



ANNEX I – RESEARCH TOPICS FOR TALENT4RURALSCEINCE CALL FOR RESEARCHERS

UNIVERSITY OF EXTREMADURA (SPAIN)

MSCA COFUND PROGRAMME (Grant Agreement No. 101217463)

Below are details of the research topics that will be worked on within the framework of the TALENT4RURALSCEINCE programme and which candidates must select in their expression of interest. Only one research topic may be selected by each candidate.

More information on the University Research Institutes where the various research projects will be carried out: <https://www.unex.es/investigacion-y-transferencia/nuestra-investigacion/institutos-de-investigacion/>

Research topics related to Challenge 1: Sustainable Development and Natural Resource Management

Research topic 1.1: Assessing land degradation neutrality and land abandonment trade-offs across Europe

Work Location: Research Institute for Sustainable Land Development

Research topic description: Rural territories across the European Union are increasingly defined by a socio-economic dualism: while highly productive areas undergo agricultural intensification, vast marginal landscapes face widespread land abandonment driven by rural depopulation. This "double exposure" to socio-environmental context pressures and demographic decline has become a primary driver of rapid environmental change. The consequences of abandonment are not uniform; while often perceived optimistically as passive "rewilding", the cessation of traditional management creates complex, poorly quantified environmental trade-offs. On one hand, it offers opportunities for carbon sequestration and biodiversity recovery; on the other, it generates increased risks of land degradation, modifications of hydrological and soil erosion dynamics, loss of landscape heterogeneity, and critically, an accumulation of biomass that exacerbates wildfire risk.



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This research proposes the development of a robust pan-European framework to quantify and map these trade-offs, aiming to operationalize the UN concept of "Land Degradation Neutrality" (LDN) at a continental scale. Moving beyond traditional, descriptive analyses of Land Use/Cover Change (LUCC) trends, this project will deploy an innovative synthesis of high-level geospatial data. It will integrate Copernicus Land Monitoring Service time-series and cutting-edge Alpha Earth AI embeddings to detect subtle LUCC trajectories, combined with LUCAS/ESDAC soil vulnerability, DEM datasets and Eurostat socio-economic indicators.

The objective is to empirically distinguish between divergent abandonment pathways: (1) Positive Passive Rewilding, where the withdrawal of human activity restores ecosystem functions and biodiversity; and (2) Negative Degradation Spirals, where the loss of management triggers irreversible soil loss, hydrological-sedimentary disfunctions, and habitat simplification.

The core innovation of the proposal is the creation of a dynamic Territorial Risk/Opportunity Index. This tool will assess whether a region's specific abandonment trajectory is contributing to or detracting from LDN goals. By spatially identifying the unique biophysical (e.g. topography, soil erodibility) and socio-economic (e.g. farmer aging, economic marginality) fingerprints of territories prone to "negative" abandonment, this research will provide a critical evidence base. This will empower policymakers to design targeted, place-based interventions (such as subsidies for active management or payments for ecosystem services) that effectively drive rural transitions toward resilience and ecological restoration, rather than degradation.

Research objectives: The general objective is to develop and apply a pan-European territorial intelligence framework that assesses the environmental consequences of rural land use transitions (intensification and abandonment), modelling the trade-offs between passive rewilding and land degradation to support targeted EU and national policies that guide rural territories toward Land Degradation Neutrality (LDN) and long-term resilience.

Specific objectives are:

- **Map pan-European land use change trajectories:** To examine the Copernicus Land Cover time series together with the High-Resolution Layers to quantify and map the main rural land-use transitions at broad spatial scales, and to leverage Alpha Earth AI embeddings for more detailed and up-to-date mapping. This approach seeks to identify and delineate zones of agricultural intensification, persistently extensive management, and widespread land abandonment across the EU.
- **Characterize the environmental consequences of abandonment:** For the identified abandoned areas, integration of LUCAS/ESDAC soil data (e.g. erodibility, organic carbon content) with DEM derived and Alpha Earth AI topographic and land use/cover data to classify abandonment pathways. This will distinguish between areas undergoing "Positive Rewilding" versus those at "High Degradation Risk".



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- **Identify socio-economic drivers of degradation vs. rewilding:** To relate the observed land use trajectories with public Eurostat socio-economic data. The objective is to identify the demographic and economic profiles of territories (e.g. farmer age structure, depopulation rates, farm profitability, CAP subsidy reliance) that are statistically associated with "negative" degradation spirals versus "positive" rewilding outcomes.
- **Develop a territorial LDN balance index:** To create a composite, policy-relevant index that weighs the ecosystem service gains from rewilding (e.g. estimated carbon sequestration potential) against the environmental losses from degradation (e.g. hydro-sedimentary conditions, fire risk). This index will score and rank European territories based on their trajectory towards or away from Land Degradation Neutrality.
- **Co-design targeted policy intervention scenarios:** To use the framework to model the potential impact of different policy measures on the LDN balance. This involves answering strategic questions like: *Which territories would benefit most from subsidies for active management of abandoned land? Where are payments for the ecosystem service of rewilding most appropriate and least risky?*

Research topic 1.2: Design and evaluation nature based solutions for the adaptation and mitigation to climate change of silvopastoral systems

Work Location: University institute of the Dehesa at the University of Extremadura - INDEHESA Research Institute on Silvopastoralism

Research topic description: Nature Based Solutions (NBS) include a broad set of practices that encourage resource conservation, minimise degradation and promote biodiversity, while helping to mitigate climate change. These practices are of particular interest for grasslands, which cover approximately 26% of the Earth's land surface, mostly in the form of silvopastoral systems in the Mediterranean and other semiarid regions. Grasslands, in particular Mediterranean grasslands, are very sensitive to climate change and often suffer some level of degradation. Consequently, the multiple ecosystem services provided by these systems are threatened by degradation and climate change impacts, in a context of low profitability and the need to reduce emissions from the livestock sector. In this regard, the main objective of this project is to assess the potential of NBS to increase resilience and mitigate soil GHGs (CO₂, CH₄ and N₂O) emissions in the dehesa and other Mediterranean silvopastoral systems. In particular, we will evaluate four practices, independently and in combination, related to i) the improvement of the productivity (i.e. the sowing of biodiverse legumes lawn and rotational grazing) and ii) the circularity (activated biochar amendments from pruned residues and keyline). The project will address the effects of NBS on: 1) the functional and structural diversity of soil microbiome, 2) the soil nutrient dynamic, with special focus on N and P, 3) the GHGs dynamics and soil carbon sequestration, 4) the



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effects on plant production and functioning, and 5) to understand the mediating effect of physical, chemical and biological properties in nutrient dynamic and GHGs fluxes in response to NBS. Unravelling the underpinning mechanisms that govern the response of these practices is key for a sustainable management of the Mediterranean silvopastoral systems in a context where the mitigation of GHGs related to livestock production systems is fundamental to combat and adapt to future climate change.

Research objectives: The main objective of the project is to assess the potential of Nature Based Solutions (NBS) to increase resilience of Mediterranean silvopastoral systems (e.g., Iberian dehesa) to face climate change at the time soil GHGs (CO₂, CH₄ and N₂O) emissions are reduced, with the aim to reach the carbon neutrality of extensive grazing livestock farms.

As such, the aim of this project is articulated in the following 5 general objectives and their respective specific objectives:

- *To assess the functional and structural diversity of soil microbiome in response to NBS.*

Specific objective 1.1. To evaluate changes in soil microbiome structure with soil management practices.

Specific objective 1.2. To quantify microbial genes involved in GHGs emissions (N₂O, CH₄, CO₂) and phosphorus mobilization.

- *To study the soil nutrient dynamic, with special focus on N and P in response to NBS.*

Specific objective 2.1. To monitor the management effects on the seasonality of soil N and P forms.

Specific objective 2.2. To monitor the management effects on the seasonality of soil enzymatic activity.

- *To evaluate soil GHGs dynamics and soil carbon sequestration in response to NBS.*

Specific objective 3.1. To measure temporal dynamics of GHGs fluxes in response to NBS.

Specific objective 3.2. To assess changes in soil carbon content and fractionation in response to NBS.

- *To evaluate the effect of NBS on plant production and functioning.*

Specific objective 4.1. Assessment of the response of pasture production, quality and biodiversity to NBS.

Specific objective 4.2. Evaluation of the tree physiological and productive status in response to NBS.



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- *To understand the mediating effect of physical, chemical and biological properties in nutrient dynamic and GHG fluxes in response to NBS.*

Specific objective 5.1. Unveiling relationships among soil physicochemical properties and soil microbial activity and structure.

Specific objective 5.2. Assessment of the relationships among soil nutrient dynamic, microbial abundances, pasture properties and GHG fluxes.

Specific objective 5.3. To model long-term dynamics of GHGs in response to CSA practices

Research topic 1.3 : Sustainable Valorisation of Agri-Food Plant By-Products for Novel Ingredients and Functional Food Design

Work Location: University Institute of Agricultural Resources Research

Research topic description: The proposal seeks to revalorise agro-industry waste by use bioactive compounds (prebiotics) with a potential to modulate beneficial microbes in the human gastrointestinal tract, such as *Bifidobacterium*, *Lactobacillus*, bacteroides, butyrogenic bacteria, etc. with the objective of restoring healthy concentrations of bacteria in the human gut microbiome. The design of this potential prebiotic/probiotic ingredient with a scalable methodology could be the basis for the development of functional food ingredients from agro-industry waste. The Extremadura's Agroindustrial sector is crucial in the regional economy. The University Research Institute for Agricultural Resources (INURA) has among its main lines of research the revalorisation of agro-industry waste, and in the last decade has advanced in the knowledge of this research line through competitive regional and national projects, as well as private funding through agreements exploring its functional properties as prebiotic capacity, antioxidant, antimicrobial and antihypertensive. This proposal will improve competitiveness, sustainability, and the circular economy of agro-food chains. In addition, it involves two major areas of interest of the European Commission, the recovery of agro-industry wastes and their potential applications to benefit human health.

Research objectives: The project aims to transform agro-industrial residues into high-value-added ingredients. Through green extraction technologies, bioactive compounds will be obtained to formulate functional foods designed to evaluate the impact of intestinal microbiota balance, providing nutritional solutions for the management of intestinal pathologies and overall well-being. To achieve this general objective, the following specific goals will be addressed:

- *Develop and optimise a scalable, sustainable (green) extraction process for isolating bioactive compounds—specifically dietary fibre and phenolic compounds—from agro-industrial plant by-products in Extremadura, through*



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modelling of extraction conditions to maximise yield and purity.

- *Characterise the phytochemical profile of the obtained extracts using chromatographic techniques.*
- *Investigate the functional properties of the extracts, including prebiotic capacity, antioxidant potential, antiproliferative effects, anti-inflammatory activity, antimicrobial activity, and fiber-associated functionalities.*
- *Evaluate the functional performance of selected bioactive compounds under simulated gastrointestinal digestion, using multi-omics approaches to investigate their stability and to elucidate the mechanisms by which the extracts influence gut microbiome composition and host physiology.*
- *Explore the techno-functional performance of the bioactive extract in different food matrices to formulate a functional food, validating its sensory acceptance and physicochemical stability during storage to assess its potential for industrial application. The evaluation will include extract stability, impact on texture, water-holding capacity, oxidative protection, and effects on product shelf-life.*
- *Conduct a life-cycle assessment (LCA) to quantify the environmental benefits of upcycling agro-industrial residues into functional ingredients. To demonstrate circularity gains and reductions in waste, emissions, and resource consumption.*

Research topics related to Challenge 2: Innovation in health and technology for rural development

Research topic 2.1: Pharmacological aspects of Equality and Inclusion in Extremadura

Work Location: University Research Institute for Biomarkers of Molecular Pathologies

Research topic description: Addressing these issues offers major benefits: improving public health, reducing healthcare disparities, and fostering social cohesion. To achieve these goals, there is an urgent need to assess how equality and inclusion affect pharmacological therapy, one of the main pillars of healthcare. Our objective is to gain a comprehensive understanding of the needs of these individuals, identify barriers to compliance, and develop strategies to optimize therapeutic outcomes.

To this end, we propose a detailed analysis of drug consumption patterns in the region, with a particular focus on immigrant populations. This will allow us to identify key factors and



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unmet needs, which can inform regional policies and clinical protocols. The study will leverage anonymized data on drug use, stratified by geographic area, sex, age, and other relevant variables, and compare these patterns with those of the general population in Extremadura. Advanced artificial intelligence algorithms will be applied to uncover trends and predictive factors. We will explore classification accuracy using Weka open-source machine learning software, and complement deep learning approaches (e.g., convolutional neural networks, generative adversarial networks) with alternative techniques better suited for smaller datasets, such as Bayesian models and decision trees, to minimize overfitting.

Ultimately, this project aims to provide actionable insights that will enhance healthcare delivery, support evidence-based policy-making, and promote equitable access to pharmacological therapies for all residents of Extremadura.

The growing impact of migration in Extremadura presents significant challenges and opportunities to ensure equity and inclusion for affected individuals. Among these, healthcare—particularly pharmacological therapy—is a cornerstone of well-being and social integration. Many migrants originate from regions with endemic diseases requiring specialized treatments that were previously uncommon in Extremadura. Additionally, cultural and educational differences can influence adherence to conventional therapies, potentially compromising health outcomes.

Research objectives: Migration is reshaping the demographic and healthcare landscape of Extremadura, creating both challenges and opportunities for equity and inclusion. Among the most critical aspects of healthcare, pharmacological therapy stands as a cornerstone for disease management. Migrants often come from regions with endemic diseases requiring treatments previously uncommon in Extremadura. Additionally, cultural and educational differences can affect adherence to conventional therapies, leading to poor compliance and compromised outcomes.

Addressing these issues is essential to prevent health disparities and ensure efficient resource allocation. Proactive measures will improve public health, foster social cohesion, and strengthen healthcare systems.

The general objective of this research topic is to evaluate the impact of migration on pharmacological therapy in Extremadura, ensuring equitable access and optimal therapeutic outcomes for immigrant populations.

Specific Objectives

- *Analyze drug consumption patterns among immigrant populations compared to the general population.*
- *Identify cultural, educational, and clinical factors influencing treatment adherence.*
- *Detect unmet needs and barriers to equitable access.*
- *Apply artificial intelligence and machine learning techniques to classify and predict trends using anonymized, stratified data.*



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- Provide evidence-based recommendations to inform regional healthcare policies.

Expected Outcomes

- Mapping of drug consumption patterns among immigrant populations.
- Identification of determinants of adherence and systemic barriers.
- Predictive models for targeted interventions.
- Policy recommendations to enhance equity and inclusion in pharmacological therapy.

Impact

This project will:

- Improve public health by ensuring effective treatment.
- Reduce healthcare disparities and promote social integration.
- Optimize resource allocation and reduce costs.
- Position Extremadura as a leader in data-driven healthcare policy.

In summary, by combining rigorous analysis with advanced computational methods, this initiative will provide actionable insights to strengthen healthcare delivery and ensure that equity and inclusion become practical realities in Extremadura.

Research topic 2.2 : IoT and Distributed Computing for Health Improvement in Rural Environments

Work Location: University Institute of Applied Information Technologies Research

Research topic description: Rural environments face persistent barriers in accessing healthcare services due to geographic dispersion, ageing populations, scarcity of healthcare professionals and limited digital infrastructure. In many rural regions, internet connectivity is intermittent, unstable or partially unavailable, which restricts the adoption of conventional cloud-based health systems. This research topic proposes the development of advanced technological solutions integrating Internet of Things (IoT), Artificial Intelligence (AI) and distributed computing to improve healthcare services in rural contexts.

The proposal focuses on the design of layered distributed solutions, where data processing and intelligent decision-making are performed at different layers depending on proximity to the end user and network conditions. The layers closer to patients and healthcare professionals will enable local data analysis and health monitoring, allowing the system to remain operational even without continuous connectivity. Outer layers will support wireless communication and remote data exchange across territories whenever communication channels become available.



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AI methods will be incorporated to enable distributed intelligence, collaborative model development and privacy-preserving analytics without relying on centralized data storage. These solutions are expected to improve robustness, scalability and reliability of rural healthcare services.

Research objectives:

General Objective:

Develop and validate intelligent distributed healthcare solutions based on distributed computing, IoT and AI that improve the functioning of rural healthcare systems and, consequently, enhance the health and well-being of people living in rural environments, particularly under conditions of limited or intermittent connectivity.

Specific Objectives:

- **Distributed computation and service placement solutions in rural healthcare systems:** Develop and evaluate distributed healthcare solutions based on efficient placement of services and computational processes across multiple layers, prioritizing proximity to users, workload distribution, and responsible use of available resources. This objective focuses on improving system performance, reducing latency, optimizing energy consumption, and ensuring scalability in resource-constrained rural environments.
- **Ensure healthcare continuity under intermittent connectivity conditions:** Develop healthcare solutions capable of maintaining reliable operation during periods of limited or unavailable internet connectivity. This objective addresses continuity of healthcare services through local data processing and autonomous decision-making, as well as system recovery and synchronization mechanisms once connectivity becomes available again, ensuring data integrity and consistency across distributed environments.
- **Strengthen health monitoring and early diagnosis:** Develop and integrate methods for continuous health monitoring, early detection of risk situations, and predictive analytics. These methods will enhance clinical decision-making and support preventive healthcare strategies suited to rural populations.
- **Enable privacy-preserving collaboration across rural territories:** Implement approaches that allow healthcare institutions and devices across rural areas to collaboratively train AI models without sharing sensitive data. This objective ensures compliance with ethical standards and data protection regulations while enabling collective intelligence for improved health outcomes.
- **Develop sustainable and transferable healthcare solutions:** Design solutions that are energy efficient, scalable and adaptable to different rural contexts, ensuring their long-term sustainability.

Research topic 2.3: Quality and safety of animal origin foods



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Work Location: Research Institute of Meat and Meat Products

Research topic description: There is a growing demand for foods that meet essential requirements: (1) a high level of food safety, (2) sustainable production, (3) balanced nutritional composition, (4) health benefits, and (5) appealing sensory characteristics. Within this global context, animal-based products traditionally produced in rural areas of Extremadura stand out as a benchmark due to their sustainable production technologies and internationally recognized sensory quality.

A detailed understanding of the factors that determine these properties is crucial both for optimizing them and for providing a foundation for the development and improvement of other foods. These factors range from the microbial populations in the products, which contribute to safety and quality, to the environmental and processing conditions that drive changes during their production.

Moreover, traditional food production systems in rural settings must adapt to current regulatory and market requirements, which may compromise their original characteristics. To address this challenge, it is essential to: (1) gain in-depth knowledge of the product's properties, (2) understand how process modifications affect these properties, and (3) design scientifically informed adjustments that preserve the essence of the product while meeting new demands.

Research objectives: The overarching objective of this proposal is to generate a comprehensive and detailed understanding of the quality and food safety characteristics of traditional animal-based products (meat and meat products, cheeses, honey, etc.) from Extremadura rural areas. This knowledge will serve as a foundation for optimizing production systems and enabling their adaptation to current demands, including legal requirements, market expectations, and consumer preferences.

Specific objectives:

- Provide a detailed characterization of the composition and properties of animal-based products from the rural areas of Extremadura. This characterization will encompass basic nutritional composition, the quantification of compounds influencing sensory attributes, and a metabolic profiling of the products, including compounds with potential beneficial or harmful effects on health.
- Determine in detail the microbial population constituting the microbiota of these products, identifying possible routes through which microorganisms reach these food products, and clarifying the potential implications of food microbiota on product quality attributes and on health risks associated with the possible presence of pathogenic microorganisms.
- Elucidate the impact of production system factors—from raw materials to the various processing conditions—on the different product characteristics, both in terms of nutritional value and potential health implications, as well as sensory

quality.

- Identify the ecological factors shaping the microbiota of the studied products and assess the extent to which their modification leads to changes in microbial populations and the resulting effects on the quality and safety of traditional foods.
- Propose new strategies concerning raw materials and processing systems, including the use of starter, protective, or probiotic cultures, and the incorporation of functional ingredients based on natural compounds native to the region. These strategies should enable the adaptation of traditional product characteristics to regulatory and market demands, including compliance with health standards, extended shelf life, more stable sensory attributes, formulations tailored to consumer preferences, and features adjusted to different market segments.

Research topic 2.4: Personalized Medicine Program for Prevalent Diseases for rural development

Work Location: University Institute of Biosanitary Research of Extremadura

Research topic description: The aim of this research topic is the personalization of therapy, both pharmacological and non-pharmacological. While medication prescription has been the basis of therapy, in the 21st century it is necessary to consider other factors relevant to maintaining health, such as education in healthy habits. Traditionally, Personalized or Precision Medicine has been based on the use of molecular (genetic) markers. Pharmacogenetics is now a reality not only at the research level, but also in clinical practice and regulation. The European Medicines Agency, in a recent review, determined that 32% of the drugs evaluated by the European centralized procedure contain a genetic biomarker in their Summary of Product Characteristics (SmPC). Therefore, this line of research aims to carry out projects for the implementation of Personalized Medicine in the Public Health Service, primarily in Primary Care, which is essential for healthcare assistance in rural areas.

This research topic aims to carry out research projects in Personalized Medicine in rural areas, through genetic and epidemiological studies of the rural population, as well as to promote and carry out training programs and activities in rural areas, aimed at both health professionals (doctors, nurses, pharmacists) who assist rural areas, and the general population, with activities in health education of the individual in rural areas, with activities to promote health research in Extremadura, such as innovation in rural sexual health, where vulnerabilities in emerging infectious diseases in the rural environment can be addressed.

Research objectives: The main objective of the project is to adapt disease prevention, diagnosis, and treatment to the individual characteristics of each patient, considering their genetic profile, environment, and lifestyle in rural areas.

The specific objectives are aligned with INUBE's strategic research line, within which the requested project is framed:

- Clinical Pharmacogenetic Methodology and Personalized Medicine.



- Personalized Medicine in Mental Health.
- Personalized Medicine in Vascular Diseases.
- Personalized Medicine in Nephrological Diseases.
- Personalized Medicine in Infectious Diseases.

Research topics related to Challenge 3: Education, inclusion and community development

Research topic 3.1: Identities, territory and demographic change: an approach to rural depopulation in Europe

Work Location: University Institute of Heritage Research

Research topic description: Depopulation and demographic ageing represent structural problems in rural areas of Europe, with both territorial and intergenerational effects. This demographic process, present in different rural contexts globally, has been studied historically in countries such as England, Italy, and the United States, where it is associated with the decline of traditional agriculture and economic and technological changes. Population loss has profoundly transformed rural social structures, in a context of increasing cultural globalisation and the expansion of the consumer society.

In Europe, ageing is considered one of the main challenges for the sustainability of rural areas, especially in Spain, where the exodus of young people intensifies demographic imbalances. The European Commission warns that depopulation and ageing are closely linked and threaten territorial cohesion and equitable access to basic services.

Given this context, the active participation of young people, older adults and local actors becomes essential to strengthening community sustainability. Shared responsibility in land-use planning promotes more inclusive and supportive environments based on the recognition of generational diversity. In this context, intergenerational learning plays a key role: not only does it promote the transmission and co-creation of knowledge and values, but it also fosters integration, mutual respect and community resilience. Likewise, in age-friendly environments, it enhances the value of older people's experience and young people's creativity, generating horizontal and collaborative relationships.

Research objectives: General objective

The general objective of the research focuses on two needs: 1) to understand ageing as a territorialised demographic process with a strong socio-spatial impact in Europe; and 2) to analyse the main community strategies that can strengthen social cohesion and intergenerational coexistence in highly ageing rural environments.

Specific objectives



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1.- To analyse the demographic structure of small rural communities in Extremadura, paying particular attention to ageing processes, with the aim of identifying associated territorial patterns and understanding the demographic dynamics that characterise the current rural context.

The study of rural demographic structure requires attention to both age distribution and the processes of depopulation that characterise much of southern Europe. Demographic ageing is one of the most profound transformations in Europe and has a particularly intense impact on rural areas, with a continuous loss of young people. The rural depopulation, especially of the young working population, combined with low birth rates, has created imbalances that are reshaping the demographic and social landscape of small rural municipalities. Analysing these dynamics in Extremadura will provide an understanding of how ageing is territorialised, determining the economic structure and the availability of local services.

2.- Evaluate community projects focused on coexistence and intergenerational interaction from a territorial perspective, considering ageing as a strategy to promote age-friendly environments and strengthen the social fabric. This objective aims to determine the effectiveness of the project's collaborative approach in building supportive relationships between generations.

Ageing should not only be addressed as a demographic challenge, but also as an opportunity for social cohesion when articulated through intergenerational projects. Intergenerational learning promotes the creation of meaningful bonds between young and old, contributing to community strengthening and the transmission of knowledge. These projects take on a territorial dimension when they aim to transform rural areas into friendly environments capable of integrating older people into community life. The World Health Organisation (WHO, 2007) argues that friendly environments require not only accessible infrastructure, but also social capital, participation and co-responsibility, elements that make it possible to evaluate the effectiveness of community initiatives based on intergenerational collaboration.

Research topic 3.2: Community development in rural contexts from an educational and inclusive perspective

Work Location: University Institute of Educational Research and Prospecting at the University of Extremadura

Research topic description: This research topic focuses on the design, implementation, and evaluation of innovative strategies that contribute to the construction of more inclusive, digitally competent, intergenerational, and community-oriented rural educational ecosystems. The research will analyse how rural schools can become agents of territorial transformation through the adoption of pedagogical methodologies that strengthen social cohesion and promote equitable opportunities for all people, with special attention to gender equality and vulnerable groups.



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The project will examine processes of social inclusion and prevention of early school leaving, incorporating digital literacy, technological skills development, and the responsible use of artificial intelligence to reduce the digital divide between rural and urban areas. It will also explore the potential of active methodologies such as Service-Learning, interactive groups, educational volunteering, and community projects, evaluating their capacity to connect schools with their socio-community environment and consolidate collaboration networks among schools, families, local entities, and development agents.

A central part of the study will address the strategic role of Local Development Agents (LDAs) in articulating socio-educational initiatives that foster employment and entrepreneurship in emerging sectors, promoting citizen participation and inclusive local governance. At the same time, the research will promote intergenerational connection and the valorisation of traditional knowledge through the integration of Nature-Based Solutions (hereafter, NBS) as opportunities for learning, social innovation, and the creation of green jobs in rural areas. The approach will be interdisciplinary, combining qualitative and quantitative analyses to identify barriers, facilitators, and good practices that contribute to the sustainable development of rural territories. As a result, this line of research aims to generate transferable educational models capable of strengthening social ties, revitalizing rural communities, and promoting active citizenship that is digitally prepared and committed to sustainability and equality.

Research objectives:

General Objective: To promote inclusive, digitally competent, intergenerational, and community-oriented rural educational ecosystems through the research and validation of innovative methodologies (Service-Learning, community projects, NBS, educational AI, intergenerational connections) that strengthen social cohesion, gender equality, and sustainability in rural areas.

Specific Objectives.

- Foster social inclusion and educational equity in rural contexts: Analyse and design strategies to prevent early school leaving, with special attention to families, students, young people, and vulnerable groups. Promote digital skills, media literacy, and ethical use of AI to reduce the rural digital divide. Develop tools to strengthen technological skills applied to the territory.
- Promote educational methodologies connected to the socio-community environment: Investigate the impact of strategies such as Service-Learning, volunteering, interactive groups, community microprojects, or rural social innovation labs. Identify barriers and facilitators for rural schools to become nodes of community development. Design replicable models of collaboration between schools–families–community agents–local administration with a gender perspective.



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HR EXCELLENCE IN RESEARCH

- Strengthen community development and the strategic role of Local Development Agents (LDAs): Analyse how LDAs can articulate projects that connect employment, entrepreneurship, and education in rural areas. Co-design innovative proposals that integrate training, employment, and sustainable socio-educational solutions linked to strategic sectors of the region. Evaluate governance models that integrate public administration, associations, businesses, and citizens to reduce inequalities.
- Promote intergenerational connection and Nature-Based Solutions (NBS): Study models of intergenerational links between youth and older adults for the transmission of traditional and local knowledges into solutions to the Socio-Ecological Transition. Assess how such knowledge can become new niches of green employment (NBS, agroecology, sustainable land management, cultural tourism, Decentralized and local composting, community caregiving). Develop educational proposals that integrate scientific and traditional knowledge, strengthening identity, belonging, and community well-being.
- Gender perspective (transversal across all objectives): Identify gender gaps specific to rural areas (digital, educational, labour, technological). Incorporate an intersectional analysis: young women, migrant women, older women, returning women scientists, etc. Evaluate the impact of interventions to guarantee equal access to technology, education, employment, and community participation. Promote female role models in science, rural development, entrepreneurship, and community leadership.



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