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LEG(O)NEST - OPTIMIZING THE VEGETABLE AGRI-FOOD SYSTEM THROUGH THE BROAD APPLICATION OF RESEARCH AND DEVELOPMENT RESULTS TO STRENGTHEN FARMERS` COMPETENCIES

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Abstract

The diversity of life on Earth is the foundation of agriculture - from the food we eat to the ecosystem `services` that sustain our existence. The loss of biodiversity can have a catastrophic impact on economic prosperity, agriculture, and other aspects of life. Biological resources are an essential contribution to the country`s economy, enhancing the sustainability of agri-food products. The genetic base of today`s crops is alarmingly narrow, posing a threat to food security for a growing population. Current aggressive agricultural practices and the excessive use of synthetic inputs severely endanger biodiversity, leading to genetic uniformity. Modern, imported varieties have replaced local varieties and populations in traditional agro-ecosystems, resulting in increased genetic vulnerability to diseases and pests. Leg(O)Nest proposes a model to promote biodiversity development through: identifying new genes/traits that enhance adaptation to specific cultivation conditions; identifying traits that ensure suitability for organic farming systems; developing new high-yielding varieties with a broad genetic base; enhancing the value of a wide range of newly created varieties in the agri-food chain.

Key words*: vegetables, plant genetic resources, varieties, resilience, use.*

INTRODUCTION

It is well known that Romania, including the North-East region, is increasingly becoming merely a market for vegetable imports; that farmers struggle to access supermarket chains; and that protected cultivation spaces (greenhouses, tunnels) are severely insufficient, even though implementing such systems and specific technologies would significantly increase the capacity to supply raw materials throughout the year. Moreover, the availability of high-quality seed material, characterised by tolerance/ resistance to different stressors, capable of performing under specific climatic conditions and meeting the nutritional and organoleptic expectations of consumers as well as the productivity needs of growers, is a recurrent necessity expressed by both farmers and consumers.

Leg(O)Nest represents a Regional and National Initiative to Support Romanian Research Competitiveness, materialized in a project cofunded by the European Union, Romanian Government, implemented through the Regio Nord Est Programm 2021-2027, ADR NORD EST. The initiative entitles the Research Centre for the Smart, Integrated and Multi-Purpose Use of Plant Genetic Resources Across the Agri-Food Chain, for the Benefit and with the Involvement of the Community.

This work represents a positioning paper, and it has as an objective the communication related to the project potential at the regional and national level. The Leg(O)Nest consists of two major components: research and **investment** in infrastructure, the second one being major in terms of allocated funds. It is considered to have potential beyond regional borders, being designed to reinforce research for vegetable production in different systems, as organic and conventional, open-field and protected systems, aiming for a solid impact on the national economy. Even though the focus is on organic agriculture, the developed solutions and materials are not restricted to it, contrary, they are designed for wide application also in conventional systems.

The objectives are clearly harmonized and linked to national and European legislation,

especially when approaching the organic sector, which is more restrictive and resources demanding. The European Commission has established several instruments, including the European Action Plan for Organic Production Development (2021), which is structured around three pillars: consumption-production- sustainability. All these pillars are addressed in the research framework proposed by the Leg(O)Nest center. The project's implementation aims to achieve the targets of the Farm to Fork and Biodiversity strategies, which include reducing the use of chemical fertilizers, pesticides, nutrient losses, and greenhouse gas (GHG) emissions, while also forecasting an increase in agricultural and organic farming areas.

Leg(O)Nest will work to strengthen a scientific framework in which farmers have access to biological materials and know-how to facilitate and motivate adherence to organic agriculture and performance in conventional systems by exploiting agroecological practices. The main challenges in implementing organic agriculture are related to insufficient financial incentives for conversion, confusion with other quality schemes, and low awareness of the benefits of organic production for health, climate, and the environment.

THE INTERNATIONAL AND NATIONAL CONTEXT

Strategies and legislation

Leg(O)Nest proposes a robust intervention in the productive sector through scientific initiatives, while also engaging in awareness-raising, information, and education activities for consumers across different age groups and educational levels.

The project will draw on key references, including: The European Green Deal (2019), The European Commission's Communication to the European Parliament on the Action Plan for Organic Production Development (2021), translated into Romania's National Action Plan for Organic Production Development (2021), The Farm to Fork Strategy (2020), alongside the upcoming Zero Pollution Action Plan for Water, Air, and Soil (2021), The Circular Economy Action Plan (2020), The EU Biodiversity Strategy for 2030 (2021), Regulation 848/2018 on Organic Production and Labeling of Organic Products (2018). From these international documents, transposed into the national legislation of member states, we highlight the following European objectives and approaches to which Leg(O)Nest actively contributes:

The Commission's goal is to achieve 25% of organic agricultural land by 2030 and 100% use of organically certified seeds, which also involves supplying farmers with seeds produced under organic conditions. Consequently, there must be more land and dedicated solutions for organic seed production.

The New Action Plan for Organic Agriculture (2021-2027) forecasts remarkable growth in the organic sector over this decade, encouraging farmers to transition to organic farming, thereby increasing the accessibility of organic food and closing the gap between the status quo scenario and the "additional effort" needed to reach the 25% target by 2030.

The Commission aims to increase the share of research and innovation (R & I) and to dedicate at least 30% of the R & I budget in agriculture, forestry, and rural areas to actions with specific or significant relevance to the organic sector. Research will focus on, among other things, changing farmer and consumer behavior, higher crop yields, genetic biodiversity, and alternatives to controversial products.

Biodiversity loss can have a catastrophic impact on our economic prosperity, agriculture, and other aspects of our lives. Biological resources are essential for the EU economy, contributing to the sustainability of agri-food products, according to the EU Biodiversity Strategy for 2030.

Since 2021, greater emphasis has been placed on organic production, among the themes targeted by the annual calls for proposals for information measures regarding the CAP (EU (COM(2021), 141 final).

Since 2022, data on the environmental, economic, and social benefits of organic agriculture have been continuously collected, and citizens and farmers are informed about these benefits through more intensive use of social media platforms. Since 2022, the Commission has measured consumer awareness of the EU organic logo to monitor progress since the 2020 Eurobarometer survey (EU (COM(2021), 141 final).

Reorienting the current EU food system toward a sustainable model, ensuring food security and safety, providing sufficient, affordable, and nutritious food, and promoting healthier and more sustainable food consumption and diets, according to the Circular Economy Action Plan: For a cleaner and more competitive Europe (2020).

Concrete actions are needed across the entire food chain, from production to consumption. The aim is to align food production with environmental protection while stimulating investment and sustainable production.

In its resolution of January 15, 2020, on the European Green Deal, the European Parliament emphasized that agriculture has the potential to contribute to reducing EU emissions through sustainable practices such as organic farming.

In its conclusions on the Farm to Fork Strategy, the Council highlighted the role of organic products in a sustainable food system. The strategy comprehensively addresses the challenges of sustainable food systems, recognizing the links between healthy people, healthy societies, and a healthy planet. It challenges the development of a sustainable food system capable of improving primary producers' incomes, strengthening sector competitiveness, and ensuring sufficient, healthy, and financially accessible food for all consumer categories.

Agriculture is both the primary source of food and a significant polluter through soil cultivation, pesticide residues in soil, water, and products. The use of chemical pesticides in agriculture contributes to soil, water, and air pollution, biodiversity decline, and can harm non-target plants, insects, birds, mammals, and amphibians. Excess nutrients (especially nitrogen and phosphorus) in the environment, resulting from overuse, are another major source of pollution with climate impacts. Organic agriculture has a positive impact on biodiversity (biodiversity in organic fields is 30% higher than in conventional fields), creates jobs, and attracts young farmers. From a niche sector, organic agriculture has become a priority for decision-makers and consumers who recognize its value as an opportunity to improve lifestyles, health, and the environment. Sustainable food systems depend on seed security and diversity. The registration of seed varieties, including for organic agriculture, and easier market access for traditional and locally adapted varieties are essential conditions for creating a functional, competent vegetable production system, as highlighted by the EU. Research must provide viable solutions to ensure the success of national action plans targeting the organic sector, and member states must build the necessary capacity for their implementation.

The current size of the sector in which the project's specific activity is carried out

The organic farming sector in the European Union has expanded rapidly in recent years in terms of agricultural areas under organic management, the number of organic farms, and the total number of registered organic operators in the Union. The area used for organic farming has increased by almost 66% over the last decade, rising from 8.3 million hectares in 2009 to 13.8 million hectares in 2019. At present, this area represents 8.5% of the EU's total utilized agricultural area. This growth in organic farmland has been accompanied by a substantial increase in retail sales, which have doubled in value over the last decade, from approximately EUR 18 billion in 2010 to over EUR 41 billion in 2019.

Romania has enormous potential for the development of this sector. Although it ranks among the top 10 European countries in terms of certified organic areas (Figure 1) - including grasslands, arable land, and perennial crops - a significant gap is still noticeable.

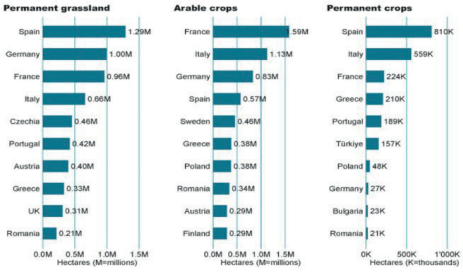

Figure 1. Top 10 countries - certified surfaces

In Romania, in 2022, the total area under organic farming amounted to 644,519.69 ha, of which 221,743.15 ha (34%) was in conversion and 422,776.55 ha (66%) was fully certified organic (Figure 2). According to FiBL 2024 data, in 2022, only 177 ha were dedicated to organic vegetable cultivation.

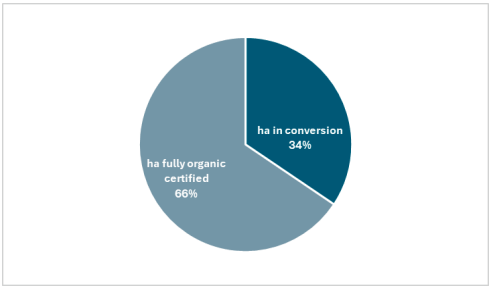

Figure 2. Distribution of areas: organic and conversion cultivation

The total number of registered organic operators in 2022 (Figure 3) included 13,260, as follows: 12,598 agricultural producers (including beekeepers), 203 processors, 502 traders, 25 importers, 25 exporters, and 6 aquaculture production units (MADR, 2024).

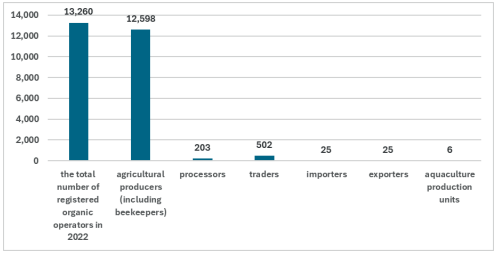

Figure 3. The total number of registered organic operators in 2022

Trends in national and international developments in the field targeted by the project

For the 2023-2027 programming period, the financial allocation for interventions targeting organic farming within the CAP Strategic Plan (SP) 2023-2027 amounts to EUR 389.12 million, of which EUR 162.6 million are dedicated to the intervention supporting commitments during the conversion period, and EUR 226.52 million to the intervention supporting commitments during the maintenance period of organic farming practices.

The *National Action Plan for the Development of Organic Production* of the Ministry of Agriculture and Rural Development (MADR) sets out the following national objectives for the development of organic agriculture:

- Increasing organically cultivated areas and the production of high-valueorganic products.
- Increasing and diversifying organic production, especially in sectors well developed in conventional farming but poorly represented in organic farming (vegetables, fruits, milk, eggs, processed foods, etc.), including the creation of product chains.
- Achieving organic production aligned with consumption needs, at prices accessible to Romanian consumers.
- Integrating organic agri-food production into market supply chains.
- Advising and training farmers for the organic farming system.
- Developing local and regional networks to support the growth of organic agriculture and encouraging farmer associations.
- Encouraging and motivating farmers to obtain organic certification.
- Educating and informing consumers about certified organic products.
- Aligning research activities with the needs of the organic farming sector.
- Increasing consumer confidence by adapting control, prevention, and anti-fraud measures.

Statistical data on organic farming shows a general upward trend in the area under organic management. Considering the unpredictability of factors that may influence organic farming, as well as fluctuations in the number of operators, it can be estimated that the area under organic farming in 2030 could reach at least 800,000 ha, representing approximately 6% of the total agricultural area. Of this target, 488,325 ha represent the objective set by the CAP Strategic Plan 2023-2027 for supporting organic farming commitments.

Factors having a direct influence on the dynamics of the sector targeted by the project

a. Economic factors have a determinant role in the adoption of the organic farming system (OF)

- Fiscal policy - fiscal incentives such as subsidies or tax reductions can encourage farmers to shift to organic practices. Clear fiscal policies supporting organic farming can make this system more financially attractive.
- Investment in R & D - essential for improving agricultural techniques and practices. Research can lead to new pest-control methods, improved soil fertility, and increased productivity in organic farming.
- Market access and international trade - a key factor; growing demand for organic products can motivate farmers to adopt organic practices to align with consumer preferences.

- Regulatory policy - government regulations on quality standards, labeling, and certification of organic products are crucial and must align with EU legislation. Clear and coherent policies build consumer trust and encourage farmers to comply with organic standards.
- Education and awareness — investments in agricultural education and consumer awareness about the benefits of organic farming can be essential. Promoting knowledge about organic practices increases demand and encourages conversion.
- Access to finance - policies that facilitate access to funding are key to supporting the adoption of organic farming.
- Economic stability - a stable and predictable economy encourages investment in organic farming; economic instability discourages farmer engagement.

b. Political factors - a favorable framework for organic farming can positively influence decisions by farmers and consumers.
- Subsidy and financial support policies - government subsidies and financial support for organic farmers are key factors. These incentives make conversion to organic farming more economically attractive.
- Environmental and sustainability policies - policies that promote sustainable agricultural practices and natural resource protection influence decisions to adopt organic farming. These may include regulations on pesticide use, waste management, and soil and water conservation.
- Public health policy - policies that encourage healthy diets and promote organic products can influence consumer demand, stimulating farmers to adopt organic practices.
- Trade policy and market access - trade policies and free-trade agreements influence market access for organic products. Access to national and international markets demanding organic goods is a key driver.
- R & D policy - government investment in research and development for organic agriculture can significantly impact the sector. Research improves techniques and practices, making organic farming more attractive and profitable.
- Education and awareness policies - policies supporting agricultural education and consumer awareness about organic farming can increase demand and encourage conversion.
- Political and governmental stability - a stable political environment stimulates investment in organic farming; instability discourages farmers from taking risks.

c. Legislative factors - provide a solid legal framework for organic farming, sustainable practices, environmental protection, and consumer welfare.
- Regulations on pesticide use - restrict or prohibit chemical pesticides in organic farming, ensuring compliance with sustainable practices and protecting consumer and environmental health.
- Legislation on labeling and certification - essential for guaranteeing that products labeled “organic” meet the required standards.
- Waste management legislation - regulations encouraging recycling and composting reduce negative environmental impacts; proper management of organic and agricultural waste influences organic practices.
- Soil and water protection regulations - important for organic farming; include measures to prevent soil erosion, ensure proper nutrient management, and protect water quality.
- Market access regulations - include quality standards, labeling requirements, and certification procedures ensuring fair and transparent commercialization of organic products.
- Consumer protection legislation - ensures the safety and quality of organic products through testing, monitoring, and traceability requirements.
- Legislation on R & D - can support organic farming by allocating funds for research, improving techniques, and developing new sustainable technologies.

d. Technological factors

Must be adapted to organic farming conditions and require continuous R & D activities.
- Environmental monitoring and control – support farmers to make informed decisions on irrigation, fertilization, and pest control, improving resource efficiency; quantifying the benefits increases acceptance.
- Irrigation and water-management systems - reduce water consumption and improve efficiency, contributing to resource

conservation and reduced environmental impact.
- Pest-control technologies - smart traps, monitoring systems, and biological control methods ensure efficient and sustainable pest management, reducing dependence on chemical pesticides.
- Soil-management systems - low-tillage practices, crop rotation, and intercropping enhance soil biodiversity and support informed decision-making.
- Waste-management technologies - organic waste can become a valuable resource through composting and anaerobic digestion, reducing waste and supplying nutrients to the soil.
- Data-management systems - help farmers collect, analyze, and interpret data on crops, soil, and environmental conditions to improve organic farming efficiency.
- Communication technologies and connectivity: internet access and communication tools facilitate information exchange, market access, and networking among farmers and experts.

e. Social factors - play a decisive role in the adoption of organic farming.
- Consumer education and agricultural training.
- Informed consumers are more likely to choose organic products, stimulating demand and encouraging farmers to convert. Agricultural education helps farmers understand the advantages of organic farming and transition successfully.
- Consumer attitudes - positive attitudes toward organic farming and understanding its benefits motivate consumers to support and purchase organic products.
- Local culture and traditions - in some regions, strong traditions of sustainable agriculture facilitate the adoption and expansion of organic farming.
- Social movements and organizations - advocacy for sustainable agriculture can create strong social pressure on policymakers to support organic farming.
- Government policies - public health campaigns, subsidies for organic products in schools or hospitals, and food-safety regulations influence adoption.
- Cooperation and social networks - collaboration among farmers, researchers, and organizations supports the implementation of organic farming through knowledge and resource sharing.
- Role of media and influencers - media coverage and influencers can significantly shape public perception; positive and educational messaging increases awareness and acceptance of organic farming.

LEG(O)NEST STRUCTURE AND VISION

Leg(O)Nest is a solid research infrastructure with immense potential for advancing the field of vegetable cultivation, high-value valorization of vegetables, and certified organic and conventional planting material, with an impact on food security, agriculture, as a response to climate change pressures, exploring judiciously the resources, and ensuring biodiversity conservation. The project responds to clearly identified market needs, extensively aligned with the regional challenges defined in the RIS3 strategy. The Leg(O)Nest infrastructure proposes an ambitious approach, starting from the discrepancy between the current status and the significant agricultural potential measurable in the performance that the agri-food sector in the North-East region could achieve through a real, efficient, and feasible alignment of research with the private sector (farmers, processors, retailers). The project addresses field/ market-identified needs:
- The imperative need to increase and improve vegetable production areas and yields through the development of productive, high-quality, resilient varieties suitable for cultivation in the region;
- Adapted and competitive practices and techniques for cultivation and for producing certified seed material;
- The necessity of consultancy and advisory services for vegetable farms;
- The need to increase added value through the development of valorization matrices/models;

Specialized studies show that improving the performance of vegetable species in the context of combating the negative effects of climate change requires significant investments in plant breeding and in improving cultivation systems. There is a vast amount of genetic resources (GenRes) as old varieties, local landraces, crop wild relatives (CWR), cultivars, or materials with completely unknown biological status,

representing enormous variability that requires collection, characterization, evaluation, and conservation in order to be effectively valorized in various directions: the food industry, breeding, cultivation technology, organic agriculture, etc.

The Leg(O)Nest thematic framework adds value through activities carried out in experimental fields (TRL 2-4), progressing to the demonstration and validation of technologies under operational conditions (TRL 5-7), and culminating in (TRL 8-9) patent applications/variety registration and the full demonstration, implementation, and sustainability of the integrated, multi-purpose management of plant genetic resources.

To valorize and exploit previous breeding results (TRL 4-5), promising material - cultivars, varieties, and lines obtained through prebreeding and breeding, open-pollinated cultivars, will be investigated under specific organic and conventional farming conditions, where practices, methodologies, and specific inputs will be tested (TRL 6). Genetic resources will be phenotyped and genotyped to identify and demonstrate specific traits relevant for productive and qualitative performance (TRL 6). To exploit plant resistance (tolerance/resistance to biotic and abiotic stress), the genes responsible for these traits will be identified and investigated, enabling targeted and competitive use of the developed resources. High-value valorization models will be created, such as sprouts, food products, mulches, green manures, compost, and dedicated links. Protocols, tools, and guidelines will be developed to improve and standardize cultivation and harvesting processes, reducing losses and enhancing the quantitative and qualitative potential of vegetable species (TRL 6-7).

The economic impact will be strengthened by dedicated technological pathways for: exploiting the potential for multi-purpose food use, increasing yield and biomass, and reducing seed loss during maturation and harvesting.

Traits selected for the agri-food chain, based on market needs and preferences, will be identified (TRL 3-5), and the germplasm collection will be valorized and exploited thanks to its visibility and availability (TRL > 6).

Interference and potential impact in different segments of the agri food chain:

Contribution to strengthen food biosecurity and food safety, through:

- providing healthy, locally produced food resources, obtained through modern technologies adapted to regional specificities, by: (a) developing new varieties adapted to the agro-climatic conditions of the region, with superior nutritional profiles, high productivity, and a positive impact on balanced consumer development, with the potential to counteract the negative effects of low-quality food and unbalanced diets that lead to obesity and other nutrition-related diseases; (b) expanding the vegetable portfolio with neglected species and acclimatized species newly introduced into cultivation, with multiple potential uses.
- diversifying processed products based on natural principles to increase national nutritional quality and food security, ensuring independence from external markets. The COVID-19 pandemic and the conflict in Ukraine have highlighted the importance of robust and resilient EU food systems within a sustainable circular bioeconomy, capable of responding to global shocks and supply chain disruptions and of mitigating the socio-economic impact of crises, particularly food poverty.
- developing models for high-value valorization of secondary products resulting from seed production (pepper pulp, pumpkin, melon, physalis, tomato juice, root vegetables, etc.).
- creating good-practice models for vegetable producers and processors - safe processed products with high nutritional value.
- improving population nutrition by supplying high-quality indigenous raw materials, including organic products, as well as planting material for large-scale production.
- Expanding the product range by developing new types of products.
- Promoting and valorizing local varieties through the development of a pilot vegetable processing station (preserves: sauces, stews, pickled cucumbers, beans, long peppers, bell peppers, kapia peppers, cabbage, red beet, etc.), based on traditional recipes and customized methods within SCDL Bacău.
- Creating intelligent exploitation models aligned with the high expectations of

consumers and diverse dietary needs: minimally processed products (freeze-dried, dehydrated, sprouted), organic products.
- Using aromatic and spice species both for their intended culinary purpose and for their natural preservative potential.

The entire set of practices and measures developed - from biological material collection, use in breeding, creation of new cultivation technologies, and specific pathogen-control steps, to high-value food valorisation - has as its main goal biodiversity conservation, eliminating the negative effects of agriculture on the environment and human health.

Contribution to Smart Farming - Leg(O)Nest creates modern, alternative solutions to classical cultivation systems through the integration of advanced, automated technologies specific to protected cultivation, improving hydroponic, vertical, and container-based cultivation systems for high-value use of new varieties. One new greenhouse and two plastic tunnels (part of the research infrastructure) will ensure the implementation of research components.

Non-food uses of agricultural by-products

These uses bring added value to the vegetable sector and ensure efficient utilization of agricultural waste (plant residues). The aim is to identify new potential applications through models for high-value valorisation of secondary products from seed production, unsuitable for human consumption, redirected towards high-quality compost production;

As previously mentioned, the project consists of two convergent components: (1) Research and Innovation (2) Investments in infrastructure, which have as a common goal the creation of new capacities for the vegetable research domain in view to supporting and stimulating farmers' competitiveness. This will be feasible through the development of new solutions and cultivation schemes: intercropping, successive, vertical, container-based, new genetic resources: patented/ homologated and specific matrices for valorization in the agri food chain. Distinct RDI services that will be available through the new infrastructure include:

Variety and hybrid testing - evaluation of agronomic performance, including genetic resistance to specific pathogens. Testing in different systems (organic vs. conventional, protected vs. open field, fully controlled environments). The novelty consists in the infrastructure's capacity to simulate different cultivation conditions, thus providing recommendations for growing varieties in specific areas, systems, and conditions.

Testing the quality of vegetable products - this service includes complex analyses aimed at validating the quality of the batches investigated. The categories of analyses will be diverse: physiological, morphological, organoleptic, biochemical, and genetic. Beyond quality validation, genetic analyses will contribute to ensuring traceability of materials and strengthening the organic certification process.

Assessment of capacity-potential and consultancy for implementing conversion towards organic certification - this service supports vegetable farms in evaluating their readiness and implementing the steps required for organic certification.

Training and professional specialization: professional training for vegetable growers and other economic operators in agriculture and rural development.

Educational networking and support for entrepreneurial initiatives - Activities aimed at fostering knowledge exchange, collaboration, and the development of new business ideas in the agri-food sector.

Seed multiplication services for higher biological categories - The newly created varieties developed in the project will be multiplied within the Leg(o)Nest infrastructure and transferred to beneficiaries for further multiplication and valorization.

Testing of certified inputs for the organic system - This service is offered both to farmers and to input producers, with the purpose of evaluating the effectiveness of these products in organic vegetable production.

Related Research and Innovation agenda, the project aims to create a functional and complete approach in terms of exploring diversity for the benefits of breeding and along agri-food chains. Four convergent themes with specific tasks and objectives will be implemented. The starting point of our initiative, materialized in Theme 1 aims to capture, investigate, and catalogue functional diversity to ensure an effective agroecological transition. This involves creating a broad and functional structure of vegetable

species by increasing the number of accessions/genetic resources (collected, inventoried, or obtained through exchanges) and by developing tools that enable the beneficial exploitation of this material.

Theme 2, Developing modern ecological practices to ensure the sustainability and resilience of the vegetable production system in line with circular economy principles, includes extensive activities aimed at developing new cultivation practices and modernizing certain technological steps for growing vegetables in protected spaces and in open fields, under ecological systems (without excluding conventional systems). These actions will ensure increased competitiveness of ecological vegetable production, reduced constraining effects of climate change on vegetable cultivation, **improved** technologically underdeveloped production capacities, more efficient use of resources, and reduced negative environmental impacts of vegetable production practices.

Theme 3. Strengthening the national vegetable germplasm heritage through innovation in breeding and seed production - has tremendous importance. This theme will support the development of new varieties with high cultivation potential and diverse valorization along the agri-food chain, the introduction of new varieties into cultivation, and the creation of specific technological steps for producing certified seed and planting material.

Theme 4. Developing value-added pathways for ecological plant resources. This theme has a strong economic impact and creates opportunities for valorizing research and development results in health and nutrition, contributing to well-being, generating ideas, and enabling partnerships and new activities in the agri-food sector. The results may also support the creation of regional eco-districts that strengthen local traditions and regional identity, with potential implications in related fields such as tourism revitalization and promoting a healthy lifestyle.

CONCLUSIONS

Leg(O)Nest is a new research infrastructure that proposes a model to promote agrobiodiversity and to ensure the development of the vegetable sector.

Leg(O)Nest plans to develop an innovative model of sustainable agriculture, grounded in agroecological principles and based on crop diversification, expanded use of plant genetic resources, and adaptable cultivation systems and solutions. The model is designed for broad applicability, including within conventional agriculture, and relies on participatory engagement of stakeholders across the agri-food sector.

This project ensures environmental benefits through: breeding for climate-adapted crops; developing environmentally friendly tools for exploiting new vegetable resources; conserving and exploring biodiversity; developing environmentally friendly methods, practices, and technologies for both conventional and organic cultivation, aimed at reducing the negative impact of agriculture; increasing soil fertility through the use of leguminous species; reducing synthetic inputs by developing intelligent cultivation schemes. Creation of adapted cultivation schemes and new varieties, identifying new genes/traits that enhance adaptation to specific cultivation conditions, are key to a successful system able to respond to the continuous pressure of climate change. Identifying traits that ensure suitability for organic farming systems, developing new high-yielding varieties with a broad genetic base, enhancing the value of a wide range of newly created varieties in the agri-food chain, and addressing key factors of a competitive sector.

Through its structure and research themes, the project assumes direct intervention in solving key problems in the vegetable agri-food sector and in creating a model-concept to serve as a reference for agricultural research, centered on issues identified or signaled by farmers, processors, and consumers.

The proposed initiative aims to enhance the competitiveness and sustainability of the vegetable sector by implementing an intelligent, integrated system for the multipurpose use of plant genetic resources. The approach responds to the current environmental and economic challenges by accelerating the transition toward regenerative growth while leveraging significant economic opportunities. The project is designed for close collaboration with economic actors, consumers, citizens, and civil-society organizations.

The expected impacts are broad and cross-sectoral:

Farmers will gain access to improved technologies, adapted varieties, efficient resource-use solutions, and training opportunities, enabling increased productivity and diversified valorization pathways.

Processors and producers will benefit from enhanced processing models, revitalized market opportunities, and know-how for developing new products.

Consumers will experience greater diversity of local products, improved awareness, and opportunities for direct engagement with research activities.

Environment and society will benefit from reduced agricultural impact, safer local food sources, and improved public health outcomes.

Research and education will see strengthened partnerships, new research directions, increased attractiveness for young researchers, and enhanced entrepreneurial skills.

At regional level, the project aims to contribute to economic growth, higher specialization, increased visibility, and improved societal well-being.

Anticipated benefits are numerous, but the needs associated with project implementation are equally significant and require specific measures, dictated by financial support mechanisms, farmers' reluctance, the need for specific methods and practices, the use of planting material capable of withstanding additional pressures, and the need for superior valorization pathways.

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