UNIVERSITY OF LIFE SCIENCES ”KING MIHAI I” FROM TIMISOARA
”YOUNG PEOPLE AND MULTIDISCIPLINARY RESEARCH IN APPLIED LIFE SCIENCES”

05-06 November 2026



Soil Water Conservation Practices for Sustainable Crop Production under Climate Change: A Case Study of the Banat Plain, Romania

Maroua DAHBI, Douaa DAHBI, Mahfoud BAKLI, Raul PAȘCALĂU, Laura SMULEAC
University of Life Sciences “King Michael I” from Timisoara
École normale supérieure d’Oran

Abstract: *Climate change is increasing the challenges associated with maintaining adequate soil water availability for agricultural production, particularly in regions experiencing high evaporative demand and variable precipitation. In the Banat Plain of western Romania, the relationship between precipitation and evapotranspiration represents an important factor influencing crop water availability and agricultural sustainability. In this context, soil water conservation practices may contribute to improving soil conditions and strengthening the resilience of agricultural systems.*

This paper aims to evaluate the potential of conservation tillage and cover crops to support soil water conservation and sustainable crop production under changing climatic conditions, with particular reference to the Banat Plain. A focused literature review will be conducted using peer-reviewed scientific publications addressing soil water storage, infiltration, evaporation, drainage, soil properties and crop productivity. Evidence from studies conducted in Romania and comparable temperate agricultural regions will be examined to identify the benefits, limitations and factors influencing the effectiveness of these practices.

The review will also consider potential trade-offs, including competition between cover crops and subsequent crops for available soil water, as well as the influence of soil characteristics, precipitation patterns and management practices. The findings will provide a comparative assessment of the applicability of conservation tillage and cover crops to the agricultural conditions of the Banat Plain and identify priorities for future regional research. This study aims to contribute to the development of evidence-based soil management strategies supporting climate-resilient and sustainable agriculture.

• Introduction

Climate change is one of the major challenges facing modern agriculture, as rising temperatures, changing rainfall patterns and more frequent droughts affect soil water availability and crop productivity. Soil water conservation is therefore essential to maintaining sustainable agricultural systems and improving their resilience to climate variability.

Soil water is crucial for plant growth, nutrient uptake and physiological processes. However, water losses through evaporation, surface runoff and deep drainage can reduce the amount available to crops, particularly during periods of insufficient or irregular rainfall. Adopting appropriate soil management practices is essential to limit these losses and reduce the risk of water stress.

Among the most promising approaches are reduced tillage and cover crops. Reduced tillage limits soil disturbance and can help preserve soil structure, reduce erosion and maintain plant residues at the soil surface. Cover crops protect the soil between main cropping seasons, improve water infiltration and reduce runoff. Nevertheless, their effectiveness depends on soil characteristics, climatic conditions, plant species and management practices. In water-limited regions, cover crops may also compete with subsequent crops for available soil moisture.

The Banat Plain, in western Romania, is an important agricultural region where climate variability can influence soil water balance and crop water requirements. Studying soil water conservation practices in this area can help identify suitable strategies for adapting agricultural systems to changing climatic conditions. Previous research has also examined the influence of climate change on water availability for agricultural production in the Banat Plain (Şmuleac et al., 2020).

The objective of this study is to evaluate the potential of reduced tillage and cover crops to improve soil water conservation and support sustainable agricultural production under climate change. Based on a review of scientific literature, the study compares the benefits, limitations and factors influencing the effectiveness of these practices, while assessing their relevance to the pedoclimatic conditions of the Banat Plain.

• Material and method

1.Geographic Location:
The study focuses on the Banat Plain in western Romania, an agricultural region where rainfall variability and rising temperatures can affect soil moisture and crop water availability. The regional context is used to assess the relevance of soil water conservation practices under changing climatic conditions.

2. Bibliographic Research and Data Sources:
Scientific articles and review papers were identified using Google Scholar and the references of selected publications. The research focused on reduced tillage, no-tillage, cover crops, soil moisture, water conservation and crop productivity, with particular attention to Romania and comparable temperate agricultural regions.

3. Comparative Analysis of Water Conservation Practices:
Reduced tillage, no-tillage and cover crops were compared based on their potential effects on soil water conservation and crop productivity. Their benefits and limitations were assessed in relation to soil properties, rainfall, temperature, crop type and agricultural management. Particular attention was given to the balance between soil protection and water consumption by cover crops.

4. Criteria for Analysis and Comparison:
The main assessment criteria included:Soil water processes: infiltration, runoff, evaporation, soil water storage and evapotranspiration.Soil characteristics: texture, structure and organic matter content.Climatic factors: rainfall distribution, temperature and dry periods.Agricultural performance: water availability, crop yield, advantages and limitations of each practice.
The analysis draws on published scientific literature, including Basche and DeLonge (2019) and Blanchy et al. (2023). Results from the Banat Plain are distinguished from findings in other regions. No original field measurements or experiments were conducted.

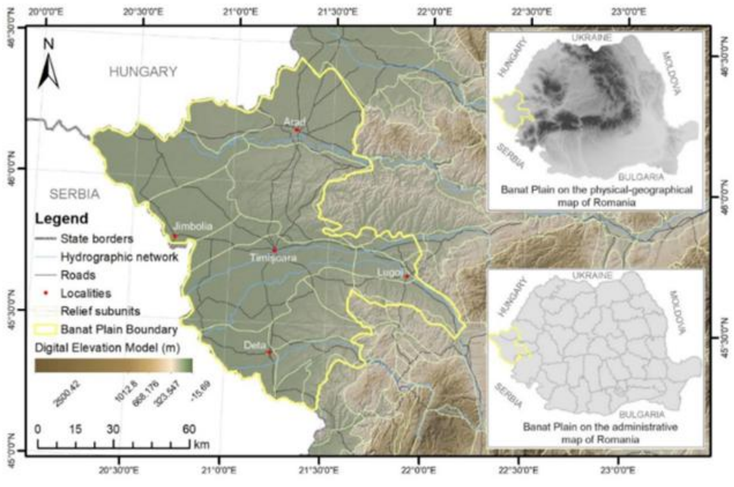


Figure 1. Study area: Banat Plain, western Romania

• Results and discussions

Reduced tillage and direct sowing can contribute to soil water conservation by reducing soil disturbance and preserving plant residues. These residues protect the soil surface, limit evaporation and runoff, and may improve water infiltration. However, their effectiveness varies according to soil properties, climatic conditions and agricultural management. Basche and DeLonge (2019) reported a 34.8% average increase in infiltration associated with cover crops, while the effect of direct sowing alone was not statistically significant.Cover crops also help protect the soil and improve water regulation, but their water consumption may reduce the reserves available for the following crop. Meyer et al. (2019) reported approximately 27 mm less water drainage under cover crops compared with bare soil. Their benefits therefore depend on plant species, rainfall and termination timing.In the Banat Plain, rainfall variability, increasing temperatures and evapotranspiration highlight the importance of improving soil water management. Combining reduced tillage, plant residue retention and appropriately managed cover crops represents a promising strategy. Nevertheless, soil texture, drainage and local climatic conditions must be considered, and field trials are needed to confirm the effectiveness of these practices under regional conditions.

• Conclusions

Soil water conservation represents a key strategy for ensuring sustainable agricultural production in the Banat Plain under climate change. Increasing temperatures, rainfall variability and periods of water deficit highlight the need for agricultural practices that improve water retention, reduce water losses and maintain soil quality.Reduced tillage and direct sowing can help preserve soil structure and reduce mechanical disturbance, while maintaining plant residues on the soil surface can limit evaporation, protect against raindrop impact and support water infiltration. Cover crops also offer important benefits by protecting the soil surface, reducing erosion risks and contributing to improved water regulation. However, their water consumption may reduce the reserves available for the following crop, particularly during dry periods.The effectiveness of these practices depends on soil texture, drainage conditions, rainfall distribution, crop water requirements and agricultural management. Therefore, combining reduced tillage, residue retention and carefully managed cover crops may provide a more effective approach than relying on a single practice. The selection of cover crop species and the timing of their termination are particularly important for balancing soil protection with water availability for the main crop.For the Banat Plain, these practices represent promising options for improving water management, maintaining crop productivity and strengthening the resilience of agricultural systems. Nevertheless, the findings of this study are based on a bibliographic analysis and cannot be considered direct experimental evidence for the region. Further field trials conducted over several agricultural seasons are needed to quantify their effects on soil moisture, infiltration, evaporation, crop yield and water use efficiency under local conditions.

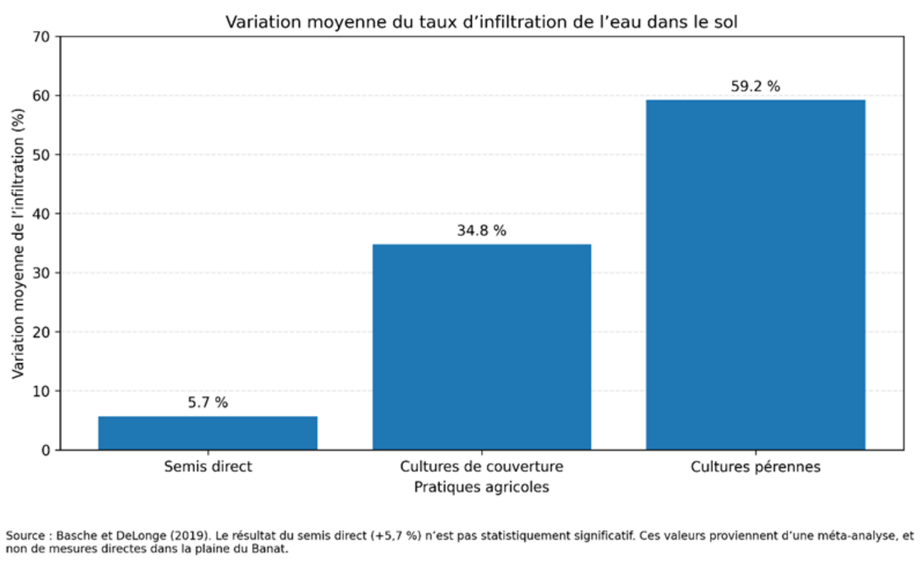


Figure 2. Mean Change in Soil Water Infiltration under Different Agricultural Practices