



CLIMATE RISK MANAGEMENT IN SUSTAINABLE AGRICULTURE IN SOUTHWEST OLTENIA: STATISTICAL ANALYSIS OF CHALLENGES, STRATEGIES AND OPPORTUNITIES FOR SUSTAINABLE DEVELOPMENT

Adriana Delia VLAICU, Dorina Nicoleta MOCUȚA

¹University of Agronomic Sciences and Veterinary Medicine of Bucharest, Faculty of Management and Rural Development, Bucuresti, Romania

Abstract: In the context of climate change, sustainable agriculture has become an essential pillar for the sustainable development of rural regions. The South-West Oltenia region, with significant agricultural potential, faces increasingly frequent climate risks, which threaten the food security and economic stability of local communities. The paper analyzes the climate risks specific to this region and their impact on sustainable agricultural practices, identifying adaptation strategies, such as crop diversification and the use of innovative and ecological cultivation techniques. The importance of effective climate risk management is emphasized to minimize negative effects and maximize opportunities for sustainable development. The study also emphasizes the role of public policies and regional cooperation in promoting sustainable agriculture, contributing to improving the quality of life and increasing the resilience of rural communities.

• Introduction

Climate change represents one of the biggest challenges to food security and rural development, especially in vulnerable agricultural regions. The South-West Oltenia region, characterized by an extreme continental climate and a predominantly plain topography, is highly exposed to extreme phenomena, such as prolonged pedological drought, heat waves and desertification. From a socio-economic perspective, Oltenia holds approximately 15% of Romania's utilized agricultural area (UAA), having a significant share in the national cereal production. The economic stability of over 200,000 farms directly depends on the performance of field crops. Thus, any production failure translates not only into local losses, but also into macroeconomic volatility. The impact of these risks is amplified by the insufficiently adapted agricultural infrastructure, especially with regard to irrigation systems.

• Material and method

The purpose of this work is to carry out a comprehensive analysis of the impact of climate risks on agriculture in South-West Oltenia, focusing on three interrelated objectives:

- assessing current climate trends (in terms of temperature and precipitation),
- quantifying the impact on the yields of main crops (maize, wheat, sunflower)
- determining the effectiveness of adaptation measures, with a particular focus on the use of irrigation as a risk management method.

The paper aims to provide a solid scientific basis for the formulation of effective regional agricultural policies that support sustainable agriculture and contribute to increasing the economic resilience of farmers in the region. The research used a mixed approach, combining the analysis of climatic data with agronomic and economic data, based on a multi-source database (1990-2023).

• Results and discussions

The climate risk analysis in the South-West Oltenia region was structured on five main components, using a combined set of agronomic and climatic data for the period 1990-2023.

1. Climate Trends in Oltenia

A time series analysis of data obtained from the National Meteorological Administration (ANM) for the period 1990-2023 revealed a clear aridification trend.

Temperature Increase: Average annual temperatures have increased by 1.5% in the last three decades, focusing especially on the summer months (June-August), which are essential for the growth of field crops.

Precipitation Decrease: Average annual precipitation in Oltenia has decreased by approximately 12% in the last 10 years, and during the vegetation season (April-August), long-term droughts and heat waves have become more frequent and intense.

2. The Impact of Climate Change on Agriculture

Statistical data on agricultural production in Oltenia, obtained from the INS and MADR, demonstrate a significant decrease in yields. This decrease is detailed in Table 1. In years of severe drought (2012, 2015, 2020), losses in non-irrigated crops ranged between 30% and 45% compared to the multi-annual average.

Table 1: Production evolution for the main crops in Oltenia (1990-2023)

Year	Wheat (ton/hectare)	Corn (ton/hectare)	Sunflower (ton/hectare)	Multiannual average
1990	4,8	6,5	2,2	-
2000	4,6	6,2	2,1	4.8(wheat), 6.5(corn), 2.2(sunflower).
2010	4,4	6,0	2,0	4.6 (wheat), 6.35 (corn), 2.1 (sunflower).
2020	3,9	5,2	1,9	4.4 (wheat), 6.2 (corn), 2.0 (sunflower).
2023	3,8	5,1	1,8	4.38 (wheat), 5.8 (corn), 2.0 (sunflower).

Regression analysis revealed a significant negative correlation ($p < 0.05$). Key relationships are summarized in Table 2.

Climate Variable	Relationship with Agricultural Yields	The Risk Factor
Average temperature July-August	Increasing the temperature by 1°C can reduce the corn harvest by 8-10%.	Thermal and Water Stress (high temperatures affecting plants).
Precipitation in May-June	Excessive rainfall affects flowering and grain development in plants.	Excess water/Local flooding (large amounts of water that can damage plants).
Drought and late frosts	Drought and late frosts reduce yields and affect the vegetation cycle.	Extreme phenomena (drought or frosts that destroy crops).

3. Effectiveness of Adaptation Measures

The farm benchmarking confirmed the crucial role of adaptation technologies. Farmers who implemented modern drip or sprinkler irrigation systems managed to maintain corn yields 12% to 25% higher than non-irrigated farms, thus demonstrating their effectiveness in combating the effects of drought. Crop diversification also contributed to a decrease in annual income volatility by approximately 15%.

4. Forecasts on the Future of Climate Change

According to time series forecast models, it is estimated that, without major adaptation measures, the Oltenia region will face an additional increase in average annual temperatures by another 2 degrees C and a decrease in precipitation by another 10% by 2043, projecting a 15% decrease in average corn yield by 2035.

The results obtained confirm the hypothesis of increased vulnerability of Oltenia agriculture and place the region in the high-risk area identified by the IPCC (2021) and EEA (2022) Reports for South-Eastern Europe.

• Conclusions

The paper aimed to analyze climate risks and their impact on agriculture in Oltenia. The main conclusions of the study are as follows:

- Aggravated Vulnerability: The strong negative correlation between high temperatures and yields highlights the systemic vulnerability of dryland agriculture.
- Decoupling Production from Weather: The Dolj case study illustrated that the only effective way to maintain economic stability in the face of drought is through controlled hydrological intervention, with investment in the rehabilitation of irrigation infrastructure being vital.
- Development Strategies: To counter unfavorable forecasts, the region needs to prioritize:
 - Major investments in irrigation infrastructure,
 - Integration of Precision Agriculture
 - Diversification of crops towards species and varieties adapted to aridification.