



UNIVERSITY OF LIFE SCIENCES "KING MIHAI I" FROM TIMISOARA

"YOUNG PEOPLE AND MULTIDISCIPLINARY RESEARCH IN APPLIED LIFE SCIENCES"



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INTEGRATED WATER RESOURCE MANAGEMENT FOR CLIMATE-RESILIENT AGRICULTURE

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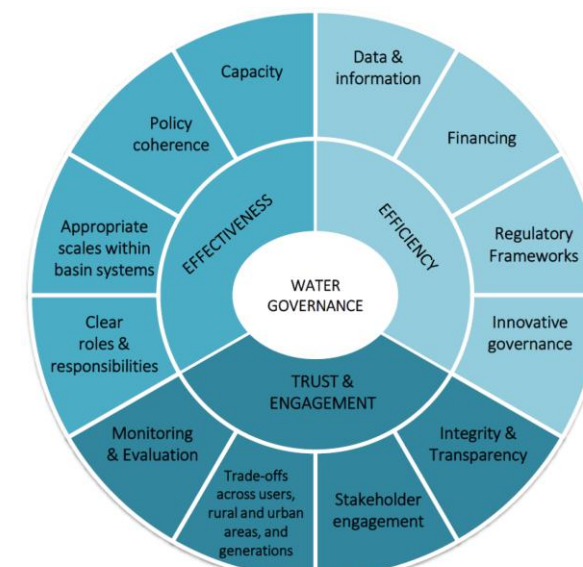
Abstract:

Water resources are fundamental to agricultural production, yet their availability and quality are increasingly affected by climate change, inefficient use, and competing demands. The intensification of droughts, irregular rainfall, and extreme weather events has made the agricultural sector highly vulnerable, particularly in regions where irrigation systems are outdated or poorly managed. This study investigates the role of Integrated Water Resource Management (IWRM) as a practical and strategic framework for enhancing the resilience of agricultural systems to climatic stressors. The research was conducted in the western region of Romania, focusing on agricultural communities facing recurring water shortages. Data were collected through field surveys, stakeholder interviews, and analysis of water-use records between 2023 and 2024. The study assessed current water management practices, irrigation efficiency, and institutional coordination among local authorities and farmers. The results revealed that adopting IWRM principles—such as participatory planning, efficient water allocation, modern irrigation technologies, and protection of watershed ecosystems—can significantly improve both water productivity and farm-level resilience. Farms implementing integrated management strategies achieved up to a 25–30% reduction in water losses, while maintaining or slightly increasing crop yields compared to conventional systems. Additionally, community-based water governance proved effective in preventing conflicts over resource distribution and promoting collective responsibility. Despite these benefits, challenges remain, including limited financial resources, fragmented policies, and insufficient technical expertise at the local level. The study concludes that strengthening institutional collaboration, investing in infrastructure modernization, and promoting education on water-efficient technologies are essential steps toward achieving long-term sustainability and climate resilience in agriculture.



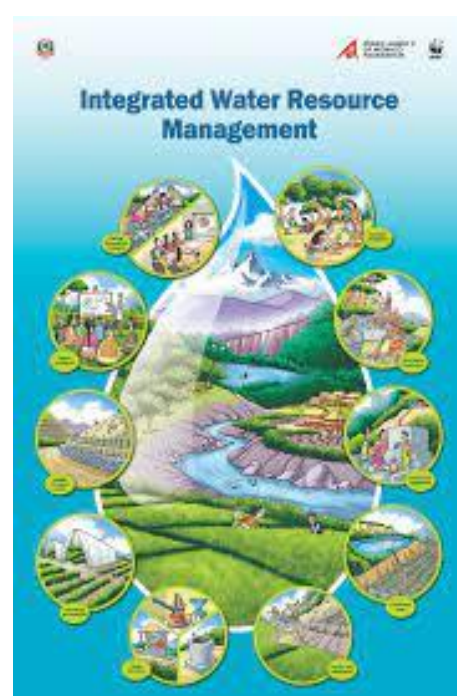
Results and discussions

The findings of the research indicate that the adoption of Integrated Water Resource Management (IWRM) practices has a measurable positive impact on water efficiency and agricultural resilience. Farms applying integrated approaches—such as improved irrigation scheduling, soil moisture monitoring, and participatory planning—achieved an average reduction of 25–30% in water losses compared with conventional systems. These farms also recorded more stable crop yields during dry seasons, highlighting the role of efficient water use in mitigating the effects of drought. The introduction of on-farm water storage facilities and the use of drip or sprinkler systems contributed significantly to improved irrigation efficiency. Farmers reported better control over water distribution and reduced energy consumption.



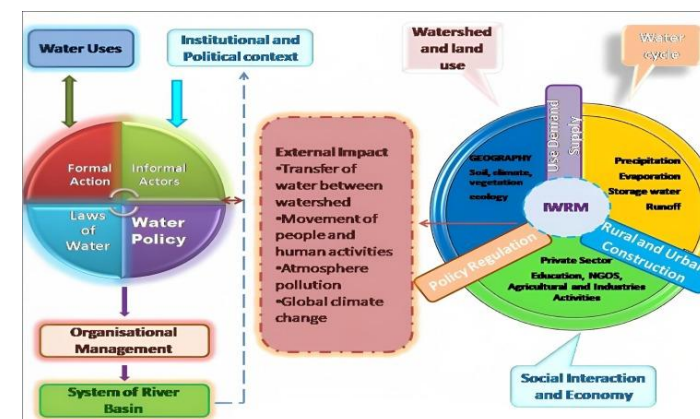
Introduction

Water is one of the most vital natural resources for sustaining life and economic development, and agriculture is its largest global consumer. In many regions, farming accounts for more than 70% of total freshwater use. However, increasing climate variability, population growth, and inefficient management have led to rising pressure on water resources. Droughts, floods, and shifting precipitation patterns caused by climate change are already threatening agricultural productivity, soil quality, and food security. These challenges demand a more integrated and sustainable approach to water governance that balances environmental, social, and economic needs. Integrated Water Resource Management (IWRM) has emerged as a comprehensive framework designed to promote coordinated development and management of water, land, and related resources. Unlike traditional sectoral management, which treats water issues in isolation, IWRM emphasizes interconnection—linking agriculture, environment, and community participation in decision-making. This approach aims to maximize economic and social welfare without compromising the sustainability of ecosystems. In agricultural contexts, IWRM encourages efficient water allocation, soil moisture conservation, and the adoption of technologies that reduce losses while improving productivity. In Romania, particularly in the western region, the effects of climate change have become increasingly visible through prolonged droughts and uneven rainfall distribution. Many irrigation systems are outdated and inefficient, leading to significant water losses and reduced crop yields. The implementation of IWRM principles could therefore provide a valuable solution to these emerging challenges by improving coordination among farmers, water authorities, and local communities. Previous studies have shown that integrating technological, institutional, and participatory elements in water management can substantially enhance resilience to climatic stress. However, the level of awareness and adoption of such integrated strategies remains limited in many rural areas. Therefore, understanding the practical implications of IWRM and identifying barriers to its implementation are crucial for designing effective management models. The main objective of this study is to evaluate the potential of IWRM to support climate-resilient agriculture in the western region of Romania. The research aims to assess the efficiency of current water use practices, identify key environmental and institutional challenges, and propose sustainable measures for improving water resource management at the local and regional levels.



Conclusions

The research demonstrates that Integrated Water Resource Management (IWRM) provides an effective framework for improving the efficiency, sustainability, and resilience of agricultural water use. The implementation of integrated practices—such as modern irrigation systems, improved water scheduling, and participatory management—resulted in lower water losses and more stable crop yields under variable climatic conditions. These findings confirm that coordinated management of water and soil resources can strengthen agricultural productivity while reducing environmental pressure. The research also revealed that IWRM contributes to better soil moisture conservation, increased awareness of water value among farmers, and enhanced collaboration at the community level, especially in rural areas.

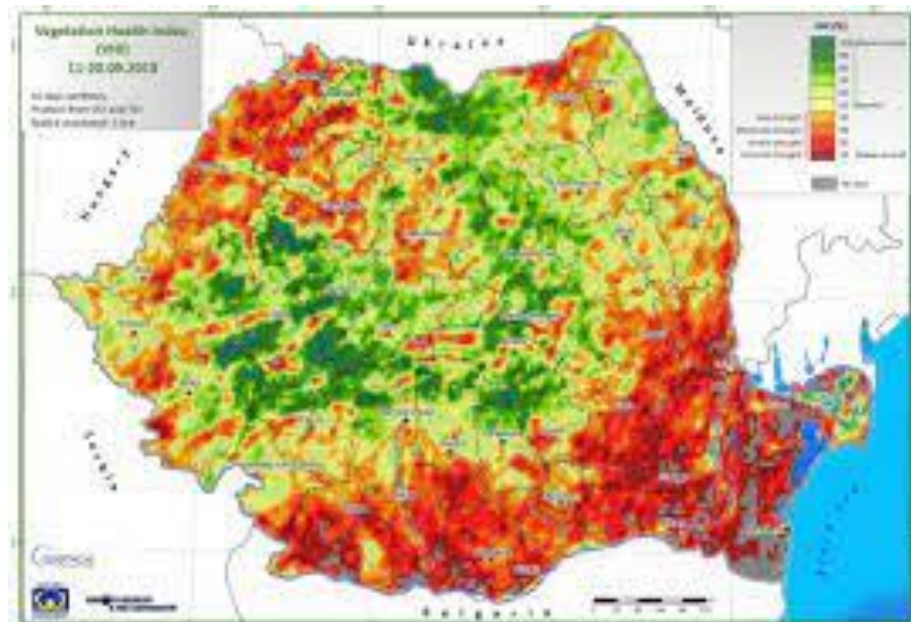
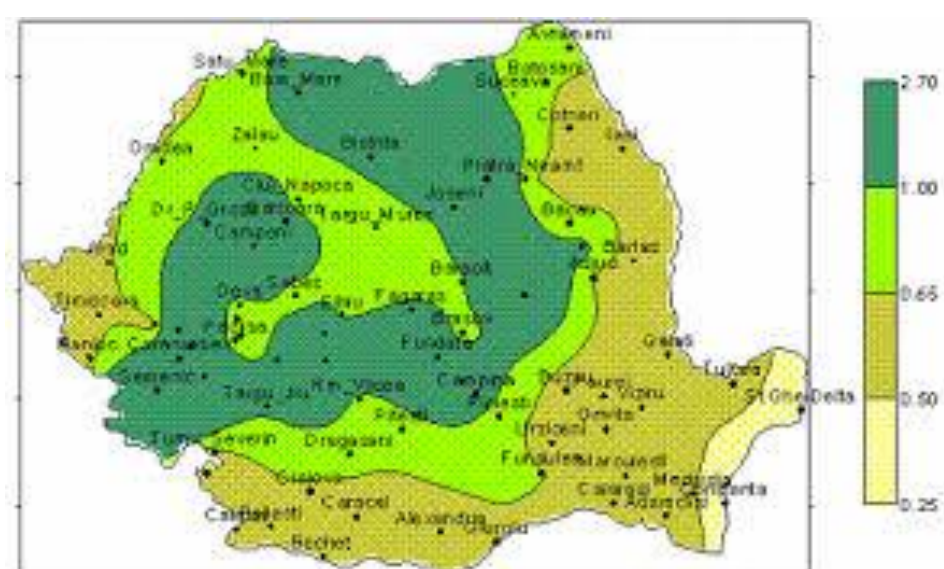


By promoting responsible use of shared water resources, IWRM supports both environmental protection and local development. Nevertheless, several barriers remain to its broader adoption. Limited access to financial support, insufficient technical knowledge, and weak institutional coordination continue to slow progress toward integrated water governance. To address these challenges, stronger cooperation between farmers, local authorities, and research institutions is needed. Investment in modern infrastructure, training programs, and information exchange platforms can further encourage the application of sustainable water practices.

In conclusion, integrating IWRM principles into agricultural planning is essential for building climate-resilient farming systems. The approach promotes balanced resource use, protects ecosystems, and ensures the long-term viability of agriculture in regions increasingly affected by drought and water scarcity.

Material and method

The research was carried out in the western region of Romania, mainly in Timiș and Arad counties, areas with a temperate-continental climate and frequent summer droughts. These conditions make the region suitable for assessing Integrated Water Resource Management (IWRM) practices aimed at improving agricultural resilience. A mixed-methods approach was used, combining field measurements, data analysis, and stakeholder interviews. Data were collected between March 2023 and September 2024 from ten farms ranging from 20 to 150 hectares. Quantitative data included irrigation volumes, crop yields, soil moisture, and energy consumption, while qualitative data were obtained through semi-structured interviews with farmers and local water experts. Water-use efficiency and irrigation performance were compared between conventional and integrated management systems. The evaluation was based on key IWRM indicators such as environmental sustainability, economic efficiency, and institutional coordination. Descriptive and comparative analyses were conducted to identify significant differences between management practices. The research design followed the principles of the Global Water Partnership (GWP), emphasizing participatory management, efficient resource use, and equitable water distribution. This integrated assessment provided valuable insights into how IWRM strategies can strengthen agricultural adaptation to climate variability and promote the sustainable use of water resources in drought-prone regions.



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