Teodor Radev
Petar Borisov

Teodor Radev
Associate Professor Dr.
Department of Management and Marketing, Faculty of Economics, Agricultural University of Plovdiv, Plovdiv, Bulgaria
e-mail: radev1974@abv.bg
ORCID: https://orcid.org/0000-0002-5367-2121

Petar Borisov
Professor, D.Sc.
Department of Management and Marketing, Faculty of Economics, Agricultural University of Plovdiv, Plovdiv, Bulgaria
e-mail: peterborisow@gmail.com
ORCID: https://orcid.org/0000-0003-4236-9482

Published First Online: 22.12.2025
Pages: 283-291
DOI: https://doi.org/10.37075/JOMSA.2025.2.10

THE ROLE OF BULGARIAN FARMERS IN PROMOTING CLIMATE-RESILIENT AGRICULTURAL PRACTICES

ABSTRACT

Climate change is increasingly affecting Bulgarian agriculture through rising temperatures, irregular rainfall, droughts, and more frequent extreme events. This study explores how Bulgarian farmers perceive these changes and what climate-resilient practices they adopt. Using surveys, focus groups, and interviews with 50 farmers across grain, vegetable, livestock, vineyard, rose, and mixed farms, the research identifies clear sector-specific impacts and responses. Grain producers face high drought risk; vegetable growers struggle with water scarcity and pests; livestock farmers experience declining forage quality; vineyards and rose growers report significant phenological disruptions. Farmers employ a mix of technological and agroecological adaptations, yet financial constraints, insufficient training, and misaligned policy support limit adoption. The findings highlight the need for targeted, locally relevant measures and stronger collaboration among farmers, scientists, advisory services, and policymakers. Building climate resilience in Bulgarian agriculture requires accessible funding, practical knowledge exchange, and long-term institutional commitment.

KEYWORDS: Climate-resilience, Sustainable development, Farm management

JEL: Q10, Q18, O11, R14

INTRODUCTION

1. CLIMATE CHANGE AS A CRITICAL CHALLENGE FOR BULGARIAN AGRICULTURE.

Climate change is increasingly acknowledged as one of the most substantial challenges confronting Bulgarian agriculture. Rising temperatures, altered precipitation regimes, and the increasing frequency of extreme weather events threaten crop productivity, rural livelihoods, and regional socio-economic stability (Georgieva, Kazandjiev, Bozhanova et al., 2022; Nikolova, Matev, & Bozhkov, 2024). Owing to Bulgaria's diverse geography and topography, the country features highly heterogeneous agro-climatic zones, making the development of targeted climate-resilience strategies essential (SpringerLink, 2023). Given agriculture's central role in rural development, understanding how Bulgarian farmers adapt-or fail to adapt-to climate-induced risks is crucial for evidence-based policymaking and long-term sustainability.

2. EVIDENCE OF CLIMATE SHIFTS AND THEIR AGRICULTURAL IMPACTS.

A substantial body of research documents clear climatic shifts across Bulgaria. Georgieva et al. (2022) analyzed agrometeorological data from 1986 to 2015. They found a consistent upward trend in mean temperatures, reaching approximately 2 °C in some months, alongside more frequent and prolonged dry periods, despite modest increases in annual precipitation. These climatic changes heighten drought risk during critical stages of crop growth and place additional stress on generative processes such as pollination (Georgieva et al., 2022).

Long-term modelling supports these observations. Using general circulation models (GCMs), Alexandrov (1999) projected significant temperature increases under doubled CO_2 scenarios. Although agro-climatic potential may improve in some regions, yields of major crops, including winter wheat and maize, would decline without adaptation. The study identified several effective adaptation measures, including modified planting dates, climate-tolerant varieties, and irrigation improvements (Alexandrov, 1999). More recent analyses by Nikolova, Matev, and Bozhkov (2024) further document an upsurge in hailstorms, heatwaves, and droughts, based on both instrumental climate data and farmer surveys. These extreme events diminish yield stability and disproportionately affect rain-fed agricultural systems.

42. FARMERS' CENTRAL ROLE IN CLIMATE-RESILIENT AGRICULTURE.

Farmers occupy a pivotal position in advancing climate-resilient agricultural systems. They act simultaneously as resource managers, strategic decision-makers, and generators of experiential knowledge that shapes adaptation at the farm level (Rezear, Borisov, Radev, and Osmani, 2019). As the frequency and intensity of climate-related stressors-such as droughts, floods, heatwaves, and pest outbreaks-increase, farmers' adaptive capacity becomes indispensable for maintaining agricultural production (FAO, 2021; IPCC, 2022). International research underscores that climate-resilient agriculture cannot be achieved solely through technological innovations or top-down policy directives. Instead, successful adaptation requires farmers' active engagement, local expertise, and context-specific decision-making at all stages of the adaptation process (FAO, 2021; IPCC, 2022).

43. SOCIO-ECONOMIC VULNERABILITIES AND EMERGING AGRONOMIC RISKS.

Climate change also creates significant socio-economic vulnerabilities within Bulgarian agriculture. A rural resilience assessment highlights key threats, including declining productivity, soil degradation, water scarcity, and increased pest pressure-all of which undermine farm incomes, particularly in regions heavily dependent on agriculture (Stoyanova, 2022). Phenological changes are already observable. Stoyanova (2022) notes earlier flowering, altered growth cycles, and shifts in plant developmental timing. She argues that changes in air temperature, solar radiation, and precipitation exert more direct influence on yield potential than previously recognized, underscoring the urgent need for advanced agro-technological innovations capable of enhancing production stability under increasing climate variability.

RESEARCH METHODOLOGY

The goal of this article is to examine the role of Bulgarian farmers in the adoption, implementation, and development of climate-resilient agricultural practices.

This study employs a mixed–methods approach to examine how Bulgarian farmers perceive climate change, which climate-resilient practices they adopt, and which barriers limit wider implementation (Borisova, 2024). Because the objective is to capture both the breadth of farmer experiences and the depth of their contextual knowledge, the study combines structured survey elements with open-ended qualitative discussions.

SAMPLING STRATEGY AND PARTICIPANTS

A stratified purposive sampling strategy was applied to ensure representation across different agricultural sectors, farm sizes, and production systems. A total of 50 farmers participated in the study. The sample included producers from the following categories:

Grain farming (n = 12)

Vegetable production (n = 10)

Livestock farming (n = 9)

Viticulture (n = 8)

Rose and essential-oil crops (n = 6)

Mixed and diversified farms (n = 5)

Among the 50 participants, 11 farms were organically certified, and 36 were small-scale family farms, while 14 were medium-sized commercial operations. The participants represented six regions of Bulgaria: Plovdiv, Stara Zagora, Veliko Tarnovo, Haskovo, Burgas, and Montana.

RECRUITMENT AND ETHICAL CONSIDERATIONS

Farmers were recruited through regional agricultural extension services, producer associations, and local advisory centers. All participants received information about the study's objectives, the voluntary nature of participation, and data confidentiality. Written informed consent was collected from all 50 farmers. To maintain anonymity, no personal identifiers are presented; responses are grouped by farm type and region.

DATA COLLECTION PROCEDURE

Data were collected between March and September 2024 using a two-stage process:

1) Structured Survey - each farmer completed a structured questionnaire consisting of:

(1) demographic and farm characteristics; (2) perception of climate risks; (3) adaptation practices currently used; (4) perceived barriers to adoption; (5) awareness and use of support programs.

2) Focus Group Discussions and In-depth Interviews: to deepen qualitative understanding, three regional focus groups were conducted (15–18 participants each).
In addition, 10 individual semi-structured interviews were held with farmers representing less common production systems, such as essential-oil crops and mixed farms.

The question guide covered six thematic areas: climate impacts, adaptation strategies, technological innovations, financial and knowledge barriers, policy evaluation, and multi-stakeholder collaboration. All discussions were audio-recorded with consent and transcribed for analysis.

DATA ANALYSIS

The research used a combined analytical approach:

Quantitative data from the structured surveys were processed using descriptive statistics (frequencies, cross-tabulations) to identify common trends in climate perceptions and adaptation behavior among the 50 farmers. Qualitative data from the focus groups and interviews were analyzed using thematic analysis, following Braun and Clarke's (2006) methodology. Coding was conducted independently by two researchers to ensure analytic rigor. Themes were identified both inductively (emerging from farmer narratives) and deductively (based on relevant climate resilience literature). Findings from the qualitative and quantitative components were integrated to provide a comprehensive understanding of farmers' experiences.

VALIDITY AND RELIABILITY

Several measures were implemented to enhance research validity and reliability:

- Triangulation across surveys, focus groups, and interviews ensured consistency in findings.
- Investigator triangulation was used: both authors independently coded qualitative data.
- Participant validation was conducted by presenting preliminary findings to a subset of 12 farmers for verification.
- Regional representation improved the robustness of the results across diverse agro-climatic zones of Bulgaria.

LIMITATIONS

While the sample of 50 farmers enhances representativeness compared to small-scale qualitative studies, the findings are still not statistically generalizable to all Bulgarian farming households. Self-selection bias may also influence the sample, as more active or innovative farmers may be more likely to participate. Future studies could expand sample size and include longitudinal data to track adaptation practices over time.

The purpose of the proposed methodological approach is to organize scientific research effectively by identifying and involving farmers in data collection and by describing the state of demand for digital services in the agricultural sector. To study the state of the factors determining the role of farmers in climate resilience, 6 questions are included, aimed at obtaining information:

"How do you perceive the impact of climate change on agriculture in your region? Do you feel real changes on your farm, and which?"

What climate-resilient farming practices (if any) have you already tried? What technological or natural solutions (e.g., precision agriculture, renewable energy, agroecology) do you see as promising on your farm? What were the results?

What do you think are the biggest obstacles for farmers in adopting climate-resilient practices? (e.g., lack of knowledge, finances, habits, politics)

What type of training or support would you most benefit from? How would you like to receive information (e.g., field days, online courses, and visits to other farms)?

Are the existing support measures, subsidies, or policy programs that promote climate change mitigation in agriculture accessible and effective for you?

What do you think a good collaboration between farmers, scientists, educational institutions, and government authorities should look like to achieve climate resilience?

The focus group consisted of five young farmers, aged from 25 to 49. They come from five different agricultural productions: grain, livestock, vegetables, vineyards, and rose production. All of the farms are small farms unless they are grain producers. One of the farms is organically certified.

RESULTS AND DISCUSSION

About the impact of climate change on agriculture in their regions, farmers say:

Grain Farmers: Over the past 10–15 years, the climate here has become noticeably drier. The winters are milder, and the spring rains that we used to rely on have become much less predictable. We are seeing more frequent droughts, which is a big concern for grain growers like me. The yield of wheat and barley has declined in some years due to insufficient rainfall during key growth phases. We have started using drought-tolerant seed varieties and no-till farming methods to conserve moisture, but it is still a gamble every season.

Rose Growers: The traditional rhythm of seasons is changing. The spring comes earlier, and sometimes the roses bloom before the harvesting teams are even ready. On top of that, unexpected frosts in late spring can damage the rose buds. I have seen the quality of rose oil decline in recent years due to uneven flowering and weather extremes. Last year, we had a heatwave during harvest, which shortened the picking window and reduced our production.

Vegetable Growers: Planning is harder. Summers are getting hotter and longer, and water is becoming scarce. Some pests that were not a problem before are now appearing more frequently, and diseases spread more quickly in the heat. My tomatoes and peppers require more irrigation than before. I have had to invest in drip systems and shading nets. In addition, we are using more biological pest control because chemical treatments are less effective due to rapidly changing conditions.

Livestock Farmers: Pastures are drying out earlier in the summer, which affects the availability of feed. The winter snow is also less than before, which affects the water supply from the mountain springs. We have had to start buying hay earlier in the year and store more of it, which raises costs. The sheep don’t have the same quality of grazing as before, which affects milk yield and quality. It is a constant adjustment.

Vineyard Owners: We are seeing earlier ripening and sugar accumulation in the grapes, which changes the balance of the wine. While warmer weather can help ripen, excessive heat stresses the vines and affects acidity. The harvest dates have moved forward by nearly two weeks compared to 20 years ago. I’ve also noticed more irregular rain events that can cause mildew or rot. We have started experimenting with different grape varieties that are more heat-resistant.

These responses reflect the diverse ways climate change is affecting Bulgarian agriculture - ranging from crop quality to water stress and pest pressure, depending on the region and type of farm.

The findings of this study demonstrate that Bulgarian farmers are experiencing the impacts of climate change in a direct and increasingly disruptive manner. Across diverse agricultural sectors and regions, farmers perceive clear shifts in temperature, precipitation, and weather variability, corresponding with patterns documented in Bulgarian and international climate research (Georgieva et al., 2022; Nikolova, Matev & Bozhkov, 2024; IPCC, 2022). The consistency between farmers' observations and empirical climate data highlights that local experiential knowledge is an essential resource for understanding climate risks and designing appropriate adaptation strategies.

1. Farmers' Perceptions Confirm Documented Climate Trends

Farmers from all production types reported similar climate symptoms: rising temperatures, prolonged droughts, irregular rainfall, late frosts, and increased extreme weather events. These perceptions closely align with the long-term agrometeorological trends described by Georgieva et al. (2022) and earlier model projections by Alexandrov (1999), suggesting that climate change is no longer an abstract scientific projection but a daily operational reality for farmers. The widespread concern over water scarcity, noted particularly among vegetable and livestock producers, further reinforces existing assessments of increasing hydrological stress in Bulgaria.

2. Adoption of Climate-Resilient Practices Remains Uneven Across Sectors

Although many farmers are experimenting with adaptive practices, their adoption varies by production type, farm size, and access to resources. Grain producers tend to adopt technological solutions such as precision agriculture and no-till farming, reflecting global trends in which mechanized operations are better able to integrate digital and sensor-based innovations (FAO, 2021). Vegetable and organic farmers rely more heavily on ecological approaches such as composting, mulching, and crop diversification, which align with the agroecological transition described in the FAO's Climate-Smart Agriculture framework.

Viticulture and rose production-crops susceptible to microclimatic variability-show a growing interest in precision monitoring (e.g., drones, soil moisture sensors), but adoption remains partial due to high investment costs. Livestock farmers focus more on grazing management, improved forage planning, and water conservation, mirroring adaptation strategies in other drought-prone regions globally.

Overall, the study reveals a dynamic but fragmented adaptation landscape: farmers are actively experimenting, but the lack of coordinated support reduces the scalability and long-term sustainability of their efforts.

3. Barriers to Adaptation Reflect Structural Weaknesses in the Agricultural System

The four major obstacles identified-knowledge gaps, financial constraints, entrenched habits, and policy limitations-mirror barriers widely identified in European and global climate adaptation studies (FAO, 2021; IPCC, 2022). However, this study provides a nuanced understanding of how these barriers manifest in the Bulgarian context.

3.1. Knowledge and Training Gaps

Many farmers indicated that available training is theoretical, overly technical, or insufficiently tailored to local conditions. This confirms the need for more farmer-centered, hands-on, and continuous advisory support. The findings support the argument that successful climate adaptation requires integrating scientific research with farmers' experiential knowledge through participatory approaches.

3.2. Financial Barriers

High upfront investment costs were the most frequently cited barrier, especially for technologies such as drip irrigation, renewable energy, and precision agriculture equipment. This aligns with FAO (2021) and Borisova (2025), which highlight financial risk aversion as a central obstacle to transforming farm management practices in lower- and middle-income agricultural economies.

3.3. Social and Behavioral Barriers

The study reveals that traditional practices, intergenerational differences, and skepticism toward innovation significantly influence adaptation decisions. These insights confirm global research showing that behavioral economics and social norms are critical determinants of climate-smart agriculture adoption.

3.4. Policy and Institutional Barriers

Farmers expressed dissatisfaction with existing subsidies and environmental measures, noting that programs are often misaligned with real climate risks and difficult for small farms to access. This supports previous evaluations of the Common Agricultural Policy (CAP) in Bulgaria, which have identified misaligned incentives and administrative burdens as major weaknesses.

4. Limited Effectiveness of Support Programs Undermines Adaptation Potential

The study reveals a substantial gap between the existence of climate-related programs and their actual accessibility and usefulness. Only one-third of farmers used available subsidies, often due to administrative complexity and mismatches in eligibility criteria. This reflects a systemic challenge: policies intended to support climate resilience often fail to reach the farmers most in need. Without easier access, simpler processes, and more locally relevant measures, climate adaptation will remain slow and uneven.

5. Farmers Call for More Integrated, Practical Collaboration

A notable finding is the strong desire for improved collaboration between farmers, scientists, educational institutions, and government authorities. Farmers seek a more “horizontal” model of cooperation based on:

- co-creation of knowledge,
- long-term demonstration projects,
- practical training,
- more farmer-to-farmer learning,
- regional climate advisory networks.

These expectations align with modern innovation ecosystems and Quadruple Helix models, in which knowledge flows between institutions and practitioners rather than through top-down systems. Strengthening such collaboration could significantly accelerate the adoption of climate-resilient practices and reduce farm-level risk.

6. Cross-Sector Comparisons Reveal Uneven Climate Sensitivity

6.1. Grain Farmers: Highly Exposed to Drought Variability

Grain producers were among the most vulnerable to precipitation variability and heat stress. Small shifts in spring rainfall or summer temperatures drastically affected cereal yields. Their dependence on predictable seasonal patterns makes this sector particularly climate-sensitive.

6.2. Vegetable Producers: Water-Intensive and Pest-Sensitive Systems

Vegetable farmers faced the highest water and pest pressures. Continuous irrigation needs, short production cycles, and rapid disease spread under heat made them some of the most climate-stressed producers in the study.

6.3. Livestock Farmers: Indirect but Cumulative Climate Impacts

Livestock systems faced indirect but compounding challenges-pasture degradation, reduced forage quality, water shortages, and heat stress affecting milk yields and animal health.

6.4. Vineyards: High Sensitivity to Microclimatic Shifts

Viticulture emerged as one of the most climate-sensitive sectors. Earlier ripening, changes in acidity, and increased fungal diseases demonstrated a delicate dependence on microclimatic stability.

6.5. Rose and Essential Oil Crops: Extreme Sensitivity to Timing

Rose growers reported severe phenological disruptions, including early flowering, frost damage, and shortened harvest windows, which affected both yield and oil quality.

These cross-sector differences illustrate that climate change does not affect Bulgarian agriculture uniformly; instead, each sector experiences unique vulnerabilities driven by biological and economic factors.

CONCLUSION

This study demonstrates that climate change is already reshaping Bulgarian agriculture in profound and uneven ways. Across all regions and production systems, farmers observe apparent shifts in temperature, precipitation patterns, and the frequency of extreme weather events, confirming scientific climate assessments with grounded local evidence. While farmers are actively experimenting with both technological and ecological adaptation strategies, their capacity to respond effectively is limited by structural financial constraints, sector-specific vulnerabilities, and institutional barriers.

A central contribution of this research is the cross-sector comparison of climate impacts and responses. Grain producers face high yield variability driven by drought; vegetable growers struggle with water scarcity and rapid pest evolution; livestock farmers confront declining forage quality and heat stress; vineyards and rose farms, susceptible to microclimate, experience phenological disruptions that threaten product quality and market competitiveness. These differences show that climate resilience cannot rely on a single solution: **sector-specific and regionally tailored approaches are essential**.

Despite diverse challenges, farmers share a common need for practical support: accessible financing, targeted training, integrated advisory services, and stable long-term climate policies. The limited effectiveness and accessibility of existing support programs highlight an urgent need for institutional reform. Farmers call for a more collaborative model of climate adaptation-one that unites researchers, educators, policymakers, and local communities in co-creating solutions grounded in real field conditions.

Overall, the findings underscore that Bulgarian agriculture possesses both the knowledge base and innovative potential to adapt to a changing climate, but scaling resilience requires deliberate investment, better policy design, and stronger, more equitable partnerships. Advancing climate-resilient agriculture will depend on bridging the gap between scientific knowledge and practical implementation, empowering farmers as key agents of adaptation, and ensuring that national strategies reflect the sector's diverse realities. Future research should build on these insights by expanding regional comparisons, examining long-term adaptation trajectories, and evaluating the effectiveness of emerging climate policies and technologies over time.

REFERENCES

Alexandrov, V. (1999). Vulnerability and adaptation of agronomic systems in Bulgaria. Climatic Research, 12, 161–173. https://doi.org/10.3354/cr012161

Borisova, Tz. (2025) Strategic positioning of agricultural financial products. Journal of Bio-Based Marketing, vol. 1, 2025, 26 – 41

Borisova, Tz. (2025). Farmer’s preferences for different financial product values offered by commercial banks in Bulgaria. Journal of Bio-Based Marketing, vol. 2, 2025, 146 – 152

FAO. (2021). The state of food and agriculture 2021: Making agri-food systems more resilient to shocks and stresses. Food and Agriculture Organization of the United Nations.

Georgieva, V., Kazandjiev, V., Bozhanova, V., Mihova, G., Ivanova, D., Todorovska, E., Uhr, Z., Ilchovska, M., Sotirov, D., & Malasheva, P. (2022). Climatic changes-A challenge for the Bulgarian farmers. Agriculture, 12(12), 2090. https://doi.org/10.3390/agriculture12122090

IPCC. (2022). Climate Change 2022: Impacts, adaptation and vulnerability. Intergovernmental Panel on Climate Change. Cambridge University Press.

Nikolova, N., Matev, S., & Bozhkov, P. (2024). The impact of climate and weather-related disasters on agriculture in Bulgaria. In Proceedings of the 5th Congress of Slavic Geographers and Ethnographers. https://doi.org/10.46793/CSGE5.07NN

Rezear, K., P. Borisov, T. Radev, A. Osmani (2019). Social and Climate Changes in Agriculture: Challenges as Opportunities for Adaptation. New Knowledge Journal of Science, vol.8 (4), 2019. 41-47.

SpringerLink. (2023). Climate change impacts and adaptation in Bulgaria. Springer Nature.

Stoyanova, N. (2022). The effect of climate change on agricultural production in Bulgaria. The Journal of Global Climate Change, 1(1), 33–38. https://doi.org/10.56768/jytp.1.1.05