INTEGRATION OF THE COMMON AGRICULTURAL POLICY AND CRITICAL INFRASTRUCTURE MANAGEMENT – CASE STUDY OF GORJ COUNTY (2022–2025)

Dr. Eng. Oliviu-Mihnea Gămulescu, *Constantin Brâncuși University from Tg Jiu, ROMANIA*

ABSTRACT: This study investigates the integration of the Common Agricultural Policy (CAP) and Critical Infrastructure Protection Management (CIPM) in the context of agricultural risk management, using Gorj County (2022–2025) as a case study. The research combines professional experience in systems engineering, drone-based crop recognition, and participation in the County Drought Commission. The methodology includes field assessments, soil moisture monitoring, aerial multispectral surveys, and GIS-based vulnerability mapping, complemented by the analysis of historical and real-time meteorological data. Key results reveal the spatial and temporal dynamics of pedological drought, its economic impact on major crops (corn, wheat, sunflower), and the effectiveness of integrated preventive measures.The study proposes an Integrated Drought Monitoring and Prevention System (SMP-SP), combining IoT sensors, early warning systems, predictive climate models, and farmer training programs. The approach enables rapid identification of drought causes, reduces economic losses, and enhances agricultural resilience. Findings highlight the importance of multidisciplinary, data-driven approaches for decision-making in agricultural risk management and recommend the development of local irrigation systems, digitalization of damage assessment, and establishment of a County Center for Climatic and Agricultural Analysis integrated with national systems.

Keywords: Common Agricultural Policy, Critical Infrastructure Management, pedological drought, GIS mapping, IoT monitoring, agricultural resilience, Gorj County.

1. INTRODUCTION

The Common Agricultural Policy (CAP) and Critical Infrastructure Protection Management (CIPM) represent complementary strategic domains, essential for managing risks and emergency situations affecting agriculture.
The professional and academic experience acquired in the field of Systems Engineering, combined with applied research regarding the automatic recognition of agricultural crops using drones, provides a solid basis for integrating these principles into practice – at local, regional, and national levels.

2. LEGISLATIVE AND INSTITUTIONAL FRAMEWORK

Management of climatic and agricultural risks is based on a coherent legislative framework, which includes:

- **Government Decision no. 557/2016** – regarding the management of risk types and protection of critical infrastructure.
- **Order of MAI and MADR no. 459/78/2019** – regarding the management of emergency situations caused by hazardous hydrometeorological phenomena (drought, floods, hail).
- **Order no. 1475/2006** – regulates measures to combat the effects of drought, fires, and pests on crops.
- **Order MADR no. 97/2020 and MAI no. 63/2020** – defines the structure of local and county commissions for evaluating damages caused by pedological drought.
- **Order of the Prefect of Gorj County no. 154/2025** – establishes the updated composition of the County Emergency Situations Commission, including the technical drought group.

3. FOUNDATION AND LINK TO PROFESSIONAL EXPERIENCE

- The course completed at the Academy of Land Forces “Nicolae Bălcescu” Sibiu regarding Critical Infrastructure Protection Management (CIPM) provided a solid theoretical foundation regarding prevention and response systems for natural risks.
- The PhD thesis in Systems Engineering (“Contributions regarding the automatic recognition of agricultural crops using drones”) allowed the application of modern analysis and monitoring methods in agriculture.
- Activity within APIA Gorj and participation in the County Drought Commission strengthened the applicability of this knowledge in agricultural risk management.

4. PURPOSE AND MAIN THEME

The study investigates how the integration of the **Common Agricultural Policy** (CAP) with **Critical Infrastructure Protection Management (CIPM**) can efficiently prevent and manage agricultural risks, particularly drought, which impacts major crops such as corn, wheat, and sunflower.

- **Objectives and Applicability**

Objectives:

- Preventing and efficiently managing critical situations in agriculture.
- Creating an integrated monitoring and reporting system.
- Promoting inter-institutional collaboration and continuous training.

Practical Applicability:

- Implementation of modern technologies (drones, moisture sensors, GIS databases).
- Development of preventive plans based on real data.
- Supporting farmers through training and access to rapid information regarding climatic risks.

5. CASE STUDY: MANAGEMENT OF PEDOLOGICAL DROUGHT IN GORJ COUNTY (2022–2025)

Context:
Between 2022 and 2025, Gorj County was affected by multiple episodes of pedological drought, with major impact on corn, wheat, and sunflower crops.

Fig. 1 – Corn Crop Affected by Drought (2025)

The 2025 drought affected corn crops, as shown in **Figure 1**, which visually presents the effects of moisture deficiency on plants. The image illustrates the affected areas and visible signs of water stress on the crops.

Effects of drought: These are usually observed at the plant level through wilting, yellowing, or drooping of leaves, as well as stunted growth and reduced yield.

Areas with moisture deficiency: These are sections of the crop where water is insufficient to support healthy plant growth.

Water stress: Drought creates water stress in plants, an imbalance between water consumption and absorption, leading to growth, development, and reproductive problems.

6. METHODOLOGY:

Data Collection: Field assessments, soil moisture monitoring, and crop observations.

Modern Technologies: Multispectral drones for automatic crop recognition, IoT sensors for soil monitoring, and GIS for mapping vulnerability areas.

Climatic Analysis: Correlation of historical and real-time data to identify critical periods of water deficit.

SWOT Analysis – Pedological Drought in Gorj County (2022–2025)

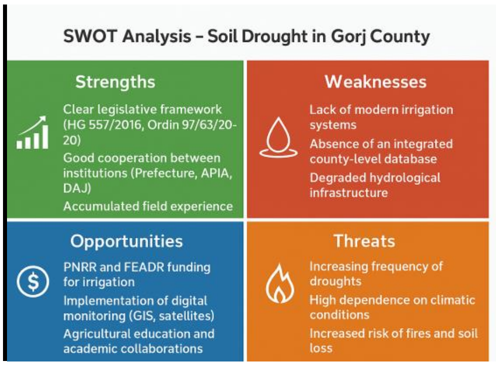

Fig. 2. SWOT analysis of pedological drought in Gorj County (2022–2025). The diagram summarizes the main internal and external factors influencing drought management capacity. Strengths include a well-defined legislative framework and institutional collaboration; weaknesses refer to outdated irrigation infrastructure and limited digitalization; opportunities derive from CAP financial instruments and IoT integration; threats are linked to climatic variability and water resource depletion.

7. DUTIES OF THE DROUGHT COMMISSION MEMBER (GORJ COUNTY)

- Monitoring crops and reporting data to the Prefecture.
- Evaluating damages according to Order 97/63/2020.
- Participating in CJSU meetings and proposing operative measures.
- Preparing minutes and technical reports.
- Coordinating with APIA, DAJ, ISU, and Romanian Waters.

8. INTEGRATED SOLUTION: PEDOLOGICAL DROUGHT MONITORING AND PREVENTION SYSTEM (SMP-SP)

a. **Identifying the causes of drought:**

- Continuous soil monitoring: Installation of IoT sensors for moisture and temperature in representative points across all agricultural areas.
- Climate analysis: Use of historical and real-time meteorological data (satellites, local weather stations) to identify periods with water deficits.
- GIS mapping: Integration of soil, topography, and crop data to identify drought-vulnerable areas.
- Interdisciplinary evaluation: Involvement of system engineers, agronomists, and hydraulic infrastructure specialists to interpret multiple causes: insufficient precipitation, groundwater depletion, inefficient irrigation infrastructure.
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B) Prevention and impact reduction:

- Early warning system: Automatic generation of alerts for farmers and authorities when soil moisture falls below critical thresholds.
- Preventive irrigation plans: Based on monitoring data, targeted irrigation is proposed, saving water and protecting crops.
- Rehabilitation of hydraulic infrastructure: Modernization of canals, reservoirs, and local irrigation systems.

- Training and education: Workshops for farmers on crop adaptation, rotation, and water conservation methods.
- Predictive simulations: Use of climate models and AI to forecast risks and adjust agricultural strategies.

C). Benefits:

- Rapid identification of real causes of drought.
- Reduction of economic losses through targeted interventions.
- Increased resilience of crops and agricultural infrastructure to drought.
- Decision support for authorities and farmers based on scientific data.

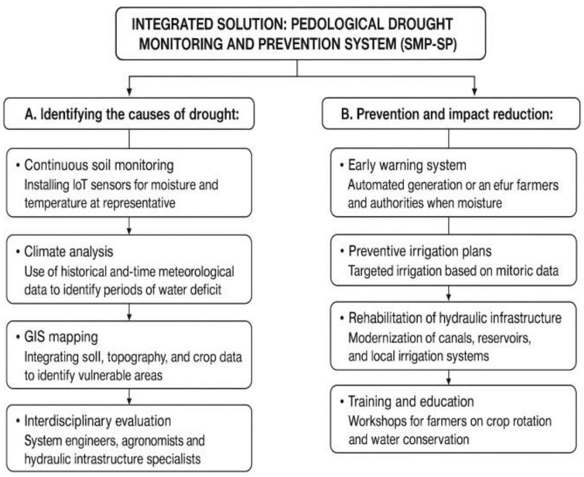
9. KEY FINDINGS

Pedological drought has a significant impact on crops and causes notable economic losses.

The integration of digital technologies and critical infrastructures enables the rapid identification of drought causes and reduces losses through preventive interventions.

Examples of proposed solutions include: SMP-SP (Integrated Drought Monitoring and Prevention System), targeted irrigation, modernization of canals and reservoirs, farmer training, and predictive simulations using climate models.

10. DIAGRAM – INTEGRATION OF CAP, CIMP, AND MODERN



TECHNOLOGIES IN DROUGHT MANAGEMENT

Title: Integrated Approach for Drought Prevention – Gorj County (2022–2025)

➢ **Strategic Level – Common Agricultural Policy (CAP) Objectives:**

- Support farmers
- Reduce agricultural losses
- Promote sustainability

Link with CIM:

- Alignment with national and European standards
- Financial and legislative support for critical infrastructure

➢ **Operational Level –** Critical Infrastructure Protection Management (CIPM)
Key Elements:

- Monitoring water and soil resources
- Managing irrigation systems and canals
- Protecting agricultural and hydro-technical infrastructure

Fig. 3 – GIS Map of Vulnerabilities (2022–2025)

- Areas identified as vulnerable to drought, overlaid on monitored agricultural lands.

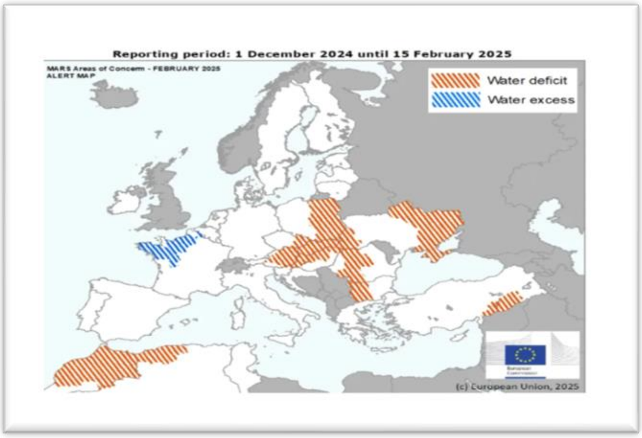


Fig. 3 EU Precipitation Map, 1 December 2024 – 15 February 2025. Photo: European Commission

As shown in Fig. 3, the European Commission's precipitation map highlights the regional variability of rainfall between December 2024 and February 2025, indicating the areas most exposed to soil moisture deficit across Southern Europe, including Gorj County.

Connections:

- Data provided to CAP for decision-making
- Support for the implementation of preventive measures

➢ **Technological Level – Modern Technologies**
Tools:

- IoT and soil moisture sensors – continuous soil measurement
- Multispectral drones – crop recognition and status assessment
- GIS Mapping – mapping vulnerable areas
- Predictive climate models / AI – drought forecasting and strategy adjustment

Results:

- Rapid identification of drought causes
- Targeted and efficient interventions
- Reduction of economic losses

Fig. 4. Multispectral drone monitoring of agricultural crops in Gorj County (2024), visualized using the NDVI (Normalized Difference Vegetation Index). Areas with higher NDVI values (bright tones) indicate healthy vegetation, whereas darker tones correspond to drought-stressed zones. Image generated using a Parrot Sequoia multispectral sensor and processed in *Pix4Dmapper*. Source: Author's own data (2024).

On a multispectral image visualized using the NDVI index, areas with healthy crops appear differently from affected areas, depending on the index values:

Healthy crop areas have high NDVI values and usually appear in bright colors (ranging from light green to intense red, depending on the applied color scheme). This indicates optimal growth and a large amount of biomass.

Affected areas (due to stress, disease, drought, etc.) have low NDVI values and appear in dark colors (such as brown, dark red, or shades of dark green, depending on the scheme), indicating reduced or absent vegetation.

Areas without vegetation (bare soil, water, structures) have very low or negative NDVI values.

The **NDVI (Normalized Difference Vegetation Index)** is calculated based on the difference between near-infrared (NIR) and red (RED) reflectance, divided by their sum, with values ranging from -1 to +1.

➢ **Practical Level – Farmers and Authorities**
Farmers:

- Receive alerts and recommendations
- Participate in training and implement preventive plans

Local Authorities (CJSU, APIA, DAJ):

- Coordination and decision-making
- Digitalization of damage assessments
- Long-term planning

➢ **Integrated Benefits:**

- More drought-resilient crops
- Rapid, data-driven decisions
- Water savings and reduced losses
- Creation of a County Center for Climate and Agricultural Analysis

10. CONCLUSIONS

The study demonstrates that integrating the Common Agricultural Policy, critical infrastructure management, and scientific research is essential for adapting Gorj County agriculture to new climatic conditions. Experience gained at APIA Gorj and in the Drought Commission shows that a multidisciplinary, data-based approach increases intervention efficiency and reduces economic losses.

Recommendations:

- Development of local irrigation systems.
- Digitalization of agricultural damage assessment.
- Creation of a County Center for Climatic and Agricultural Analysis, integrated with national MADR-APIA systems.

11. REFERENCES

1. Government of Romania. **HG no. 557/2016** regarding risk management and protection of critical infrastructure. Official Gazette of Romania, 2016.
2. Ministry of Agriculture and Rural Development / Ministry of Internal Affairs. **Order no. 97/63/2020** on the management of pedological drought. Official Gazette of Romania, 2020.
3. Ministry of Internal Affairs / Ministry of Agriculture and Rural Development. **Order no. 459/78/2019** on emergency situations caused by hazardous hydrometeorological phenomena. Official Gazette of Romania, 2019.
4. Government of Romania. **OUG no. 157/2022** regarding financial support for farmers affected by drought. Official Gazette of Romania, 2022.
5. Gorj County Directorate of Agriculture, APIA Gorj. **Statistical data on agricultural losses and affected areas (2022–2025)**. Internal reports.
6. Gămulescu, O.-M. (2024). **Contributions to automatic recognition of agricultural crops using drones**. PhD thesis, University of Petroșani, Romania.
7. Brâncuși, C. University of Târgu-Jiu. **Course materials on agricultural policy and management**, 2022–2025.
8. Nicolae Bălcescu Land Forces Academy, Sibiu. **Course on Critical Infrastructure Protection Management (CIPM), 2015.**
9. European Commission. **Common Agricultural Policy (CAP) framework documents**. Available at: https://agriculture.ec.europa.eu/cap
10. https://revista-ferma.ro/harta-precipitatii-seceta-ingrijoreaza-deja-fermierii-care-este-starea-culturilor-de-toamna-in-ue/?cn-reloaded=1

12. Professional Biography – Dr. Eng. Oliviu-Mihnea Gămulescu

Dr. Eng. Oliviu-Mihnea Gămulescu is a public official at APIA – Gorj County Center, senior advisor in the Field Control Service, and member of the County Commission for Evaluating Drought Damage.
He holds a PhD in Systems Engineering (University of Petroșani, 2024), with research focused on using drones and artificial intelligence for automatic crop recognition. He completed the Critical Infrastructure

Protection Management (CIPM) course at the Academy of Land Forces “Nicolae Bălcescu” Sibiu (2015), strengthening his competencies in infrastructure security and climatic risk management.
Through his professional and scientific activity, he contributes to developing integrated models for analysis, prevention, and intervention to protect agricultural heritage and critical infrastructure in Romania.