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A living heritage: old and traditional horticultural varieties supporting biodiversity from gene bank to field

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Abstract. Agriculture remains to be a major threat to biodiversity, primarily due to partial habitat destruction, unsustainable land use, and the erosion of plant genetic diversity. At the same time, plant genetic resources are essential for crop improvement and long-term food security. A significant share of global agrobiodiversity is safeguarded through *ex situ* conservation, stored as seed collections in gene banks around the world. These collections include cultivated varieties and crop wild relatives, which play a crucial role in broadening the genetic base for breeding resilient crops. In Poland, the active collection of vegetable genetic resources, including traditional and old cultivars as well as wild relatives, is maintained by the Regional Centre for Horticultural Biodiversity (RCBO) at The National Institute of Horticultural Research in Skierniewice. The living collection supports both scientific research and biodiversity-based development in rural areas. One of the ongoing initiatives of the RCBO focuses on the multiplication, evaluation, and registration of regional and amateur vegetable varieties. It aims to increase their representation in the National List of Vegetable Plant Varieties and supports the implementation of agri-environment-climate schemes under the EU's Common Agricultural Policy (CAP). It also assists farmers in reintroducing locally adapted, historically cultivated varieties. To date, eleven old vegetable varieties have been submitted for registration and are currently awaiting approval. There is growing recognition of the need to preserve these genetic resources, not only for their breeding potential but also as a moral responsibility to protect biodiversity and regional heritage for future generations.
Key words: plant genetic resources, collection missions, *ex situ*, *in situ*, agri-environmental schemes, old varieties, vegetable plants.

Introduction

The safeguarding of plant genetic resources is fundamental to food security, agricultural sustainability (Mba, Dullo & Nnadozie, 2021), as well as the heritage of Poland and the entire European Union. Without this effort, we risk losing invaluable genetic diversity - diversity that has been shaped over centuries and which continues to be the foundation of horticultural traditions and the future of horticulture.

A gene bank serves as a repository of plant genetic resources, ensuring their conservation, accessibility and sustainable use (Engels & Visser, 2003). The entire process in the gene bank begins with the collection of plant material. All procedures in gene banks are in accordance with international standards set by the Food and Agriculture Organization (FAO, 2019) to ensure high-quality conservation practices. Seeds, seedlings or other propagating material are identified and collected from cultivated fields, natural and semi-natural habitats and traditional home gardens across Poland, giving priority to endangered and underutilized species. Each accession is carefully documented, including its origin, morphological features and ecological conditions (Engels & Visser, 2003).

The International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA), adopted by the FAO, promotes a complementary approach to the conservation of plant genetic resources – both *ex situ* (in gene banks) and *in situ* (and *on farm)*. According to the Standards for Plant Genetic Resources for Food and Agriculture (FAO, 2014), gene banks should also "promote the availability of genetic resources for uses including research, breeding, education, farming and repatriation".

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The growing interest in old species and varieties of agricultural and horticultural plants, as well the desire to expand crop diversity and increase production diversification, creates opportunities for their reintroduction into cultivation (Diddona *et al*., 2024). The landraces (old and local varieties of plants) grow well in poor soils and often are characterized by greater tolerance to environmental stresses. These forgotten crops supplement the diet with valuable, nutrient-rich products, providing people with a diverse diet. They serve as the starting material for the creation of new varieties (Anglin *et al*., 2025).

Old varieties of cultivated plants constitute highly diverse genetic material. Their occurrence in the Polish countryside, along with the abundance of wild plant species, signifies a high level of biodiversity in rural areas and the possibility of maintaining biological balance in agroecosystems. As a source of many valuable genes, these varieties can serve as starting material for breeding new varieties, including those resistant to diseases and pests, as well as tolerant to abiotic stresses, including drought, frost and high temperatures.

According to the third report on the state of the world's Plant Genetic Resources for Food and Agriculture (FAO, 2025), almost 38% of sources of the accessions in gene bank collections come from farms and cultivated habitats and were collected during collection missions.

In Poland, due to the significant fragmentation of agricultural holdings and the resulting extensive land use, many old varieties of crops are still found (Dostatny, 2013). Old varieties and indigenous populations of vegetable and ornamental plants are still cultivated in home gardens. Old varieties of fruit trees still occur in traditional orchards, monastery orchards, manor houses, and home gardens, on field margins, and also in parks and avenues. However, these varieties and forms are becoming fewer each year, and many are threatened with extinction. Therefore, as part of the Polish activity under the International Treaty on Plant Genetic Resources for Food and Agriculture, The National Institute of Horticultural Research is undertaking collection missions aimed at their preservation *ex situ*, in gene bank. During expeditions, besides passport data, the collectors documented valuable traditional knowledge shared by farmers regarding plant traits considered agronomically, culturally, and locally important, as well as the ways they cultivated, harvested, and processed them. This information provides significant data that can help us better understand the consequences of climate change and changes in agricultural practices (Bioversity, 2025; Dostatny *et al*., 2014; Dostatny *et al*., 2021; Dostatny *et al*., 2024; Thormann *et al*., 2015).

Collecting populations and varieties of old cultivated and wild plants threatened by genetic erosion is just one of the aims of gene bank. In addition, the gene bank has other roles, such as: i. description and evaluation of collected materials, ii. maintaining seed samples in a viable state (including long-term storage) while preserving their genetic integrity avoiding loss of alleles during regeneration, iii. documentation of collected materials, iv. effective management of germplasm for further use by plant breeders, farmers, scientists and other users.

Endangered plant species and traditional horticultural varieties can be conserved through two complementary strategies: *ex situ* and *in situ*. *Ex situ* conservation involves maintaining genetic resources outside their natural habitats and represents one important strategy for safeguarding endangered plant species and traditional horticultural varieties. This approach involves preserving genetic resources, for example in gene banks, as explained above, but also in botanical gardens, and open-air museums, where they can be maintained under controlled conditions and made available for research, breeding, and education. Complementary to this, *in situ* conservation, including *on farm* management, focuses on maintaining these genetic resources within their natural habitats or traditional agricultural systems. This dynamic form of conservation enables continued adaptation through natural selection and human management. The integration of both strategies is essential to ensure the long-term preservation of plant genetic diversity and its adaptive potential in the face of future environmental and agricultural challenges.

For the purpose of promoting *on farm* conservation, support mechanisms within the Common Agricultural Policy (CAP) could play a significant role. The CAP Strategic Plan for 2023–2027, developed on the basis of an assessment of the specific needs of Polish agriculture and in line with the opportunities provided by the reformed Common Agricultural Policy, sets out a framework for achieving nine specific objectives. Among these are the promotion of sustainable development and the efficient management of key natural resources, including water, soil, and air, as well as the protection of biodiversity. The plan also emphasizes the enhancement of ecosystem services and the safeguarding of habitats and landscapes, thereby integrating environmental and climate considerations into agricultural policy and practice.

Materials and Methods

This study focused on plant genetic resources stored in the Regional Centre for Horticultural Biodiversity (vegetable gene bank) in Skierniewice and their use in agri-environmental schemes

implemented under the Common Agricultural Policy (CAP). Agri-environmental schemes, as an instrument of the CAP, have been in place in Poland since 2004 (pilot phase) and have been fully operational since 2007. The analyses carried out as part of this work placed particular emphasis on activities aimed at preserving plant genetic resources.

The analysed material included accessions of vegetable seeds collected from farms and preserved in the Regional Centre for Horticultural Biodiversity. Standardised procedures were used for seed collection (field sampling, documentation of origin and registration of passport data in accordance with FAO gene bank standards (FAO, 2014), evaluation and long-term storage (at −20°C in dedicated facilities). Selected vegetable genotypes stored in the gene bank were identified and prepared for distribution to farmers participating in agri-environmental schemes. The criteria for selecting vegetables included adaptation to local conditions, conservation status and compliance with programme requirements.

Furthermore, this paper examines agri-environmental schemes implemented from 2004/2007 to the present, with particular emphasis on packages directly related to the conservation of plant genetic resources. The study also demonstrates how gene banks can serve as a link, enabling the reintroduction of old and local vegetable varieties, collected in the past and stored in gene banks, into the fields by farmers participating in agri-environmental schemes.

Results and Discussion

This section first presents the development of agri-environmental schemes in Poland, with particular emphasis on packages dedicated to the conservation of plant genetic resources. Next, research on old and traditional horticultural varieties preserved in the vegetable gene bank and their reintroduction into farmland is presented and discussed, emphasising their role in supporting biodiversity on farms and combining *ex situ* collections with sustainable agricultural practices.

During the first implementation period of the agri-environmental schemes (2007-2013), the scheme consisted of, among others, package 6 dedicated to the preservation of endangered plant genetic resources in agriculture. Its implementation concerned the propagation and maintenance of: local crop varieties, landraces, endangered crop species and endangered species of plants that accompany them in their habitats (preservation of rare wild segetal flora accompanying cultivations). This package continues in the second implementation period, i.e. 2014-2020 with some modifications, addressing only to the conservation of endangered crops and registered amateurs and regional varieties of cultivated plants. The implementation of the package involved the cultivation or production of seed material of plant species threatened by genetic erosion, including: emmer wheat (*Triticum diccocum* Schrank), einkorn wheat (*Triticum monococcum* L.), rye (*Secale cereale* var. *multicale* Metzg. ex Alef.), camelina (*Camelina sativa* (L.) Crantz), white melilot (*Melilotus alba* Medik.), grass pea (*Lathyrus sativus* L.), lentil (*Lens culinaris* Medik.), parsnip (*Pastinaca sativa* L.), kidney vetch (*Anthylis vulneraria* L.), buckwheat (*Fagopyrum tataricum* L. Gaertn), in addition the cultivation or production of seed material/seeds of conservation varieties registered (regional and/or amateur) in the National Register. At that time, only five regional varieties of winter wheat and nine potato varieties, as well as one regional variety of garlic were registered.

The next period of agri-environmental schemes (2023–2027) continues to support the package dedicated to the conservation of plant genetic resources, while also expanding its scope. In addition, a new and noteworthy initiative has been introduced, focusing on the establishment of biodiversity gardens. Description of the two packages below (now so called "intervention"):

Intervention 5. Preservation of endangered plant genetic resources in agriculture: cultivating rare plant species or varieties. The agri-environmental-climate payment is granted for land on which the following plants are cultivated:

- regional varieties or amateur varieties, entered in the National Register;
- varieties of marginal agricultural plant species, entered in the National Register or registered in the Common Catalogue of Varieties of Agricultural Plants;
- species of rarely cultivated agricultural and vegetable plants;
- species of rarely cultivated herbal plants.

Intervention 7. Biodiversity on arable land. The aim of this intervention is to enrich biodiversity and the rural landscape, as well as to provide a habitat and food base for beneficial organisms. The intervention consists of establishing and maintaining the following on arable land:

Variant 7.1. Field margins as flower strips, which are also ecological corridors and refuges for many animal species.

Variant 7.2. Biodiversity gardens to increase biodiversity in rural areas. This approach involves cultivation diverse plant species and varieties together to enhance biodiversity in a garden. This, in turn, will facilitate achieving other goals (soil health, beneficial insects, animal habitat). In this kind of gardens (measure 0,1 to 0,5 ha) must be cultivated

15 species of plant as the previously list from the intervention 5.

According to the Polish Journal of Laws (Ustawa z 2017), "*Amateur varieties* refer to vegetable plant varieties that have been discovered and developed for cultivation under specific agrotechnical, climatic, or soil conditions. They are not intended for large scale vegetable production but are important for preserving biodiversity". However, "*regional varieties* are crop varieties that have been traditionally grown in a specific region and have adapted to local climatic and soil conditions. These varieties are important for preserving biodiversity and agricultural heritage". Regional varieties and amateur varieties of specific agricultural and vegetable varieties, after fulfilling the criteria established by the legislator, are officially recognized as regional or amateur and subsequently entered into the national register maintained by the Central Research Centre for Cultivar Testing (COBORU, 2025). According to Commission Directive 2009/145/EC (Commission Directive 2009/145/EC) of the European Union, the term *"amateur"* refers to so-called *"varieties developed for growing under particular conditions"* and the term *"regional varieties"* refers to *"conservation varieties" (*Didonna et al., 2024). In this paper, the terms *"amateur"* and *"regional"* were used in accordance with the terminology adopted in Poland.

At the Regional Centre for Horticultural Biodiversity (vegetable gene bank) in Skierniewice – Poland, an active collection of seeds representing horticultural genetic resources is maintained (Chojnowski *et al*, 2022). One of the key tasks of Regional Centre for Horticultural Biodiversity is to support the Common Agricultural Policy by participating in the propagation, evaluation, and registration of amateur varieties of vegetable plants, with the aim of increasing their representation in the National Register of Vegetable Plant Varieties. In addition, the Centre assists the Ministry of Agriculture and Rural Development in the implementation of agri-environmental and climate schemes under the Common Agricultural Policy. During this process, six tomato varieties, one bean variety, two bean populations, one lettuce population, and one pepper variety were submitted to the National Register.

The Regional Centre for Horticultural Biodiversity on the base of active collection of horticultural genetic resources has been prepared seeds from 100 genotypes of the following vegetable species for farmers implementing agri-environmental-schemes:

Within this task, the Regional Centre also organizes a variety of educational activities aimed at raising awareness and promoting the use of old vegetable varieties. These activities include contests for pupils and students, educational meetings, workshops, and tasting sessions of heritage vegetable varieties, among others. By engaging with young people, farmers, agriculture advisors and the wider community, these initiatives contribute to the preservation of agricultural biodiversity, the dissemination of traditional knowledge, and the promotion of sustainable horticultural practices.

Table 1

Vegetable species and number of genotypes with seeds prepared by the Regional Centre for Horticultural Biodiversity for farmers participating in agri-environmental schemes

TAXON	**No.**
Anethum graveolens L.	1
Apium graveolens L.	4
Brassica oleracea L.	10
Cucumis sativus L.	11
Daucus carota L.	2
Lactuca sativa L.	42
Lactuca sativa L. var. *angustana* Irish	1
Petroselinum crispum (Mill.) Fuss	5
Raphanus sativus	4
Solanum lycopersicum	20
TOTAL	**100**

Gene banks should facilitate access to stored genetic resources for research, breeding programmes, educational activities, agricultural practice, and on-farm conservation. The effective implementation of educational activities, including the preparation and distribution of appropriately developed material for farmers, requires additional financial resources and the engagement of multiple stakeholders, such as non-governmental organizations, agricultural advisory units, scientific institutions, and intersectoral cooperation networks. Due to staffing and budget limitations, gene banks focus primarily on core tasks, such as long-term preservation of resources in a living state and their evaluation and documentation (Fu, 2017).

Conclusions

Ensuring stable funding for all activities carried out in the gene bank is essential to maximise the potential of old horticultural varieties as living heritage, including the collection of plant material, proper management of germplasm resources, their distribution and promotion, while supporting agri-environmental schemes under the Common Agricultural Policy, thus enhancing biodiversity from the gene bank to the field.

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