, institutional and environmental changes that have occurred in Bulgarian agriculture, encompassing three clearly defined and key stages:

Transition from a planned to market economy (1990-2000) - characterized by structural reforms, privatization and a change in the model of agricultural production. This stage is important for understanding the initial conditions that determine future adaptation strategies in the sector.

Preparation and accession to the European Union (2001-2007) - a period during which the necessary institutional frameworks were created and national policy was harmonized with European standards and regulations. The analysis of this stage allows for an assessment of the initial effects of integration and the adaptation of Bulgarian agriculture to the requirements of the Common Agricultural Policy (CAP).

Implementation of the Common Agricultural Policy after EU membership (post-2007) - characterized by significant financial and regulatory mechanisms that transform production and environmental practices. This stage also includes important external shocks such as the global financial crisis (2008), the COVID-19 pandemic (2020) and the geopolitical consequences of the war in Ukraine (2022).

To ensure comprehensiveness and analytical accuracy, the present research uses multiple authoritative data sources, among which are:

Eurostat - for obtaining agro-economic, demographic and environmental indicators related to agricultural development and the sustainable development of rural areas;

The Food and Agriculture Organization (FAO) - for global comparisons, data on productivity, greenhouse gas emissions (GHG) and the carbon footprint of agriculture;

The World Bank - for macroeconomic context, analysis of institutional capacity and indicators of economic development;

The National Statistical Institute (NSI) - for specific regional data, indicators of population dynamics, agricultural land use, production prices and regional economic trends;

The Ministry of Agriculture and the State Fund "Agriculture" - for information related to subsidies, measures under the Rural Development Programme (RDP), employment in the sector and identification of beneficiaries;

The European Commission, the European Court of Auditors and Transparency International - for assessing the effectiveness and transparency in policy implementation, as well as for analysis of corruption risks and the administrative capacity for managing European funds.

The use of such diverse and reputable sources guarantees high reliability, comparability and validity of the collected data, which is essential for the correctness and precision of the assessments and conclusions made.

The use of a complex methodological toolkit not only guarantees depth and interdisciplinarity of the analysis, but also allows for the validation of the research thesis through quantitative evidence and logical consistency between the theoretical framework and empirical results. This confirms the applicability of the developed proposals and models at both strategic and operational levels.

The expected **scientific results** are related to identifying key factors for an economically efficient and environmentally sustainable adaptation of Bulgarian agriculture to the EU's green policies. Based on a systemic analysis, the aim is to derive the dependencies between the structure of land use, resource efficiency, demographic characteristics and institutional support - both at national and regional levels.

The research provides an empirically substantiated basis for rethinking the current mechanisms of financing and management in agricultural policy, emphasizing the importance of strategically redirecting European funds to sectors and territories with high adaptation potential. In this context, particular attention is paid to small and medium-sized farms, cooperative structures and territorial models of sustainable land use.

Parallel to this, the dissertation demonstrates that the effective implementation of European programmes requires not only technical compatibility, but also institutional sensitivity to regional differences. Therefore, the understanding of the necessity for a local, decentralised approach in the application of European policies is established as a key element for achieving long-term sustainability, economic viability and social justice in rural areas.

The expected contribution is also expressed in the development of applicable analytical tools - such as index assessments, scenarios and impact assessment models - which can be used

by both researchers and public administration and practising agricultural specialists. These results have the potential to enrich the political debate regarding the adaptation of the agricultural sector and to support the formation of more flexible, adaptive and effective strategies in the context of the Green Transition.

II. MAIN CONTENT OF THE DISSERTATION

The unfolded main content of the dissertation presents a systemic and multi-layered analytical framework for investigating the adaptation of Bulgarian agriculture to the European Union's green policies. The first chapter lays the theoretical-methodological foundation through an interpretation of classical and contemporary paradigms of sustainability and institutional adaptability. The second chapter structures a critical and innovative methodological toolkit, including three authorial indices allowing for an integral assessment of economic, environmental and social parameters. The third chapter offers an empirical analysis of the dynamics of the sector in the period 1990-2022, revealing statistically significant dependencies and trade-offs between productivity, demography and environmental sustainability. The fourth chapter formulates strategic scenarios and policies for adaptation, aimed at achieving balanced development and strengthening institutional capacity. The critical gap between normatively stated goals and the real administrative and social potential for their realization is emphasized. Methodological rigor is combined with applied relevance, which gives the work high scientific and practical value. The dissertation research is distinguished by an interdisciplinary approach, in which economic, social and environmental dimensions are considered in an organic interrelationship. Through the integration of international standards and national specificities, an analytical model is outlined, capable of supporting effective strategic planning in the context of the European Green Deal. Thus, the dissertation transcends the boundaries of academic theory and offers concrete managerial solutions for the modernization and sustainability of the Bulgarian agricultural sector.

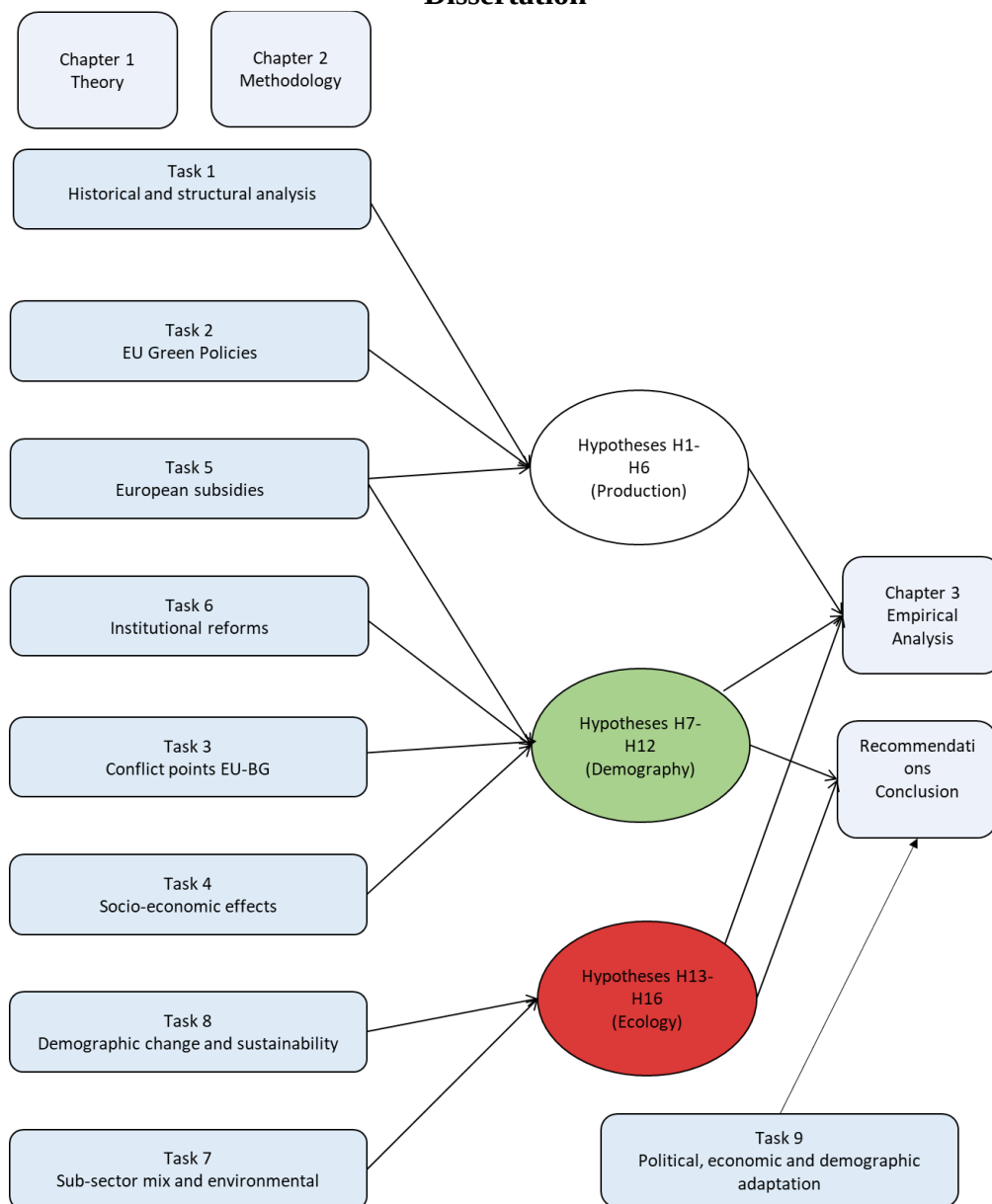
The logical structure, on the basis of which this dissertation is built, is schematically illustrated in Figure No. 1.

CHAPTER ONE: THEORETICAL FOUNDATIONS AND CONCEPTUAL FRAMEWORK OF ADAPTATION

The historical trajectory of Bulgarian agriculture is key to understanding its adaptation capacity vis-à-vis the Green Deal and EU regulations. From feudal dependence during the

Ottoman period, through modernization impulses after the Liberation, socialist collectivization and the post-socialist restitution chaos, the sector has undergone a series of structural transformations, each of which has left a lasting institutional imprint. The present chapter systematizes these stages, showing that the accumulated fragmentation, concentration of resources and regional polarization are direct legacies of previous management models. These affect the possibility of implementing integrated green policies, which presuppose consolidation, technological investments and cooperative mechanisms.

Figure 1. Logical Architecture of the Dissertation Research: Interrelationships between Research Tasks, Thematic Hypothesis Groups and Structural Parts of the Dissertation



Source: Author's analysis.

In theoretical terms, the research is based on a synthesis between classical economic models (rational choice, market incentives), institutional theories (role of formal and informal rules), socio-ecological paradigms (sustainability, adaptability) and the concept of "sustainability by imposition" – a new analytical term defined by the author. This concept emphasizes the discrepancy between externally imposed goals and the internal legitimacy of sustainable practices, viewing adaptation as a process of balancing between normative pressure and national interests.

Chapter One also outlines the structural points of tension between the Bulgarian agricultural profile and European green policies – from the misalignment of priorities (economic viability versus environmental goals), through a deficit in administrative capacity, to differences in socio-cultural attitudes towards land use and innovations. Thus, an analytical framework is built, which in the subsequent chapters will be empirically tested through indicators and models.

The structure of the dissertation is sequentially built so as to progress from theoretical substantiation to practical applicability. The first chapter outlines the conceptual framework of sustainability, based on international and national scientific experience, and systemizes the key factors determining the effectiveness of sectoral policies. The second chapter analyses the content and application of strategic and normative documents, assessing their consistency and realism. The third chapter presents an analytical model through which the political and managerial mechanisms for achieving sustainability can be assessed. In the fourth chapter, specific conclusions and recommendations are formulated, aimed at strengthening institutional capacity and optimizing management processes. This logical sequence ensures a full transition from theory to practice.

The scientific work guides the reader from the theoretical framework, through the analytical model, to the applied conclusions and recommendations.

The first chapter lays the foundation of the dissertation research by examining the concept of adaptation through the prism of a historical chronological line on the one hand, and various theoretical paradigms on the other. The necessity of moving away from a mechanistic understanding of adaptation as passive compliance and transitioning to its perception as an active, strategic process of institutional and social transformation is emphasized.

A wide range of theories on agricultural adaptation are considered, but particular attention is paid to four main approaches:

Classical Economic Approach, which treats adaptation through the prism of resource efficiency and the search for equilibrium between alternative benefits;

Sustainable Livelihoods Approach (SLA) – focused on vulnerability, social capital and local resistance;

Institutional Approach, emphasizing rules, norms and organizations as mediators of change;

Public Choice Theory, in which adaptation is viewed as a result of the struggle between group interests in conditions of limited resources and political asymmetry.

The key concept of "institutional subjectivity" is introduced, considering the capacity of institutions to define and model their own role in the adaptation process. The relationship between institutional design and the environmental effectiveness of agricultural policy is analysed.

The analysis accents the theoretical framework of the concept of "sustainability by imposition", understood as a state in which sustainable development is realized as a result of external normative and institutional mechanisms, and not as a consequence of internally motivated actions and consensus among local stakeholders. This form of sustainability questions the long-term effectiveness and legitimacy of the applied policies, especially in contexts with limited institutional capacity and a low degree of public participation.

Chapter One also outlines the issue of territorial justice – the idea that sustainability must be correlated with the specific geography, demography, resources and institutional history of each country.

CHAPTER TWO: METHODOLOGICAL FRAMEWORK AND ANALYTICAL APPROACH

The methodological basis of the research is built on an integrated approach that combines qualitative and quantitative methods for assessing the adaptation of Bulgarian agriculture to the Green Deal and EU policies. The analysis period (1990-2022) encompasses both the post-socialist transformation and pre-accession processes, as well as Bulgaria's full EU membership and the effect of new environmental standards.

Data were collected from reliable institutional and statistical sources, such as the National Statistical Institute, Eurostat, the Ministry of Agriculture, FAO and IPCC. The indicator apparatus is structured into five groups – economic, environmental, demographic, production and aggregated indices, including 42 indicators. For each indicator, the source, unit of measurement, standardization method and logic for inclusion in the analysis were determined.

This standardization ensures high comparability between the different thematic groups and allows for tracking dependencies over time and space.

A key element in the methodological construction are the three authorial indices developed for the purposes of the dissertation:

1. **Agro-Ecological Footprint Index (AFI)** – an aggregated measurement of the environmental impact of agriculture, including emissions of CO₂, CH₄ and N₂O, the share of renewable energy and land use indicators. The index allows for comparative analysis between regions and assessment of the effectiveness of green practices over time.
2. **Livestock Density Index (LDI)** – a measure of the ratio between the number of animals and the available agricultural land area. This index serves to assess the pressure on ecosystems and to determine optimal load levels in livestock farming, taking into account the specific conditions of Bulgarian regions.
3. **Cooperative Agro-Climatic Index (CACI)** – an integrated indicator that combines economic, environmental and social components to measure the effectiveness of cooperative and integration models for sustainable land use. The index is conceived as a tool for strategic planning and monitoring, especially in the context of regional consolidation and green innovations.

One of the main methodological contributions of the dissertation is the critical selection of indicators, on the basis of which the authorial indices were developed. Such a selection is not arbitrary, but is the result of an in-depth comparative analysis of existing international practices and the specific characteristics of Bulgarian agriculture. For example, the **Agro-Ecological Footprint Index (AFI)** builds upon the concept of Ecological Footprint, widely used in environmental sciences, but is adapted for the needs of the agricultural sector by including indicators for greenhouse gas emissions, fertilizer use and energy efficiency. Thus, it builds upon international experience, while taking into account Bulgaria's specific production structure.

The Livestock Density Index (LDI) has an analogue in practices for monitoring the load on agro-ecosystems, but its implementation in the present dissertation allows for a systemic assessment of the relationship between livestock production and sustainable land management.

The Cooperative Agro-Climatic Index (CACI), in turn, has no direct equivalent in the international literature, which underscores its innovative value. It integrates social and institutional aspects, such as the degree of cooperation, access to common resources and participation in climate adaptation policies – factors that often remain outside the purview of purely economic analyses.

Thus, the methodological contribution is not exhausted by the technical development of new indices, but consists in the creation of analytical tools, comparable to international standards, but at the same time sensitive to national specificities.

Processing methods include trend and index analyses to establish long-term dependencies, correlation analysis to identify statistically significant relationships between indicators, as well as regression models to test 17 research hypotheses, grouped into three thematic clusters: production, demography and ecology. Particular attention is paid to testing for multicollinearity through VIF analysis, which increases the reliability of the conclusions.

This chapter provides a logical link between the theoretical framework (Chapter One) and the empirical analysis (Chapter Three), by offering clearly defined methods, indicators and authorial tools for assessing sustainability. In this way, it is guaranteed that the results and recommendations presented in the final chapters are based on a solid and reproducible analytical base.

The second chapter presents the overall research architecture. The data sources are unfolded: Eurostat, NSI, FAO, MAF, World Bank. Over 40 aggregated and specific indicators related to land use, production mix, exports, yields, categorized or indexed livestock density, climate pressures, demographic dynamics, etc., were used. The research is conceptual in nature, based on a critical analysis of strategic documents, normative formulations and program declarations, without including field data.

An index system was developed, including:

- Agro-Climatic Footprint Index (AFI) – combines emissions of harmful elements, energy intensity and agro-ecological vulnerability;
- Livestock Density Index (LDI) – ratio between the number of animals and the area of agricultural land;
- CACI Index for economic and administrative comparison, indices of sustainability, crop cycles and institutional capacity are theoretically mentioned.

16+ hypotheses were formulated, structured into three analytical clusters:

- **Cluster 1:** Economy – e.g., relationship between production mix and efficiency; between exports and sustainability.
- **Cluster 2:** Demography – e.g., relationship between depopulation and land use.
- **Cluster 3:** Ecology – e.g., relationship between livestock density and climate pressure.

The used statistical analysis methods include:

Correlation analysis – presented with a pie chart and heat map;

Regression modelling – applied to individual indicators and composite indices;

Spatial visualization – through comparison of regional values;

Scenario modelling – based on empirically validated hypotheses.

A logical matrix was created, demonstrating coherence between the hypotheses, research tasks and chapters of the dissertation.

CHAPTER THREE: EMPIRICAL ANALYSIS AND HYPOTHESIS TESTING

The empirical part presents the dynamics of key indicators in Bulgarian agriculture, considered in the context of the Green Deal and CAP. The analysis of time series shows clearly distinguishable stages – a decline in production and demographic indicators in the 1990s, partial recovery after EU accession, but also new forms of unevenness and concentration of resources. Regional differences are noticeable, with the northern plain regions dominating grain production, while the mountainous and semi-mountainous regions remain marginalized.

Correlation analysis identifies strong links between farm size, level of subsidization and export value, as well as between digitalization and resource efficiency. Regression models confirm the significant influence of investments in irrigation, mechanization and education on productivity and environmental outcomes. Some hypotheses related to the direct role of demographic factors show weaker statistical support, which points to the necessity of complex policies combining economic incentives and social infrastructure.

The empirical analysis, conducted on aggregated statistical data for the period 1990-2022, reveals clear dependencies between economic, demographic and environmental indicators in Bulgarian agriculture. The application of trend and index analyses shows substantial changes in production volumes, employment and environmental load. Correlation analysis establishes statistically significant relationships between production intensity and greenhouse gas emissions, as well as between the demographic characteristics of the rural population and labour productivity. The regression models, used to test the 17 hypotheses, confirm that economic factors have a direct and significant impact on production results, while environmental and social factors exhibit a complex but sustained influence on long-term sustainability.

The juxtaposition of these results with the three authorial indices (AFI, LDI and CACI) allows for outlining the interrelationships between production efficiency, resource load and cooperative potential. The obtained dependencies show that sustainability is formed as a result

of the balanced interaction between economic, environmental and demographic parameters, which provides grounds for formulating targeted management decisions at the national level.

One of the key conclusions is that, under the current structure of subsidization and land use, sustainable adaptation is hindered by institutional inertia and a lack of flexible mechanisms for small and medium-sized farms. Despite the apparent availability of technological and market opportunities, the effect of green policies is limited by uneven application, the lack of a national strategy reflecting the real structural characteristics of Bulgarian agriculture, and the weak link between the strategic goals of the EU and real practices at the local level.

Chapter Three contains the most voluminous part of the research. An analysis was performed on a 32-year period (1990-2022), covering key economic, environmental and social indicators.

- Hypotheses were confirmed, among which:
- High positive correlation between export value and sustainability (H3);
- Inverse relationship between subsidies and environmental efficiency (H4);
- Strong negative relationship between depopulation and production capacity (H8);
- Positive relationship between livestock density and emissions (H13).

One of the most important scientific findings arising from the empirical analysis is the presence of clearly expressed trade-offs between the different dimensions of sustainability. First, the data show that an increase in productivity in the short term is often accompanied by an increase in the environmental footprint. This dependency is particularly noticeable in the intensification of grain production, where the use of chemical fertilizers and pesticides leads to a significant increase in the AFI.

Second, another tension is highlighted between social sustainability and mechanization: increasing productivity through mechanization leads to a reduction in employment in rural areas, which deepens demographic problems and undermines social capital. This is particularly critical in conditions of an ageing population and migration of young people to cities or abroad.

Finally, a trade-off is also observed between short-term profitability and long-term sustainability. High production intensity can generate profits in a short horizon, but simultaneously depletes natural resources and creates conditions for future crises. It is precisely these trade-offs that show that sustainable development cannot be reduced to one dimension, but requires a balanced approach that takes into account the interdependencies between economy, society and nature.

Regression tables, moving averages and trend lines are presented, which prove:

- Continuing vulnerability of the sector;
- Presence of "environmental and demographic dumping" in intensive livestock farming and annual crops;
- Fragmentation of institutional control.

In the course of the analysis, it was traced how sustainability is articulated at different levels – from the community strategy to Bulgarian normative and program documents.

Particular emphasis is placed on the Strategic Plan for the Development of Agriculture and Rural Areas 2023-2027, where sustainability features as a goal, indicator and result. The dissertation shows that there is a significant gap between declarative rhetoric and the real institutional capacity for implementing the measures. The analysis reveals that sustainability is often reduced to formal reporting through quantitative indicators, without an in-depth understanding of the processes that generate it. This conclusion is at the core of the critical assessment of the policies.

The development of a zoned classification according to adaptation potential is proposed – the development of a regional typology. The model for adaptation through index comparison – between natural constraints, institutional capacity and production resources – is validated. Based on the statistical results, a conditional typology of sustainability can be derived, in which regions could be grouped according to production structure, demographic resources and climate vulnerability. Thus, for example, regions with high production capacity but strongly negative demographic trends turn out to be the most vulnerable in the long term. Such a classification would offer a valuable tool for targeting public policies.

Based on the analysis performed, it is established that there is a lack of a consistent logical link between the stated goals of sustainability, the chosen measures and the indicators used for reporting. The goals are often formulated generally and are not linked to measurable criteria, which hinders the real assessment of progress. Thus, sustainability is reduced to a reporting category, without guaranteeing institutional or practical realization. This is particularly evident in climate adaptation measures, where the indicators do not reflect the specificity of local agro-ecosystems.

Chapter Three represents the empirical backbone of the dissertation, on the basis of which the policy proposals in the next part are built. In its sequential course, 16 hypotheses were investigated and argued, the results of which are systematically presented in Table No. 2:

Table 2. Visualization from the research hypotheses

Hypothesis	Result	Model power	Justification
1	✗ Rejected	$R^2 = 0,878$	Employment is not affected by production indicators
2	△ Partially confirmed	$R^2 = 0,755$	Exports and the added value explain the structure of plantations
3	△ Partially confirmed	$R^2 = 0,612$	Permanent crops do not positively impact exports
4	△ Partially confirmed	$R^2 = 0,786$	Annual crops increase the inflation index
5	☑ Confirmed	$R^2 = 0,291$	No relationship has been established between rural population and permanent crops
6	☑ Confirmed	$R^2 = 0,367$	Only one of the components shows a significant relationship
7	☑ Confirmed	$R^2 = 0,899$	FDI is positively related to permanent crops
8	☑ Confirmed	$R^2 = 0,856$	Added value depends on permanent crops
9	✗ Rejected	$R^2 = 0,942$	Population growth is not positively related to crop production
10	☑ Confirmed	$R^2 = 0,849$	Agricultural share does not explain the degree of urbanization
11	☑ Confirmed	$R^2 = 0,913$	No significant relationship is confirmed in the model
12	△ Partially confirmed	$R^2 = 0,449$	Positive relationship between FDI and exports
13	☑ Confirmed	$R^2 = 0,648$	Animal density and exports lead to an increase in the agroclimatic footprint
14	☑ Confirmed	$R^2 = 0,455$	Some livestock subsectors affect energy consumption
15	☑ Потвърдена	$R^2 = 0,525$	Employment + Livestock = agroclimatic load
16(1)	☑ Confirmed	$R^2 = 0,555$	Permanent crops increase N ₂ O emissions
16(2)	△ Partially confirmed	$R^2 = 0,426$	The second part of the hypothesis has not been confirmed.

Source: Author's interpretation.

The results from Table No. 2 confirm, for conceptual clarity, the heterogeneous, asymmetric logic of the transition in Bulgarian agriculture. Most confirmed hypotheses demonstrate that intensification through annual crops and livestock farming leads to a high environmental and energy cost. The hypotheses related to value added and FDI confirm that structural upgrading through permanent crops brings economic benefits, but without an automatic link to exports.

The models categorically show that increased exports will be accompanied by demographic and environmental pressure, which requires a new framework for strategic

planning. The partially confirmed hypotheses emphasize that the interactions between investments, inflation and crop structure are complex and often influenced by external factors outside the agricultural sector.

The conclusion from the regression analyses is clear: expansion in the spheres of exports and production without structural reform and an agrarian strategy leads to social and environmental instability. For a real sustainable transformation, the strategic integration of economic, social and environmental indicators into Bulgarian agricultural policy is necessary.

The obtained regression dependencies suggest the existence of deep structural, parametric dysfunctions that have defined the sustainability of the agricultural sector in Bulgaria until now. Therefore, in the next step, it is necessary to move from mathematical correlation to the interpretation of these dependencies in a political-economic context. This allows for the identification of systemic barriers, institutional deficits and strategic opportunities to overcome the observed disproportions.

CHAPTER FOUR: STRATEGIES, SCENARIOS AND POLICY INSTRUMENTS FOR ADAPTATION

The final analytical chapter offers a set of scenarios and instruments for balancing national interests and the EU's green policies. Among them stands out the redirection of European funds towards national priorities through differentiated subsidization of farms with high adaptation potential and environmental contribution. Cooperative and integration models for territorial consolidation are proposed, supported by a developed "cooperative agro-climatic index" for monitoring effectiveness.

Digitalization and precision agriculture are considered as dually directed strategies – both for increasing productivity and for reducing the environmental footprint. A scenario for "synergy between exports and ecology" is presented, in which the competitiveness of Bulgarian products on international markets is achieved through the implementation of sustainable practices, certification and branding.

Important emphasis is placed on the integration of monitoring systems, adaptive management mechanisms and community participation in political processes. The proposals are linked to specific indicators and models described in the previous chapters, and aim to ensure sustainability not only as a normative requirement, but as an economically and socially viable reality.

The last chapter summarizes the main challenges to the real applicability of the concept of sustainability within the CAP and Bulgarian strategic documents. It focuses on the deficits in the institutional logic of planning, including the lack of internal consistency between goals, measures and indicators. The research shows that the formulated goals are often too general, the indicators are weakly linked to reality, and the measures are mechanically transferred from previous periods. Thus, a cyclical structure of planning is created, in which sustainability is reproduced rhetorically but not realized structurally. The analysis proposes a rethinking of planning as a process requiring not only accountability but also real transformation.

The last chapter examines the applied dimension of the dissertation – the derived models, scenarios and policies for adapting Bulgarian agriculture to the EU's green requirements. Based on the previous empirical results, three adaptation scenarios are proposed:

1. Centralized Scenario ("Directive Adaptation")

- Dominated by external requirements and centralized regulation;
- Leads to weak national commitment and reduced capacity for innovation;
- Suitable only in conditions of high administrative control and low local resistance.

2. Regional Scenario ("Territorial Balancing")

- Introduces adaptive strategies taking into account regional differences;
- Requires coordination between local administration, NGOs and agricultural cooperatives;
- Suitable for regions with medium to high institutional capacity.

3. Integrated Scenario ("Strategic Adaptation")

- Combines territorial, environmental and economic sustainability;
- Assumes the existence of a strategic vision, a toolkit for monitoring and active participation of all stakeholders;
- Proposed as the optimal scenario for a sustainable transition.

Within the integrated scenario, three policy instruments have been developed:

1. Sustainability Indicator Panel – includes indices, traceable by regions and over time.
2. Feedback and Adaptability Mechanism – through monitoring, indicative targets and sanctions/incentives.
3. Model for Integrated Territorial Planning – based on a regional typology (resource availability, demography, crop structure).

The concept of "adaptation maturity" is introduced – the degree to which a region or institution can benefit from the green transformation without suffering economic or social upheavals.

In this chapter, the scientifically substantiated logical structure of the dissertation is visualized with the help of Figure No. 2, clearly demonstrating the interrelationships between the tested hypotheses, the specific strategic scenarios, the applicable policy instruments and the necessary institutional mechanisms for their effective implementation.

The hypotheses are organized into three main thematic clusters:

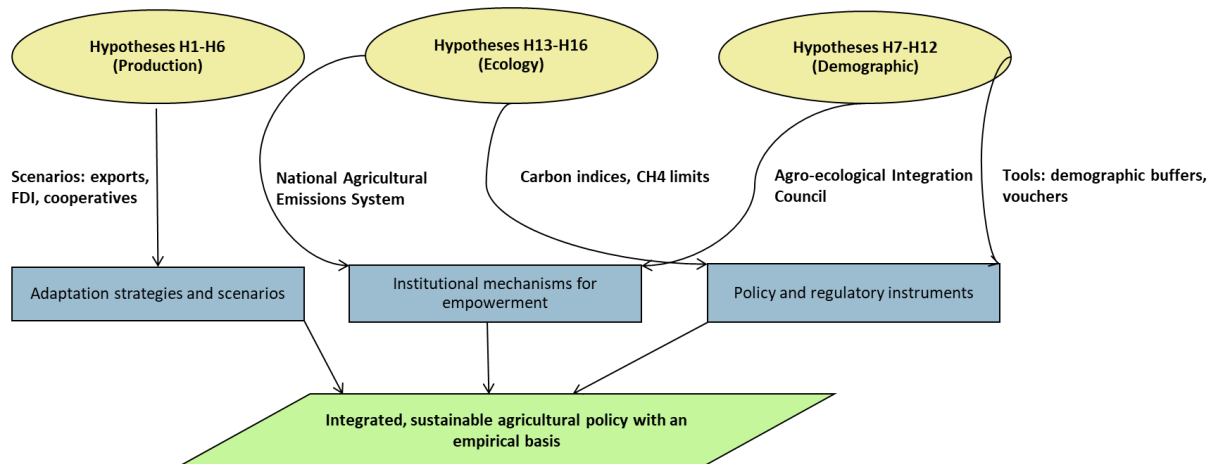
Production (H1-H6) – covers the relationships between production models, export opportunities, foreign investments and technological innovations.

Demography (H7-H12) – includes the interactions between demographic trends, employment and structural changes in the agricultural sector.

Ecology (H13-H16) – examines the environmental effects of agricultural activity, focusing on greenhouse gas emissions and the agro-climatic footprint.

Each of these clusters represents a logical entry point to specific political and strategic actions.

Figure 2. Infographic Mapping of the relationship between thematic hypothesis clusters, strategic scenarios and instruments for agrarian transformation



Source: Author's interpretation

On a base level, the adaptation scenarios outline the empirically validated relationships between the export of agricultural products, attracted foreign investments and various forms of cooperative integration. Second level take, the regulatory-policy instruments, which are designed to formulate solutions aimed at mitigating demographic risks, effective fiscal

mechanisms and technological renewal of the sector. The third level of intervention is dedicated to the institutional mechanisms, which propose the creation of structures for long-term coordination between different levels of governance – for example, through the formation of a Council for Agro-Ecological Integration and a national system for monitoring agro-emissions.

The overall vector of the presented visual scheme is oriented towards integral political impact, in which the adaptation process is not considered solely as a reactive activity, but as a strategic restructuring, based on empirical validity, systemic coherence and interdisciplinary realism. Thus, the figure summarizes the transition from scientific analysis to applicable policy strategies, clearly demonstrating the link between theoretical postulates and real practical actions in the agricultural sphere.

At the end of this section, an integral Table No. 3 is presented, which serves as a generalized framework, synthesizing the hypothetical design and the actually observed interactions in Bulgarian agriculture. The table systematizes all tested hypotheses according to their thematic categories (production, demography, ecology), clearly indicating the key variables, the type of logical relationship and the corresponding strategic and policy instruments for action. Through this structured system, it becomes possible to clearly show how scientific analysis leads to practically applicable solutions, supporting national interests. Each of the presented relationships does not represent a mere quantitative ratio, but reflects real processes and dependencies that are critical for the sustainable development and food security of Bulgaria. Thus, the table categorically confirms the thesis that policies based on empirical data and scientific evidence represent the most effective and powerful tool for institutional impact.

Table 3. Logical Correlation between Tested Hypotheses and Proposed Strategies/Instruments

No	Hypothesis (Summarized Content)	Category	Key Variables	Logical Relation	Strategic/Policy Instrument
1	Higher employment in agriculture increases export and FDI	Production	Employment, Export, FDI	Direct linear relation	Cooperative logistics; FDI incentives

2	Permanent crops → Added value and Export	Production	Permanent crops, Added value, Export, износ	Cumulative causation	Preferential subsidies; investment credit
3	Temporary crops → FDI and Inflation stability	Production	Temporary crops, FDI, CPI	Induced relation	Stock exchange guarantees; priority access
4	Stock-raising ↔ higher employment and environmental sustainability	Production	Livestock, GHG, employment	Double effect (positive and negative))	Biogas stations, precision nutrition
5	RES consumption → Added value in GDP	Production	RES, Added value	Positive economic relation	Tax credit; energy transformation fund
6	FDI → reduced GHG emissions through innovation	Production	FDI, Innovation, GHG	Mediated regression	Green accreditation; innovation incubator
7	Rural population growth → Added value, Employment	Demographic	Rural population, Added value, Employment	Proportionate relation	Agricultural scholarships; social land use
8	Annual growth in rural areas → production volume	Demographic	Growth, production	Linear relation	Demographic buffers; labor mobility
9	Urban population → ↓ share of agriculture in GDP	Demographic	Urbanization, agricultural GDP	Negative correlation	Urban-agrarian buffer policies
10	Total population growth → exports and real output	Demographic	Population, Export, Added value	Direct relation	Export incentives, food sovereignty

11	↓ Rural population → ↑ GHG emissions (due to concentration)	Demographic	Demographic decline, concentration, GHG emissions	Reversed relation	Anti-concentration quota for land
12	Urban population growth → ↑ AO	Demographic	Urban population, AFI	Indirect positive relation	Regional monitoring, AFI indexing
13	Export + animal density → ↑ AFI	Ecology	Export, animal density, AFI	Cumulative effect	Carbon export tariff
14	Expanding exports → ↑ carbon footprint	Ecology	Export, transport, CO ₂	Logistical dependence	Green logistics and certification
15	Density of livestock/hectare → ↑ agroclimatic footprint	Ecology	Livestock density, AFI	Linear relation	Emission quota; monitoring system
16	Permanent crops → ↓ CH ₄ and N ₂ O	Ecology	Crops, methane, nitrogen emissions	Negative relation	Priority subsidy; agroforestry

Source: Author's conclusions

Chapter Four concludes with a proposal to reform the EU agricultural subsidy framework, which currently allocates payments primarily based on the amount of land owned or cultivated. The proposed reform advocates a transition toward a results-oriented model that links financial support to measurable economic, environmental and social outcomes, while redirecting funds to vulnerable regions and genuinely sustainable agricultural practices.

CONCLUSION

Based on the theoretical analysis, empirical research and the constructed regression models, a number of significant conclusions were formulated in this research, reflecting the state, challenges and potential for adaptation of Bulgarian agriculture in the context of European green policies:

1. The adaptation of Bulgarian agriculture to the EU's green policies is structurally asymmetric, as the adopted regulatory frameworks often do not account for the demographic, regional and resource differences between farms. This leads to uneven effects regarding sustainability and efficiency.

2. Regression analysis reveals clear dependencies between the intensity of livestock farming and greenhouse gas emissions (CH_4 and N_2O). A higher concentration of livestock units per unit area is positively associated with increased values of the agro-climatic footprint, indicating that unbalanced use of intensive livestock models can become a major source of agro-ecological stress.
3. Investments in permanent crops have a positive environmental effect, contributing to the reduction of emissions due to low resource intensity and high absorption capacity. This positions them as a strategic element in sustainable agricultural practices.
4. The demographic characteristics of rural areas are of substantial importance for the sustainability of the sector – settlements with a high share of economically inactive persons or an ageing population demonstrate weaker adaptability, limited production possibilities and lower environmental efficiency.
5. Urban urbanization and increased consumption of industrially produced food intensify environmental pressure on agriculture, forcing production models with a higher carbon and logistical footprint. A direct link exists between the growing urbanized population and the increased climate footprint of agricultural production.
6. Land use has a decisive influence on the emission profile of agricultural activity. Regions with highly intensive cultivation and predominant grain production demonstrate higher emission values, while territories with mixed farming and a larger share of permanent crops show better eco-indicators.
7. The bipolar model in the agrarian structure – between small farms with low productivity and industrialized agro-holdings – creates institutional challenges for the application of unified green policies and leads to a further deepening of socio-economic stratification in rural areas.
8. The Agro-Climatic Footprint Index, developed within the research, offers an innovative possibility for integrated tracking of the environmental, resource and territorial effects of agricultural activity. It has the potential to be introduced into the CAP monitoring mechanisms and national agricultural statistics.
9. A discrepancy exists between the objects of state support and those contributing the most to sustainability, necessitating a revision of the subsidization criteria and prioritization of CAP resources, including towards decentralization and territorial orientation.
10. Economic efficiency and environmental sustainability do not always overlap, necessitating a clearly balanced adaptation strategy that integrates environmental goals, social cohesion and economic viability.

Based on the drawn conclusions and the in-depth assessment of the impact of green policies on the structure and sustainability of Bulgarian agriculture, the following **recommendations** are formulated. They are directed towards the state administration, European institutions, as well as the agricultural scientific community and practising agricultural producers. Their main focus is encouraging territorially adapted, socially sensitive and environmentally effective policies and interventions that guarantee the long-term sustainability of the sector.

1. Territorially oriented adaptation of green policies: Introduce a differentiated approach in the application of the Common Agricultural Policy, taking into account regional differences regarding demography, land use, agro-ecological capacity and social structure.
2. Integration of the Agro-Climatic Footprint Index into agricultural statistics: The index developed in the dissertation should be used as an analytical tool for monitoring the impact of agricultural activities on the climate and environment, with the potential for inclusion in the indicator system of the MAF and NSI.
3. Support for sustainable forms of agriculture with a low carbon footprint: Encourage the development of sectors such as permanent crops and organic farming, which have proven better environmental indicators, through targeted financing, technical assistance and simplified administrative procedures.
4. Rethinking subsidies in terms of efficiency, sustainability and social capacity: Discontinue the application of uniform subsidy mechanisms, and instead prioritize farms that show both economic viability and environmental responsibility, especially in socially vulnerable areas.
5. Decentralization of CAP implementation and strengthening of local capacity: Build regional structures for the application and monitoring of policies, which take into account the local context and ensure more effective interaction between administration, farmers, public-private groups and NGOs.
6. Institutional expansion of participation in the policy formulation process: Strengthen Bulgaria's role as an active participant in the creation of European policies by coalescing with similar member states and proposing normative initiatives based on empirical evidence.
7. Increasing the awareness and capacity of agricultural producers: Develop educational and consultancy programmes aimed at building capacity in sustainable practices, digitalization, environmental certification and access to new markets.

8. Development of scientific-applied tools for policy impact assessment: Support research and pilot projects for creating models that combine economic, social and environmental impact in the formulation of agricultural policies.

The dissertation has substantial **practical applicability** for institutions responsible for agricultural policy, as it provides an analytical toolkit for assessing the impact of the EU's green policies on Bulgarian agriculture. The developed Agro-Climatic Footprint Index and regression models can be used in strategic planning, territorially targeted subsidization and sustainability monitoring. The results are also applicable for agricultural producers, local authorities and academic institutions in forming adaptive practices, training and regional strategies for sustainable development.

The conclusion validates the thesis that the adaptation of Bulgarian agriculture requires not merely compliance with the Green Deal, but a strategic transformation. The presented regression models not only confirm or reject the main hypotheses but also direct attention to institutional deficits and opportunities. The research proves that effective adaptation must be integral – combining ecology, economy and social justice. The final table systematizes the results and turns them into practically applicable recommendations. The dissertation concludes with a proposal for a new analytical language that turns adaptation from a normative goal into a manageable process.

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

The research presented in the dissertation builds a reliable analytical framework for understanding and assessing the processes of adaptation in Bulgarian agriculture vis-à-vis the European Union's green policies. At the same time, its results open important new perspectives that deserve subsequent academic investigation. Below are formulated priority directions that can be built upon through future interdisciplinary developments.

Future research should focus on the development of spatial econometric models that integrate data on the agro-ecological footprint, livestock density and cooperative capacity to predict the effects of different policy scenarios. The integration of satellite observations, GIS technologies and machine learning algorithms can significantly improve the accuracy of predictions and support real-time decision-making. It is also important to investigate the links between social capital in rural areas and the effectiveness of sustainable practices, as the human factor is crucial for the success or failure of green policies.

1. Building a Multi-Layered Adaptation Typology of Regions (NUTS 3 and LAU level)

The present research works with data primarily at the national and NUTS 2 level. Future developments can use even finer spatial units to derive localized models of sustainability, demographic vulnerability, institutional capacity and environmental sensitivity. Example: comparative analysis between Vidin, Targovishte and Kardzhali regarding agro-climatic constraints and access to subsidies.

2. Modelling Adaptation Dynamics through Artificial Intelligence Systems

The dissertation uses classical statistical methods for hypothesis testing. In the future, it is possible to apply machine learning and artificial intelligence models to predict the effects of certain policies or climate scenarios. The use of neural networks, decision-tree algorithms and Bayesian inference will allow for the discovery of non-trivial dependencies between parameters such as: investments, crop composition, administrative efficiency and climate shocks.

3. Analysis of the microeconomic behaviour of agricultural entities in the context of the Green Deal

The research focuses mainly on the macro- and meso-levels. Future research can be directed towards a detailed analysis of the reactions of individual agricultural producers to regulations, subsidies, climate conditions and environmental requirements. Such research would identify key factors for innovation, resistance or consent regarding the green transition.

4. Institutional Design of Adaptation Policies – Comparative Analysis between CEE Countries

The Bulgarian case can be utilised in a comparative framework with countries such as Romania, Lithuania, Poland and Hungary. The common features in agricultural history (post-socialist transition, restitution, dependence on EU funding) suggest the presence of structural similarities. Analysis of good practices and institutional innovations in these countries can enrich the policy proposals formulated in the present research.

5. Extended Integration of Climate Models and Agro-Ecological Scenarios

The presented Agro-Ecological Footprint Index (AFI) can be further developed by including agro-ecological zones, soil diversity and access to water resources. Dynamic climate models can be applied to assess the influence of climate change on yields, market cycles and production security.

6. Participation and acceptance of Local Communities towards adaptation policies

A more in-depth sociological and anthropological analysis of the attitudes, fear of livelihood loss and readiness for transitioning to ecological practices is necessary. Qualitative methods (focus groups, in-depth interviews) can provide a clear view of the real motivations and barriers faced by agricultural producers.

7. Analysis of Demographic Cycles as an Adaptation Indicator

The conclusions of the dissertation emphasize the strong link between depopulation and loss of production capacity. Future research can treat demographic dynamics not only as a passive result but also as a key factor for predicting sustainability. The creation of a composite index of "territorial vitality" is proposed, combining age structure, migration dynamics and economic engagement.

8. Assessment of the Long-Term Effect from Current Subsidy Practices

Although partially addressed in the present research, the long-term effect of the EU derived system of direct payments in agriculture requires prolonged observation and analysis. It is proposed to monitor the effectiveness based on indicators such as: innovation activity, production diversification, export value, environmental results.

9. Development of a Digital Toolkit for Strategic Planning

The indexing system developed in the dissertation can be transformed into a platform for visualization and planning. Thus, local administrations, universities, NGOs and farmer

associations will be able to analyse in real time the level of adaptation, potential for vulnerability and scenarios for sustainable growth.

The prospects for future research include deepening the analysis through the integration of quantitative methods that complement the already developed qualitative approaches. It is possible to expand the scope to other economic sectors that face similar challenges regarding strategic coherence and sustainable management. There is also significant potential in the development of cross-sectoral models that assess the effectiveness of policies in conditions of limited resources and a dynamic external environment. Such research would support the creation of more flexible management decisions and strengthen the link between scientific analysis and the practical implementation of policies.

In the future, a particularly promising direction is the integration of digital technologies and "smart agriculture" with the aim of reducing the agro-ecological footprint. Satellite observation, artificial intelligence and real-time monitoring systems can become key tools for resource management. Alongside this, an in-depth investigation of social capital and cooperative networks is necessary, as their role for the sustainable management of agriculture is often underestimated. Thus, scientific research will continue to support the process of building a sustainable, competitive and socially responsible agricultural system.

Future research should be directed towards the implementation of new methodological tools that enrich the analysis of sustainability. Particularly promising is the use of machine learning and artificial intelligence for predicting agro-ecological and economic trends. Through classification and regression algorithms, scenarios for the development of agriculture under different political and climatic conditions can be modelled.

Another important approach is spatial econometrics, which allows for the analysis of spatial dependencies and neighbourhood effects between different territories, such as the introduction of new crops in traditionally specialized cultivation regions. This is especially important in the Bulgarian context, where agricultural practices are highly differentiated. In addition, system dynamics can serve to build simulation models that capture the interaction between economic, environmental and social factors in the long term.

It is necessary to mention that in the future, additional interest will be represented by the behaviour of individual agricultural farms at the microeconomic level. Analyses in this direction show that access to financing and propensity for innovation can significantly influence the efficiency of farms and their readiness to introduce green practices. This perspective reveals hidden dependencies that cannot be captured through macro-aggregated indicators.

Integrating these new methods will increase analytical precision and enable the formulation of data-based policies. This will ensure a smooth transition from traditional statistical analyses to modern tools that are adequate to the challenges of the 21st century.

IV. STATEMENT ON THE SCIENTIFIC AND PRACTICAL CONTRIBUTIONS OF THE DISSERTATION

The indicated contributions are the result of a critical reading of the existing literature, a synthesis of different analytical paradigms, original use and detailed analysis of data, and the creation of new tools for strategic and territorial planning. They meet the criteria of scientific novelty, methodological innovation, demonstrability and applicability in real management practice. They can be distinguished into scientific and scientific-applied ones:

Scientific Contributions

First. A comprehensive methodological framework for the analysis of sustainable development in the agricultural sector has been built, based on a critical-discursive analysis of a broad set of macro indicators, strategic documents, institutional review and functional mapping of management processes.

Second. Concepts from institutional theory and strategic management have been integrated into a unified analytical scheme, which allows for the systematic tracking of the link between set goals, chosen indicators and applied tools for achieving sustainability.

Third. The analytical concept of "sustainability by imposition" has been introduced and substantiated in the context of the EU's agricultural policy as an analytical tool for diagnosing the formalization of processes. This concept has potential for application in other sectors of public policy where the transfer of external requirements dominates over internal legitimization.

Fourth. Normative and operational sustainability have been distinguished in the context of Bulgarian institutional constraints.

Fifth. An authorial definition of sustainability in the agricultural sector with practical application in the assessment of public policies has been proposed.

Sixth. A systematic approach for investigating the logical structure of the agrarian strategy through the structural deconstruction of program documents has been developed.

Scientific and Applied Contributions

First. An applicable methodology for assessing the degree of consistency between different management levels – from national strategies to specific sectoral measures – has been formulated, supported by examples and analyses from the Bulgarian agricultural context. This methodology can be adapted to other spheres with a high degree of regulation, such as energy or natural resource management, and thus ensures both academic novelty and operational applicability.

Second. A critical analysis of the Strategic Plan 2023-2027 has been performed, identifying discrepancies between goals, measures and indicators.

Third. The need for reform of the system of direct payments has been argued. The author argues for the necessity of a transition from a "quantitative model" (based on area) to a "qualitative model" (based on results, commitment, adaptation contribution). The introduction of "green indicators" as part of the application for subsidies would increase not only the environmental efficiency but also the social legitimacy of EU support.

Fourth. An index system has been developed, including three authorial indices: the Agro-Climatic Footprint Index (AEFI), which combines emissions of harmful elements, energy intensity and agro-ecological vulnerability; the Livestock Density Index, which is the ratio between the number of animals and the area of agricultural land; and the Cooperative Agro-Climatic Index (CACI), which includes indicators such as methane (CH₄) and nitrous oxide (N₂O) emissions, energy consumption and water footprint.

V. STATEMENT OF COMPLIANCE WITH NATIONAL REQUIREMENTS ACCORDING TO THE REGULATIONS FOR THE APPLICATION OF THE ADASRB

The present dissertation fully complies with the provisions and requirements laid down in the Act on the Development of the Academic Staff in the Republic of Bulgaria (ADASRB), as well as in the Regulations for its application, which govern the procedure for awarding the educational and scientific degree "Doctor". In terms of content and methodology, the work meets the criteria of Art. 2, Para. 1 of the Regulations – through the formulation of a relevant scientific problem, an independent theoretical substantiation, a clearly defined thesis, contributory results and a corresponding structure of the exposition. The compliance covers not only the formal aspects of volume, structure and published materials, but also the substantive

academic criteria – originality of the contribution, scientific novelty, methodological soundness and significance of the results for practice and theory.

1. Compliance regarding the volume and content of the dissertation

The dissertation has a volume of over 230 standard pages, containing a fully structured academic exposition, substantiated with over 200 bibliographic sources, including international scientific literature, official EU documents, statistical databases and national policies. The content of the dissertation covers all mandatory components: introduction, theoretical review, methodology, empirical analysis, contributory part, conclusions, list of references and appendices.

2. Compliance with the requirements for independence and originality

The dissertation was developed independently by the PhD student Georgi Gerov within the framework of a regular form of study at an accredited higher education institution. The text lacks plagiarism, improperly borrowed passages or intertextual violations of scientific ethics. According to Art. 7 of the RAADASRB, the work is accompanied by a declaration of originality and independence of the research, as well as a list of publications reflecting part of the results.

Originality is proven not only by a formal declaration but also through the introduction of new concepts, original indices and authorial methodological models, which do not exist in this form in previous research. The developed adaptation typology of Bulgarian regions is unique in its structure and analytical approach.

3. Compliance with the criteria for the presence of scientific publications

According to Art. 9 of the RAADASRB, for admission to defence it is necessary for the candidate to present at least two scientific publications in peer-reviewed publications, reflecting results from the dissertation. In this case, five scientific publications are presented, published in academic proceedings and journals, all of which are linked to corresponding paragraphs and empirical sections of the dissertation.

The publications contain expanded versions of the methodology, discussions regarding the indices, as well as comparative analyses of the policy scenarios. They prove not only the

author's participation in the scientific debate but also his ability to communicate the results to different target audiences – academic, managerial and expert.

Scientific Articles (3):

1. **Guerov, G.**, 2023. The Great Reset – a key for transformation of Bulgarian agriculture. AGRICULTURAL SCIENCES, Volume 15, Issue 38, pp. 40-52, ISSN 3033-0149 (30pts.)

2. Georgieva, V, **Guerov, G.**; Blagoeva, N., 2024. Impact of economic and environmental factors on agricultural product pricing in the EU, Agricultural and Resource Economics, volume 10, issue 4, 47-73, ISSN 2414-584X (30/n=30/3=10pts.)

3. **Guerov, G.**, 2025. Agriculture under pressure: anthropogenic flows and global risks, AGRICULTURAL SCIENCES Volume 17, Issue 45, 5-18, ISSN 3033-0149 (30pts.)

Scientific Reports (2):

1. **Guerov, G.**, Blagoeva, N., Georgieva, V. 2024. Agricultural Dynamics in The EU and the Raw Material Super Cycle, Innovative Development of Agricultural Business and Rural Areas : Fourth International Scientific Conference IDARA, 239-253 (10/n=10/3=3.33 pts.)

2. **Guerov, G.**, Georgieva, V., Blagoeva, N., 2025. Asymmetric economic effects on bulgarian agriculture from EU membership. AGRIBUSINESS AND RURAL AREAS – ECONOMY, INNOVATION AND GROWTH, 267-277, ISBN 978-954-21-1199-3 (10/n=10/3=3.33pts.)

With a required minimum of 30 points and 2 scientific publications, the total accumulated points for the PhD student are: 76.66 points and 5 scientific publications.

4. Compliance with the criteria for contributory character

The dissertation complies with Art. 8, Para. 1 of the RAADASRB, which requires it to contain new scientific results, with demonstrable originality and significance for the respective scientific field. As shown in the previous section, the contributions of the research encompass:

- formulation of new concepts (institutional subjectivity);
- construction of adaptation models and indices;
- empirical verification of theoretical hypotheses;

- formulation of applicable strategies for policies and management.

Furthermore, the results are presented in a way that allows for real use by public institutions, scientific teams and local administrations. This turns the scientific value of the work into applied, meeting the requirements for interdisciplinary and socially significant science.

5. Compliance regarding the structure of the abstract

The present abstract is prepared in accordance with the requirements of Art. 13 of the RAADASRB – as a summary of the main elements of the dissertation, including: general characteristics, content, results, contribution and bibliographic references. The volume of the abstract exceeds the minimally required 10 standard pages and reflects the actual content of the research, while preserving its logical sequence, scientific lexicon and formal-academic style.

VI. DECLARATION OF ORIGINALITY OF THE DISSERTATION

The content of the dissertation corresponds to Art. 13, Para. 1 of the ADASRB and Art. 2, Para. 1 and 2 of the Regulations for the Development of the Academic Staff. The author has demonstrated skills for independently formulating a scientific problem, substantiating the aim and tasks, 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, defended with reasoned logic, analytical apparatus and empirical evidence.

I declare that the present dissertation is entirely the result of my independent scientific 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 observed.

With my present 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 preparation of the dissertation, exclusively reliable academic sources have been used, which are correctly cited in accordance with international academic standards;

- The text does not contain foreign materials that violate the provisions of the Copyright and Related Rights Act;
- The dissertation has not been submitted in other procedures for acquiring the educational and scientific degree "Doctor" in the Republic of Bulgaria or in another country;
- The research has not been published in another form and has not been used for acquiring an academic position or title;
- The declaration has been prepared in good faith, and I assume full responsibility for its content and the consequences of any potential violations.

This declaration is an integral part of the abstract and the defence file, and is subject to verification by the scientific jury, the commission on academic ethical conduct and other competent bodies within the procedure for awarding the degree.