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LANDRACE ELECTRONIC CATALOGUE – *EX SITU*/*ON FARM* CONSERVATION, DOCUMENTATION AND MANAGEMENT

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Abstract

Although the majority of agricultural production in Europe currently depends on formally registered, genetically uniform cultivars, landraces are still cultivated in home gardens. A comprehensive inventory of on-farm-maintained local varieties is currently lacking in Europe, resulting in limited and dispersed data regarding their cultivation locations and associated crops. The creation of such a catalogue is of considerable importance for promoting actions aimed at enhancing the conservation and utilization of landraces. The results showed that the highest number of landrace cultivation sites in Bulgaria are located in semi-mountainous rural areas and are represented mainly by horticultural species. During the period 2024-2026, progress has been made in creating the database of ex situ conserved landraces through activities conducted under the DIGIVALPGR project, funded by the Bulgarian Science Fund (Contract KP-06-Slovakia/9/13.08.2024). It includes information on over 100 local accessions, adding value to landraces in socio-cultural, environmental, and economic contexts.

Key words*: plant diversity, genebank, digitalization, valorization, European collaboration.*

INTRODUCTION

Global climate change and its adverse impact on agricultural production and biodiversity are creating serious socio-economic challenges and increasing the risks associated with natural disasters such as droughts and floods. These processes threaten natural resources and highlight the need to explore plant diversity in order to ensure food security and sustainable agricultural systems (FAO, 2022).

The global trend of decreasing agrobiodiversity poses a serious threat to the sustainability of agricultural production. Reduced genetic diversity negatively affects plant resistance to diseases and pests and limits the adaptive capacity of crops under climate change conditions, thereby affecting global food security (Raza et al., 2019).

Plant genetic resources represent the diversity of crops and their wild relatives, including local populations and forms, as well as old, traditional, and improved varieties. Their sustainable conservation for present and future generations is a key objective of the European Strategy for Plant Genetic Resources (ECPGR, 2021).

Landraces and traditional home gardens are increasingly recognized as important heritage values and hotspots of biodiversity conservation. Studies show that traditional home gardens can preserve crop diversity for more than a century through the maintenance of local seed systems and farmers' knowledge (Jani et al., 2015; Antofie, 2024; Antofie et al., 2024; Lun, 2026).

To feed more than 9 billion people by 2050, agricultural production must significantly increase while ensuring environmental sustainability. Landraces possess valuable adaptive traits developed through long-term cultivation under specific environmental conditions. Their genetic diversity provides important resources for crop breeding and for the adaptation of agriculture to climate change (Kumar, 2026; Fowler, 2026).

Pedrali et al. (2026) highlighted the prospects for the valorization of *Phaseolus* spp. landraces in the mountain areas of Northern Italy. A rich diversity of common bean local varieties - an important traditional grain legume crop in Bulgaria, has also been reported. This diversity is expressed through various biological traits and is explained by the different geographical origins of the accessions (Neshev, 2025).

The risk of losing plant genetic diversity is increasing. Therefore, researchers are exploring

different seed technologies for the conservation and reproduction of horticultural crops (Shallal et al., 2020; Nicolae et al., 2023).

The management of *ex situ* collections includes activities such as collection, evaluation, documentation, and long-term storage of plant genetic resources. As a National Coordinator in Bulgaria, the Institute of Plant Genetic Resources - Sadovo maintains an information system documenting accessions preserved in the National Genebank.

However, information on landraces conserved *ex situ* and maintained *on farm* is often fragmented and dispersed. Digital tools and open access catalogues are essential for improving documentation, management, and utilization of plant genetic resources (Raggi et al., 2024; Maxted et al., 2025).

Therefore, the aim of this study is to develop and present an electronic catalogue of Bulgarian landraces documenting the enrichment of *ex situ* collections in the National Genebank in Sadovo and supporting their conservation, management, and sustainable utilization.

MATERIALS AND METHODS

The Information and Documentation Center at the IPGR-Sadovo was established in 1982. It is responsible for the digitalization of plant genetic resources entering the National Genebank. All accessions are registered in an electronic database according to the approved international FAO/Bioversity descriptors (2017; 2022).

Passport information includes the catalogue number, taxonomic description, accession name, date of registration in the collection, biological status, donor of the accession, ecological and geographical origin, and description.

During the period 2024-2026, collecting missions in rural areas of Bulgaria were conducted within the DIGIVALPGR project following the methodology of the European Cooperative Programme for Plant Genetic Resources (ECPGR, 2017). The seed accessions are donated by local farmers and conserved in the National Genebank (Figure 1). A total of 20 localities and 18 households were investigated. Local farmers were interviewed using a project questionnaire.



Figure 1. Collected landraces for enrichment of the Bulgarian genebank collection (February, 2026)

Open access to plant genetic resources is ensured through the participation of the National Inventory in international databases. The European Cooperative Programme for Plant Genetic Resources (ECPGR) requires a unified structure for building genebank databases to facilitate participation in the European Search Catalogue (EURISCO). In addition, the European Integrated Genebank System (AEGIS) provides access to conserved unique landraces.

RESULTS AND DISCUSSIONS

The climatic characteristics of Bulgaria differ from those typical of many continental European countries, as frequent and unpredictable natural anomalies are increasingly observed. In response to climate change, breeding programs are directed toward the development of new varieties that are well adapted to the specific agro-ecological conditions of the country. In this context, the importance of plant genetic resources, particularly landraces, is increasing, as they represent an invaluable source of useful genes for breeding programs.

Since 1982, a total of 11,539 landraces has been collected through various expeditions and research projects and conserved *ex situ* in the genebank in Sadovo. The collection includes local varieties and populations originating from home gardens and small farms, as well as crop wild relatives collected from their natural habitats.

The main characteristics of the digital registry for documentation of plant genetic resources in Bulgaria are presented in Table 1.

Table 1. Main features of the digital registry of landraces and database structure

Information resource	Database/electronic catalogue
Objective	Conservation and management of plant genetic resources in Bulgaria
Information format	GeneBank System
Content description	Documentation of accessions registered in the National Collection and stored in the National Genebank in Sadovo
Database structure	FAO/Bioversity International Descriptors
Data type	Passport, evaluation and characterization characteristics
Data language	Bulgarian, English, Latin (taxonomic descriptions)
Data update	Periodically
Collection period	1982-2026
Basis for collecting the information	National Biodiversity Conservation Strategy; Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture
Method of collecting and updating information	Database with information on landraces, received from expeditions; on-farm maintenance of old and forgotten varieties in different geographical regions of the country; marked and surveyed localities for *in situ* monitoring of crop wild relatives in the habitat area
Purpose of the information	Management of *ex situ* genebank collections; breeding programmes; international relations – FAO, Bioversity International/ ECPGR; transfer data to international networks – EURISCO, AEGIS, GENESYS, FAO WIEWS; partners including other genebanks, institutes, universities, and botanical gardens; all users
Dissemination and open access	https://genbank.uni-plovdiv.net/ https://eurisco.ipk-gatersleben.de/ https://www.ecpgr.org/aegis
Exchange of seeds	Bulgarian genebank is a partner in the global network for the free germplasm; the Standard Material Transfer Agreement is adapted (SMTA)
Users of the electronic catalogue	Breeders, researchers, authorities, organic producers, farmers, ecologists, botanists, etc.

One of the main directions of the expedition activities is the collection of cultivated forms of field and horticultural crops. In home gardens, traditional varieties of tomato, pepper, cucumber, pumpkin, melon, watermelon, onion, leafy vegetables, and potato have been identified. These genotypes are well adapted to specific agro-ecological conditions and possess valuable traits such as early maturity, resistance to biotic and abiotic stresses, and a high content of biologically active compounds.

For cereal and grain legume crops, particular attention is given to the collection of primitive wheat forms and old populations of maize, as well as traditional varieties of common bean, cowpea, chickpea, lentil, and other legumes.

Of particular interest is the species diversity of several poorly distributed or almost forgotten spice and medicinal plants, which are currently being rediscovered and increasingly used for dietary and health-promoting purposes, as well as in alternative therapeutic practices for the prevention and treatment of various diseases.

However, increasing urbanization, the expansion of transport infrastructure, and other environmental pressures pose serious threats to a large number of crop wild relatives and other wild species belonging to different botanical families. Their conservation is important not only for maintaining biodiversity but also because they have valuable traits that could be utilized in crop improvement programs using innovative breeding approaches, as molecular and genomic technics. The collected germplasm includes sources of high protein content, fertility enhancers, resistance to fungal, bacterial, and viral diseases, and high adaptive capacity in the context of global warming and climate change.

Cooperation and information exchange between researchers working on plant genetic resources and plant breeders play a key role in optimizing activities aimed at the sustainable use of genebank collections. Through the introduction of new varieties resulting from targeted breeding programs, as well as through the reintroduction of traditional and old varieties in agricultural holdings, the benefits of conservation activities ultimately reach their end users – the farmers, including organic producers.

In connection with the implementation of the activities within the DIGIVALPGR bilateral project, an inventory of rural areas in Bulgaria was conducted, accompanied by expeditions aimed at collecting landraces. As a result, the electronic register was enriched with 55 landraces collected from Bulgaria, 2 old Bulgarian cultivars, 3 traditional species originating from the Romanian flora, and 67 accessions introduced from the project partner – Slovakian genebank.

In total, 127 new accessions belonging to 28 crop species were registered in the electronic catalogue, including: *Apium graveolens* – 1 acc.; *Avena sativa* – 2 acc.; *Calendula officinalis* – 1 acc.; *Capsicum annuum* – 14 acc.; *Cicer arietinum* – 4 acc.; *Citrullus lanatus* – 4 acc.; *Cucumis melo* – 2 acc.; *Cucurbita* sp. – 13 acc.; *Daucus carota* – 1 acc.; *Geranium* sp. – 1 acc.; *Hordeum vulgare* – 2 acc.; *Lactuca sativa* – 2 acc.; *Majorana hortensis* – 1 acc.; *Mentha* sp. – 1 acc.; *Origanum vulgare* – 1 acc.; *Phaseolus vulgaris* – 38 acc.; *Phaseolus coccineus* – 3 acc.;

Pisum sativum – 10 acc.; *Salvia variegata* – 1 acc.; *Secale cereale* – 1 acc.; *Sideritis syriaca* – 1 acc.; *Solanum lycopersicum* – 5 acc.; *Thymus vulgaris* – 1 acc.; *Triticum aestivum* – 1 acc.; *Triticosecale* – 7 acc.; *Vicia faba* – 1 acc.; *Vigna unguiculata* – 3 acc.; *Zea mays* – 2 acc.; *Zinnia elegans* – 1 acc.

Traditional local varieties cultivated in home gardens in Bulgaria are presented in Table 2. Information was collected using a specially developed questionnaire administered to farmers maintaining local varieties of plant genetic resources in Bulgaria.

The survey revealed that in the home gardens of the visited regions in Southern Bulgaria - Pazardzhik, Plovdiv, Smolyan, Madan, Haskovo, Yambol, Blagoevgrad, and Petrich - a large number of vegetables, grain legumes, medicinal plants, and spice species are still widely cultivated. In contrast, in villages located in Northern Bulgaria (in the regions of Sofia, Pleven, and Vratsa), old varieties of maize and common bean, and a rich local diversity of Cucurbit crops, were identified. The results indicate that the highest number of landrace cultivation sites in Bulgaria are located in semi-mountainous rural areas.

Similar data were reported by Antofie (2024) and Antofie et al. (2024), based on an investigation of 120 households in the hilly and mountainous areas of the Romanian Carpathians. The studies found that a rich diversity of traditional crop species is still maintained by local Romanian farmers, with some varieties preserved for more than 100 years.

In most cases, heirloom seeds are used, which have been preserved within families for generations. The long-term conservation of these traditional varieties is closely related to their continued use in local food systems, as well as to the cultural traditions, customs, and festivals of local communities. This unique agricultural heritage enables each village and region to maintain distinctive characteristics and specific taste qualities in its traditional agricultural production.

The structure of the farms from which seeds were collected varies depending on the specific characteristics of the region. In general, these farms are small-scale and primarily oriented toward meeting the needs of individual households.

Table 2. Local varieties used in traditional home gardens in Bulgaria

Taxonomic description of crops	Villages/regions	Number of accessions, local name
Zea mays	Lakatnik, Sofiya	1 old variety (100 years)
	Dolno Belevo, Haskovo	1 acc. Local corn
Phaseolus vulgaris	Bratzigovo, Pazardzhik	1 accession, Prevren
	Sarnitza, Pazardzhik	2 acc. – Rancha, Batev
	Sadovo, Plovdiv	1 acc. Local black
	Ochindol, Vratza	2 acc. – Local black and Ochindolski green (100 years)
	Lakatnik, Sofiya	1 acc. Local white
	Smilyan, Smolyan	1 accession, Sharen bob
	Metcho korito, Pazardzhik	1 acc. Local (30 years)
	Osenovlag, Sofia	2 acc. – Sharen and Pritkan bob
	Visokite, Madan	7 local varieties
	Stoykite, Smolyan	2 acc. Local Rodopski bob
	Varbovo, Smolyan	1 acc. Local bean
	Dolno Belevo, Haskovo	1 acc. Local white
Phaseolus coccineus	Sarnitza, Pazardzhik	1 traditional large variety, Pehlivan
	Visokite, Madan	1 accession, Vasulvitsa, pink with black spots
	Stoykite, Smolyan	1 local accession, brown with black spots
Vigna unguiculata	General Inzovo, Yambol	1 accession, local brown
	Kluch, Petrich	1 old white variety
	Dolno Belevo, Haskovo	1 accession, Bob Roglyo
Capsicum annuum	Dolno Belevo, Haskovo	1 acc., Local Kapia (traditional)
Solanum lycopersicum	Bratzigovo, Pazardzhik	2 local pink varieties
	General Inzovo, Yambol	2 old varieties (100 years) – Rozalina (pink) and Red Generalinzovski
	Dolno Belevo, Haskovo	1 acc. – "Royal tomato" from the garden of King Boris III, grown for 80 years
Cucurbita maxima	Levishte, Sofiya	1 local variety, White pumpkin
Cucurbita moschata	Sarnitza, Pazardzhik	1 acc. Violin type
	Levishte, Sofiya	1 acc. Violin type
	Radinovo, Plovdiv	1 acc. Violin type
	Sinitovo, Pazardzhik	1 acc. Violin type
	Dolno Belevo, Haskovo	1 acc. Violin type
Cucurbita pepo	Nikudin, Blagoevgrad	2 accessions, Pork pumpkin type
Cucurbita pepo var. *giromontiina*	Sinitovo, Pazardzhik	1 local accession
Cucumis melo	Nikudin, Blagoevgrad	1 acc. Honey type
	Komarevo, Vratza	1 acc. Dessert type
Citrullus lanatus	Krivodol, Pleven	2 local varieties
	Komarevo, Vratza	1 acc. Local large
*Traditional gardening is located outside the urban area.		

Alongside the cultivation of a wide range of local species, farmers often apply ecological cultivation practices and pay particular attention to the selection and preservation of high-quality seeds in order to maintain these traditional varieties. The enrichment of the collection and the establishment of an organized database with passport descriptors for each accession have created favourable conditions for mapping and zoning of the local gene pool. This also provides a solid basis for expanding future expedition activities in specific regions of the country that are rich in valuable plant genetic resources. In many of these areas, informal rural breeding practices are observed, mainly focused on traits such as taste quality, fruit size, and resistance to diseases.

Data were collected using a questionnaire applied through direct interviews with local authorities and household representatives in rural communities. The survey aimed to identify local varieties, document traditional agricultural knowledge, and evaluate opportunities for supporting food security through the conservation and use of local genetic resources.

The results identified four major motivational factors for the valorization of landraces, the reintroduction of traditional varieties into farms, and their on-farm conservation: (1) access to reliable and structured information; (2) appropriate segmentation of potential customers, including opportunities related to agrotourism; (3) identification of the optimal size of the target market, such as local markets and rural festivals; and (4) access to consulting services and cooperation with public institutions, including research institutes. In addition, universities play an important role through agricultural education and knowledge transfer.

In recent years, market demand for local agricultural products has increased significantly. This trend highlights the need to develop supportive tools for farmers aimed at facilitating the use of local genetic resources. All surveyed agricultural producers indicated that, if they had greater certainty regarding the marketing and sale of their production, they would increase the cultivation of local varieties due to their higher market value.

Farmers expressed a positive assessment of public institutions, such as research institutes, universities, and the National Agricultural Advisory Services, particularly with regard to the provision of information. However, local farmers also emphasized the lack of coordination among different institutions within the agricultural sector, which often leads to delayed, fragmented, or inconsistent information when support measures for farmers are implemented.

The economic and social environment also plays a crucial role in shaping farmers' motivation to cultivate plant species originating from local genetic resources. Labor shortages in agriculture, combined with limited mechanization, represent additional challenges for agricultural producers.

Furthermore, limited access to markets, uncertainty regarding the sale of agricultural products, and insufficient storage facilities—especially among small-scale farmers who are more likely to cultivate local varieties—significantly reduce farmers' motivation to utilize local genetic resources.

According to the surveyed farmers, the most important factor for the valorization of local plant genetic resources is the identification of an optimal target market for their products. The second most important factor is rapid access to structured information on the characteristics and advantages of local plant species. The third key factor is effective cooperation with public institutions. These results highlight the importance of building strong relationships with farmers to promote the sustainable use of local genetic resources and to increase the income of small-scale producers. The conservation of traditional varieties is crucial not only for sustainable agricultural development but also for environmental protection and adaptation to climate change.

The developed electronic catalogue provides rapid access to structured information on plant genetic resources. Through the innovative digital platform, farmers who cultivate and preserve local genetic resources can improve their awareness and knowledge of the characteristics and benefits of these varieties. This contributes to increased profitability, improved farm management, enhanced market access, and, importantly, to the preservation of traditional local products and environmental sustainability.

CONCLUSIONS

Public funding for both fundamental and applied scientific research in European countries in the field of conservation and documentation of plant genetic resources, at national and international levels, aims to mitigate biodiversity loss and enhance its valorization in order to ensure food security under the conditions of climate change. In the context of increasing digitalization, an open-access electronic platform has been developed for mapping the local gene pool in Bulgaria, addressing this strategic priority.

The *ex situ* collection of landraces has been established through direct seed donations from farmers and represents specific populations originating from particular localities that have been traditionally cultivated for local consumption.

The highest level of diversity among old varieties and local forms is observed in horticultural crops.

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