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Summer School 2025 Takeaway Brief

With the collaboration of:



This brief highlights the main findings, discussions, conclusions, and policy recommendations from the recent research report, **"Artificial Intelligence for Next-Generation Agriculture at the Nexus of Energy Security and Rural Transformation: A Policy and Ethical Analysis in Post-Lignite Greece."** It offers an overview for all interested stakeholders, exploring how Greece can effectively manage its transition away from coal and strengthen the affected regions by integrating smart technology and Artificial Intelligence in agriculture.

The challenge addressed by the project

Greece is undertaking a significant energy transition, moving from lignite-based power generation to renewable sources. This shift, while vital for environmental sustainability, poses *substantial socio-economic challenges for regions historically reliant on lignite mining*, such as Western Macedonia and Central Peloponnese. These areas face economic decline, job losses, and significant demographic shifts, including the departure of younger generations. Concurrently, other *agricultural regions*, exemplified by Laconia (Sparti), *are grappling with their own critical issues*. These include severe water scarcity, which threatens the foundation of their agricultural economy, and an aging farming population, which impacts future productivity.

AI for Next-Generation Agriculture at the Nexus of Energy Security and Rural Transformation

A Policy and Ethical Analysis in Post-Lignite Greece

Can a new economic model that includes AI and smart agriculture be developed for Greece's coal phase-out regions? A Report by the Summer School 2025 Program Participants explores this prospect



In response to these interconnected challenges, the project aimed to answer several key questions:

- *How can we mitigate the negative socio-economic impacts of the lignite phase-out and develop new economic models for sustainable growth?*
- *What role can technologies like AI and smart agriculture play in revitalizing economies, creating high-skilled jobs, and ensuring long-term sustainable development in post-lignite and water-stressed regions?*
- *What are the primary barriers to adopting these new technologies, and what government support and regulatory frameworks are needed for a fair and successful transition?*



Research methodology

Through interdisciplinary research, extensive stakeholder engagement, and detailed case studies, the project sought to analyze these complex interdependencies, identify actionable insights, and propose practical policy recommendations. The goal is to help Greece's lignite-dependent and rural communities become more resilient, environmentally sound, and economically vibrant.

Key Findings

Research conducted in former lignite regions (Western Macedonia, Megalopolis) and a water-stressed farming area (Sparti, Laconia) revealed several clear trends:

- In regions dependent on lignite, significant **economic uncertainties and population decline** are evident. These areas are experiencing a "brain drain" as younger people seek opportunities elsewhere due to unemployment and economic instability. Despite considerable funding from European and national sources, an aging and shrinking population remains a persistent concern.
- **Environmental legacies** from extensive lignite mining are a significant concern. Former mining areas suffer from *soil degradation, contamination, and adverse impacts on water quality, complicating efforts for land rehabilitation and reuse.*
- The **adoption of AI and smart agriculture technologies faces multiple barriers** across all studied regions. These include *high initial investment costs for equipment, a noticeable "education deficit" and lack of digital literacy among farmers, and fragmented land ownership patterns that hinder large-scale technological integration.* Additionally, *bureaucratic hurdles, skepticism towards new technologies, and a preference for traditional methods* are common. *Poor internet infrastructure in many rural areas, unclear regulations* concerning practices like agrivoltaics, and *psychological fears about job displacement* also contribute to slow adoption rates.
- **Water scarcity** presents a severe challenge in agricultural regions like Sparta. The lack of sufficient water critically threatens the agricultural sector, which forms the backbone of the local economy. This issue is further compounded by a declining number of young people entering the farming profession.
- Regarding **governance**, while various funding instruments are available, there is a strong call from communities for more empowered local ecosystems and a shift towards a more balanced policy approach. Stakeholders emphasize the *need for national policies to be complemented by robust bottom-up involvement* to ensure solutions are tailored to local needs and widely accepted by affected communities.

Discussion: Creating a new economic future

The transition away from lignite, while challenging, presents a vital opportunity for Greece to develop resilient, low-carbon economies in its affected regions.

This shift requires a **transformation from traditional manual labor to more skilled, knowledge-based roles**. This is crucial to attract and retain younger generations.

Educational programs must clearly connect smart technologies to defined career pathways and the potential for higher earnings.

AI and smart technologies are identified as **essential tools for rural revitalization**.

Establishing **small-scale "demonstration projects"** is critical to building trust and demonstrating the practical value of these innovations, thereby overcoming initial skepticism and addressing digital literacy gaps.

The Sparti case study offers valuable lessons for climate adaptation in agriculture. Although not a lignite-dependent area, Sparti's struggles with water shortages and an aging agricultural workforce highlight the **importance of investing in "smart water management" solutions**, such as soil moisture sensors and efficient drip irrigation.

Engaging younger generations in tech-enabled farming practices in such regions could serve as a model for other climate-vulnerable areas.

Effective integration of new technologies requires **targeted regional solutions and strong cross-regional coordination**.

Collaboration among the European Union, national, and local authorities, along with private enterprises, universities, and research institutions, is essential.

Establishing local multi-stakeholder committees can effectively foster **bottom-up approaches, ensuring that development plans are inclusive and responsive to community needs**.

Conclusion

The successful integration of AI and smart agriculture in Greece's post-lignite and water-stressed regions demands a comprehensive and balanced strategy. This strategy must combine financial investment in critical infrastructure, such as reliable broadband internet and modern irrigation systems, with supportive "soft" measures, including extensive skills training and educational programs.



Overcoming existing cultural and informational barriers requires a measured approach that effectively leverages both national policy guidance and empowered local community involvement. This holistic transformation has the potential to turn current challenges into significant opportunities for sustainable rural development, attract new talent, and increase the overall resilience of these regions.

Policy Recommendations

To develop a new economic model that includes AI and smart agriculture for Greece's coal phase-out regions, the following recommendations are proposed:



1. Simplify access to funding for small enterprises: Streamline application processes and provide dedicated support for small farmers and businesses to access European and national funding, to ensure that financial aid benefits a broad range of enterprises, not just larger entities.



2. Invest in digital and green skills training: Implement comprehensive and accessible training programs on AI, smart agriculture, and renewable energy technologies. These programs should target existing workforce reskilling needs and younger generations to combat the "brain drain" from rural areas.



3. Prioritize digital infrastructure development: Accelerate investments in expanding reliable, high-speed internet access across all rural communities. This is a foundational step for enabling widespread adoption of smart technologies.



4. Promote pilot projects and demonstration farms: Establish accessible pilot farms and demonstration projects. These initiatives can effectively showcase the practical benefits and return on investment of AI and smart farming solutions, thereby building trust and encouraging broader adoption among farmers.



5. Develop integrated water management strategies: For water-stressed regions like Laconia, it is essential to implement and rigorously enforce comprehensive water management plans. These plans should include smart irrigation techniques, water reuse technologies, and economic incentives for adopting sustainable water practices.



6. Foster bottom-up governance and local ownership: Create mechanisms that enable local communities to provide direct feedback on fund allocation and policy effectiveness. This ensures solutions are tailored to local needs and garner community support and buy-in.



7. Address environmental remediation of former mining sites: Expedite and adequately fund the environmental restoration of former lignite mining sites. The goal is to reclaim and convert these lands into productive areas suitable for agriculture or renewable energy projects.



8. Encourage inter-sectoral collaboration: Strengthen partnerships among government bodies, academic institutions, industry, and local communities. Such collaborations are vital for sharing knowledge, fostering innovation, and maximizing resource sharing across sectors.



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