EU CAP Network Focus Group 'Local plant genetic resources in view of climate change and biodiversity loss'

Starting paper

Vasileios Gkisakis, coordinating expert

4 November 2024

Funded by the European Union

Disclaimer

This Starting Paper has been developed within the frame of the EU CAP Network Focus Group 'Local perennial plant genetic resources in view of climate change and biodiversity loss' with the purpose of providing input to the Focus Group discussions and final report. The information and views set out in this Starting Paper are those of the author(s) and do not necessarily reflect the official opinion of the Commission. The Commission does not guarantee the accuracy of the data included in this Starting Paper. Neither the Commission nor any person acting on the Commission's behalf may be held responsible for the use which may be made of the information contained therein.

If you wish to cite this Starting Paper, please refer to it as 'Starting Paper of the EU CAP Network Focus Group 'Local perennial plant genetic resources in view of climate change and biodiversity loss', 2024'.

Funded by the European Union

Content

Funded by the European Union

1. Introduction: FG's purpose & tasks

The current EU CAP Network Focus Group involves a temporary team of 20 selected experts focusing on the subject of 'Local perennial plant genetic resources in view of climate change and biodiversity loss'. The **main purpose** is to promote the use of locally adapted, under-utilised perennial crop varieties, under the view of climate change & biodiversity loss. Specifically, the **main tasks** of the focus group include:

- Identify the **benefits** of local under-utilised perennial varieties in adapting to climate change & maintaining biodiversity.
- Identify the **challenges & opportunities** for farmers in conserving and using under- utilised local perennial crops.
- Collect & highlight **good practices & inspiring success stories**, approaches and methodologies for maintaining and cultivating local perennial crops, covering different pedo-climatic areas.
- Identify **examples of valorising** local perennial plant varieties (from the environmental and economic point of view).
- Identify **capacity building** experiences & needs for conserving and using local perennial crops at farm level.
- Suggest **innovative & appropriate** management practices.
- Identify further **research needs** from practice, and possible gaps in technical knowledge.
- Suggest **innovative ideas** for EIP-AGRI Operational Groups & other innovative projects.

The current starting paper serves as **preparatory material, describing the state of the art from research and practice point of view,** by providing a general framework for the different tasks awaited to be accomplished by the participating experts.

2. Perennial crops in the EU's farming sector: Facts & figures

Perennial crops have an **important role for the European farming sector** due to their several environmental, economic, and agricultural benefits. They include mostly fruit and nut crops, but also certain herbs and vegetables also qualify as such. In 2022, approximately 1.5 million holdings in the EU managed fruit orchards representing 3.7 million ha and a share of production value reaching €27.3 billion (Eurostat, 2024).

Major perennial crops in EU countries are:

- **Fruit and Nut Trees:**

- Olives: EU is usually the largest producer of olive oil & table olives in the world, accounting for almost 2/3 of global production. Most of the EU production comes from southern Europe, with Spain, Italy, Greece, and Portugal being among the world's top olive producers. Spain is the leading producer, responsible for about 40-50% of global olive production.

Funded by the European Union

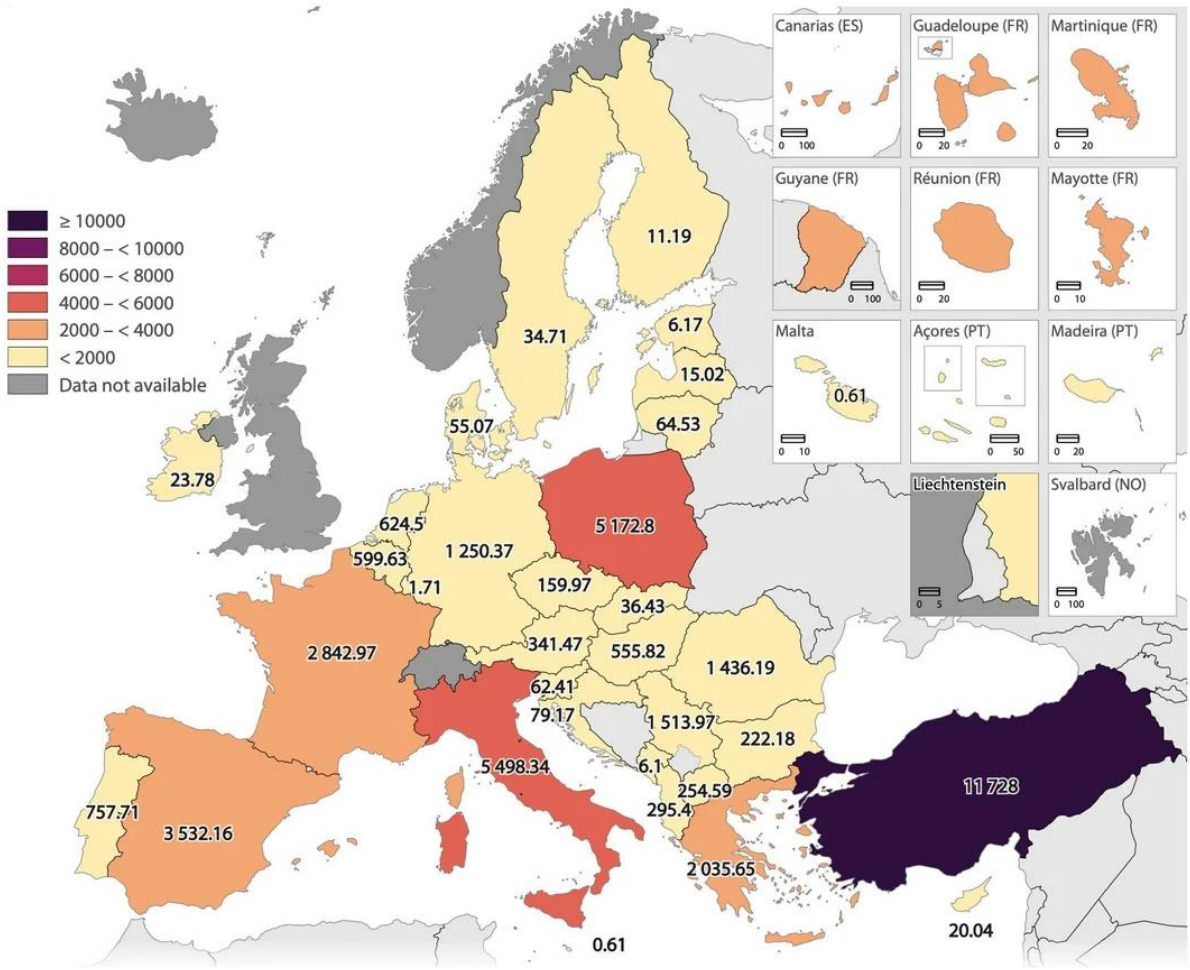

Figure 1. Production fruits, berries and nuts (in million tonnes) in EU for 2002 (source: Eurostat)

- Citrus Fruits: Spain, Italy & Greece produce the most significant quantities of oranges, lemons, and other citrus fruits.
- Apple & Pear Trees: Poland, Italy, and France are major producers of apples and pears, with Poland being one of the largest apple producers in the EU.
- Nuts: Almonds, hazelnuts, and walnuts are widely grown, particularly in Mediterranean regions. Spain is a leading producer of almonds.

- **Vineyards:**

France, Italy, and Spain are some of the largest wine-producing countries globally, with extensive vineyards.

- **Berries:**

Including strawberries, raspberries, blueberries: Grown especially in Poland, Spain, & Netherlands.

- **Medicinal & aromatic plants:**

Medicinal & aromatics plants are domestically cultivated or wild-harvested, for use in pharmaceutical, food & beverage, cosmetic and agrochemical sector, but still in very small compared to other crops. Main countries of production are France, Poland and Spain.

Funded by the European Union

- **Energy Crops:**

Miscanthus & Switchgrass are currently considered for bioenergy purposes, contributing to renewable energy production in the EU, namely in Germany, Netherlands, Poland, France, Italy and others.

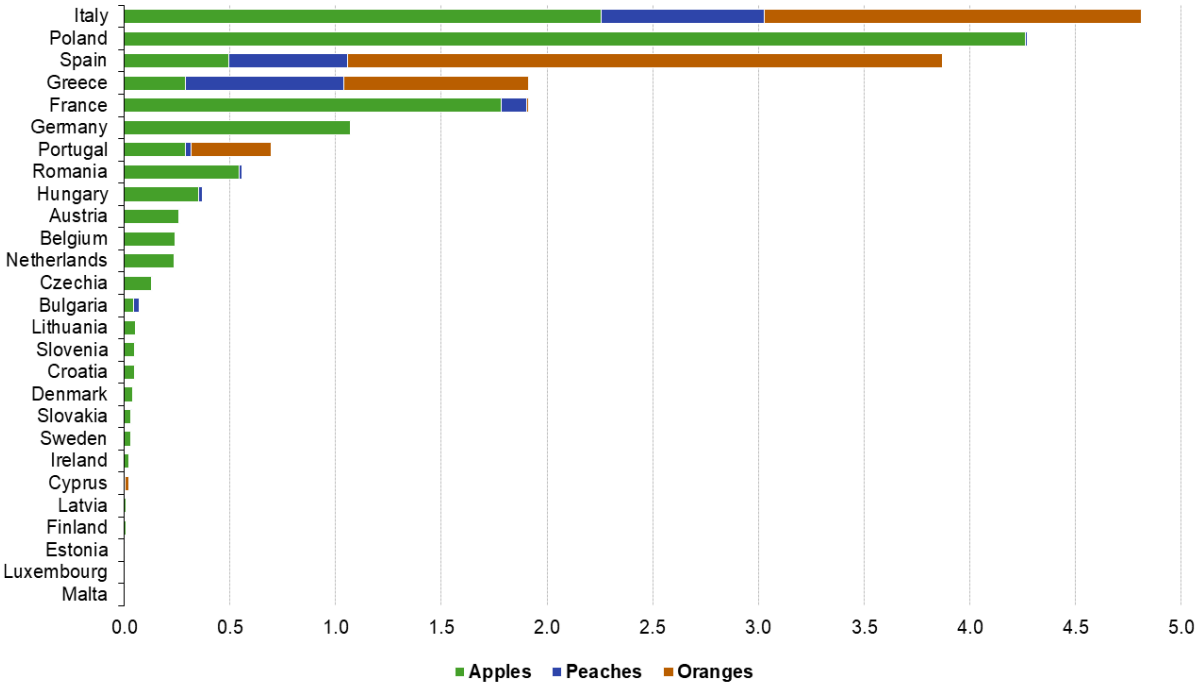

Figure 2. Production of apples, peaches and oranges (in million tonnes) in the EU for 2002 (source: Eurostat)

3. Local & under-utilised perennial crops

Local perennial crops represent an **important yet rather overlooked resource** for agriculture. This is particularly evident in terms of **promoting important agroecosystem services**, diversification at farm-level, sustainability, and food security, as they hold a **potential for climate change adaptation, resilience and mitigation**, as well as diversified income, and enhancement of ecological health in rural Europe (Weißhuhn et al, 2017).

Despite their value, many of these crops, traditionally used for centuries, are **currently under-utilised due to the rise of commercial, competitive cultivars**. Indeed, the EU's Common Catalogues of plant varieties contains several hundred perennial varieties for legal protection and use within the EU, however **only a very small fraction is actively commercialized**. F.i. although there are more than 2,000 registered **apple** varieties in EU (2024) and the apple production area is widespread geographically, the production is **dominated by only 38 cultivars**, many of which are closely related, while 4 varieties (Golden Delicious, Idared, Jonagold and Gala) make up almost 45% of the production area (Hokanson et al., 2001; Urrestarazu et al., 2016). **Pear** varieties registered in EU reach a number of 2364 (EU, 2024), however only 15 of them are the most broadly commercialised. Regarding **grape** varieties, Anderson & Aryal (2013) reported 1271 ones cultivated worldwide, but a continuing concentration was determined, with only 15 wine varieties planted on half of the world's grape areas. Additionally, EU's Common Catalogue of Varieties lists 1237 registered **olive** varieties

Funded by the European Union

across its member states (EU, 2024). However, very few of these varieties dominate the European and global markets, such as Arbequina, Picual, Hojiblanca & Manzanilla in Spain, Frantoio and Leccino in Italy, Koroneiki and Kalamata in Greece (also holding a PDO status).

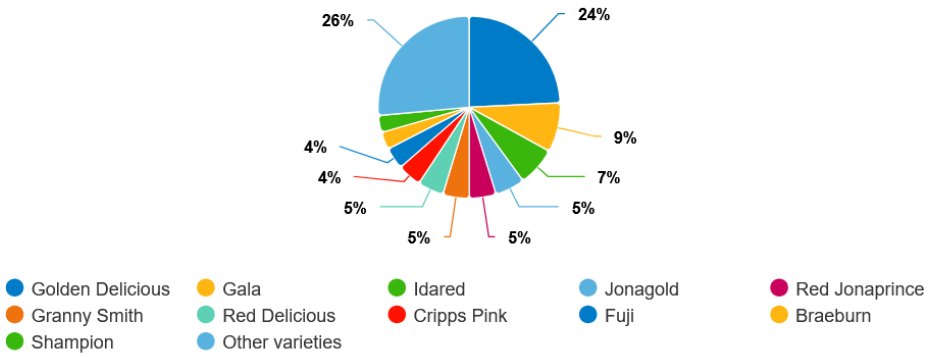

Figure 3. Apple stock (n 1000 tonnes) in EU in 2021 (source: TasteAtlas)

a. Importance & value

Main aspects of their importance & value include the following:

Climate change adaptation, resilience & mitigation:
Local and underutilized perennial crops are increasingly recognized for their role in climate change conditions. By evolving in specific regions, they are inherently well-**adjusted to local micro-climates**, becoming resistant to environmental stresses, including drought, temperature fluctuations, and pests (Padulosi et al., 2013). This adaptability is especially **important for areas facing climate stresses**, as these crops provide stable, nutritious food sources when other crops may fail (Chivenge et al., 2015).

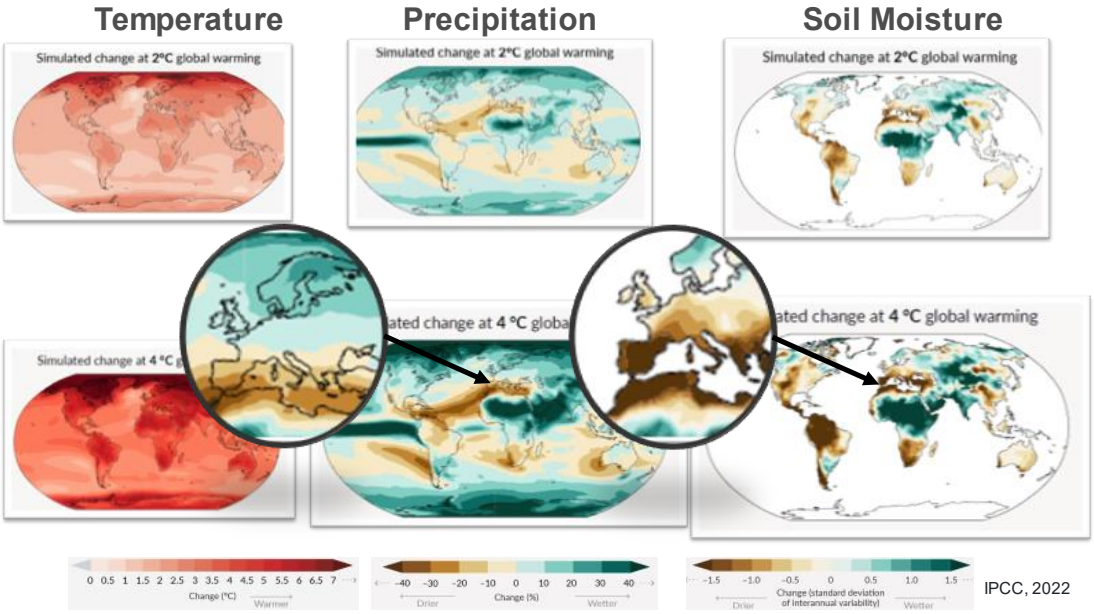

Figure 4 – Maps indicating global temperature, precipitation & soil moisture, according to future climate change global warming scenarios of 2ºC & 4ºC until year 2100 (source: IPCC)

Funded by the European Union

Indeed, the deep root systems of perennials enhance water retention and reduce soil erosion, a crucial factor for maintaining agricultural productivity in degraded or arid regions (Pimentel et al., 2012). By **diversifying local farming systems** with the inclusion of appropriate adapted varieties can create **a more robust and well-functioning agroecosystem**, which in turn improves resilience to climate-induced stresses (Foley et al., 2011). Additionally, they use per se a **greater fraction of carbon to produce root systems**, therefore more carbon is integrated into soil organic matter, contributing to increases in soil organic carbon stocks and consequently mitigation of greenhouse gases emissions (Board et al., 2019). Furthermore, incorporating these crops into farming systems can reduce greenhouse gas emissions due to **lower input requirements**, such as fertilizers and pesticides, compared to more intensive monocultures (Glover et al., 2010). As perennials are not replanted annually, they also **reduce soil disturbance**, thus improving soil health, and consequently enhance carbon sequestration (Crews et al., 2018).

There are interesting **practical examples** of the use of local perennial crops across Europe which display unique resilience traits, making them suitable climate-related challenges: The "**Assyrtiko**" originating from the island of Santorini, Greece, is highly resistant to drought and thriving in nutrient-poor volcanic soils, is now tested in other Mediterranean countries, exploring options to adapt viticulture practices to the changing climate (Jones et al., 2012); The "**Rambour Franc**" apple variety, grown in eastern France and Germany is drought-tolerant and well-suited to warmer conditions, also resistant to apple scab, reducing the need for fungicides. This variety is considered with a high potential to support crop stability, especially in areas prone to water stress, under climate change conditions (Eccher et al., 2006).

Agroecosystem diversification: Diversity at gene, species & landscape level to maintain ecosystem functioning is referred as an **important resilience strategy & toolkit**, as well for reversing biodiversity loss at agroecosystem level (Altieri et al, 1999). By growing a wider variety of varieties, especially under-utilised ones, farmers contribute to agricultural diversity. This also contributes at enhancing important agroecosystem services, among others such as pollination and pest control, considered crucial for the sustainability of farming systems (Jackson et al, 2007).

Low-input farming: As related to the above, many of these crops are **adapted to conditions of minimal agricultural inputs**. e.g. synthetic fertilizers or pesticides. These attributes make them particularly attractive for diversified, agroecological farming systems and methods including agroforestry, polycropping and others (Altieri et al., 2017).

Plant breeding: Local perennial plant varieties are considered **as critical resources needed by farmers and breeders to develop new crop varieties** with desirable traits, such as higher yields, resistance to pests and diseases, and adaptability and resilience, to meet current and evolving human needs, growing food demands and changing climatic and environmental conditions (FAO, 2023).

Nutritional and health benefits: Certain under-utilised perennial crops offer **high nutritional value** and contain compounds beneficial for human health (Kreitzman et al., 2020).

Funded by the European Union

Cultural and Economic Importance: In many regions, local perennial crops may have **special cultural significance** and form an **important part of traditional diets**. Therefore, they can deliver an added market value of agricultural products (P.D.E., local products, gastronomic tourism).

b. Conservation & sustainable use

The conservation & sustainable use of local perennial crops **is considered more critical than ever** for lowering the pressure to the respective agricultural genetic resources and address efficiently the issues of **biodiversity loss and climate change adaptation**, together with food insecurity, and poverty alleviation (FAO, 2023). Indeed, the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA), regarded as a legally binding instrument, prioritises the facilitation of conservation and sustainable use of plant genetic resources and the **fair and equitable sharing of benefits** derived from their use, in harmony with the Convention on Biological Diversity, for sustainable agriculture and food security (Cooper, 2002).

Several **key approaches** exist for the conservation & sustainable use of perennial crops, both at research and farming level:

1. On-farm (In Situ) conservation

It involves the maintenance of local perennial crops within their natural ecosystems or traditional farming landscapes allowing them to evolve alongside local environmental and cultural changes. This approach largely foresees the farming community Involvement as local farmers can play a crucial role in conserving perennial traditional varieties as well as and farming practices (Brush, 2000).

Figure 4. Open farm days in Biofru organic farm, Greece presenting the local apple varieties collection (source: Biofru)

An interesting farmer-led example of in-situ conservation is the "**Biofru"** organic farm in Kastoria, Greece, being part of the "Aegilops" network (described in Annex I), and conserving more than 100 hundred local & underutilised varieties of apples and 60 pear varieties, most of them endangered due to abandonment by commercial farmers.

2. Ex Situ conservation
Refers to preservation of genetic material of perennial crops outside their natural environment, such as on-field collections (at institutional or farm community level), botanical gardens but also seed banks. For perennial crops not producing viable seeds, such as certain fruit trees, clonal repositories maintain live specimens for future cultivation & breeding.

3. Breeding
Breeding programs which invest in research on the advantages of agronomic and physiological attributes e.g. as related to yield, disease resistance, and adaptability of local perennial crops is essential (Hatfield & Walthall, 2014). **Participatory plant breeding (PPB)** approaches with the direct involvement of farmers, appears as better incorporating the perspective of end users into the process of varietal development (Morris & Bellon, 2004). Example of a PPB program on organic perennial crops is the "**apfel:gut**" project specializing in the organic on-farm breeding of pome fruits through a collaborative approach involving a diverse group of practitioners, advisors, breeders, and researchers within the organic fruit growing sector (Ristel & Sattler, 2014).

4. Nutritional value
Promoting the health benefits of under-utilised perennial crops through respective scientific research can boost consumer interest and support their conservation, as several local crops may possess nutrient-density related attributes and offer potential as functional foods (Kreitzman et al., 2020).

c. Successful initiatives

- **Valorisation & value chain creation**

Valorisation is a process requiring **a multifaceted approach,** including **sustainable** farming approaches, **economic** incentives, **consumer** awareness, also **policy** support. Main key approaches to achieve the above include i) promotion of **local agricultural knowledge & traditional practices**, ii) implementation of **sustainable farming practices based on agroecological principles** that enhances agroecosystem diversity and resilience iii) economic aspects of **value-added production** taking advantage of the special attributes of the local genetic resources iv) **Participatory approaches** in research, especially breeding v) **Networking** and **collaboration** (Voglhuber-Slavinsky et al., 2023).

In Figure 4, it appears a specific, representative case study of a local & under-utilised olive crop variety, namely "**Mavrelia**" or Mavrolia), an olive oil producing Greek variety, as valorised by the "**Nileas**" Farmers Group, Chora Messinias, Greece.

Use of « Mavrelia» local olive variety to valorise olive oil production

NILEAS FARMERS GROUP

DESCRIPTION OF THE CASE

Nileas Group of Farmers, based in the Peloponnese region of Greece, is known for its innovative use of local olive varieties, such as "Mavrelia" variety, an under-utilized, local perennial olive variety with unique characteristics, such as early ripening largely neglected in favor of more commercial olive varieties but offering opportunities for sustainable agriculture, economic growth, and biodiversity conservation.

AGRONOMIC & ENVIRONMENTAL VALUE:

The use of Mavrelia variety for commercial olive oil production enhances:

Biodiversity Conservation: The cultivation of "Mavrelia" helps conserve genetic diversity in olive production. By promoting a lesser-known variety, the farmers contribute to maintaining local biodiversity, which is critical in an era of increasing monoculture.

Adaptation to local conditions: As a native variety, Mavrelia is naturally adapted to the local climate and soil conditions. This reduces the need for water, fertilizers, and chemical pesticides, minimizing the environmental footprint of farming;

Soil and Water Management: By using organic farming practices, the Nileas Group focuses on maintaining soil health through crop rotations and composting, preventing erosion, and promoting water retention in drought-prone regions.

GEOGRAPHICAL LOCATION:

Messinia area, Peloponnese, Greece

INVOLVED ACTORS:

NILEAS Farmers Group

SOURCES OF INFORMATION, REFERENCES, WEBSITES:

https://nileas.gr/

SOCIO-ECONOMIC VALORISATION

Commercialization of the Mavrelia olive variety have opened an economic opportunity for the Nileas farmers through:

i) **Premium Product Marketing**: Mavrelia's unique flavor profile & early-ripening attribute successfully positions Mavrelia olive oil as a niche, high-value product;

ii) **Branding**: By emphasizing the local, traditional, and ecological aspects of Mavrelia production, the Nileas Group has tapped into markets that value sustainability, heritage, and artisanal products.

The conservation & use of Mavrelia has a potential positive social impact on the local farming community through:

i) **Community Cohesion**: By promoting collective farming activities, bringing together small-scale farmers to share resources, knowledge approach it strengthens the local community's resilience.

ii) **Traditional olive farming**: By reviving a traditional olive variety, the farmers are helping to preserve cultural heritage and pass on agricultural knowledge to younger generations.

SUCCESS FACTORS:

Collective Action: Nileas operates as a cooperative, allowing farmers to pool resources, share risks, and collectively access markets.

Market Differentiation: By focusing on the unique characteristics of the Mavrelia variety, the group has successfully differentiated its product in a competitive olive oil market.

Sustainability Focus: The group's commitment to organic farming and environmental sustainability resonates with modern consumers who are increasingly concerned with the ecological impact of the products they purchase.

CHALLENGES & OPPORTUNITIES:

Challenges include factors related to marketing as access to premium markets requires investment. Also, further research is required with regards to the agronomic characteristics of the variety, regarding early ripening, optimization of harvest time, response to low input conditions, as well as market research & branding. Opportunities appear though regarding market positioning as a premium artisanal product based on the use of local genetic resources.

Figure 5. "Mavrelia" by "Nileas" Farmers Group in Greece: Case study of valorisation of a local and under-utilised perennial variety with emphasis on halting biodiversity loss and adapting to climate-stress conditions. (source: Nileas Farmers Group)

Funded by the European Union

- **Farmer-related collective initiatives**

Several initiatives across the European Union are currently working to conserve and promote the sustainable use of local and under-utilized perennial crops. These involve mostly, non-institutional **networks & organizations, working in direct collaboration with farmers and civic society**, focus on conserving biodiversity, but also promoting agroecological practices, enhancing food security by ensuring the continued use of traditional and native crop varieties.

Importantly, several of these initiatives are connected through the **European Network Let's Liberate Diversity!** (LLD) which collectively works on promoting the conservation and sustainable use of agricultural biodiversity through farmer-led initiatives and participatory seed systems. The network established in 2005, connects a wide range of stakeholders, including farmers, researchers, breeders, civil society organizations, and policymakers, to advocate for the recognition and protection of farmers' rights on biodiversity conservation and use. Some LLD's **key activities** include the i) Hosting annual forums & events, ii) Supporting community-level activities, iii) Advocating for farmers' rights, iv) Encouraging Participatory Plant Breeding, and vi) Raising awareness & training.

A list of **representative initiatives** at EU level, including details can be found in **Annex I** of the current paper.

- **Innovative practice-oriented projects: Operational groups**

EIP-AGRI Operational Group projects (OGs) are **groups of stakeholders** with complementary knowledge (e.g. practical, scientific, technical, organisational expertise, etc.) to **co-create practical solutions** for agriculture, forestry and rural communities in an innovation project. Several EU-funded Operation Groups (OGs) are dedicated to the topic of conserving and using local and underutilised perennial crops.

Figure 6. Area of the "Biodiversamente Castagno" Operational Group (Source: OG website)

A successful example of such OG has been the **Biodiversamente Castagno**: "**Guidelines for the preservation and enhancement of biodiversity the chestnut in Emilia Romagna**" materialised in Italy during 2017-2020. The project aimed to protect and promote the diversity of chestnut varieties in the Emilia Romagna region by targeting specifically varieties at risk of genetic erosion. It sought to characterize the biodiversity of chestnut groves and develop sustainable practices for conservation. The initiative involved mapping and genetic characterization of local chestnut varieties as

well as studying soil biodiversity, and eventually establishing guidelines to conserve chestnut germplasm. It also engaged local producers to act as biodiversity custodians while supporting eco-friendly farming practices.

A relevant list of **representative OGs** at EU level can be found in **Annex II** of the paper, as well as in the EIP-AGRI database, found here:

- **Research**

The importance of conservation and sustainable use of crops' genetic resources is **already reflected in the EU's research policy**, mainly within the frameworks of "Farm to Fork" strategy and the EU biodiversity strategy for 2030. **Several research activities at EU-wide level have been & currently related to the promotion of use of local and under-utilized perennial crops**, aiming at halting the further loss of genetic diversity to become available for breeders, farmers, and eventually consumers, as well as to face important environmental **challenges generated by climate change**.

The current **main focusing axes of research** dedicated to perennial plant genetic resources & breeding, with frequent overlap among them, are related to:

➢ **Enhancing diversity of crops & cropping systems**
A centred approach focusing on advancing the monitoring, characterization, conservation and use of perennial plant genetic resources, to promote crop improvement, sustainable farming and for meeting the demands of food security and better nutrition. Such initiatives include the **FRUITDIV** project, focusing the potential of diversity of fruit tree Crop Wild Relatives (CWR), **DiverIMPACTS**, promoting the diversification of cropping systems for improved productivity, delivery of ecosystem services and resource-efficient and sustainable value chains. Also, **EUFORGEN** program, which although focusing primarily on forest species, it deals also with under-utilized perennial tree crops,

➢ **Climate-resistant & resilient farming:**
Focusing on the reality of increasing climate stresses occurring and the respective need for perennial crops capable of capturing resources more efficiently and being resilient to abiotic & biotic stresses. The main objective of this approach is the breeding of crops adapted to the challenging growth conditions and to increase the use of genetic resources to broaden the genetic base of crops and create new breeding opportunities. Most related R&I initiatives include the projects **BreedingValue,** aiming to improve the genetic diversity and breeding efficiency of berry crops, **CLIMED-FRUIT,** developing climate-resilient farming strategies for Mediterranean fruit trees, **DREAM4FRUIT**, to improve resilience to climate change, functional biodiversity sustainability of small farming systems in the Mediterranean, **GEN4OLIVE**, to enhance olive breeding for productivity, resilience, and climate change adaptation.

➢ **Adaptation and boosting of low input & organic production**
It aims to enhance the shift towards low-input & organic production systems, helping to boost organic farming in Europe through the use of biodiversity. Respective initiatives include **Ecobreed**, focusing on breeding under-utilized crops, including

Funded by the European Union

certain non-fruit perennials, for improved organic and low-input farming systems and **InnObreed,** aiming to foster organic crop breeding and improve the performance of the fruit sector, by enhancing innovative organic fruit breeding and uses.

➢ **Sustainable value chains**

Focusing on the enhancement of the whole supply chain, with emphasis given on value added by crop diversification along with new openings for regional, high-quality products and economic development. Such initiatives include the **BIOVALUE** project, for the development of an agent-based simulation tool, to analyse links among biodiversity, agri-food value chain, environment, consumer's preferences and health. Also, **Diversifood** project, enhances the description and evaluation of local varieties to increase their performance, resilience and quality through a multi-actor approach, **RADIANT**, for developing solutions & tools that promote under-utilised crops, agrobiodiversity, sustainable diets and dynamic value chains.

➢ **Capacity building for genetic resources conservation**

It involves mainly the formulation of decentralised networks of stakeholders to increase awareness, communication and competences regarding the conservation & sustainable use of crop genetic resources. Namely, **FARMERS PRIDE**, creating a network of stakeholders to conserve & utilize local plant diversity & promote the sustainable use of under-utilized perennial crops in local farming systems. Also, **DYNAVERSITY**, building a network of stakeholders to facilitates exchange and integration of scientific as well as practical knowledge on how to best manage diversity in agriculture and in the entire food chain.

A list of further research projects & activities, including details, can be found in **Annex III** of the current paper.

d. Challenges & constraints

As part of the global decrease of agrobiodiversity, due to loss of genetic & species diversity of food crops, the conservation and sustainable use of local perennial crops face **several challenges and constraints**, hindering their potential to contribute to climate resilience, biodiversity loss, and eventually food security.
These challenges & constraints are **both technical and socio-economic**, and addressing them would require **integrated approaches involving farming, research, and market-related aspects**.

Main challenges and constraints to deal with, include:

➢ **Genetic erosion & diversity loss**

Local perennial crops are often overlooked in breeding programs, as **studies of yields, resilience, and market potential of local perennial crops are relatively rare**. This results in slow adoption by farmers who might otherwise benefit from improved, locally adapted varieties. Also, the conservation of genetic material for perennial crops is often neglected, particularly in **regions where financial and technical resources are scarce**. Together with the global trend towards intensive monoculture and the use of

Funded by the European Union

uniform, high-yielding crop varieties, it collectively results to high genetic erosion, making it difficult to restore or reintroduce these crops, once lost from farming systems.

➢ **Loss of Traditional Agricultural Knowledge (TAK) & lack of formal training**
Farmers' knowledge associated with agronomic aspects of using local perennial crops is often neglected, due to **dominance of modern, industrialised farming practices** not fitting to the non-competitive varieties. This leads to the under-utilisation of crops that have long provided resilience and sustainability in local farming systems (Wood & Lenne, 1997). Furthermore, farmers frequently **lack access to formal agricultural training services** providing technical knowledge of conserving and using local perennial crops sustainably.

➢ **Research gaps**
Local perennial crops **are rather not well-studied with regards to important aspects** and potentiality for promoting their sustainable use, like agronomic behaviour, nutritional profiles, pest resistance and adaptation to climatic stress. Indeed, conservation initiatives for local perennial crops are mostly **disjointed or project-based, with limited long-term funding or integration** into national agricultural development plans. The above create condition of scarcity for farmers in terms of finding high-quality genetic material, eventually limiting their attractiveness and the integration into modern farming systems.

➢ **Market and Economic Constraints**
Local perennial crops, especially under-utilised species, often face limited market demand because of **unfamiliarity among consumers and limited promotion**. Therefore, farmers may favour higher-productivity or more commercially viable varieties, due to their faster return. Additionally, the **absence of infrastructure for processing or value-adding**, may limit the economic viability of local perennial crops, reducing the incentive for farmers to prefer them.

4. Main discussion points

The **key outputs** expected from the FG's processes and discussion is related to a **main question:** *How can the conservation and use of local under-utilised varieties of perennial crops be attractive & profitable for farmers and thereby* ***contribute to biodiversity-friendly sustainable farming under climate change***?

Based on the above query, a series of escalated questions related to FG's tasks will be addressed & debated, including:

➢ Which are the most **successful on-farm examples** of conservation & use practices, categorized per crop & pedo-climatic zones in different EU countries?
- How they are **valorised**, in terms of economic outcome for farmers as well as environmental benefit?

➢ Which are the **most effective practices of conservation & use**, f.i farming methods, promotion & commercialization of related products, as well collective efforts of farmers, networks, NGOs & scientific community?

Funded by the European Union

- Which of the above are the **most feasible** to be adapted & widely mainstreamed?

➢ Which are **main barriers & challenges** in conserving & using local perennial crops? How can they be overcome?
- Which are the main respective **opportunities**? How they could be succeeded?

➢ What are the most important **tangible benefits & opportunitites** for agriculture & ecosystems regarding the use of conservation & use of local perennial crops?
- Which of the above are better **valorised** in terms of adaptation to climate stresses & for enhancing farming system diversification?

In the **long-term**, also the following topics will be addressed:

➢ Identify further **research needs** from practice, and possible gaps in **technical knowledge**?

➢ How could **research outcomes & traditional knowledge** on local, underutilized perennial crops be integrated into effective conservation & use strategies?
Are there successful examples of **capacity building**, steaming from both academic & farmer community-based initiatives?

Funded by the European Union

5. References

Altieri, M. A. (1999). The ecological role of biodiversity in agroecosystems. In Invertebrate biodiversity as bioindicators of sustainable landscapes (pp. 19-31). Elsevier.

Altieri, M. A., Nicholls, C. I., & Lana, M. A. (2017). Agroecology: Using functional biodiversity to design productive and resilient polycultural systems. In Routledge Handbook of Agricultural Biodiversity (pp. 224-237). Routledge.

Board, O. S., on Agriculture, B., on Energy, B., & National Academies of Sciences, Engineering, and Medicine. (2018). Terrestrial Carbon Removal and Sequestration. In Negative Emissions Technologies and Reliable Sequestration: A Research Agenda. National Academies Press (US).

Brush, S. B. (2000). Issues of in situ conservation of crop genetic resources. In Genes in the field: On-farm conservation of crop diversity. IDRC, Ottawa, ON, CA.

Chivenge, P., Mabhaudhi, T., Modi, A. T., & Mafongoya, P. (2015). The potential role of neglected and underutilised crop species as future crops under water-scarce conditions in sub-Saharan Africa. International Journal of Environmental Research and Public Health, 12(6), 5685-5711. https://doi.org/10.3390/ijerph120605685

Crews, T. E., Blesh, J., Culman, S. W., et al. (2018). Going where no grains have gone before: From early to mid-succession. Agriculture, Ecosystems & Environment, 257, 68-77. https://doi.org/10.1016/j.agee.2016.03.012

Cooper, H. D. (2002). The international treaty on plant genetic resources for food and agriculture. Rev. Eur. Comp. & Int'l Envtl. L., 11, 1.

Delgado, R., Charcosset, H., Bert, P. F., & Salin, F. (2019). Listán Prieto grapevine variety in the Canary Islands: Characterization and conservation perspectives. Acta Horticulturae, 1248, 151-158.

Eccher, T., Granelli, G., Maffeo, M., Pontiroli, R., Testoni, A., Tonesi, R., & Silvi, E. (2006). Evaluation of old apple cultivars once grown in Lombardy region.

European Commission. EUPVP—Common Catalogue Information System. Available online: https://ec.europa.eu/food/plant-variety-portal/ (accessed on 04 November 2024).

Eurostat, Data Browser, Crop production in EU (https://doi.org/10.2908/APRO_CPSHR)

FAO (2018) Catalysing dialogue and cooperation to scale up agroecology: outcomes of the FAO regional seminars on agroecology. Rome. http://www.fao.org/3/I8992EN/i8992en.pdf

FAO (2023). Conservation and sustainable use of plant genetic resources for food and agriculture – Safeguarding our food security. Rome. (https://doi.org/10.4060/cc9031en)

Foley, J. A., Ramankutty, N., Brauman, K. A., et al. (2011). Solutions for a cultivated planet. Nature, 478(7369), 337-342. https://doi.org/10.1038/nature10452

Gliessman, S. (2016). Transforming food systems with agroecology. Agroecology and sustainable food systems, 40(3), 187-189. https://doi.org/10.1080/21683565.2015.1130765

Glover, J. D., Reganold, J. P., & Cox, C. M. (2010). Agriculture: Plant perennials to save the planet. Nature, 464(7288), 559-561. https://doi.org/10.1038/489359a

Hatfield, J. L., & Walthall, C. L. (2014). Climate change: Cropping system changes and adaptations. Encyclopedia of agriculture and food systems, 2, 256-264.

Hokanson, S., Lamboy, W., Szewc-McFadden, A. et al. Microsatellite (SSR) variation in a collection of Malus (apple) species and hybrids. Euphytica 118, 281–294 (2001). https://doi.org/10.1023/

Jackson, L. E., Pascual, U., & Hodgkin, T. (2007). Utilizing and conserving agrobiodiversity in agricultural landscapes. Agriculture, ecosystems & environment, 121(3), 196-210. (https://doi.org/10.1016/j.agee.2006.12.017)

Jodha, N. S. (1980). Intercropping in traditional farming systems. The Journal of Development Studies, 16(4), 427-442. https://doi.org/10.1080/00220388008421770

Jones, G. V., Duff, A. A., Hall, A., & Myers, J. W. (2012). Climate change impacts on grape growing and wine production: A global overview. Climatic Change, 111(3-4), 337-385. https://doi.org/10.1504/IJGW.2012.049448

Krebs, J., & Bach, S. (2018). Permaculture—Scientific evidence of principles for the agroecological design of farming systems. Sustainability, 10(9), 3218. https://doi.org/10.3390/su10093218

Kreitzman, M., Toensmeier, E., Chan, K. M., Smukler, S., & Ramankutty, N. (2020). Perennial staple crops: Yields, distribution, and nutrition in the global food system. Frontiers in Sustainable Food Systems, 4, 588988. https://doi.org/10.3389/fsufs.2020.588988

Liebman, Matt. "Polyculture cropping systems." In Agroecology, pp. 205-218. CRC Press, 2018. eBook ISBN 9780429495465

Morris, M. L., & Bellon, M. R. (2004). Participatory plant breeding research: opportunities and challenges for the international crop improvement system. Euphytica, 136(1), 21-35. (https://doi.org/10.1023/B:EUPH.0000019509.37769.b1)

Padulosi, S., Thompson, J., & Rudebjer, P. (2013). Fighting poverty, hunger and malnutrition with neglected and underutilized species: Needs, challenges and the way forward. Biodiversity International.

Funded by the European Union

Pantera, A., M. R. Mosquera-Losada, F. Herzog, and M. Den Herder. "Agroforestry and the environment." Agroforestry Systems 95, no. 5 (2021): 767-774. https://doi.org/10.1007/s10457-021-00640-8

Pimentel, D., Cerasale, D., Stanley, R. C., et al. (2012). Annual vs. perennial grain production: A sustainable solution to help feed the world. Agriculture, Ecosystems & Environment, 161, 1-4. https://doi.org/10.1016/j.agee.2012.05.025

Ristel, M., & Sattler, I. (2014). Apfel: gut-participatory organic fruit breeding.

Urrestarazu, J., Denancé, C., Ravon, E. et al. Analysis of the genetic diversity and structure across a wide range of germplasm reveals prominent gene flow in apple at the European level. BMC Plant Biol 16, 130 (2016). https://doi.org/10.1186/s12870-016-0818-0

Voglhuber-Slavinsky, A., Lemke, N., MacPherson, J., Dönitz, E., Olbrisch, M., Schöbel, P., ... & Helming, K. (2023). Valorization for biodiversity and ecosystem Services in the Agri-Food Value Chain. Environmental Management, 72(6), 1163-1188. https://doi.org/10.1007/s00267-023-01860-7

Weißhuhn, P., Reckling, M., Stachow, U., & Wiggering, H. (2017). Supporting agricultural ecosystem services through the integration of perennial polycultures into crop rotations. Sustainability, 9(12), 2267. (https://doi.org/10.3390/su9122267)

Wezel, A., Herren, B. G., Kerr, R. B., Barrios, E., Gonçalves, A. L. R., & Sinclair, F. (2020). Agroecological principles and elements and their implications for transitioning to sustainable food systems. A review. *Agronomy for Sustainable Development*, *40*, 1-13. https://doi.org/10.1007/s13593-020-00646-z

Wood, D., & Lenne, J. M. (1997). The conservation of agrobiodiversity on-farm: questioning the emerging paradigm. Biodiversity & Conservation, 6, 109-129. https://doi.org/10.1023/A:1018331800939

Funded by the European Union

Annexes

I. Farmer-related initiatives

Representative examples of farmer-related **networks & organizations** in EU countries actively working on the conservation and use of local perennial crops include (non-exhaustive list & in alphabetical order):

- **AEGILOPS – Network for Biodiversity & Ecology in Agriculture**

Country: Greece.
Focus: The organisation is dedicated to the conservation of agricultural biodiversity and the promotion of sustainable farming practices in Greece. It functions as network that collaborates with farmers to conserve and utilize local, traditional crop varieties, including perennial crops.
Key activities: Seed saving, participatory plant breeding, and sustainable farming practices.
Website: AEGILOPS

- **Arche Noah - Austria**

Focus: Conservation and sustainable use of plant biodiversity.
Description: A prominent organization in Austria dedicated to preserving heirloom and rare plant varieties, including local perennial crops such as traditional fruit trees and grapevines. It operates a seed bank, runs educational programs, and supports farmers in cultivating heritage varieties.
Key activities:

- Operation of seed bank & nursery conserving several traditional varieties of fruits, vegetables, and herbs.
- Collaboration with farmers to grow & market rare varieties of fruit and vegetable crops.
- Workshops & events on biodiversity, agroecology, and traditional farming practices.

Website: Arche Noah.

- **Association Quinta das Águias**

Country: Portugal.
Focus: This Portuguese organization focuses on sustainable agriculture, agroecology, and the conservation of local biodiversity, including perennial crops. They run a farm where they apply permaculture principles and cultivate traditional crop varieties.
Key activities: Biodiversity conservation, permaculture practices, and environmental education.
Website: Quinta das Águias

- **Dachverband Kulturpflanzen- und Nutztiervielfalt e. V.**

Country: Germany.
Focus: This organization advocates for the preservation of plant and livestock diversity in Germany. It supports the conservation and use of local, traditional varieties, including perennial crops like fruit trees.
Key activities: Advocacy, education, and support for biodiversity conservation in agriculture.
Website: Dachverband Kulturpflanzen- und Nutztiervielfalt

- **Danish Seed Savers**

Country: Denmark.
Focus: Non-profit organization that works to conserve traditional Danish plant varieties, including perennial fruit trees and berries. They support farmers and gardeners in growing heritage crops.
Key activities: Seed exchanges, conservation of traditional varieties, and education on seed saving.
Website: Danish Seed Savers

- **Ecovar**

Country: Belgium.
Focus: Organization that promotes organic farming and conservation of traditional and local varieties, including perennial crops. It works with local farmers to support the cultivation and market development of these varieties.
Key activities:

- Seed exchanges and provision of planting material for local fruit and vegetable varieties.
- Collaboration with organic farmers to promote biodiversity and sustainable agricultural practices.
- Workshops & training sessions on organic farming and seed saving.

Website: Ecovar

- **Föreningen Sesam**

Country: Sweden.
Focus: Swedish organization promoting the conservation & use of traditional plant varieties, including perennial crops like fruit trees and berry bushes. The organization runs a seed bank and organizes educational activities.
Key activities: Seed saving, promotion of biodiversity, and seed exchanges.
Website: Föreningen Sesam

- **Kokopelli**

Country: France.
Focus: Kokopelli works on the conservation and free distribution of heirloom and traditional seeds, including those of perennial crops. They aim to protect biodiversity and promote food sovereignty by supporting seed saving efforts.
Key activities: Seed bank management, distribution of traditional seeds, and educational activities.
Website: Kokopelli

- **MAGHÁZ – Hungarian Community Seed Network**

Country: Hungary.
Focus: Organisation that promotes the conservation of agricultural biodiversity in Hungary by supporting the exchange of traditional seeds, including local perennial varieties. They encourage seed-saving practices among farmers and gardeners.
Key activities: Seed exchanges, education on seed-saving practices, and biodiversity conservation.
Website: MAGHÁZ

- **Red de Semillas "Resembrando e Intercambiando"**

Country: Spain.
Focus: National level network that promotes the conservation and use of local and traditional varieties, including perennial crops such as olives and fruit trees.
Key activities: Seed exchanges, conservation of traditional varieties, and farmer engagement.
Website: Red de Semillas

- **Rete Semi Rurali (RSR) - Italy**

Focus: National network of farmers, seed savers, and researchers working to conserve and promote the use of traditional, local, and under-utilized crop varieties, including perennial fruit trees and vegetables.
Key activities:

- Participation in research and breeding projects to conserve local varieties.
- Workshops and events to share knowledge on biodiversity and sustainable farming.
- Promotion of seed exchange networks among farmers, particularly for perennial crops like olives, grapes, and figs.

Website: Rete Semi Rurali

- **Réseau Semences Paysannes**

Country: France.
Focus: Réseau Semences Paysannes is a network of farmers, seed savers, and organizations dedicated to the conservation and promotion of traditional seeds, including perennial crops like fruit trees. The network supports farmers in growing and conserving local varieties.
Key activities: Seed exchange, farmer education, and biodiversity advocacy.
Website: Réseau Semences Paysannes

II. Operational Groups

A non-exhaustive list, in alphabetical order, of previous & current operational groups includes the following as well as in the database found here:

- **"Approaches to genetic improvement integrated with the fruit supply chains for the development of eco-sustainable varieties of apple and strawberry"** (2021-2022)

Country: Italy
Focus: Breeding of new varieties resistant to pests and diseases adapted to minimal inputs and with high-quality fruit characteristics

Description: The initiative used advanced genetic & phenotyping methods, applying marker-assisted selection and other biotechnological tools to breed new apple and strawberry varieties. By involving breeders, farmers, and supply chain partners in the process, the project emphasized practical application & rapid uptake of results, ensuring that developed varieties align with industry standards and consumer preferences.
Key achievements: Identification of key traits for resilience & quality in apples and strawberries, including disease resistance & improved fruit qualities. Development of innovative breeding pipelines shorting breeding cycles.
Impact: Reduced environmental footprint of apple & strawberry farming. Bolstered local agricultural sectors by providing varieties that are resilient and economically viable, promoting sustainable practices in European fruit production.
Website: link

- **Biodiversamente Castagno: "Guidelines for the preservation & enhancement of biodiversity the chestnut in Emilia Romagna"** (2017-2020)

Country: Italy
Focus: Protect and promote the biodiversity of chestnut varieties in the Emilia Romagna region.
Description: It involved the mapping & genetic characterization of local chestnut varieties, studying soil biodiversity & establishing guidelines to conserve germplasm. Activities included detailed soil and genetic analyses across different chestnut groves and engaging local producers to act as biodiversity custodians.
Key achievements: Successfully mapped genetic diversity of chestnut varieties using molecular markers. Established conservation groves with endangered chestnut varieties. Developed detailed soil biodiversity profiles and sustainability guidelines, assessing soil health through bio-indicators like arthropod diversity. Created "guidelines" to help producers and stakeholders preserve chestnut diversity while supporting eco-friendly agricultural practices.
Impact: Protected local chestnut varieties & strengthened local ecosystems by enhancing soil health. Positioned local farmers as active stewards of biodiversity, helping to preserve both the environmental and cultural heritage of the area.
Website: link

- **"Characterisation and exploitation of local fruit biodiversity and evaluation of innovative apple genotypes for agriculture in mountain areas"** (2020-2023)

Country: Italy
Focus: Characterization of local fruit biodiversity, particularly focusing on local apple and pear varieties.
Description: This OG characterized a selection of traditional apple and pear varieties alongside new genotypes. Analyses included pomological (fruit characteristics), chemical, genetic, & nutritional assessments for fresh & processed forms. It also documented the historical and cultural significance of these varieties, creating an ethnobotanical archive that helps retain local knowledge.
Key achievements: It identified nutritional & sensory qualities distinguishing local varieties. Data gathered, including metabolite profiles, were added to existing genetic resource databases, enhancing conservation & commercialization potential. E.g.

"Angelica" cultivar was found to be both economically viable & well-regarded by consumers. New eco-friendly packaging was also developed.
Impact: Supported regional biodiversity and offered farmers alternatives for profitable, sustainable fruit production, particularly suited to mountain agriculture.
Website: link

- **"Development of an environmental sustainable cultivation model, improving the spread of old vineyard varieties, within Colli Bolognesi area"** (2018-2020)

Country: Italy
Focus: Promote sustainable viticulture while preserving and enhancing older grape varieties of Colli Bolognesi region, Italy.
Description: It conducted research and practical trials aimed at integrating eco-friendly cultivation methods for vineyards, such as reducing the use of chemical pesticides and herbicides, improving soil management, and optimizing water usage.
Key achievements: It established guidelines for eco-friendly vineyard management practices and identified effective, sustainable approaches to cultivate underutilised grape varieties helping reduce dependency on chemical inputs & foster resilience against environmental stresses
Impact: Promoted diversity within vineyards by reintroducing traditional previously declined grape varieties. Contributed to local environmental sustainability and increased the appeal of wines made from indigenous grapes.
Website: link

- **"Development of Commercial Line for Biodiversity and Local Fruit and Vegetable Products"** (2018-2020)

Country: Italy
Focus: Development of commercial products from local fruit and vegetable varieties.
Description: This OG aimed at creating value-added products from local, under-utilized fruit and vegetable varieties to support biodiversity. It also seeks to link biodiversity conservation with economic sustainability for farmers.
Key achievements: Product development, such as commercial products using local fruit and vegetable varieties that are under-utilized in mainstream agriculture. Biodiversity conservation by encouraging the cultivation of lesser-known local varieties**.** Market integration by developing branding and marketing strategies for these products, increasing their market visibility and consumer demand for biodiversity-friendly products.
Impact: Provided economic incentives for farmers to grow and conserve local varieties, creating a sustainable business model that benefits both biodiversity and local economies.
Website: link

- **"Extensive Orchard of Indigenous and Traditional Slovenian Fruit Varieties and their Role in Biodiversity - The Preservation of the Traditional Cultura"** (2019-2022)

Country: Slovenia
Focus: Conservation of traditional Slovenian fruit varieties and promoting biodiversity.
Description: This Operational Group focuses on the preservation and promotion of indigenous and traditional fruit varieties in Slovenia, which are crucial for maintaining

biodiversity and cultural heritage. The project involves establishing extensive orchards with these local varieties to demonstrate their ecological, agricultural, and cultural value.
Key achievements: The OG established extensive orchards preserving and propagating indigenous Slovenian fruit varieties, supporting biodiversity and reducing the risk of genetic erosion. It also promoted traditional knowledge of fruit growing and the use of heritage varieties in local communities and showcased how traditional fruit varieties can contribute to sustainable farming systems that are more resilient to climate change and pests.
Impact: Helped maintain genetic diversity in fruit production, raised awareness of the cultural importance of local varieties, and provided an alternative to intensive agricultural practices that often rely on a few commercial varieties.
Website: link

- **"Selection and development of frost-tolerant apple and pear varieties to avoid frost injuries in organic fruit growing"** (2021-2024)

Country: Germany
Focus: Advance frost-resistant apple and pear varieties suitable for organic cultivation.
Description: The OG apple field trials & breeding efforts to evaluate frost resistance in different apple & pear genotypes, focusing on critical periods of flowering and budding. Eventually, it aims to provide organic growers with more resilient varieties that reduce the need for costly and complex frost protection measures.
Key achievements expected: Enhance the creation of a new set of cultivars specifically adapted to organic conditions with minimal frost-related yield loss.
Impact expected: The project may reduce the economic impact of frost on organic fruit growers by lowering yield losses and minimizing the need for active frost protection methods, such as sprinklers and wind machines.
Website: link

- **"Selection of autochthonous biotypes of castellano-manchega vine varieties"** (2022-2024)

Country: Spain
Focus: Identify and preserve local grape varieties that are indigenous to the Castilla-La Mancha region, Spain.
Description: The OG gathers regional stakeholders to explore native vine varieties with high adaptability to the area's climate. The goal is to strengthen the agricultural and environmental sustainability of vineyards by using vines that require fewer external inputs and are naturally suited to local conditions.
Key achievements expected: Successful selection & propagation of hardy, native grape varieties that can withstand local environmental stresses. Create a sustainable supply of unique, high-quality grapes that showcase the distinctive characteristics of the region.
Impact expected: Bolster local biodiversity, reduce environmental impacts through lower chemical use, and support the region's wine industry by providing unique varieties that highlight the terroir of Castilla-La Mancha
Website: link

- **"Traditional Romanian apple in ecological system in the present: preserving genetic resources and economical development on long term"** (2021-2023)

Country: Romania
Focus: Conservation & economic revitalization of traditional Romanian apple varieties within organic farming practices.
Description: The initiative focused on cultivating traditional apple varieties under organic conditions and protect genetic diversity while promoting their long-term economic viability. By integrating traditional apple varieties into modern organic systems, the project intended to offer a viable model for other regions looking to preserve local biodiversity.
Key achievements: The project successfully established guidelines & strategies for managing & marketing these apple varieties. It also demonstrated how organic farming practices can improve both their quality & marketability of traditional apple varieties, potentially increasing their demand in both local and international markets.
Impact: It assisted to secure a market for traditional apple varieties and support local farmers & communities. It served as a model for other European regions interested in linking biodiversity preservation with organic farming and economic development.
Website: link

III. Relevant research projects & programmes

Current and previous notable examples of such EU funded projects & programmes are (non-exhaustive and in alphabetical order):

- **BIOVALUE** (2021–2025)

Focus: Enhancing the value of biodiversity in agricultural landscapes.
Description: BIOVALUE Horizon Europe project seeks to improve the use of biodiversity, although not strictly focusing on perennial crops, by supporting the development of a dynamic and modular agent-based simulation tool that will analyse the link among biodiversity, the agri-food value chain, the environment, consumer's preferences and health.
Key achievements expected: To review the existing agri-food value chain state-of-the-art modelling tools and review the cultivation trajectory of underutilized, genetically diverse crops and promote the use of biodiversity in farming systems.
Website: BIOVALUE

- **BreedingValue** (2021–2025)

Focus: Improve the genetic diversity and breeding efficiency of berry crops.
Description: This H2020 project aims to develop innovative breeding strategies to enhance the genetic base of strawberries, raspberries, and blueberries, focusing on traits such as disease resistance, climate adaptability, yield stability, and fruit quality.
Key achievements expected: The project foresees the creation of a genetic resource database, the development of improved berry varieties, the establishment of climate-resilient breeding programs, the delivery of support for sustainable agricultural practice as well as strengthened collaboration between stakeholders.
Website: BREEDINGVALUE

- **CLIMED-FRUIT** (2021–2024)

Focus: Sustainable fruit farming in Mediterranean climates.
Description: The project (Horizon Europe) addresses the challenges of climate change for perennial fruit crops like olives, grapes, and figs. It also promotes agroecological approaches and local varieties that are well-suited to the Mediterranean climate.
Key achievements expected: To develop climate-resilient farming strategies for fruit trees, promote traditional and under-utilized fruit varieties, better adapted to local climates and foster knowledge exchange between Mediterranean farmers.
Website: CLIMED-FRUIT

- **DREAM4FRUIT** (2022-2026)

Focus: Development and research on resilient fruit varieties.
Description: This PRIMA project promotes the breeding and cultivation of resilient perennial fruit crops that can thrive under changing climatic conditions.
Key achievements expected: To advance breeding programs for climate-resilient fruits and promote under-utilized fruit varieties adapted to local conditions.
Website: DREAM4FRUIT

- **EUFORGEN – European Forest Genetic Resources Programme**

Focus: Conservation and sustainable use of forest and perennial genetic resources.
Description: Although the programme focuses primarily on forest species, it contributes as well to the conservation of under-utilized perennial tree crops like chestnut, hazelnut, and walnut. Importantly it provides a platform for European countries to collaborate on conserving forest genetic diversity, which includes economically important but under-utilized tree crops.
Key achievements: It has helped conserve and promote the sustainable use of genetic resources of important perennial species in Europe, supporting biodiversity and climate resilience.
Website: EUFORGEN

- **FruitDiv** (2024-2028)

Focus: Enhancing fruit diversity in European agricultural systems.
Description: The newly started Horizon Europe project aims to promote the cultivation of diverse and under-utilized fruit species, particularly perennial crops, to support biodiversity and farm resilience.
Key achievements expected: To increase awareness and use of lesser-known fruit species in farming systems and enhance market opportunities for under-utilized fruit species through value-added products.
Website: FRUITDIV

- **GEN4OLIVE** (2020–2024)

Focus: Olive breeding for productivity, resilience, and climate change adaptation.
Description: the project (H2020) focuses on improving olive genetic resources and breeding to enhance resilience to climate change, pests, and diseases. It promotes under-utilized olive varieties with desirable traits.
Key achievements expected: the project will create a database of olive genetic resources, as well as it will develop new breeding tools to speed up the development of climate-resilient olive varieties.

Funded by the European Union

Website: GEN4OLIVE

- **INNOBREED** (2022-2026)

Focus: innovative organic breeding for fruit crops.
Description: This Horizon Europe project promotes and aggregates innovative solutions focused on the participative development of fruit varieties dedicated to the organic farming system.
Key achievements expected: To deliver social innovations, ideotypes and methods for screening resilient cultivars and genitors with larger genetic bases for fostering organic fruit breeding and to their application for the improvement of the whole organic fruit chain.
Website: INNOBREED

- **RADIANT** (2021–2025)

Focus: Enhancing the role of neglected and under-utilized species in sustainable agriculture.
Description: This Horizon 2020 project focuses on unlocking the potential of under-utilized crops, including perennials, by developing solutions and tools that promote underutilised crops, agrobiodiversity, sustainable diets and dynamic value chains.
Key achievements expected: To demonstrate successful transitions to inclusive agrobiodiversity systems, carry out improvement programs so that under-developed crops become more competitive and test the best respective agricultural practices.
Website: RADIANT

Previous respective R&I activities are:

- **DIVERSIFOOD** (2015–2019)

Focus: Enhancing the use of agrobiodiversity, including local and under-utilized crops.
Description: This Horizon 2020 project explored the potential of diverse, locally adapted crops, including perennials, in sustainable farming systems. It aimed to reintroduce under-utilized crops into European food systems by developing short supply chains and enhancing local food production.
Key achievements: The project worked successfully in reintegrating several local varieties into markets, raising awareness of their cultural and nutritional value, and fostering collaborations between farmers, researchers, and consumers.
Website: DIVERSIFOOD

- **DiverIMPACTS** (2017–2022)

Focus: Crop diversification for sustainable agricultural systems.
Description: Horizon 20220 project working on the promotion of crop diversification strategies, including the use of perennial crops, to enhance farm resilience & reduce the environmental impact of agriculture. It involved partnerships with farmers, scientists, and policymakers across Europe to implement innovative diversification strategies.
Key achievements: The project demonstrated the benefits of perennial crops in mixed farming systems, reduced reliance on chemical inputs, and increased biodiversity in agricultural landscapes.

Website: DiverIMPACTS

- **ECOBREED** (2018–2023)

Focus: Breeding of crops for improved sustainability and reduced input needs.
Description: Horizon 2020 project focusing on breeding under-utilized crops, including certain non-fruit perennials (e.g. buckwheat and alfalfa), for improved organic and low-input farming systems. Its aim was to develop resilient crop varieties suited to organic agriculture and less dependent on fertilizers and pesticides.
Key achievements: The project has enhanced the genetic diversity of these crops and developed varieties adapted to local growing conditions, increasing their use among European farmers.
Website: ECOBREED

- **FARMERS PRIDE** (2017–2020)

Focus: Conservation of plant genetic resources in Europe.
Description: This H2020 project aimed to establish a Europe-wide network for the conservation and use of plant genetic resources, including perennial crops and under-utilized species.
Key achievements: Created a network of stakeholders to conserve and utilize local plant diversity & promote the sustainable use of under-utilized perennial crops in local farming systems.
Website: Farmers Pride