PRO-GRACE

PROMOTING A PLANT GENETIC RESOURCE COMMUNITY FOR EUROPE

DELIVERABLE 2.5

A blueprint for constructing national inventories of *in situ* resources

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Promoting a plant genetic resource community for Europe

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ABBREVIATIONS AND ACRONYMS

CBD: Convention on Biological Diversity

CITES: Convention on International Trade in Endangered Species of Wild Fauna and Flora

CWR: Crop Wild Relatives

CWR-NI: Crop Wild Relatives National Inventory

CWR-POP-NI: Crop Wild Relatives Populations National Inventory

ECPGR: European Cooperative Programme for Plant Genetic Resources

EU: European Union

EURISCO: European Search Catalogue for Plant Genetic Resources

GRACE-RI: Plant Genetic Resource Community for Europe Research Infrastructure

FAO: Food and Agriculture Organization of the United Nations

GBIF: Global Biodiversity Information Facility

GPA: Global Plan of Action

GRIN: Germplasm Resources Information Network

ITPGRFA: International Treaty on Plant Genetic Resources for Food and Agriculture

IUCN: International Union for Conservation of Nature

LTER: Long Term Ecological Research

LR: Landraces

LR-NI: Landraces National Inventory

LR-POP-NI: Landraces Populations National Inventory

MCPD: Multi-Crop Passport Descriptors

NGO: Non-Governmental Organization

OCDT: Occurrence Data Collation Template

OECM: Other Effective area-based Conservation Measures

PGR: Plant Genetic Resources

PGRFA: Plant Genetic Resources for Food and Agriculture

PRO-GRACE: Promoting a Plant Genetic Resource Community for Europe

UK: United Kingdom

WG: Working Group

WHP: Wild Harvested Plants

WIEWS: World Information and Early Warning System on Plant Genetic Resources for Food and Agriculture

WP: Workpackage

1. Executive summary

The long-term conservation and sustainable use of Plant Genetic Resources (PGR) are critical to ensuring the resilience of food systems and the adaptability of crops to changing climatic, environmental, and socio-economic conditions. Deliverable D2.5 of the PRO-GRACE project contributes to this objective by providing a strategic blueprint for the development, structure, and implementation of national-level *in situ* inventories of two key categories of plant genetic resources: a) Crop Wild Relatives (CWR), which often include Wild Harvested Plants (WHP); and, b) Landraces (LR).

For both CWR and LR inventories, the deliverable is divided into two main components. First, it proposes a harmonized methodological framework for building and maintaining National Inventories (NIs) at two complementary levels: a taxonomic-level inventory (NI) that identifies priority taxa or landraces of interest for conservation and use, and a population-level inventory (POP-NI) that documents specific *in situ* occurrences, management practices, and conservation actions at the population scale. Second, it presents an updated overview of the status and implementation of these inventories across Europe, based on the results of two targeted questionnaires sent to national stakeholders involved in the conservation and management of CWR and LR.

The deliverable presents a set of blueprints for the development of CWR-NI, CWR-POP-NI, LR-NI, and LR-POP-NI, describing essential components such as inclusion criteria, data sources, prioritization steps, recommended descriptors, verification protocols, and links with international platforms such as EURISCO. These blueprints are designed to be adaptable to national contexts while fostering common structures that enable interoperability, comparison, and aggregation at the European level.

Based on the analysis, the deliverable puts forward a series of recommendations to guide the future GRACE Research Infrastructure (GRACE-RI). These include the provision of financial and technical support to national programs, the creation of advisory bodies under relevant ECPGR Working Groups, and the development of shared tools for data management, stakeholder coordination, and population monitoring. Specific recommendations are also made for enhancing the accuracy and utility of POP-NIs, including the establishment of “core lists” of actively conserved populations and support for on-farm documentation and verification mechanisms.

The results show that progress in developing National Inventories varies considerably between countries and resource types. For CWR, responses from 34 countries reveal that many have made significant advancements in compiling national checklists, setting conservation priorities, and in some cases developing and publishing CWR-NIs. However, fewer countries have progressed to the population level, with only a minority reporting completed or validated CWR-POP-NIs. The integration of WHP into national strategies remains partial, though growing. For landraces, responses from 30 countries indicate that the development of LR-NIs and LR-POP-NIs remains less advanced and more fragmented than for CWR. The identification of landraces on-farm was highlighted as a particularly significant challenge by many countries, and the lack of dedicated financial resources and policy support remains a limiting factor in the establishment and maintenance of LR inventories.

A key finding of the analysis is the difference in the institutional and operational context of CWR and LR conservation. CWR efforts are often coordinated by national authorities and research institutions and rely heavily on biodiversity databases and formal prioritization frameworks. In contrast, landrace conservation is more community-driven and decentralized, requiring close collaboration with farmers,

NGOs, seed networks, and local governments. As a result, LR inventory development calls for flexible, participatory approaches and support tools adapted to local realities.

In conclusion, Deliverable D2.5 provides both a practical framework and a status update that together lay the groundwork for a European-wide approach to *in situ* conservation planning. It emphasizes that National Inventories must be seen as dynamic, evolving tools, requiring regular updating and strong institutional and community engagement. The alignment of national efforts with the future GRACE-RI will be essential to build an integrated, effective infrastructure that supports the conservation and sustainable use of Europe's rich and diverse plant genetic heritage.

2. Introduction

The conservation of plant genetic resources plays a pivotal role in addressing the ongoing challenges posed by climate change, global food security, and the development of sustainable agricultural systems (Ford-Lloyd et al., 2011; Heywood, 2011; Maxted et al., 2013. Within the context of this Deliverable, our primary focus is on the development of blueprints for the construction of national inventories for *in situ* genetic resources, specifically addressing Crop Wild Relatives (CWR) and Wild Harvested Plants (WHP) on one side ("in nature genetic resources"), and Crop Landraces (LR) on the other ("on-farm genetic resources") (Negri et al., 2009, 2012; Maxted et al., 2015; Magos Brehm et al., 2017). Both genetic resources have different characteristics regarding their conservation, as outlined below, and therefore need different treatment.

Genetic resources of CWR (and WHP) and LR serve as a critical reservoir of traits that are essential for crop improvement, resilience, and the overall diversification of agricultural systems. Well-structured national inventories are crucial for effectively managing and conserving these CWR and LR resources. CWR, for example, hold valuable genetic material that can be utilized for crop breeding and improvement, particularly in the context of traits related to stress tolerance and disease resistance (Maxted et al., 2013). WHP, similarly, offer essential resources for local communities, serving as food, medicine, and cultural products, and very often, WHP are also CWR, making their conservation even more critical for maintaining genetic diversity (El Mokni et al., 2022; Almeida et al., 2023). Landraces, on the other hand, represent dynamic genetic resources of great value for breeding and are a genetic link between past agricultural practices and the present need for sustainability and adaptability in changing environments. Landraces are also closely linked to local culture and traditions, which adds significant value beyond their agricultural importance, making them vital for preserving both biodiversity and cultural heritage.

However, distinct approaches must be employed for the *in situ* conservation of wild and cultivated plant genetic resources. The conservation strategies for CWR and WHP often involve a focus on population-level data due to the spontaneous and dynamic nature of their existence in natural environments (Maxted et al., 2013). The Deliverable emphasizes the importance of developing national inventories for CWR at both the taxonomic and population levels (CWR-NI and CWR-POP-NI, respectively; Box 1), a point reiterated in the discussions within the PRO-GRACE community. For CWR, the population data (CWR-POP-NI) is crucial for setting up conservation programs that ensure the survival of individual populations and for making these resources accessible to potential users, including plant breeders (van Hintum and Iriondo, 2022).

Box 1. CWR inventory at the taxonomic (CWR-NI) and population (CWR-POP-NI) levels: a clarification

There are two distinct applications of the term CWR inventory in the plant genetic resources (PGR) literature depending on whether the data included are at the taxonomic or population level, as follows:

1. A list of the priority CWR taxa found in a geographic region, usually applied to a country (CWR-NI).

2. A list of the CWR populations for priority CWR taxa found in a geographic region, usually applied to a country (CWR-POP-NI).

To distinguish the two uses of the term CWR inventory, given the original use of the term was for a list of priority CWR taxa found in a geographic region, CWR inventory or CWR-NI is retained for this usage and CWR population inventory or CWR-POP-NI is used when referring to CWR populations.

For LR, from the point of view of conservation of genetic resources, as they are primarily maintained by farmers through traditional practices, their locations may shift quickly over time, and detailed population-level inventories are not always practical if the objective is the conservation of the genetic resources. In this way, a comprehensive prioritized LR National Inventory (LR-NI) of LR that are worth maintaining from a country or a region in order to ensure that these LR are maintained, monitored, and conserved, either *ex situ* or *in situ*, depending on their status and potential for future use, should be established as a first step. For those LR from the LR-NI conserved only *in situ*, it should be a priority to collect them for safe *ex situ* conservation, ensuring their preservation for long-term use and safeguarding against potential environmental or agricultural changes. An additional development with additional information of relevance is the establishment of the Landraces Populations National Inventories (LR-POP-NI), which can include information on associated knowledge and should contain ecogeographic information of the site where it is cultivated, details about the farm and the farmer that grows them, nomenclature, cultivation and habits, distinctive traits, and their conservation status (Almeida et al., 2023). As a result of the Discussions within the PRO-GRACE community, we emphasize the importance of developing LR National Inventories (LR-NI) and LR Populations National Inventories (LR-POP-NI) (Box 2).

Box 2. LR checklist and national inventory: a definition

A definition of the terms LR National inventory (LR-NI) and LR Populations National Inventory (LR-POP-NI) is presented below:

1. A subset of the priority LR drawn from the LR National Checklist from a geographic region, usually applied to a country (LR-NI).

2. A list of the LR populations contained in the LR-NI from a geographic region, usually applied to a country, associated to the sites where LR-NI populations are maintained *in situ* (LR-POP-NI).

In this way, the LR-NI may include a certain number of landraces (LR), but each LR can be cultivated by multiple farmers. Each farmer's LR is considered a distinct LR population, depending on how closely the farms are situated and whether germplasm is routinely exchanged between neighbouring farmers. The different LR populations constitute the LR-POP-NI, with each LR population having unique data associated with its maintenance at a specific site by a particular farmer or maintainer.

In line with the overarching objectives of the PRO-GRACE project, this Deliverable proposes blueprints for the development of these national inventories (CWR-NI, CWR-POP-NI, LR-NI, and LR-POP-NI), with the aim of facilitating their implementation across European countries. Importantly, we emphasize the need for compatibility with EURISCO, as this is essential for integrating national inventories into a broader European framework, thus promoting the accessibility and utility of genetic resources on a

regional scale (van Hintum and Iriondo, 2022). As a result, we outline the development of national inventories for CWR and WHP on one side, and for LR, acknowledging the specific conservation needs and strategies required for each category. To assess the current status of national inventories across Europe, two questionnaires were developed: one on CWR and WHP National Inventories (CWR-NI and CWR-POP-NI) directed to the members of the ECPGR Crop Wild Relatives Working Group, and the other on LR National Inventories (LR-NI and LR-POP-NI) to the ECPGR On-farm Conservation and Management Working Group. These questionnaires aimed at gathering information on the progress, challenges, and gaps in the establishment of these inventories. The insights gained from these questionnaires will be instrumental for the future GRACE-RI in shaping future conservation efforts and refining the blueprint strategies proposed in this document. The list of contributors who responded to the questionnaires is provided in Annex 1.

The blueprint approaches developed in this deliverable are aligned with the technical foundations established in Deliverable D1.3 and the methodological standards set out in Deliverable D2.3. D1.3, which focuses on system architecture and data interfacing with EURISCO for *in situ* conserved populations, while D2.3 provides the underpinning quality criteria and descriptor sets essential for documenting and managing CWR and LR *in situ*. Together, these documents form an integrated package that supports the long-term objective of a harmonized, pan-European infrastructure for *in situ* genetic resource conservation.

3. Constructing National Inventories of Crop Wild Relatives

3.1. Introduction

Crop Wild Relatives (CWR) have been defined as wild plants taxa that have an indirect use derived from its relatively close genetic relationship to a crop (Maxted et al., 2008), although practically when establishing a checklist of CWR for a given crop, a CWR may be considered as any wild taxon within the same genus as a crop species or closely related genera (Kell et al., 2017). Historically, their potential as gene donors for crop improvement was clearly recognized by the Russian plant geneticist and breeder Nicolai Vavilov in the 1920s and 1930s (Vavilov, 1926). According to FAO's Second Report on Plant Genetic Resources (FAO, 2010), the number of wild species belonging to the same genera as cultivated species is estimated at 50,000 to 60,000 worldwide, of which approximately 1,392 species and 299 sub-specific taxa have been recognized as high priority for conservation because they belong to their primary and secondary gene pools (Maxted and Kell 2009; Vincent et al., 2013). In global terms, CWR are seriously threatened by processes driven by human activities such as habitat fragmentation and loss, competition with invasive species, nitrogen depositions or changes in land uses, just like any other component of biological diversity (Ford-Lloyd et al., 2011; Heywood, 2011; Kell et al., 2012; Prabhakaran, 2019). The importance of CWR conservation and the best approaches to preserve these natural resources have been widely discussed (Maxted et al. 1997a; Heywood et al., 2007; Magos Brehm et al., 2010; Maxted, 2003; Pautasso, 2012; Maxted et al., 2013; Kell et al., 2017; Labokas et al., 2018; Engels and Thormann, 2020; Maxted and Magos Brehm, 2023) and over the past few years, several international projects initiatives have been implemented to conserve and manage CWR, such as the EU-funded projects PGR Secure and Farmer's Pride. Also, the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) coordinated and led the publication of a descriptor list for CWR conserved *in situ* (Alercia et al., 2021).

On the other hand, Wild Harvested Plants (WHP) are non-cultivated species that are collected from the wild and used by local people (Magos Brehm et al., 2008). These species are particularly used as food, medicines and fibres sources, and may also play key roles in cultural traditions (Plants for a Future, 2024). Several non-cultivated plant species are harvested from the wild to be consumed as

food or drink (Teixidor-Toneu et al., 2022), often used in times of scarcity by subsistence farming communities or civil unrest (Harisha et al., 2023), or by diverse communities for cultural and traditional reasons (Pinela et al., 2017). Often, WHP are also CWR, as is exemplified in the case of the inventory of CWR and WHP from Tunisia, where 93% of the WHP are also CWR (El Mokni et al., 2022). Also, 85% of the European flora comprise crop and CWR species if the crop genus wide definition is applied (Kell et al., 2008). Because of this, WHP national inventories are frequently included in CWR national inventories (Magos Brehm et al., 2008; El Mokni et al., 2022). For the purposes of this deliverable, the denomination CWR national inventories may also include WHP.

To establish specific actions for the *in situ* and *ex situ* conservation of CWR (and WHP, where appropriate), it is essential to carry out inventories to identify not only the CWR existing in a country (CWR-NI) and their priority regarding conservation, but also their populations (CWR-POP-NI). In this respect, at the European level, the ECPGR Concept for *In Situ* Conservation of Crop Wild Relatives in Europe (Maxted et al., 2015) recognized the importance of identifying the relevant CWR diversity at the national and regional levels. Subsequently, the Plant Genetic Resources Strategy for Europe (ECPGR, 2021) aims to significantly increase CWR and WHP inventories by 2030 to better understand their distribution and target priority populations. Globally, an increasing number of countries have conducted their CWR inventories (see Labokas et al., 2018; http://www.cropwildrelatives.org/cwr-strategies/), either as part of their national biodiversity action plans or, more frequently, as part of individual PGR-based projects. Most of these studies are limited to single crops, small groups of species or limited areas within the national territory (FAO, 2010). In Europe, the production of checklists and inventories has taken place in over 20 countries in Europe, and national or regional strategies or concepts for CWR conservation have been developed (Labokas et al., 2018; ECPGR, 2021; http://www.cropwildrelatives.org/cwr-strategies/). However, depending on the country, information about CWR is heterogeneous: sometimes it is scattered over various sources or not available at all, whereas in some other European countries, national checklists of CWR, priority lists, population occurrence records and *ex situ* and *in situ* conservation assessments are available (e.g. Maxted et al., 2007; Smekalova, 2008; Phillips et al., 2014; Landucci et al., 2014; Labokas et al., 2018; Taylor et al., 2017; Rubio Teso et al., 2018; van Treuren et al. 2017; Weibull and Phillips, 2020; Thormann 2020; Fitzgerald et al., 2023; http://www.cropwildrelatives.org/cwr-strategies/). In some cases, specific websites have been created to showcase CWR in a country, providing information about the occurrence, distribution, availability and other data (such as https://www.cwrnl.nl/en/CWRnl-1.htm with information about CWR occurring in the Netherlands, or https://pgrdeu.genres.de/en/in-situ-vorkommen/occurences-of-priority-crop-wild-relatives/ with CWR occurring in Germany). This heterogeneity of cases is one of the reasons why it is difficult for users (plant breeders and crop scientists) to find out about and access these resources. So, there is an urgent need to develop a blueprint for the creation of such inventories, and the information gathered needs to be compatible with EURISCO. Furthermore, reviewing the current status of CWR inventories across Europe is of great relevance for understanding the advancements made in the European countries in the development of CWR-NI and CWR-POP-NI, as well as the obstacles and deficiencies that remain. The findings from this review will help fine-tune the blueprint and direct future conservation strategies under the GRACE-RI initiative.

3.2. Activities

We have performed a comprehensive review of the approaches used for the development of national inventories of CWR and WHP, including CWR-NI and CWR-POP-NI. In this context, Maxted et al. (2013) developed a procedure for the creation of National inventories of CWR. Also, within the framework of the ECPGR project 'Extension of EURISCO for Crop Wild Relatives (CWR) *in situ* data and preparation of pilot countries' data sets' (CWR data in EURISCO)", funded by the German Federal Ministry of Food

and Agriculture, van Hintum and Iriondo (2022) prepared the document "Principles for the Inclusion of CWR Data in EURISCO" (https://www.ecpgr.cgiar.org/resources/ecpgr-publications/publication/principles-for-the-inclusion-of-cwr-data-in-eurisco-2022), in which they detailed the process in two steps, first the 'Development of CWR National Inventories' and second, 'Feeding EURISCO with information on CWR populations'. The first step fits very well with the objective of D2.5, so we have taken this document, together with the procedures proposed by Maxted et al. (2013), as a starting point for discussion and further improvement and adaptation. Although these documents are focused on CWR, the authors refer that most of the approaches proposed here can also be applied to WHP. So, we understand that it is still valuable for the scope of this Deliverable. A very important point is that the data in these CWR National Inventories must be compatible with EURISCO (van Hintum and Iriondo, 2022). To achieve the objective of this Deliverable, we performed three activities, a) Preparing a blueprint with guidelines that facilitates the development of CWR National Inventories (CWR-NI and CWR-POP-NI) in countries lacking them or which need an update or improvement, b) Updating the current state of both types of *in situ* National Inventories in European countries based on a questionnaire sent to the relevant actors of European countries including their compliance with the present blueprint guidelines, and c) Providing recommendations for the future GRACE-RI for the construction of CWR-NI and CWR-POP-NI national inventories.

3.3. Results

3.3.1. Framework for establishing Crop Wild Relatives (CWR) National Inventories

A designated *in situ* CWR National Inventory Focal Point should have the responsibility to assure the creation of the *in situ* CWR National Inventories (CWR-NI, and CWR-POP-NI) . The CWR-NI should include the CWR taxa that the country has identified as a priority for conservation, while a further step, that is of great relevance in the implementation of conservation strategies, is the development of the CWR-POP-NI, which includes a list of occurrences of populations belonging to those CWR (see Box 1 for a definition of CWR-NI and CWR-POP-NI). In addition, the CWR-POP-NI could usefully differentiate populations actively conserved, found in protected areas or Other Effective area-based Conservation Measures (OECM), or in nature with no active conservation. Descriptors recommended for the generation of these CWR National inventories exist, including those from Alercia et al. (2021) as well as the ones proposed by the PRO-GRACE community and that can be consulted in D2.3. In addition, van Hintum and Iriondo (2022) proposed a list of descriptors for including *in situ* CWR data in EURISCO. Individual countries may decide to extend, reduce or modify this list for their own purposes but only *in situ* data in the agreed format can be uploaded to EURISCO.

The construction of CWR National Inventories has been treated in detail by Maxted et al. (2013) and by van Hintum and Iriondo (2022). Additionally, an *Interactive Toolkit for Crop Wild Relative Conservation Planning* (http://www.cropwildrelatives.org/conservation-toolkit/) exists which has been developed by Magos Brehm et al. (2017) based on the recommendations of Maxted et al. (2013) and provides great assistance in the creation of the national inventories of CWR (Box 2).

Box 2. The Interactive Toolkit for Crop Wild Relative Conservation Planning (Magos Brehm et al., 2017; http://www.cropwildrelatives.org/conservation-toolkit/introduction/).

The Interactive Toolkit for Crop Wild Relative Conservation Planning is designed to provide guidance to plan and implement active *in situ* and *ex situ* conservation of CWR at national level. The conservation recommendations that result from this national CWR conservation planning process are used to develop National Strategic Action Plans (NSAP) (or National Strategies) for the conservation and sustainable use of CWR (to know more about NSAP development: http://www.cropwildrelatives.org/conservation-toolkit/the-toolkit/national-strategic-action-plans/).

There is no single method for planning CWR conservation or for developing an NSAP for the conservation of CWR. This is mainly due to factors concerning financial resources, availability of baseline biodiversity data, appropriately skilled staff availability and other factors defined by the country where the NSAP is to be implemented, as well as the focal area and remit of the agencies that are responsible for formulating and implementing the NSAP. Nevertheless, CWR conservation planning can be viewed as a series of steps and decisions that follow the same basic pattern in all countries. This Toolkit and its protocols, examples and resources should thus be viewed as a framework and an aid for planning CWR conservation, not a prescription. It is important to note that the Toolkit can be used for the entire conservation planning process or for individual steps, and that the steps do not necessarily have to be followed in a prescribed order.

The Interactive Toolkit for Crop Wild Relative Conservation Planning was based on Maxted N, Magos Brehm J and Kell S (2013) Resource Book for the Preparation of National Plans of Crop Wild Relatives and Landraces. Food and Agriculture Organization of the UN, Rome, Italy.

The Toolkit can be exported to be used offline. All its contents will be accessible via this exported version. All that is needed is to click on the EXPORT TOOLKIT button in the web page. You can also download a PDF version for consultation and easy printing of its content by clicking on DOWNLOAD THE PDF VERSION OF THE TOOLKIT in the web page.

3.3.2. Blueprint for the development of CWR-NI

Two different general approaches can be followed for developing a CWR-NI (Maxted et al., 2013): the floristic approach, that aims to produce national inventories of all the CWR that occur in the country; and the monographic approach, which is used to produce an inventory of one or several crop genepools. A practical tool to support this process is the CWR Checklist and Inventory Data Template, available at: https://dataverse.harvard.edu/dataset.xhtml?persistentId=doi:10.7910/DVN/B8YOQL. This template offers a ready-to-use format for structuring checklist and inventory data and facilitates alignment with EURISCO data requirements. The steps for constructing a CWR-NI can be summarised as follows (Maxted et al., 2013; Magos Brehm et al., 2017; van Hintum and Iriondo, 2022):

a) **Determining the geographical scope**, which in the case of the CWR-NI will generally be the country.

b) **Identification of the crops whose CWR will be considered.** A digitised list of crops needs to be produced. The identification of these crops should consider the socioeconomical relevance of crops both at the national and the international levels or could involve a complete list of crop genera. In general, though a national CWR inventory should contain all priority CWR taxa present in the country, whether they are related to nationally cultivated crops or not – no country is independent of the need for CWR diversity so disregarding CWR related to non-native crops is counter-productive. The relevance of crops at the country (or global) level can be obtained from different sources such as:

- Global list of crop genera for matching to national floristic list (Kell, unpublished results).

- Statistical reports about crop production areas and economic revenues of crops in the country (or at regional or global level).
- Country or European plant variety list.
- EU database of registered plant varieties (EU, 2022).
- FAO world primary crop list (FAO, 2022).
- Crops or taxa included in Annex 1 of the ITPGRFA (ITPGRFA, 2022).
- Cultivated species publications, such as Mansfeld's World database of Agricultural and Horticultural Crops (https://mansfeld.ipk-gatersleben.de/).
- National and international ethnobotanical literature (for WHP).
- Expert consultation, particularly with members of the ECPGR CWR Working Group and public and private breeders.

It is also advisable to indicate and store the data regarding the selection of the crops to be considered and the motivation and/or prioritization. This step will not be needed for WHP.

c) **Procure a digitised list of the flora of the country**. Given that the aim of the CWR checklist is providing a comprehensive view of the CWR present in the country, in general, the "floristic" approach should be used in creating a CWR-NI. The digitised flora of the country can be obtained from different sources, such as the following:

- Existing national Flora, checklist, which is usually the preferable source. When this is not available the sources listed below can be used.
- Floras from neighbouring countries.
- Global or regional plant checklists.
- Expert consultation.

d) **Matching the flora against crops**. A first draft of the CWR checklist of interest for conservation is produced by matching the national floristic list with crop genera and species belonging to the same genus as crops form the first iteration of the national checklist of CWR taxa. This step is not needed for WHP.

e) **Production of the CWR checklist**. The provisional checklist obtained in point "d" can be refined to obtain a final CWR checklist based on validation with experts,. Information on the species from these genepools can be obtained from the GRIN Taxonomy (https://npgsweb.ars-grin.gov/gringlobal/taxon/taxonomysearchcwr), where lists of the CWR of most crops are available, with information of the genepool they belong to. In some crops, the scope may be broadened to include species of closely related genera (e.g. the genera *Beta* and *Patellifolia* in beet, or the genera *Aegilops*, *Agropyron*, *Amblyopyrum*, *Elymus*, *Elytrigia*, and *Leymus* for bread wheat) that are still considered to be part of the crop genepool.

g) **Production of the CWR National Inventory**. Given the large numbers of CWR usually present in a country, there is a need to prioritize the CWR for an effective conservation (Maxted et al., 2013; Magos Brehm et al., 2017; Engels and Thormann, 2020). The prioritization may be based on diverse factors (e.g., Maxted et al., 2007; Hunter and Heywood, 2011; Maxted et al., 2013; Vincent et al., 2013; Iriondo et al., 2016; Labokas et al., 2017; Magos Brehm et al., 2017, Kell et al., 2017; Nilsen et al. 2017; Rubio Teso et al., 2018; Engels and Thormann, 2020), such as the following:

- Socioeconomic value of the related crop (i.e., their value to society, both in terms of ensuring food and nutrition security and supporting sustainable economic growth)
- Taxa that belong to the primary, secondary, and tertiary genepools
- The genetic potential as a gene donor (i.e., the genepool to which the CWR species belongs to)
- Stakeholder priorities (particularly those of plant breeders)
- Category of the related crop (human food, animal food, forestry species, cultivated medicinal and aromatic plants, industrial crops, and cultivated ornamental plants)
- Multiple or combined value (single use or multiple uses)
- Use by local people as a food source (wild harvested plant or not)
- Traditional use (ethnobotanic knowledge and uses or not)
- Included in Annex I of the International Treaty of PGRFA (whether the related crop is listed or not)
- Species distribution (very limited distribution to widely distributed)
- Geographical or regional responsibility for taxa with restricted worldwide distributions (obligation for conservation)
- Species included in the annexes of EU habitats directive (whether listed or not)
- Status of occurrence (native, archaeophyte, neophyte)
- Endemic status (national or regional)
- Rarity of the habitat in which the species grows (rare to common habitats)
- Degree of genetic erosion (evidence of genetic erosion due to loss of habitats, change in land use, etc.)
- Threat status (usually based on Red List assessments)
- Status in surrounding countries (from absent to commonly distributed)
- Centre of diversity of the crop gene pool (centre of diversity or margins of the range of the crop gene pool)
- Conservation status (conserved or not *ex situ*)
- Vulnerability to climate change (not vulnerable to highly vulnerable)
- State of knowledge and availability of information (from no or little to very high)
- Protection legislation (non-protected or protected)
- International legal and policy instruments vis-à-vis the national legal framework

However, most commonly, the prioritization of the CWR checklist is based on: (a) the value of the related crop, (b) crossability of CWR with their corresponding crops, (c) the threat status of the taxon being assessed, and (d) their endemic or native status. Several works, such as Maxted et al. (2013), Magos Brehm et al. (2017), Kell et al. (2017), and Nilsen et al. (2017) provide a good synthesis of the criteria and procedures that can be used in this step. Some illustrative examples of the generation of CWR checklists and priority lists in European countries are available in Maxted et al. (2007), Magos Brehm et al. (2008, 2010), Smekalova (2008), Phillips et al. (2014), Landucci et al. (2014), Taylor et al. (2017), van Treuren et al. (2017), Labokas et al. (2018), Rubio Teso et al. (2018) and Şandru (2021).

Different approaches have been used for CWR prioritization, including scoring and ranking schemes and rule-based systems (Magos Brehm et al., 2010).

A conceptual diagram (Figure 1) showing a harmonized, logical, and pragmatic approach to CWR prioritization was developed by Kell et al. (2017). The prioritization is performed based on three main criteria (socioeconomic value of crops, potential value of wild relatives for variety improvement, and threat status of wild relatives of priority crops), which results in a list of taxa that are of greatest use potential for crop improvement and/or considered to be worthy of special conservation attention due to their relative threat status and which we recommend for the GRACE-RI.

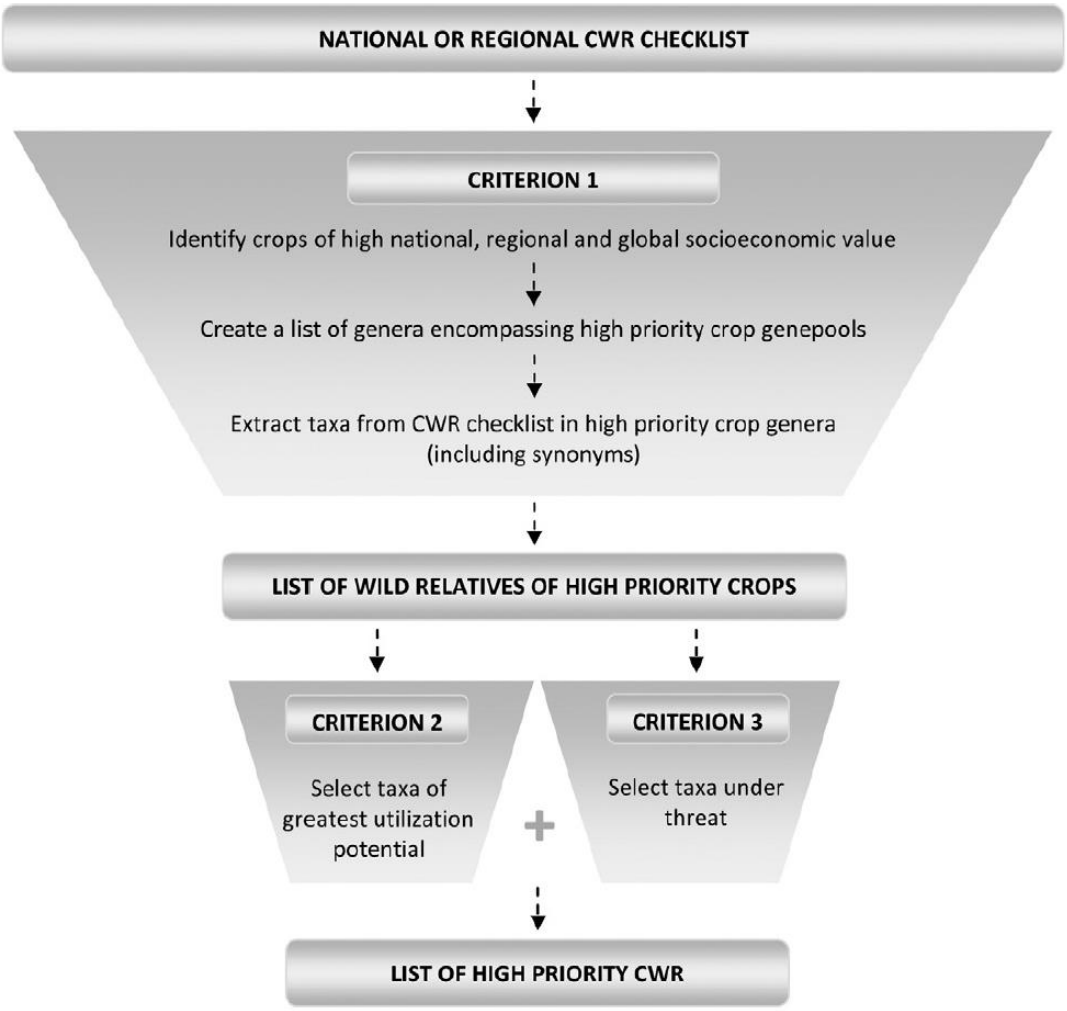


Figure 1. Diagram illustrating a practical method for prioritizing crop wild relatives based on three main criteria, producing a list of taxa valuable for crop improvement or in need of conservation due to threat status (taken from Kell et al., 2017).

The prioritized CWR checklist of taxa, species, and infraspecific taxa is then transformed in the CWR National Inventory (CWR-NI) by populating it with additional data such as the following for each CWR:

- Scientific name of the related crop (sources such as GRIN-Global, The Catalogue of Life, The Plant List database)
- Economic value of related crop (FAO and national statistics)
- Crop gene pool level/taxon group level (GRIN taxonomy, Inventory from the EURISCO Database)

- Confirmed or potential uses of the taxon as a gene donor (GRIN taxonomy, The Crop Wild Relatives Project, scientific publications)
- Taxon description (Flora Europaea, National/regional floras, Plants of the World online, scientific publications and taxonomic monographs)
- Critical taxonomic notes (Flora Europaea, National/regional floras, Plants of the World online, scientific publications and taxonomic monographs)
- Synonyms (The Plant List, International Plant Names Index, Taxonomic monographies)
- Vernacular names (Ethnobotany databases and publications)
- Plant life-form (Flora Europaea, National/regional floras, Plants of the World online)
- Ecology and habitat (European Nature Information System, GBIF)
- National invasive category / invasiveness (Global Invasive Species Database, EPPO Global Database, national or regional databases on invasive species, scientific publications)
- Reproductive system (technical and scientific publications)
- Flowering time (Flora Europaea, National/regional floras, phenotypic data in germplasm databases, scientific publications)
- Level of heterogeneity within the species (population genetics studies)
- Chromosome number (Index to Plant Chromosome Numbers, The Chromosome Count Database)
- Ploidy level (The Chromosome Count Database; Plant Genome Size Database)
- Genome size (Plant DNA C-values Database)
- Ethnobotanical Direct uses (i.e., not as a gene donor) (ethnobotany databases, local ethnobotanical studies, scientific publications)
- Elevation range (floras, GBIF, EcoCROP Database, WorldClim Database)
- Temperature range (EcoCROP Database, WorldClim Database)
- Precipitation range (EcoCROP Database, WorldClim Database)
- Global and national distribution (floras, GBIF, European Nature Information System, IUCN Red list)
- Threat category (IUCN Red List, National Red Lists, CITES Database)
- *Ex situ* and *in situ* conservation status (EURISCO, Genesys, FAO WIEWS, IUCN Protected Areas Database)
- Legislation applied (EU Legislation Database, CBD, ITPGRFA, National Biodiversity Strategy and Action Plans)
- Images of different parts of the plant (Germplasm databases containing images, PlantImage Gallery, Botanical Illustration Databases)

A flowchart of the different steps to develop the CWR-NI are presented in Figure 2.

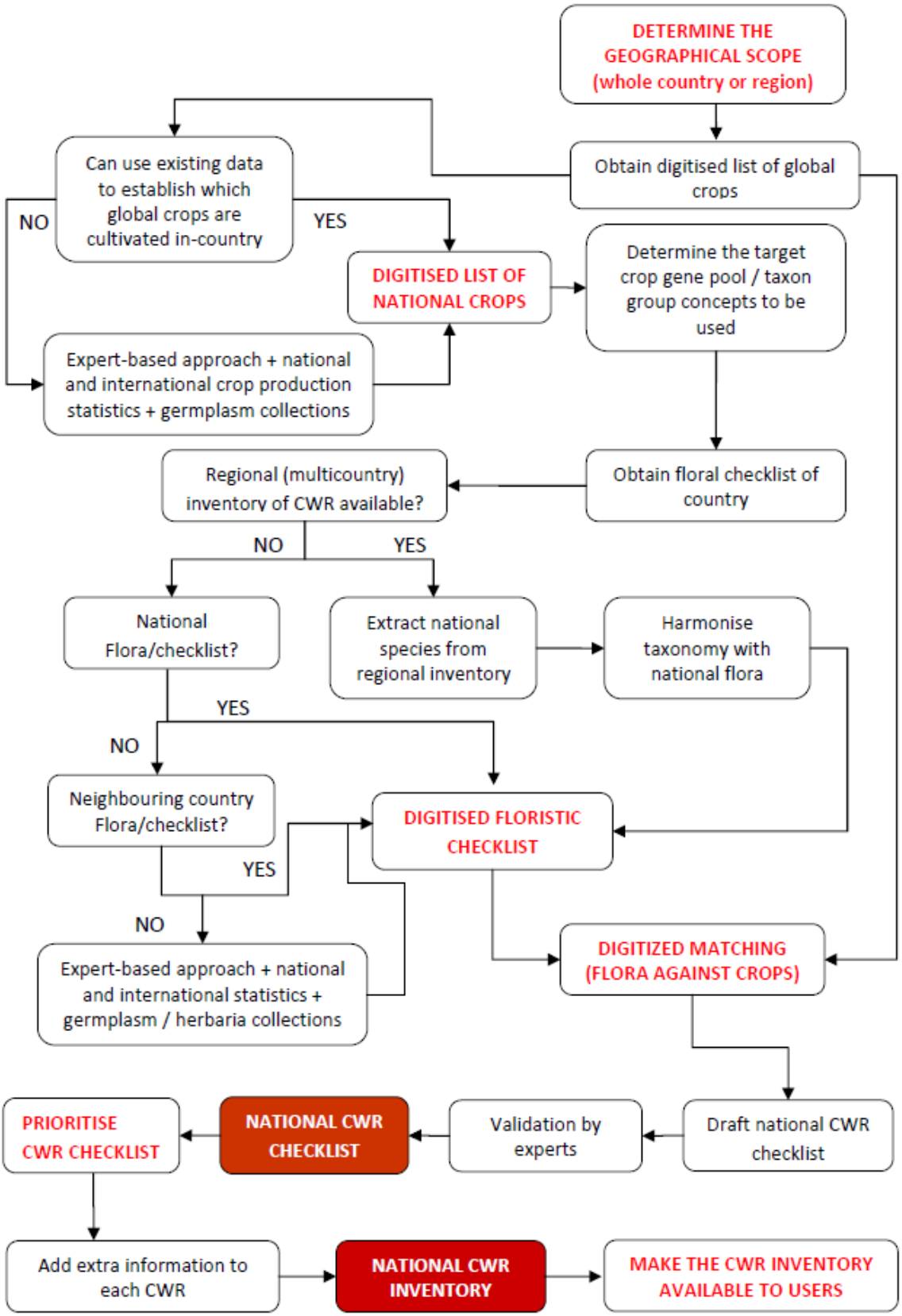


Figure 2. Flowchart for the creation of a CWR-NI (from Maxted et al., 2013; Magos Brehm et al., 2017).

3.3.3. Blueprint for the development of CWR-POP-NI

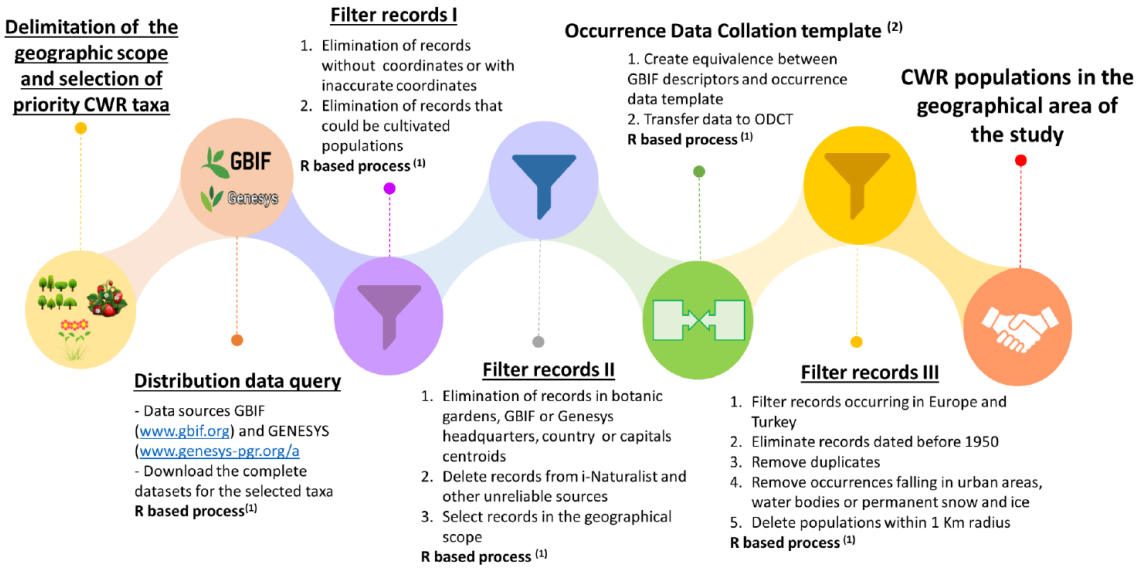
After the CWR-NI has been created a subsequent development consists in adding population data to develop a CWR population inventory (CWR-POP-NI) by including information on the populations of each taxon included in the CWR-NI. This is an important subsequent step to create a CWR *in situ* National Conservation Strategy and Action Plan (Maxted et al., 2013; Labokas et al., 2018). A related concern is to determine the criteria for deciding when a CWR population can be considered as an *in situ* accession that is worth recording into a CWR-POP-NI and making it available to potential users. Active *in situ* conservation involves the location, designation, management and monitoring of target population in the location where they are found (Maxted, 1997b). However, a strict application of this term would currently render only a limited number of records across Europe. Therefore, in order to develop comprehensive conservation strategies, the CWR-POP-NI should not be limited to populations that are already actively conserved. Instead, it should include all verified or likely occurrences of CWR populations, even those that are not yet under active conservation. Populations may be flagged as either conserved or not, including recording different levels of conservation, such as actively conserved, passively conserved (in a protected area) or not conserved, allowing users to filter the data accordingly. This broader approach ensures that researchers and conservationists can devise strategies that address both conserved and non-conserved populations, identifying gaps and targeting areas for future conservation efforts. In this way, the CWR-POP-NI could include populations that are likely to exist at present, whose location is known, where the land management is compatible with the persistence of the population, and where there is a management institution or person that can be approached that is likely to facilitate access to the material (van Hintum and Iriondo, 2022). This latter approach would provide potential PGR users with a relevant complementary source of material to consider in their breeding programmes. It would also provide *in situ* conservation stakeholders in the country with a set of populations that could be taken into consideration for the establishment of genetic reserves. It is also the case that with time, more active *in situ* conservation of CWR populations will extend the actively conserved populations in many European countries, converting many currently, passively conserved populations to actively conserved. Although it is up to each country to decide which criteria suit their interests best, some considerations to take in mind are (van Hintum and Iriondo, 2022):

1. The most recent observations should be not too old so that they are likely to remain current. Records where current presence of the population is confirmed should be prioritized.
2. Records with precise geolocation data should be prioritized because they will be easier to find if access to them is required and for use in GIS-based predictive distribution modelling. A particular situation concerns widespread species with continuous distributions over a large territory. In these cases, precise geolocation data is not necessary, and their presence may be reported in a more general way, for instance, by adding the coordinates and specifying a radius, or indicating their ubiquity in the country or certain regions.
3. Populations occurring in public land, protected areas, collaborating farms or in long-term ecological research infrastructures (LTER; https://www.lter-europe.net/), where the managers of the land are aware of their existence and consider population retention when designing land management interventions, may be more likely to be in good status and accessible for use.
4. Populations that, according to the landowners of the site and the competent public authorities, are available for access under the Multilateral System (MLS) of Access and Benefit-sharing of the ITPGRFA should be included.

In essence, the most relevant CWR populations to be considered as *in situ* accessions in the CWR-POP-NI will be **those whose current presence and precise location are known**, **are being or expected to be**

actively conserved to guarantee their long-term persistence, and that are available for access under the MLS. In this respect, Rubio Teso et al. (2020) provide a detailed account of the data collection and curation processes followed in the preparation of an occurrence database for European priority CWR taxa (Figure 3). In this way, once the geographic scope (country) and the list of species in the CWR-NI have been established, the site and population occurrence data for each species for developing the CWR-POP-NI can be obtained from national and global databases, such as:

- GBIF (https://www.gbif.org/), including the Global Database for the Distributions of Crop Wild Relatives (https://www.gbif.org/dataset/07044577-bd82-4089-9f3a-f4a9d2170b2e).
- EURISCO (https://eurisco.ipk-gatersleben.de/), database of European plant genetic resources.
- Genesys database of *ex situ* conserved samples (https://www.genesys-pgr.org/).
- Biodiversity databases created by national and subnational public administrations and NGOs that may be accessible.
- Gathering information through searches in public herbaria and chorological bibliographic references.
- IUCN Red List (https://www.iucnredlist.org/), which provides occurrence data for those taxa that have been assessed.



(1) Custom made R scripts using ad hoc created R functions and the following packages: 'rgbif', 'genesysr', 'CoordinateCleaner', 'countrycode', 'data.table', 'devtools', 'dplyr', 'magrittr', 'spocc', 'stringr', 'sp', 'ggplot2', 'tidyr', 'readxl', 'rgeos', 'maptools', 'rgdal', 'rworldmap', 'rworldxtra' and 'raster'
(2) Adapted from Magos Brehm J, Kell S, Thormann I, Gaisberger H, Dulloo E and Maxted N 2017. Occurrence data collection template v.3. University of Birmingham and Bioversity International. doi: 10.7910/DVN/5B9IV5

Figure 3. Steps taken to obtain a high-quality dataset of occurrences of the priority CWR taxa in Europe (taken from Rubio Teso et al., 2020).

Special attention must be given to the correct use of taxonomic nomenclature and synonyms in the data query. The information obtained from these sources will often contain a high degree of redundancy and several errors that need curation. Subsequently several steps of filtering are applied (Rubio Teso et al., 2020), including those mentioned in Figure 3. In this way, a first filtering eliminates records that do not contain accurate geographic coordinates or where the given coordinates are wrong or likely correspond to cultivated populations. A second filtering step involves the elimination of species occurrences in botanic gardens, GBIF or Genesys headquarters, as well as those marked as country centroid or capital centroid. In addition, in order to obtain accurate occurrences of CWR populations, it has been suggested to eliminate records from i-Naturalist and other unreliable sources (Rubio-Teso et al., 2020; Figure 3). However, while at the whole European continent level it may make sense excluding i-Naturalist or other similar sources, at the more detailed national level it might

exclude some relevant records and therefore, including these amateur sources could be reconsidered for the creation of the CWR-POP-NI. In any case, the data collection process requires considerable effort in data curation, including resolving taxonomic and nomenclatural issues by standardizing names using resources such as GRIN (https://npgsweb.ars-grin.gov/gringlobal/taxon/taxonomysearch), the Plant List (https://wfoplantlist.org/), and national floras or checklists. Additionally, redundancies and low-quality records must be identified and eliminated.

Subsequently an equivalence is created between the GBIF descriptors and the occurrence data template and this is transferred to the Occurrence Data Collation Template (OCDT) in the *Interactive toolkit for crop wild relative conservation planning* (Magos Brehm et al., 2017), which is also available at https://dataverse.harvard.edu/dataset.xhtml?persistentId=doi:10.7910/DVN/5B9IV5. Then, a new filtering step is performed, by filtering the records occurring in the geographical scope, and the old records dated before a certain date, such as 1950 (although this can depend on the country), the duplicates, and those falling in urban areas, water bodies or permanent snow and ice, are removed. Finally, the populations that fall within 1 km radius of another one can also removed (Rubio Teso et al., 2020).

It should be noted that, even after filtering, the records obtained in this way may refer to population observations made many years back in time. Therefore, it is important to confirm the present occurrence of those populations of interest. To facilitate this and to obtain additional data on *in situ* conserved CWR, it is advisable to create a national network of stakeholders that may be able to provide direct information on *in situ* CWR populations that are being actively managed and confirm the presence of other targeted CWR populations. This network could include technical staff from regional and local administrations involved in the conservation of legally protected, threatened CWR. It would also encompass those working on the conservation of protected habitats that include target CWR as characteristic species, such as Annex I habitats in Natura 2000 sites. Additionally, farmers and farmer associations that conserve CWR in agricultural margins should be part of this network, as CWR population data are likely to be used in the future to monitor environmental stewardship schemes in agricultural policies. Scientists managing long-term ecological research (LTER) infrastructures, which contain target CWR, would also be valuable members of the network. Other relevant individuals involved in initiatives for CWR *in situ* conservation should also be included. Ideally, the database containing the CWR-NI should have a platform where members of this network can contribute their data.

Finally, the CWR-NI and CWR-POP-NI data must be included in the CWR-NI database, which should be compatible with EURISCO. Ideally, this database should be integrated into existing national frameworks for reporting species occurrences, where available, to avoid duplication of efforts and ensure that users do not have to learn a new system.

The database structure will need to contain: 1) information at the taxon level that was used in the generation of the CWR checklist and inventory (CWR-NI), and 2) information at the population level that will provide the specific details about each population (CWR-POP-NI):

1. Information available at the taxon level used for the generation of the checklist:

    - Taxonomy of the CWR (family, genus, species, subtaxon, authority, common name)

    - Crossability of the CWR with the associated crop (genepool)

    - Threat status, legislative protection, endemicity

    - Related crop (scientific name and/or common name)

2. Information at the population level to provide the characteristics of each record:

- Site descriptors (geographic coordinates, name of the site or municipality, country, site protection, habitat descriptors)
- Population descriptors (most recent observation date, holding institution, biological status, presence of ex situ accessions, herbarium specimen, availability of the material)
- Population management descriptors (threats, conservation actions in place, *ex situ* conservation)

In case additional information about the population is available, such as characterization and evaluation data, or information about the trends of population size across time, etc., appropriate solutions (i.e., specific dataframes) should be created. Further discussion of these points is provided in PRO-GRACE Deliverables D1.3 and D2.3. Also, the descriptors to be used to account for all this information (as indicated in Deliverable D2.3) should preferably, as far as possible, follow international standards and be compatible with EURISCO.

3.4. Update on the current state of National Inventories of CWR in European countries

Crop Wild Relative National Inventories aim to monitor the extent of CWR (and including WHP in some instances) occurrence and diversity in the country, offering the means to identify the most suitable populations for active conservation and use. To evaluate the status and progress in the development of CWR-NI and CWR-POP-NI, as well as their compliance with the principles for the inclusion of CWR data in EURISCO (van Hintum and Iriondo, 2022), a questionnaire was prepared to collate information on these aspects (Annex 2). The questionnaire contained 22 questions, some of which were already included in a questionnaire sent in November 2015 by Labokas et al. (2018), which allows comparing the changes and developments taken place in the last decade. The questionnaire was distributed among the ECPGR CWR Working Group (https://www.ecpgr.org/contacts-in-ecpgr/ecpgr-contacts/crop-wild-relatives), as well as with relevant contacts from Iceland, North Macedonia, and Norway, by November 2024 and responses were received from 34 countries within 5 months.

A summary of the results obtained through this questionnaire is presented below, providing an overview of the current status of national CWR inventories and population inventories in Europe. The full compilation of the responses received from participating countries can be found in Annex 3. Where appropriate, the results are contextualized with those reported by Labokas et al. (2018), who analyzed a similar questionnaire circulated at the end of 2015. This comparison offers valuable insights into the progress made over the last decade in developing national CWR conservation strategies and inventories, highlighting changes in prioritization criteria, conservation actions, and stakeholder involvement across Europe.

The responses to Question 1, illustrated in Figure 4, show that the majority of countries have taken initial steps toward developing a comprehensive national strategy for the conservation and use of CWR. Most notably, 28 countries report having completely or partially developed a national CWR checklist (Step 1) and completed prioritization of CWR taxa (Step 2). However, the number of countries achieving subsequent steps progressively declines. While approximately half have finalized establishing a national CWR inventory (Step 3), far fewer have conducted a gap analysis (Step 4) or developed a national strategy and action plan (Step 5). Fewer than ten countries have completely or partially implemented a strategy (Step 6) and only two have finalized developing an *in situ* population network (Step 7a). Also, only 13 countries have completely or partially implemented an ex situ back-up of the *in situ* maintained CWR populations. The steps associated with *in situ* genetic diversity characterization and evaluation (Step 8) and availability of such diversity for use (Step 9) show very low levels of achievement, with only one and two countries, respectively having achieved this stage. These findings reflect similar trends observed in the earlier survey reported by Labokas et al. (2018), where the greatest bottlenecks were found beyond the prioritization phase, particularly in translating planning into action. The results reinforce the importance of supporting countries in transitioning from early planning steps to concrete conservation implementation (Maxted et al., 2015).

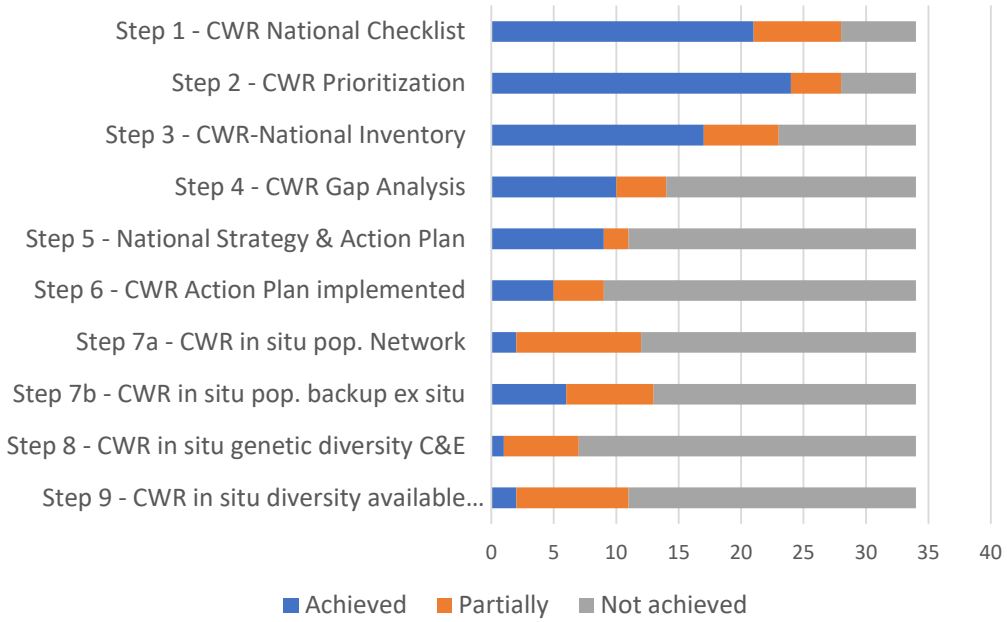


Figure 4. Stage of development of CWR National Conservation and Use Strategy reached by the countries that responded to the survey (Q1).

Figure 5 presents the results for Questions 2 to 5 (Q2-Q5). For Q2 (stage of preparation of the CWR-NI), most countries report that their inventories are either in preparation or already approved and published, reflecting steady progress in this area. In Q3, a clear majority of countries applied a floristic approach to developing their inventory, in line with established conservation planning frameworks. Q4 shows that more than two-thirds of countries include both CWR and WHP (wild harvested plants) in their inventories, reflecting an expanded and more integrated view of wild plant genetic resources. Only Q5 (occurrence status) is directly comparable with the data reported by Labokas et al. (2018). In the earlier survey, 44% of countries included native, archaeophyte, and neophyte species in their CWR lists, while 30% restricted their inventories to native species only. The current results confirm a similar pattern, with a majority of countries now embracing broader occurrence categories, including neophytes and archaeophytes (57%). This indicates an increasing acceptance of naturalized and long-established species as valid targets for conservation and use, particularly when they may contain valuable traits. These findings suggest a modest but important shift toward broader genetic resource representation in European inventories.

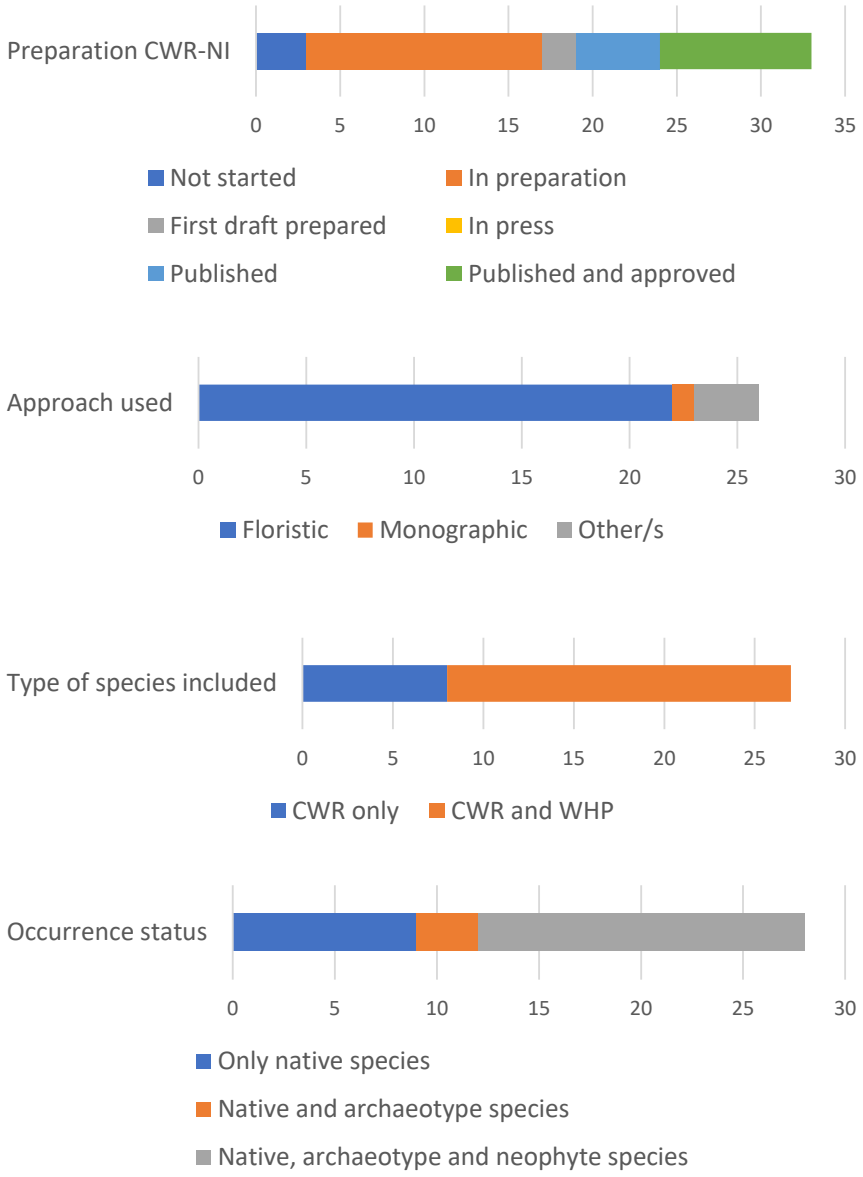


Figure 5. Stage of preparation of the CWR-NI reached (Q2), type of approach used for developing the CWR-NI (Q3), type of species included in the CWR-NI (Q4), and occurrence status (autochtony) of the priority CWR included in the CWR-NI (Q5) by the countries that responded to the survey.

The results of Question 6 (Figure 6) show that the most commonly used categories for prioritizing CWR and WHP in national inventories are human food and beverages and animal food, each selected by nearly all responding countries (27 and 25, respectively). This aligns closely with the findings of Labokas et al. (2018), where these same two categories were also identified as the top priorities by the majority of countries (23 and 22 countries, respectively). Categories such as medicinal and aromatic plants, industrial crops, and cultivated ornamental plants were used to a lesser degree (18, 16, and 9 countries, respectively), indicating broader, though secondary, interests beyond food and feed uses. Notably, forestry species, while the less frequently selected category in the current survey (6 countries), were more prioritized than ornamental plants in the study by Labokas et al. (2018), with 9 countries for cultivated ornamental species and 12 for forestry species. This shift, with less representation of forestry species in the CWR-NIs, is likely to reflect the division of responsibility for forest genetic resources among different institutional actors at the national level Overall, the results

indicate a consistent prioritization logic over the past decade, centered on food-related uses, but with some variation in secondary categories.

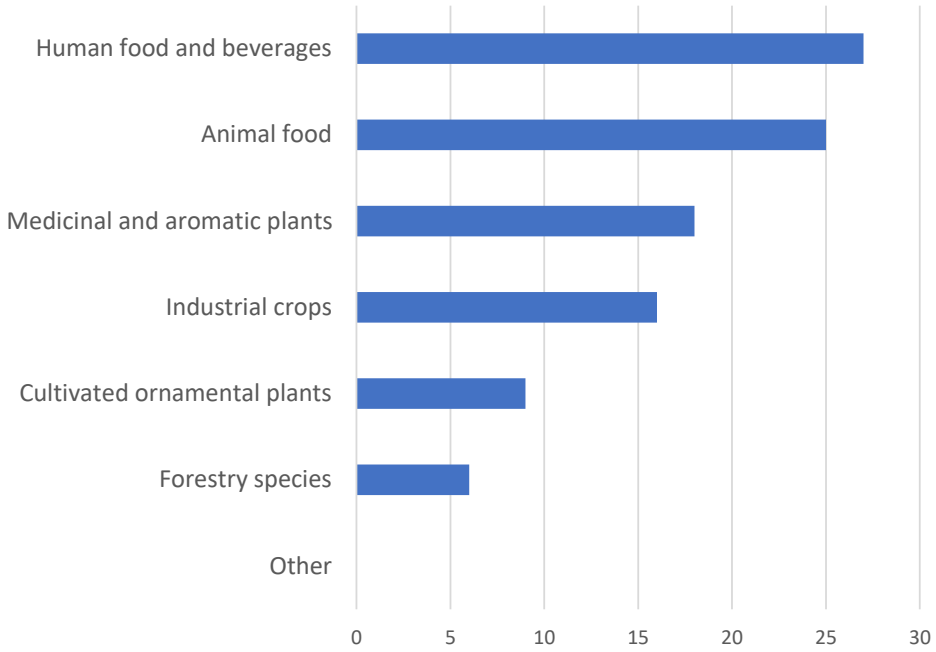


Figure 6. Categories of crop use / WHP selected to prioritze the nation's CWR / WHP for the CWR-NI by the countries that responded to the survey (Q6).

Figure 7 presents the results for Question 7, which asked countries to identify additional criteria used for prioritizing CWR and WHP in their national inventories. The most frequently applied criterion is the utilization potential of the CWR, cited by 24 countries in the current survey, compared to 18 countries in the 2015 questionnaire reported by Labokas et al. (2018). This is followed by the relative level of threat (21 countries now vs. 15 before) and the economic value of the related crop (18 now vs. 16 before), confirming the continued relevance of these core criteria over the past decade. The autochthony of the CWR, selected by 16 countries in the current survey, was not included in the 2015 questionnaire, indicating a more recent emphasis on ecological origin and adaptation in national prioritization frameworks. The (socio)economic value of WHP, also newly introduced, was selected by 10 countries, highlighting the growing inclusion of WHP in inventory planning. Additionally, 11 countries cited other criteria, compared to 9 in the earlier survey. Overall, the results reflect both continuity and evolution in prioritization approaches, with countries building on established criteria while progressively broadening their scope.

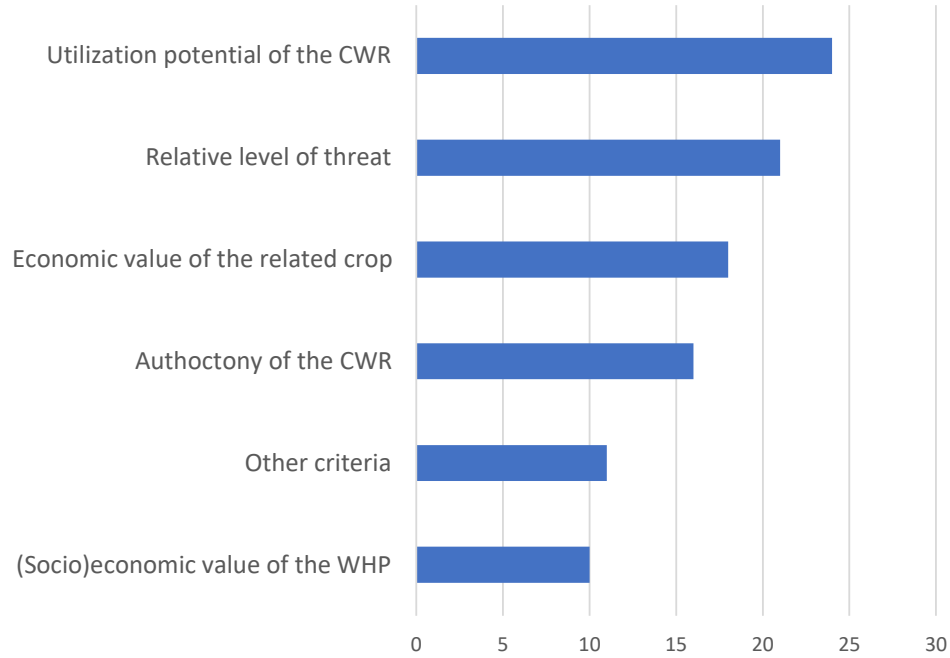


Figure 7. Other prioritization criteria applied for the CWR-NI by the countries that responded to the survey (Q7).

Figure 8 presents the results for Question 8, which asked countries to indicate the method applied to prioritize CWR for their national inventories. The responses show that 14 countries used a parallel method, where multiple criteria are considered simultaneously, while 12 countries applied a serial approach, prioritizing sequentially based on pre-defined criteria order. One country reported using other criteria or a different method. These results show a shift toward the parallel method, which is now slightly more common than the serial approach. Compared to the 2015 questionnaire analyzed by Labokas et al. (2018), where 15 countries reported using a serial approach and 8 a parallel one, this marks a notable reversal. The trend suggests a growing preference for integrated, multi-criteria decision-making frameworks, which may offer more flexibility and nuance in selecting high-priority CWR taxa. The reduction in reliance on the serial approach may reflect a maturing of national prioritization systems and the adoption of more sophisticated methodologies.

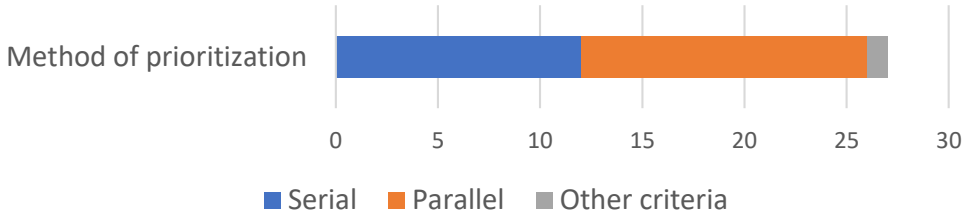


Figure 8. Method of prioritization applied for the CWR-NI by the countries that responded to the survey (Q8).

Table 1 presents the number of CWR species included in national checklists and in national inventories (CWR-NI) as reported by the countries that responded to the survey (Q9). The data show considerable variation, both in the total number of CWR taxa identified in national checklists and in the extent to which these have been prioritized for inclusion in inventories. Some countries, such as Italy, Türkiye, and Lithuania, report national checklists with several thousand taxa, while others, such as Malta, Ireland, or some of the smaller or regionally reported lists (e.g. Azores, Madeira), contain fewer than

500 taxa. These differences reflect a range of factors including national flora richness, criteria for defining CWR, and whether regionally disaggregated data were provided. In terms of prioritization, countries such as Türkiye, Ukraine, and the United Kingdom, the number of prioritized CWR in the inventory is relatively high (>200), reflecting a more comprehensive scope of prioritization. In contrast, countries like Malta, Ireland, and some Portuguese regions report smaller sets of prioritized taxa, often below 50.

Table 1. Number of CWR species in national checklists and CWR-NI by the countries that responded to the survey (Q9).

Country	National checklist	CWR-NI
Albania	470	168
Armenia	2518	
Azerbaijan	304	117
Czech Republic	1393	207
Estonia	1761	88
Finland	1935	88
France	855	≈80
Germany	2471	117
Iceland	≈650	≈60
Ireland	162	31
Israel	323	170
Italy	8766[f]	
Latvia	440	94[i]
Lithuania	2630	147
Malta	378	44
Netherlands	214	53
Norway	>3000	206
Portugal	637 (Azores) 884 (Madeira) 2403 (Mainland)	27 (Azores) 56 (Madeira) 165 (Mainland)
Romania	937	272
Slovakia	≈200	50
Slovenia	≈150-300	
Spain	n.a.	521
Switzerland	2200	285
Türkiye	7235	764
Ukraine	894	385
United Kingdom	2109	223

When comparing these results to those reported by Labokas et al. (2018), certain patterns emerge. Countries like Türkiye, Portugal, and the United Kingdom report similar figures to those from the 2015 questionnaire, suggesting that CWR prioritization frameworks were already well established at that time. Others, such as Lithuania, Romania, and Switzerland, show a notable increase in the number of prioritized CWR, indicating progress in inventory development over the last decade. In contrast, some countries, including Ireland and Malta, continue to report relatively small inventories, as they did previously. As was also the case in the 2015 questionnaire analyzed by Labokas et al. (2018), figures

reported must be interpreted with caution: in many instances, the reported numbers are only partial or preliminary, and do not necessarily reflect the final scope of national lists. Differences in methodology, definitions of what constitutes a CWR, and institutional responsibilities contribute to the observed heterogeneity. Nonetheless, the table provides a useful snapshot of progress in compiling and prioritizing national CWR datasets across Europe.

Figure 9 shows the types of additional data included in the CWR national inventories (CWR-NI) as reported by the countries that responded to the survey (Q10). The most frequently included descriptors are the scientific name of the related crop (24 countries) and the crop gene pool level or taxon group level (20 countries), both fundamental for establishing the relationship between CWR and cultivated crops. A second tier of data types includes *in situ* conservation status (16 countries), *ex situ* conservation status (15), and synonyms (15), which support conservation planning and taxonomic clarity. Other widely used descriptors, each reported by 13 or 14 countries, include distribution data, legislation applied, vernacular names, economic value, and potential use as a gene donor, reflecting a strong interest in both the legal and practical aspects of conservation and utilization. Less commonly included data types are those related to ecological, morphological, or genomic attributes. These include ecology and habitat (12 countries), flowering time (11), invasiveness, plant life-form (each 9), images and reproductive system (8 each), and ethnobotanical uses (7). Only 5 countries report the inclusion of genetic or genomic data and/or reference genome links, suggesting that this type of information, while valuable, is still rarely integrated into national CWR inventories, possibly due to limited data availability or the scope of the inventories being focused on taxonomic rather than molecular-level information. Overall, the results indicate that while core taxonomic and conservation-related descriptors are widely adopted, the integration of more detailed biological, ecological, and genomic information remains limited and uneven across countries.

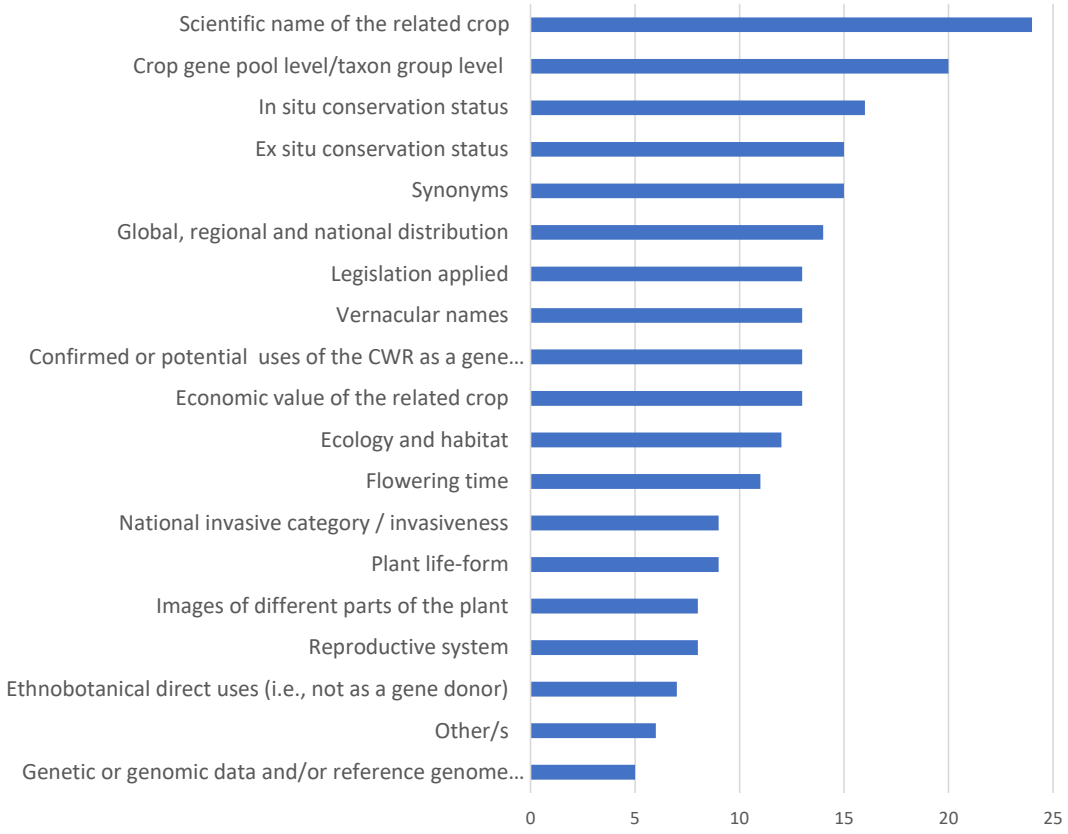


Figure 9. Other types of data are included in the CWR-NI by the countries that responded to the survey (Q10).

Figure 10 presents the average impact scores assigned by countries to different limitations encountered during the development of their CWR National Inventories (Q11). The most significant challenges, scoring above 3.5 on average (on a 1–5 scale), are the lack of financial resources (3.57) and the lack of political interest at the national level (3.54). These were followed by structural gaps at the European level, including the lack of an EU agency (3.25) and the absence of an EU regulation for plant genetic resources (3.18), as well as a lack of political interest at the EU level (3.06). These results point to both national and EU-level governance issues as key bottlenecks for progress. Mid-level limitations (scores around 2.4–2.5) include technical and institutional challenges such as prioritizing the checklist, lack of expertise, and producing the checklist itself. Lower average scores, generally below 2.4, were recorded for more foundational tasks such as procuring a digitised list of the national flora and identifying the crops whose CWR will be considered, suggesting these issues may be more tractable or already resolved in several countries. As in previous surveys (e.g. Labokas et al., 2018), these findings highlight that while technical challenges persist, political will and financial investment remain the most pressing barriers to the full development and implementation of national CWR National Inventories.

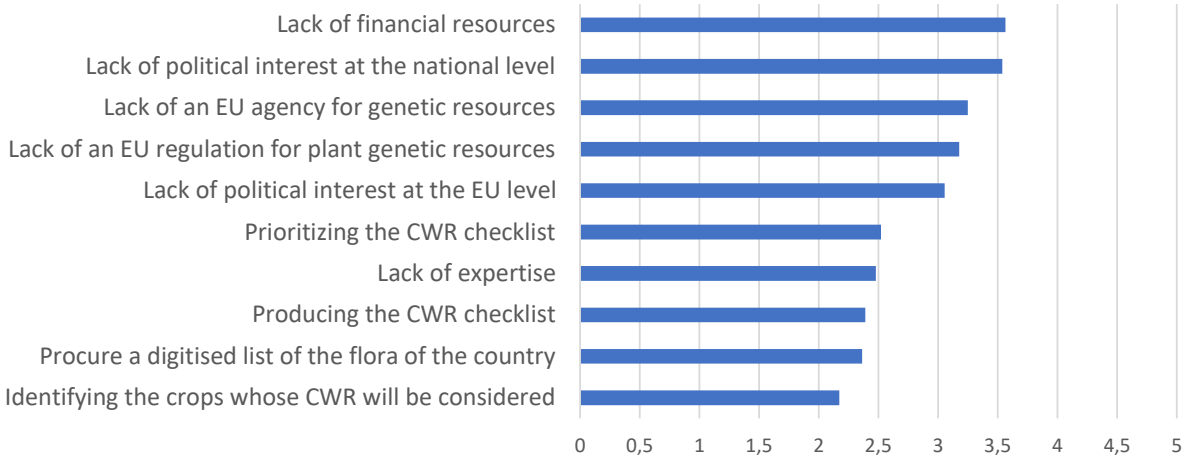


Figure 10. Average impact assessment of limitations encountered in the generation of the CWR-NI as assessed by the countries that responded to the survey (1 = very low, …, 3 = medium, …, 5 = very high) (Q11).

Figure 11 shows the stage of development of CWR population inventories (CWR-POP-NI) reported by countries in response to Question 12. Compared to the general CWR-NI (Q2), progress on population-level inventories remains more limited. A total of 14 countries have not yet started the development of their CWR-POP-NI, while 9 report that they are in preparation. Only 3 countries have reached the stage of first draft prepared, and another 3 countries have published and approved inventories. This contrasts with the broader CWR-NI reported in Q2, where the majority of countries had either completed or were well advanced in developing their inventories. The lag in population-level inventory development likely reflects the greater technical and data demands associated with identifying and documenting populations in situ. These findings underscore the need for targeted support and capacity building, particularly in field-based population monitoring, spatial data management, and threat assessment, to help countries implement the principles recommended for population-level documentation and integration in EURISCO (van Hintum and Iriondo, 2022). Advancing in this area will be essential to ensure that CWR conservation planning is not only comprehensive in terms of species coverage but also spatially and ecologically representative.

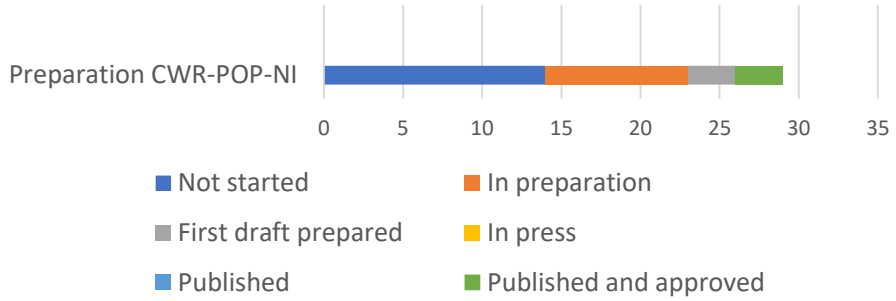


Figure 11. Stage of development of the CWR-POP-NI by the countries that responded to the survey (Q12).

Figure 12 illustrates the range of data sources used by countries to develop their CWR population inventories (CWR-POP-NI), corresponding to Question 13. The most frequently used source is biodiversity databases created by national and regional authorities, cited by 13 countries, highlighting the reliance on domestically curated information for population-level planning. The IUCN Red List follows with 9 countries, serving as a key reference for threat assessments and conservation status. Several sources were cited by 8 countries each, including field surveys, public herbaria (including digitised collections), *ex situ* conservation databases, EURISCO, and GBIF. This suggests that while field-based and institutional sources are widely used, global data repositories and digitised resources are playing an increasingly complementary role in informing national inventories. Other notable sources, cited by 6 countries each, include Genesys, chorological bibliographic references, and contributions from national NGOs focused on botanical diversity. Less frequently cited sources include citizen science platforms such as iNaturalist (5 countries), references cited in national floras (5), and the BGCI database of botanic garden holdings (4), showing that while these platforms are used, they remain secondary to more formal data infrastructures. Overall, the data indicate a diverse and multi-layered approach to information sourcing, combining national datasets, international platforms, and field-based verification to construct comprehensive population-level inventories.

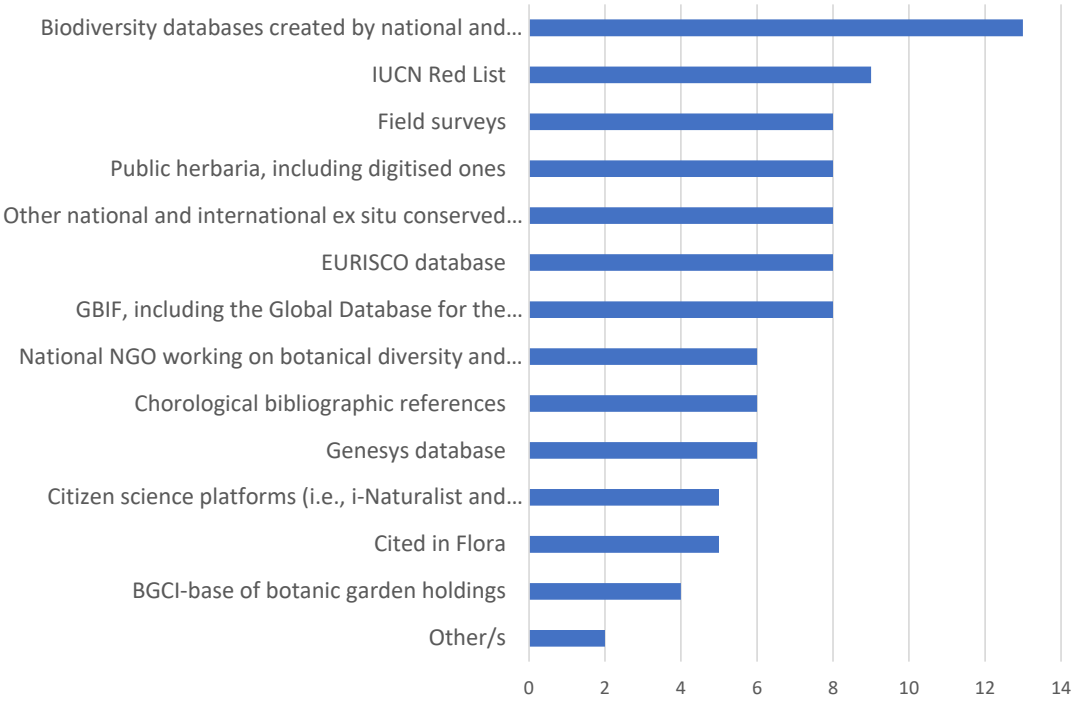


Figure 12. Sources used to create the CWR-POP-NI by the countries that responded to the survey (Q13).

Figure 13 presents the types of data-cleaning and filtering measures applied by countries when compiling their CWR population inventories (CWR-POP-NI), corresponding to Question 14. The most commonly used filter, applied by 9 countries, is the elimination of records that could represent cultivated populations, underscoring the importance of distinguishing wild populations from *ex situ* escapes or cultivated specimens. A cluster of filters were each applied by 7 countries, including: eliminating records dated before 1950 (or other specific dates), removing records from platforms like iNaturalist (or at least those lacking research-grade validation), excluding records with inaccurate or missing coordinates, and eliminating records where coordinates could not be verified. These filters reflect a common concern over data precision and temporal reliability, particularly in publicly aggregated or older sources. Additional quality control steps, each reported by 6 countries, include the removal of duplicates, eliminating occurrences in urban areas, water bodies, or roads, and other miscellaneous filters. More advanced or context-specific filters, such as the removal of centroid-based records (e.g., national/capital locations), or those located at institutional headquarters (e.g., GBIF, Genesys), were applied by fewer countries (4–5), likely reflecting varying technical capacity or levels of detail in the underlying datasets. Together, these results suggest that while countries apply a broad range of filters to improve data quality, practices are still diverse and likely depend on the type and resolution of data sources used. Establishing common filtering protocols and sharing good practices could support harmonisation and improve the comparability and robustness of population-level inventories across Europe.

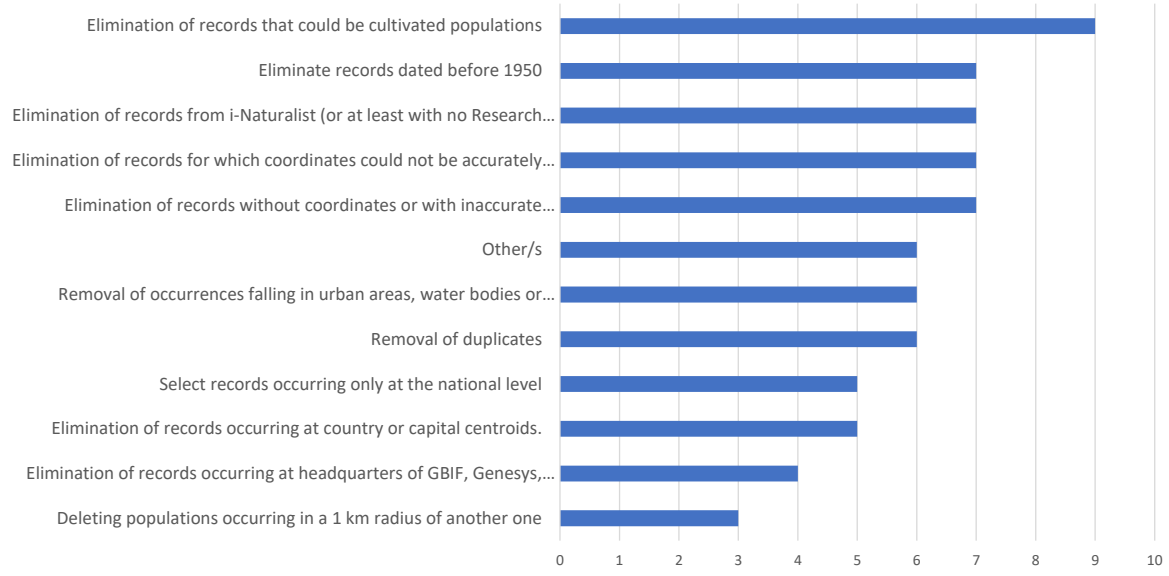


Figure 13. Filters applied to create the CWR-POP-NI by the countries that responded to the survey (Q14).

Table 2 presents the number of CWR populations included in the national CWR-POP-NI after the application of filtering criteria, as reported by countries in response to Question 15. As in the case of the CWR-NI data discussed in Question 9, the figures vary widely among countries and must be interpreted with caution, since in many cases they are partial and reflect inventories that are still under development or cover only a subset of species or regions. The range of reported population numbers is substantial. Spain and the United Kingdom stand out with exceptionally high numbers, having registered 624,237 and 646,816 CWR populations, respectively, suggesting highly comprehensive and extensive location of populations, and/or data integration from multiple sources. Similarly, Portugal

reports very large numbers—24,270 (Azores), 1,914 (Madeira), and 74,980 (Mainland. These contrast sharply with countries such as Norway and Romania, which reported only 1 and 20 populations, respectively, and reflect the divergent levels of maturity and scope of national efforts at the population level. When compared to the CWR-NI data (Table X from Q9), which show how many CWR taxa are included in national inventories, the number of countries reporting population-level data is lower. While Table X (Q9) included data from 26 countries, this table includes only 10, reinforcing the observation that fewer countries have advanced to the CWR-POP-NI stage and that the development of these inventories is still at an early and uneven stage across Europe. The number of CWR populations per species, where provided, also varies considerably. For example, the United Kingdom reports an average of ≈3,250 populations per species, and Spain approximately 1,198, indicating that some species are overrepresented compared to others in the CWR-POP-NI, while countries like Romania and Italy report much lower averages (e.g., 3–4). These differences reflect not only ecological and biogeographic variability, but also divergent methodological approaches, data availability, and filtering criteria.

Table 2. Number of CWR populations included in the CWR-POP-NI after the filtering step by the countries that responded to the survey (Q15).

Country	Number of CWR populations in the CWR-POP-NI	Number (mean and/or median) of CWR populations per species
Italy	97	3.46
Ireland	246	3-4
Lithuania	1080	11.25 / 7
Netherlands	1912	9
Norway	1	1
Portugal	24270[e] (Azores) 1914[e] (Madeira) 74980[e] (Mainland)	1011.25 (Azores) 33.38 (Madeira) 45.69 (Mainland)
Romania	20	3
Slovakia	≈1200	24[a] / 18
Spain	624237	1198
United Kingdom	646816	≈3250

Figure 14 shows the level of verification and currency of CWR population occurrence records in the CWR-POP-NI, as reported by the countries that responded to Question 16. Among the 13 responding countries, only 5 indicated that their occurrence data are fully verified and up to date, while another 4 reported that this was done partially. The remaining 4 countries stated that no such verification has been carried out. These results indicate that even among countries that have developed a population inventory, the quality control and updating of occurrence data remains a challenge. This is likely due to the technical and logistical demands of verifying spatial data, particularly for *in situ* populations, which often require field validation or expert review. Without up-to-date and validated records, the utility of the CWR-POP-NI for conservation planning, monitoring, and policy integration may be significantly reduced. The findings reinforce the need to invest in field verification, data curation workflows, and the integration of real-time or citizen science–supported updates to ensure that national inventories not only exist but also remain functionally relevant for conservation action.

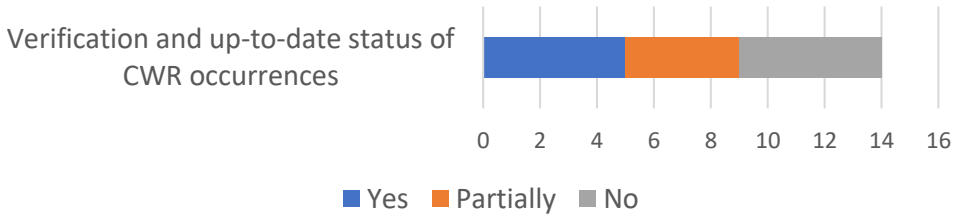


Figure 14. Verification and up-to-date status of CWR population occurrences in the CWR-POP-NI, as reported by the countries that responded to the survey (Q16).

Figure 15 presents the average impact scores (on a 1–5 scale) assigned to various limitations encountered in the development of national conservation strategies for CWR populations (CWR-POP-NI), as reported by countries in response to Question 17. The results show that the most critical barrier remains the lack of financial resources, with an average score of 4.06, closely followed by the lack of an EU regulation for plant genetic resources (3.89) and the absence of an EU agency for genetic resources (3.71). Also scoring high are difficulties in procuring occurrence data (3.63) and lack of political interest at the national level (3.63), reinforcing the pattern seen in previous questions where both institutional and structural constraints are major obstacles. Interestingly, some limitations scored slightly lower than in the case of the broader CWR-NI (Q11). For example, lack of political interest at the EU level (3.10), database development (2.93), filtering of records (2.87), and lack of expertise (2.47) were perceived as moderate rather than severe limitations. In comparison to Q11 (limitations in developing the CWR-NI), these results reflect a remarkably similar hierarchy of constraints, but with slightly lower average impact scores overall. Notably, the lowest scoring limitations in Q17 (2.47–2.93) are slightly higher than the lowest in Q11, indicating that countries responding to this question perceive the barriers to population-level planning as slightly more balanced across technical and political dimensions. However, both sets of responses converge on the conclusion that long-term investment, institutional coordination, and regulatory support at the EU level are essential for meaningful progress in national CWR conservation planning.

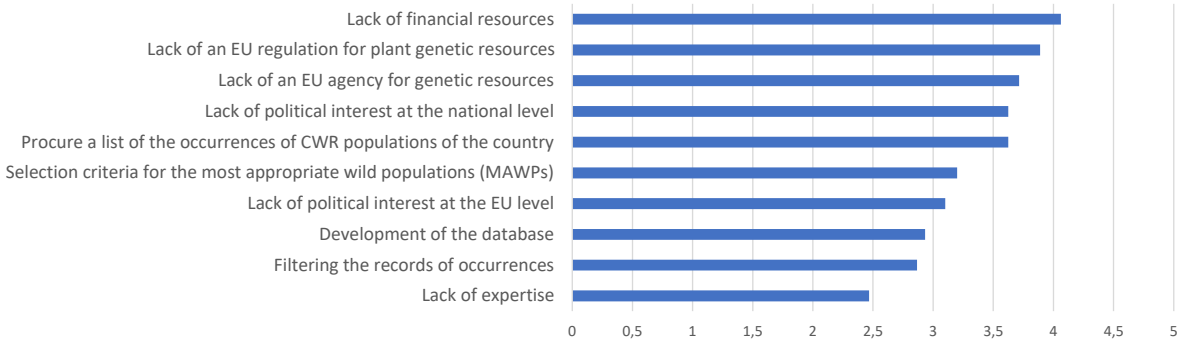


Figure 15. Average impact assessment of limitations encountered in the generation of national CWR-POP-NI conservation strategies as assessed by the countries that responded to the survey (1 = very low, …, 3 = medium, …, 5 = very high) (Q17).

Figure 16 presents the responses to Questions 18 and 19, which assess the extent to which countries are using available tools and standards to support the development of their CWR national and population inventories. For Q18, which asked about the use of the Interactive Toolkit for Crop Wild Relatives Conservation Planning (Magos Brehm et al., 2017), only 6 countries reported having used it, with 8 using it partially, and 14 not using it at all. According to the footnotes reported in Annex 3, several countries indicated that they the toolkit was not available when the inventory was created, or that its structure resulted in technical challenges from data exporting. Others mentioned that they

preferred to rely on pre-existing national frameworks or expert committees. In Q19, countries were asked whether their CWR-POP-NI adhered to the Principles for Inclusion of CWR Data in EURISCO (van Hintum and Iriondo, 2022). The level of reported compliance was higher: 12 countries said yes, 4 partially, 1 no, and 3 did not know. Where explanations were provided, non-compliance or partial compliance was often due to ongoing development of the inventory, uncertainty about technical compatibility, or lack of clarity on how to operationalize the principles in existing database structures. Overall, the results suggest that although tools and principles are available to guide national efforts, awareness, capacity, and perceived applicability still limit their uptake. There may be a need for additional training, technical guidance, or targeted technical support to facilitate broader and more effective use of these resources across countries.

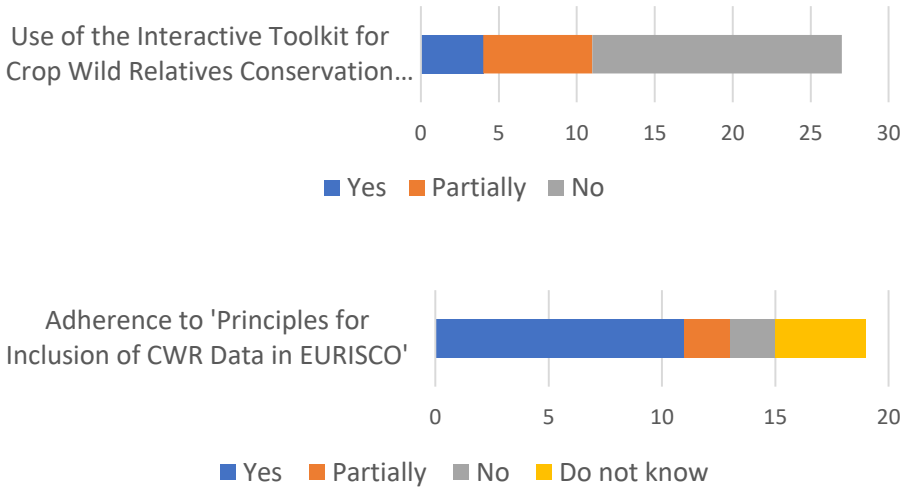


Figure 16. Use of the Interactive Toolkit for Crop Wild Relatives Conservation Planning in the preparation of the CWR-NI and, if applicable, the CWR-POP-NI (Q18) and Adherence of the CWR-POP-NI to the 'Principles for Inclusion of CWR Data in EURISCO,' (Q19) as reported by the countries that responded to the survey.

Figure 17 illustrates the diversity of actors involved in the development of national CWR-NI and CWR-POP-NI, as reported by countries in response to Question 20. The most commonly involved stakeholders are genebanks (24 countries) and national authorities or agencies involved in the conservation and use of plant genetic resources (23 countries), reflecting their central institutional roles in coordinating and managing genetic resource inventories. Other frequently cited contributors include taxonomists, conservation scientists, and national representatives in the ECPGR Crop Wild Relatives Working Group, each involved in 21 countries. This highlights the essential contributions of both scientific expertise and policy coordination in the design and implementation of CWR and CWR-POP national inventories. Managers of protected areas and OECM (Other Effective area-based Conservation Measures) sites were reported as contributors in 17 countries, suggesting a growing awareness of the importance of linking inventory work with in situ conservation management. Less frequently mentioned, but still significant, are crop breeders (12 countries) and other types of actors grouped under “Other/s” (6 countries), which may include NGOs, academic institutions, or regional networks. These results demonstrate that the development of national CWR inventories is a multi-actor process, requiring coordination across policy, science, and conservation practice. However, the relatively lower involvement of stakeholders like breeders and protected area managers in some countries also points to opportunities for broader engagement, particularly to strengthen the links between conservation planning and downstream use in breeding and sustainable agriculture.

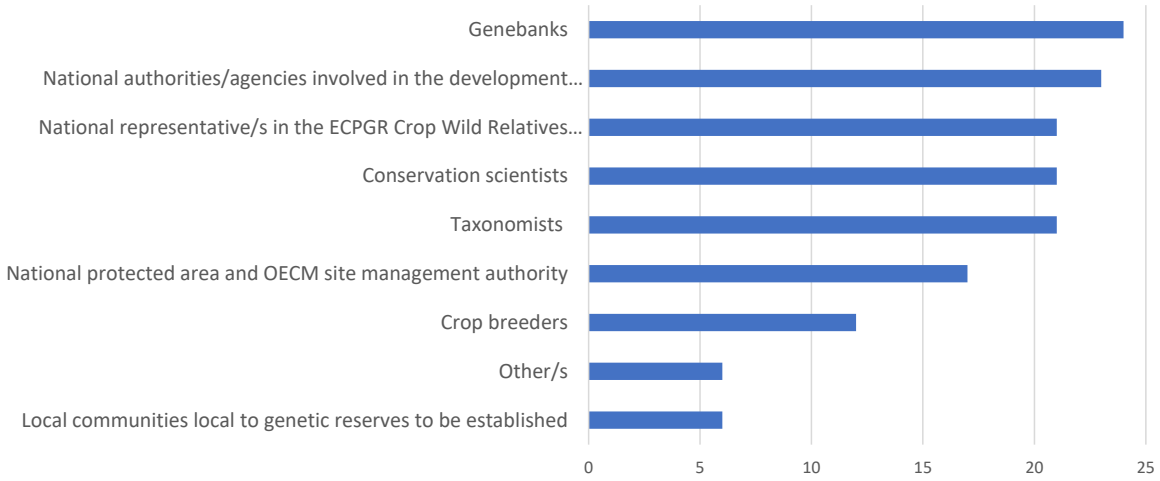


Figure 17. Actors involved in the development of the CWR-NI and, if applicable, the CWR-POP-NI, as reported by the countries that responded to the survey (Q20).

Figure 18 presents the expected impact of the future Plant Genetic Resources Research Infrastructure (GRACE-RI) on the creation and updating of CWR-NI and CWR-POP-NI, as assessed by the countries responding to Question 21. The results show a clear consensus regarding the potential value of this infrastructure, with all listed areas receiving average scores well above 3.9 on a 1–5 scale. The highest-rated area is financial support, with an average impact score of 4.62, indicating that countries see direct funding as the single most important contribution the GRACE-RI could make. This is followed closely by training activities (4.47) and promotion of collaboration among stakeholders (4.45), reflecting strong recognition of the need for capacity building and coordination mechanisms across actors involved in CWR conservation. Other highly rated areas include support for developing digital tools (4.30), organization of workshops and knowledge-sharing events (4.14), and provision of technical expertise and consultancy (4.10), as well as facilitation of data standardization and interoperability (4.10). Even the lowest-rated area (facilitating compatibility with the EURISCO database) still scored 3.95, indicating a uniformly high level of expectation across all listed domains. Compared to Q11 and Q17, which focused on the limitations encountered in developing the CWR-NI and CWR-POP-NI, the responses to Q21 reflect a clear understanding of the gaps that currently constrain national progress and a broad confidence that a European-level infrastructure could address them. These results highlight the need for the future GRACE-RI to deliver integrated support that combines funding, tools, expertise, and coordination, and confirm that countries are eager to engage if such mechanisms become available.

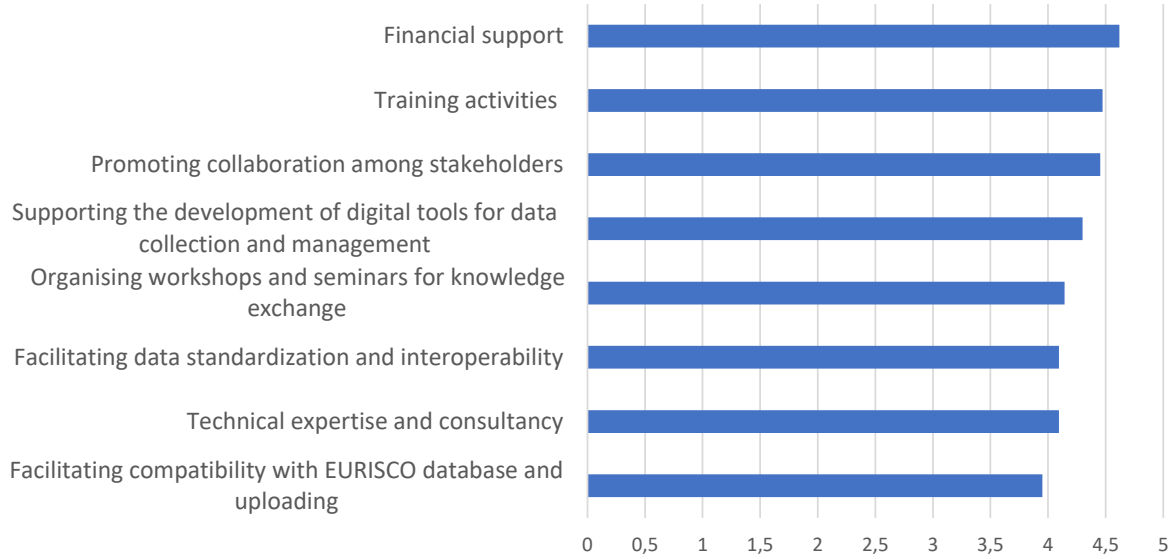


Figure 18. Expected impact of the future Plant Genetic Resources Research Infrastructure on the creation and updating of the CWR-NI and CWR-POP-NI, as assessed by the countries that responded to the survey (1 = very low, …, 3 = medium, …, 5 = very high) (Q21).

Taken together, the results presented above offer a detailed picture of the current state of development of CWR-NI and CWR-POP-NI across Europe. While considerable progress has been achieved, particularly in the formulation of national checklists and inventories, the responses also reveal persistent challenges and variation among countries in terms of technical capacity, institutional coordination, and available resources. In this way, the analysis of responses from 34 European countries shows that, significant although not dramatic progress has been made over the past decade in the development of Crop Wild Relative National Inventories (CWR-NI) and their associated population-level inventories (CWR-POP-NI). Compared to the previous survey conducted by Labokas et al. (2018), more countries have now developed national CWR checklists and prioritization strategies, with a growing number also publishing national inventories. However, progress is uneven across countries and between taxonomic and population levels, reflecting varied national capacities, institutional priorities, and funding availability.

While most countries have initiated the development of a CWR-NI, fewer have advanced to developing a comprehensive CWR-POP-NI. Only a subset of countries have conducted population-level assessments or implemented *in situ* conservation actions, and even fewer have verified and updated these data regularly. A consistent trend observed is that while species-level prioritization is becoming standard practice, population-level work remains constrained by technical and financial limitations. The inclusion of WHP (wild harvested plants) in national inventories alongside CWR is now widespread, indicating an expanded and more integrated vision of wild plant genetic resources. Furthermore, the broader acceptance of neophyte and archaeophyte species as part of national inventories suggests a shift towards more inclusive conservation practices that reflect the dynamic and historical complexity of European floras. The criteria used for prioritization have also evolved, with countries increasingly incorporating ecological and threat-based considerations alongside traditional economic and gene pool-related ones. At the methodological level, there has been a notable shift toward the parallel approach to prioritization, suggesting a maturation of national frameworks toward more sophisticated, multi-criteria decision-making.

Another key finding is the diversity of data sources and filters applied to build population inventories, ranging from public herbaria to citizen science platforms. However, the lack of standardized quality

controls and the varying levels of verification across countries point to the need for harmonized guidelines and technical support. Countries clearly recognize the potential role of a future Plant Genetic Resources Research Infrastructure (GRACE-RI), with particularly high expectations regarding its ability to provide financial support, promote stakeholder collaboration, and offer training and technical tools. At the same time, the relatively low uptake of available tools, such as the Interactive Toolkit for Crop Wild Relatives Conservation Planning, and only partial compliance with the EURISCO population-level data standards indicate a gap between available guidance and its practical implementation.

Overall, the results highlight both substantial advancement and persistent fragmentation in the development of national inventories. While many countries have embraced the core components of CWR-NI and are progressively building their CWR-POP-NI, sustained investment, capacity building, and European-level coordination will be critical to consolidate gains and ensure that these inventories fully support conservation and sustainable use objectives across the region.

3.5. Final considerations

The CWR-NI and CWR-POP-NI should be envisioned as dynamic inventories that are subject to periodical updates due to changes in the composition of the national CWR checklist and inventory of taxa, correction of existing data and new data acquisition on population occurrences and active conservation practices. Changes in taxon nomenclature and threat status should be reflected in the different CWR-NI iterations, and if the national inventory is created within an existing framework, updates regarding taxonomy and threat status are likely to be automatically transferred into the CWR inventory, streamlining the update process. Therefore, each country should periodically update occurrence data from regional, national and global biodiversity databases and consider the addition of new records to the national *in situ* CWR-NI and CWR-POP-NI after proper assessment.

Once the CWR-NI and CWR-POP-NI of a country are compiled, they can be used for multiple purposes, such as developing a national conservation strategy, ensuring the long-term conservation of populations, starting with raising awareness amongst owner/managers and then ensuring commitment and funds, setting up a monitoring system for the vulnerable species, combined with *ex situ* back up and promoting conserved resource usage. In addition, research and dissemination publications can also be developed, and a website can be made available to raise awareness of these important resources in the country. As such, the CWR-NI and CWR-POP-NI can be useful in many instances. The establishment of the CWR-POP-NI can also be used to identify the CWR populations that can be made available to scientists and plant breeders. Ideally data from these national inventories is provided to EURISCO (van Hintum and Iriondo, 2022), to support CWR research and conservation also at regional and global level. The data can also be used as a basis of communication material about CWR in a country, such as websites that can also provide an interface for users to request the material. An example of the latter is the Dutch CWR website CWRnl.nl.

Given that CWR-POP-NI lists can include large numbers of records of populations, it would be advisable to create a subsection or “core list” that corresponds to populations that are actively conserved (i.e., that are likely to exist at the present time, whose location is known, where land management is compatible with the persistence of the population, and where there is a management or person that can be approached that can facilitate access to the material). This core list could correspond to populations that are actively conserved and managed by a national CWR network of protected areas for CWR.

The results of the questionnaire clearly support the notion that CWR-NI and CWR-POP-NI must remain dynamic instruments, subject to continuous refinement and updating. While most countries have

developed national CWR checklists and many have moved toward compiling population-level inventories, fewer have systems in place for regularly verifying occurrence data or updating inventories to reflect taxonomic changes, new population discoveries, or evolving threat statuses. Only a minority of countries reported having fully verified and up-to-date population data (Q16), and filtering protocols varied widely (Q14), further underscoring the need for harmonized, systematic updating procedures. Moreover, while some countries reported very large CWR-POP-NI datasets, others submitted only preliminary or partial inventories (Q15), suggesting that current lists may not always reflect fully curated or actively conserved populations. The idea of developing a "core list" of populations under active management, as proposed in this section, is particularly relevant in this context, offering a way to distinguish high-confidence, conservation-ready entries from broader sets of records with varying reliability or accessibility. The recognition by most countries of the high expected impact of the future GRACE-RI, especially regarding financial, technical, and coordination support (Q21), further reinforces the value of fostering a structured, well-resourced approach to maintaining and improving the utility and quality of CWR-NI and CWR-POP-NI across Europe.

3.6. Recommendations for the GRACE-RI

Considering the results described in the previous sections, the recommendations for the GRACE-RI regarding National Inventories of CWR-NI and CWR-POP-NI are the following:

General recommendations:

- Provide technical assistance, training, and financial resources to countries for developing and updating National Inventories of Crop Wild Relatives (CWR-NI) and their populations (CWR-POP-NI).
- Create an expert advisory group, through the ECPGR CWR Working Group, to offer guidance throughout the process of creating and updating CWR National Inventories, ensuring standardized approaches.
- Implement long-term strategies for regular data reviews, verification, and updates for both CWR-NI and CWR-POP-NI, accounting for taxonomic changes, threat status updates and new discoveries of species and populations.
- Organize seminars and publish case studies addressing common challenges and solutions related to CWR-NI and CWR-POP-NI development. These products will discuss specific problems encountered during the construction process and explore practical solutions.
- Ensure national inventory efforts are complemented by regional activities led by the ECPGR CWR Working Group, fostering collaboration across Europe.
- Promote the integration of CWR-NI and CWR-POP-NI data into EURISCO, ensuring the data is accessible to a wide range of users for research, plant breeding, and conservation purposes.
- Promote the use of standardized methodologies and descriptor sets, facilitating harmonization across countries and increasing data comparability and usability.
- Support awareness-raising actions, including the development of national websites or portals for CWR inventories, to enhance visibility, encourage stakeholder engagement, and facilitate user access.

Recommendations specific to CWR-NI:

- To support the creation and update of CWR-NIs in European countries through different resources, such as the Interactive Toolkit for Crop Wild Relative Conservation Planning (Magos Brehm et al., 2017) and enhancing it with descriptors list for the CWR-NI, sources needed to

elaborate the national inventories (e.g., the FAO primary crop list, the crops and taxa included in the ITPGRFA, the EU database of registered varieties, the GRIN-Global CWR dataset, and relevant publications).

- Facilitate the adoption of the blueprint for CWR-NI construction, ensuring that the necessary descriptors and methodologies are compatible with EURISCO and other international standards.
- Encourage countries to update occurrence data from regional, national, and global biodiversity databases, with proper assessment for inclusion in the national CWR-NI.
- Support the harmonization of CWR-NI data to enable cross-border collaboration and recommend that countries prioritize CWR based on relevance to crop improvement, genetic potential and threat status.
- Offer technical support to countries still in early stages of development, particularly those that reported low numbers of prioritized taxa or limited use of threat-based or ecological criteria.
- Facilitate the wider adoption of inclusive prioritization practices, including WHP and non-native taxa where relevant, in line with trends observed across many countries.

Recommendations specific to CWR-POP-NI:

- Establish a "core list" of populations that are actively conserved, whose locations are known, and where land management is compatible with long-term conservation.
- Focus on identifying priority CWR populations that can be made available to scientists and plant breeders, ensuring these populations are accessible for research and other use.
- Develop national CWR networks, including technical staff, regional administrations, farmers, and scientists, to facilitate the collection of data and ensure active management of CWR populations.
- Promote the establishment of monitoring systems for actively conserved CWR populations, combined with *ex situ* conservation, to ensure the long-term preservation of valuable genetic resources.
- Ensure that CWR-POP-NI data structure is compatible with EURISCO, integrating population descriptors such as site characteristics, management actions, and conservation status for *in situ* accessions.
- Encourage countries to apply robust filtering and quality control protocols for occurrence data, addressing the issues of outdated or imprecise records, which were identified as key limitations in the current inventories.
- Support the implementation of population-level prioritization and conservation planning in countries that have not yet started or are in early stages, with particular focus on technical training and funding.

4. Constructing National Inventories of Landraces

4.1. Introduction

There has been extensive discussion on what constitutes a landrace (LR), and even whether it is possible to define them (Zeven, 1998). However, although it may be difficult to precisely define LR, practically they are widely recognised by farmers and scientists alike and are key components of PGRFA. As such, they exist, and it is necessary to provide a working definition. Two such definitions

are: “Dynamic population(s) of a cultivated plant species that has historical origin, distinct identity and lacks formal crop improvement, as well as often being genetically diverse, locally adapted, associated with traditional farming systems and having cultural associations” (Camacho Villa et al. 2005), and “A landrace of a seed-propagated crop can be defined as a variable population, which is identifiable and usually has a local name. It lacks “formal” crop improvement, is characterized by a specific adaptation to the environmental conditions of the area of cultivation (tolerant to the biotic and abiotic stresses of that area) and is closely associated with the traditional uses, knowledge, habits, dialects, and celebrations of the people who developed and continue to grow it” (Negri, 2007).

Within LR two types are distinguished (Kell et al. 2009):

- *Primary landrace*: a crop population that has developed its unique characteristics through repeated *in situ* cycles of grower selection, cultivation and harvesting, and that has never been subjected to formal plant breeding (as opposed to selection / breeding undertaken by independent LR maintainers). These can be divided into *autochthonous* (a crop that is grown in the original location where it developed its unique characteristics through grower selection; its genetic and socio-economic characteristics are associated specifically with this location) and *allochthonous* (an introduced crop that is locally adapted but that has developed its unique characteristics through grower selection in another region) (Zeven, 1998).
- *Secondary landrace*: a crop variety that has been developed in the formal plant breeding sector, but is now maintained through repeated *in situ* grower selection and seed saving, which is likely to be genetically distinct from the original bred material.

Some authors question whether locally adapted ‘allochthonous landraces’ fit within the above definitions of LR because they lack a historical origin among farmers. However, these LR do have local economic importance, are likely to contribute to increase crop diversity availability to farmers and breeders, and many were introduced a significant time ago so that they have passed through numerous cycles of sowing, cultivation, harvesting since introduction so may be regarded as distinct from the original introduction. In this respect, the ECPGR (2017) instead of providing a definition of a landrace indicated that the cultivated materials that are the object of *in situ* conservation include “true landraces”, introduced landraces, cross composite populations and varietal mixtures (Raggi et al., 2022). For the purposes of this Deliverable the term “landrace” refers to both primary and secondary landraces as well as to other cultivated materials as indicated in the last sentence.

Genetic erosion is the main threat to LR and has been referred to in the literature as the loss of a crop, variety or allele diversity (Maxted and Guarino, 2006; van de Wouw et al. 2009), the reduction in richness (in the total number of crops, varieties or alleles) (Hammer et al., 1996; Hammer and Laghetti, 2005; Ford-Lloyd, 2006; Nabhan, 2007), and the reduction in evenness (i.e., of genetic diversity) (Khlestkina et al., 2004; Ford-Lloyd, 2006).

The main factors that contribute to the genetic erosion of LR diversity include (FAO, 2015):

- changes in agricultural practices and land use;
- use of pesticides and herbicides;
- replacement of traditional varieties with modern, uniform cultivars which lead to a genetic bottleneck
- type of variety and seed certification systems associated with the enforcement of plant breeders’ rights, which limits the sale of crop seed unless the variety is included in the national or regional varietal list; LR growers do not usually register their varieties since this process is relatively expensive and generally returns limited value to individual farmers;

- simplification of silvi-agriculture productive processes due to high manpower costs;
- subsidy schemes that promote the use of uniform varieties;
- perverse incentives given by, for instance, government agricultural advisory services;
- constant decrease of rural populations due to migration and emigration;
- research programmes that ignore LR and their associated knowledge and uses;
- ageing of farmers and the unsuccessful passage of LR and associated knowledge from one generation to the next
- lack of education of the unique value of LR as a local, national and global resource
- changes in consumption habits;
- food standards that limit entry of LR and products into markets;
- war and political instability;
- climate change – changes in climate are expected to directly affect the cropping patterns.

To these we can add (Maxted, 2006; Negri et al., 2009; Almeida et al., 2024):

- lack of LR inventories, meaning we have limited knowledge on how many LR still exist;
- the landrace maintainers are almost always older, and their number is dwindling each year (= average age in Scottish islands was 65 in 2003);
- LR maintainers have, by definition, a commercial imperative, they grow a crop to generate an economic return, they are not conservationists where profit is not a consideration;
- seed companies, breeders and government agencies are actively promoting modern cultivar replacement of LR;
- in most countries no agency has direct responsibility for LR conservation.
- global food market pressures and rising demand for uniform crops, making it difficult for LR to compete in global trade systems;
- the lack of financial incentives or governmental policies supporting the continued cultivation of LR, making it less attractive for farmers to maintain them;
- the increasing impact of climate change, which disproportionately affects the marginal environments where LR are often grown, reducing their resilience and pushing farmers toward more resilient modern varieties.

While the trend of cultivation of landraces has been declining since the appearance of modern varieties, their conservation as genetic resources is an imperative. Many landraces have been collected and conserved *ex situ*; however, many others still remain to be collected and conserved. The establishment of LR National Inventories (LR-NI) to identify the landraces that exist in a country and that deserve being conserved (i.e., after a prioritizing step) is a first step to verify that they are already conserved in a germplasm bank and are accessible to users. On the other hand, landrace on-farm conservation is complementary to *ex situ* conservation and consists in the active management of LR diversity typically within the traditional agricultural systems where they have developed their unique characteristics and to allow the LR to evolve according to the farmer's needs and to sociocultural, economic, and environmental changes (Brush, 2000). However, on-farm conservation can also take place outside of the original traditional agricultural systems, where landraces are maintained in new locations while still preserving their diversity and adaptability. In this respect, Maxted et al. (2020)

propose a more inclusive definition of on-farm conservation as the maintenance of genetic diversity of locally developed traditional crop varieties (landraces) by farmers within traditional or sustainable agricultural, horticultural or agri-silvicultural cultivation systems, where the focus is the maintenance of the genetic diversity / resource. They distinguish between on-farm conservation and on-farm management, in the latter the focus is not on maintenance of the intrinsic genetic diversity / resource but of the diversity-based on-farm system itself. The distinction is important because of recent promotion of cross composite populations and varietal mixtures (Raggi et al., 2022) that may involve the replacement of local LR with allochthonous (introduced) LR or other crop varieties that are not LR, therefore potentially resulting in local intrinsic LR diversity loss if managed poorly. Both on-farm conservation and management are valuable PGR activities that should be central to GRACE-RI, but clear acknowledgement of the distinction can ensure that both are addressed adequately and appropriately.

All on-farm activities imply that the conservationists work closely together with farmers to manage and monitor their LR populations aiming at the long-term preservation of the dynamic of the agricultural systems while maintaining genetic richness and evenness of the included diversity (Maxted et al., 2002). Landraces are unique resources for food security but are becoming more threatened and suffering from genetic erosion (Almeida et al., 2024). The systematic, coordinated and integrated *in situ* and *ex situ* conservation of LR diversity is thus fundamental and best implemented via a national management plan (Maxted and Scholten, 2007; García et al., 2021). A National management plan for LR conservation aims at the long-term active conservation of the country's LR diversity, while at the same time promoting its use. Also, given the limitation of resources, the LR on-farm conservation efforts must be focused on areas where they can lead to better impacts, such as an improvement of agrobiodiversity, having favourable ecogeographical conditions for the maintenance of LR, or with socioeconomic and demographic factors that facilitate the utilization of LR, and for this several approaches are available (García et al., 2021). For all these purposes, National Inventories of *in situ* conserved populations of landraces (LR-POP-NI) are required, as has been recognized in the ECPGR Concept for on-farm conservation of plant genetic resources for food and agriculture (ECPGR, 2017), with the construction of a European inventory of on-farm genetic diversity, based on the LR-NI and LR-POP-NI, as one of the priority actions identified. Unlike for CWR, the number of national inventories of on-farm conserved landraces is much more limited and only a few have been published so far (Veteläinen et al., 2009; Negri et al., 2013; ECPGR, 2021; Almeida et al. 2023) and possibly none are LR comprehensive. However, in many cases, these inventories are compilations of names of landraces derived either from farmer interviews, genebanks or seed catalogues or from historical documents that do not document the current on-farm situation. Recently, Raggi et al. (2022) obtained a first inventory of landraces grown across Europe and identified 19,335 Landrace Cultivation Sites (LCS) from 14 European countries representing 189 different crop species. Almost 20% of the LCS fell in protected areas of the Natura 2000 Network. Despite lack of information from several countries and biased distribution among countries in the number of LCS, the approach used is of interest for the development of National Inventories of on-farm conserved landraces. Finally, these LR-POP-NI should be compatible with relevant international data exchange formats such as the MCPD, to possible provide data to data portals such as EURISCO, if those will be extended to include LR data, to facilitate their accessibility to user as well as their conservation.

In conclusion, for the purposes of this Deliverable, it has been recognized that the LR-NI should take a pragmatic approach, focusing on the effective conservation of landraces as dynamic elements of agrobiodiversity. Rather than attempting to capture every individual landrace population, which can shift rapidly due to changes in agricultural practices, the LR-NI should prioritize a comprehensive checklist of key landraces that are valuable for their genetic, cultural, or agronomic traits. This checklist

should be maintained and updated to ensure these landraces are conserved either *in situ* or *ex situ* based on their conservation status and potential future use. For landraces conserved only *in situ*, it should be a priority to collect them for *ex situ* conservation to safeguard against genetic erosion or other threats. While the LR-POP-NI can include ecogeographic data, farm and farmer details, nomenclature, and cultivation practices, emphasis should be on the conservation of the landraces included in the LR-NI and ensuring that they remain accessible for future use by farmers, breeders, and researchers. This more streamlined and focused approach aligns with the recommendations from PRO-GRACE discussions and recognizes the dynamic nature of landraces, ensuring their preservation while optimizing available conservation resources.

4.2. Activities

For the elaboration of this Deliverable, we have considered the discussions that took place in the PRO-GRACE community on the purpose of the LR-NI and LR-POP-NI, particularly regarding the conservation of genetic resources, the scientific literature on the subject as well as the "Resource book for preparation of national conservation plans for crop wild relatives and landraces" (Maxted et al., 2013). This latter publication includes all aspects related to the conservation planning, prioritization of landraces conservation, examples and policy drivers of agrobiodiversity conservation. Discussion with all partners involved in the writing of the Deliverable took place and a final consensus was adopted. As for CWR, we performed three activities, a) Preparing a blueprint with guidelines that facilitate the development of LR National Inventories in countries lacking them or which need an update or improvement, b) Updating the current state of LR-NI and LR-POP-NI Inventories in European countries based on published information and a questionnaire sent to the relevant actors of European countries and their compliance with the present blueprint guidelines, and c) Providing recommendations for the future GRACE-RI for the construction of the LR national inventories.

4.3. Results

4.3.1. Blueprint for the development of the LR-NI and LR-POP-NI

The LR National Inventory (LR-NI) is the prioritized checklist of landraces of a country (Maxted et al., 2013). The LR-NI is particularly important for the conservation of genetic resources, as it provides a comprehensive overview of landraces in a country and helps identify which ones require attention for *ex situ* conservation. Ensuring that the landraces in the LR-NI are included in genebanks or other *ex situ* facilities is crucial for safeguarding them against potential loss. While the LR-NI builds on the LR checklist, it contains additional information, such as cultivation and management practices, that can be valuable for a range of purposes, including conservation planning, research, and policy-making.

In this way, whereas the LR-NI is the prioritized checklist of the different LR that occur in the country, the LR Populations National Inventory (LR-POP-NI) includes individual populations of the LR maintained by each farmer in the plus associated information (ecogeographic, cultivation, characterisation, evaluation and farmer-based knowledge data) for (Maxted et al., 2013; FAO, 2015). In practice, there is commonly one entry for each LR name in the LR-NI, whereas in the LR-POP-NI each LR name can have multiple accessions as different farmers/maintainers can grow the same LR. For the purposes of conservation of genetic resources, it is agreed that the LR-NI is the most relevant. However, the LR-POP-NI may provide additional information on other aspects, as discussed in Section 4.1.

There is in practice often use of the same LR name for either genetically similar or distinct populations. For example, on the three main Scottish archipelagos (Shetland, Orkney and Hebrides), on each island chain populations of LR known as 'bere' barley are cultivated by multiple maintainers, it being a long established LR grown for human and animal feed (and to a lesser extent whisky production). Although there are similarities between all 'bere' LR populations, there are thought to be genetic distinctions

between the LR populations found on each archipelago – physical distance and terrestrial isolation being a barrier to introgression. As a result, the UK is thought to have three distinct 'bere' barley LR populations that are recorded in the UK LR-POP-NI, but only one LR in the LR-NI.

In most cases the safest and most cost-efficient way of conserving LR and making them available for use is to collect them and include them in a genebank collection. The LR-NI can be used to check in how far this has been accomplished, and which LR still need attention in terms of conservation and access. For some specific crops, where *ex situ* conservation might not be the most appropriate methodology for conservation and providing access, such as fruit trees, the LR-POP-NI could be the tool for identifying the occurrence of specific genotypes on farm, and possibly also providing access.

For the landraces included in the LR-NI, the LR-POP-NI results from the collation of taxonomic, ecogeographic, characterisation and evaluation data as well as farmer knowledge on management and conservation of each LR grown (Maxted et al., 2013). The knowledge obtained from the LR-POP-NI complements the one from the LR-NI and:

i. help to characterise and evaluate the LR diversity present in a country;

ii. assist authorities in planning and implementing policies and strategies for conservation and use of agro-biodiversity, which is essential in underpinning national food security; and

iii. allow the accessibility and exchange of information within existing PGR networks, as well as other researchers and research stations.

The process of collating geographic, agroecological, taxonomic and genetic data and using it to help plan conservation is called an 'ecogeographic survey'. It is formally defined as "an ecological, geographical, taxonomic and genetic information gathering and synthesis process, where the results are predictive and can be used to assist in the formulation of collection and conservation priorities" (Castañeda-Álvarez et al., 2011). The LR characterisation and evaluation data along with farmer knowledge on management complements the information more regularly collated as part of an ecogeographic survey and should be integrated with it when undertaking an ecogeographic survey of LR diversity (Guarino et al., 2005).

The ecogeographic survey methodology comprises three main phases: **project design**, **data collection and analysis**, and the **ecogeographic products** (Maxted et al., 2013). The LR conservation project design includes: (1) Identification of taxon or crop expert, (2) Selection of target taxon/crop taxonomy, and (3) Design and creation of the database structure. The data collection and analysis include: (4) Survey of passport, management, site and environment, and existing characterization and evaluation data, and collation of data into database, (5) Data verification, and (6) Data analysis. The ecogeographic products include: (7) LR inventory (which contains raw data on existing LR grown by each farmer together with the ecogeographic, characterisation, evaluation and farmer knowledge on its management and conservation), (8) Conspectus (that summarizes all data for each LR), and (9) Report (which interprets the data obtained). However, these two later points are not required for the development of the LR-POP-NI.

Methodology for the LR ecogeographic survey (Maxted et al., 2013; FAO, 2015):

The different steps in the development of the LR-POP-NI by using the ecogeographic survey are the following:

(1) <u>Identification of taxon/crop expertise</u>

- Farmers (often female): generally, play a key role in the management of many crops, should also be identified and contacted;

- Crop experts or botanists: can give advice on the location of important plant collections and suggest relevant grey literature, monographs, crop databases and other works;
- Extension agents, breeders, agronomists with experience in the crop gene pool, and other users of PGR working in national agricultural research centres: they are usually familiarised with documenting, interpreting, and using genetic diversity at the infra-specific level, as well as identifying gaps in existing collections, regions known or suspected to harbour interesting LR germplasm, and what traits to look for and pay particular attention to when in the field;
- Global and regional crop-specific networks, NGOs, governmental or international agencies working in rural development projects in the target region (Guarino et al., 2005);
- Social scientists working in the target region: can provide information on farming systems and crops.

(2) Selection of target taxon/crop taxonomy. The generally accepted taxonomic classification can be determined with the help of:

- Target taxon experts;
- National, regional or global Floras;
- Crop monographs;
- Recent crop studies;
- Crop databases, etc.

(3) Design and creation of the ecogeographic, characterisation, evaluation and farmer-based knowledge database structure.

- A careful reflection on the types of data to be included in the database should precede its creation. The collecting form (when surveying farmers for LR information) should be strongly linked to this database meaning that all fields in the collecting form are included in the database structure.
- Types of data include: passport data (generally include accession descriptors, collecting descriptors, nomenclatural data, socio-economic data, and farmer-based knowledge descriptors), site and environment data (describe environmental and site-specific parameters which can be associated with characterization and evaluation trials, characterisation data (related to the highly heritable traits that are expressed in all environments), and evaluation data (associated with the traits that are susceptible to environmental differences).
- Data descriptors and data standards that should be compatible with the central databases, such as EURISCO, that will be searchable for users.
- The national database software package for the LR-NI should be both user-friendly and able to accommodate the complexity of a database of this kind.
- The data format should be standardised.
- The ecogeographic, characterisation, evaluation and farmer-based knowledge database may be directly linked to the LR national inventory through a unique identifier number (LR name or LR ID); alternatively, they can be two independent products.

(4) Survey and collation of passport, management, site and environment of existing characterisation and evaluation data into the database. Sources of data are likely to include:

- Gene banks: e.g., Genesys, EURISCO, local germplasm banks and collection, etc.

- Printed or online catalogues and lists of local varieties at the national and/or regional level.
- List of conservation varieties.
- Scientific and 'grey' literature: crop monographs, recent crop studies, crop databases, gazetteers, scientific papers, soil, vegetation and climate maps, atlases, etc., available both in conventional printed paper and in digital files.
- Crop experts.
- Farmers and maintainers of LR: engaging farmers/LR maintainers in conservation, even before starting the inventory, is important to facilitate the exchange of information; while collecting farmers' knowledge on the management of LR, material can be collected (e.g. whole plants or seeds) together with passport and other relevant associated data.
- Databases of *in situ* maintained landraces, such as the one developed in the Farmers' Pride project (https://www.ecpgr.org/in-situ-landraces-best-practice-evidence-based-database).
- Seed exchange networks.

(5) Ecogeographic data verification

- Check for duplicates. Namely regarding the gene bank and herbaria survey, those records with the exact same data should be highlighted as duplicates so to avoid a false impression of the intensity of LR collection.
- Dealing with synonymy and homonymy, when different names are used for the same landrace, or the same name for different landraces.
- Check for spelling errors and standardise the data format.
- Georeference all the entries, if possible. While undertaking the farmers' survey, LR populations should be georeferenced *in situ*; data from other sources should also be georeferenced by using (on-line) gazetteers, maps, Google Earth, etc.
- Assign a level of data accuracy; different levels of data accuracy could be assigned to each record.
- Check for outlier locations. Distribution maps should be created (with a GIS, if possible) to look for outlier collection sites. All individual records should then be corrected for these mistakes or deleted if correction is not possible.

(6) Analysis of collated data. It may include:

- The distribution of LR;
- The distribution of specific character states within LR;
- The variation displayed by the LR regarding characterization and evaluation traits;
- Analysis of major agronomic problems faced by the crop (pest, diseases, drought, etc.);
- The mapping and detection of ecogeographic patterns (e.g. phenology of the crop in different areas, whether a particular LR occurs on a particular soil type, or whether the frequency of a character state changes along an environmental gradient);
- The identification of sites for on-farm conservation;
- Target LR with traits of interest for plant breeders or to complement existing *ex situ* conservation.

(7 to 9) Data synthesis. The products that synthesise the data collated include the LR-NI (which contains raw data; step 7). The conspectus (that summarizes all data collated for each LR; step 8) and the report (which interprets the data obtained; step 9) complement the LR-NI, although these two latter are not required for having a complete LR-POP-NI.

A flowchart of the different steps to develop the LR-NI is presented in Figure 19.

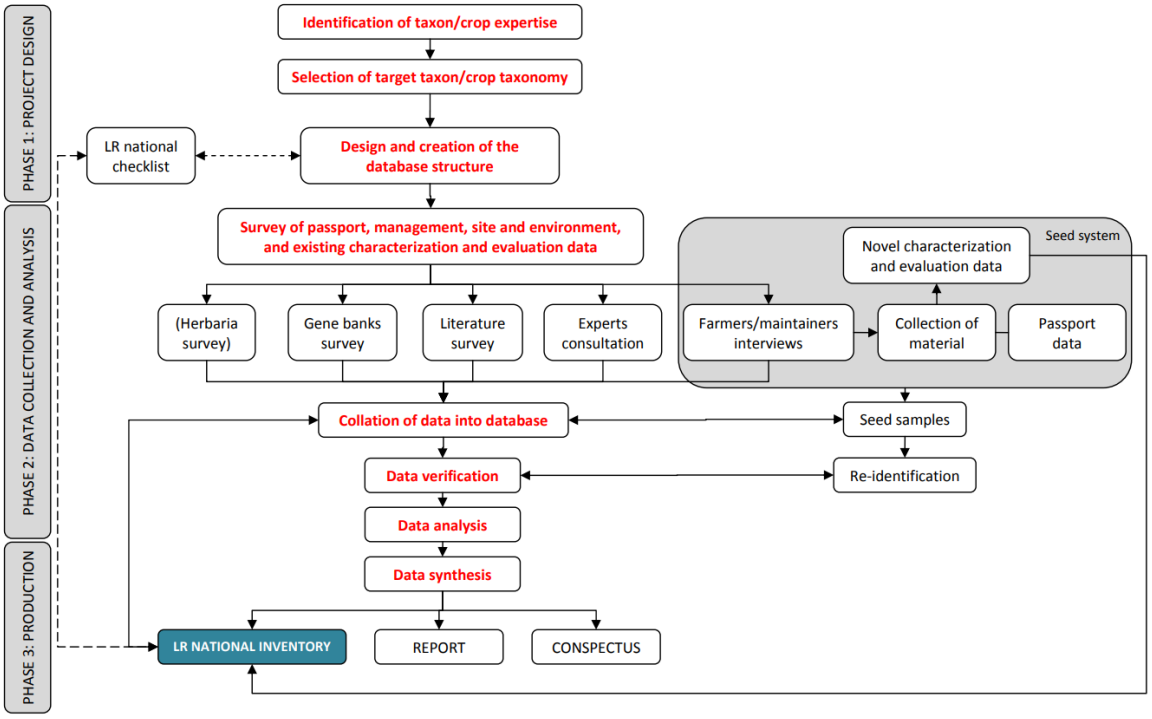


Figure 19. Flowchart of the ecogeographic approach to develop a LR National Inventories (taken from Maxted et al., 2013).

One exemplification of the development of the LR-POP-NI is the one by Almeida et al. (2023) on the development of the national inventory of LR for Portugal, where the LR diversity was identified from different national sources, including published and grey literature, relevant websites and through field surveys (using a questionnaire to farmers). Several national catalogues, as well as the varieties registered as conservation or traditional varieties were included. Filtering of data was performed in conjunction with the national germplasm bank (Banco Português de Germoplasma Vegetal) by assuming that LR with the same name and same collection site were the same LR populations, where LR with different names or same name but different 'remote' collection sites were assumed to be different LR populations. This resulted in the creation of the Portuguese LR-POP-NI, which contains 14,813 LR that correspond to a LR-NI of 7,492 unique LR grouped in 36 families, 88 genera, 130 taxa and 123 crops. In an approach considering only LR that are still cultivated on-farm, Negri and Torricelli (2005) identified that in Italy at the time there were 2,365 LR belonging to 329 crops cultivated.

According to the ECPGR Concept for on-farm conservation of plant genetic resources for food and agriculture (ECPRG, 2017), the European national inventories of on-farm diversity should respond to the following objectives, scopes and methods:

Objectives of the LR-POP-NI:

a) Inventory the on-farm diversity, within the scope defined below, to obtain snapshots of the situation at given intervals (e.g., every five years).

b) Identify valuable on-farm genetic resources that require *ex situ* complementary measures.

c) Establish a knowledge base of guidelines and case studies for the assessment and monitoring of genetic erosion.

d) Identify material defined by the respective National Focal Point as 'PGRFA naturally adapted to the local and regional conditions and under threat of genetic erosion', thereby eligible to be registered as 'Conservation varieties'. Similarly, identify material eligible to be considered for the other legal categories of 'Amateur varieties', 'Populations' and 'Mixtures'.

e) Identify material that may be included in programmes or projects enhancing their use in meeting changing market demands.

f) Populate the knowledge base of case studies for adding value to and promoting LR cultivation, and best practice conservation (see https://www.ecpgr.org/in-situ-landraces-best-practice-evidence-based-database).

g) Contribute to documenting European on-farm genetic resources in compliance with the Second GPA, the ITPGRFA and the EU 2020 Biodiversity Strategy and facilitating interoperability among different information systems.

h) Identify hotspots of on-farm diversity to support the creation of European agro-diversity sites.

i) Inform potential users about terms and conditions of access to on-farm managed genetic resources.

Also, given the recent publication of a comprehensive, objective methodology for LR threat assessment (Almeida et al., 2024), we consider that an additional objective should be added, that being the threat assessment of national LR to aid the prioritization of conservation actions.

Scope of the LR-POP-NI:

a) Existing endangered genetic resources, with a focus on LR and obsolete cultivars, as well as conservation varieties and other legal categories.

b) Genetic resources that are continuously grown on sites or areas that can be precisely geographically positioned and identified as the sites of adaptation or adoption, as well as genetic resources corresponding to legal categories.

c) Indicators of threat, genetic erosion and extinction.

d) Local knowledge associated with the given genetic resources, which is useful for its unique identification, maintenance and value adding.

e) Adding value to LR products as a means of promoting LR cultivation.

f) Institutions or individuals that can be either formally or informally identified as the maintainers of a given genetic resource.

g) Terms and conditions of access for direct use, breeding, research and education.

Methods for developing the LR-POP-NI:

a) A National On-farm Inventory Focal Point should be nominated through their ECPGR National Coordinator, with responsibility to manage the LR-POP-NI and make data available for incorporating into EURISCO according to an agreed data exchange format.

b) Use of a list of common descriptors among different countries should be agreed by the Focal Points, including a mandatory minimum set for data exchange. Descriptors developed by PGR

Secure (Negri et al. 2012) can be the starting basis to reach an agreement (Deliverable D2.3). Specific descriptors should be agreed to inventory the material according to both biological and legal categories, as well as to cover the scope of the Inventory, as indicated above. Descriptors of genetic erosion should also be included.

c) Each entry in the database should include the accession name of the given genetic resource and the corresponding cultivation site at a given time. A reference related to the grower(s) is also desirable.

d) The data should be made available to create the European On-farm Inventory, which should be completed as a concerted effort at given intervals (e.g. five years) under the coordination of an ECPGR or EU body.

e) As the Inventory also serves to monitor genetic erosion, each snapshot of genetic diversity data deployed on-farm should be archived to allow comparisons at time intervals.

f) Coordination with the activities of the FAO-Treaty Global Information System should be pursued.

g) Links and collaboration with inventories and databases maintained by seed savers' associations or farmers' associations involved in agrobiodiversity conservation should be sought.

h) Possible synergies and complementarity between the Inventory and EURISCO should be explored.

4.3.2. Types of data to include in a LR-POP-NI

The types of data to that ideally should be included in the LR-POP-NI should encompass those indicated below (Negri et al., 2012; Maxted et al., 2013; FAO, 2015):

- Crop maintainer details: name, address, contact details, year of birth, gender, family structure, education, main source of income, owned or rented land, etc. These data are particularly sensitive taking into account the Data Protection Laws and Regulations and should be managed accordingly and in some countries it may not be practicable to take personal data, which may need to be anonymized.
- Crop maintainer data: how long maintainer will continue cultivation/conservation, whether someone (from younger generations, other relatives, neighbour, etc.) will continue to cultivate the LR.
- Site geographic data: location, coordinates, size of farm, site environmental data: cropping site type, altitude, landform, aspect, slope, soil texture, soil drainage, soil pH, temperature, rainfall.
- Crop nomenclature data: genus, species, authority, infra-specific epithet, infra-specific epithet authority, taxonomic rank, crop cultivar name, synonyms, vernacular names.
- Socio-economic data: crop purpose and the contribution it makes to adding value to grower income and nutrition, usage (e.g., description of main usage, secondary usage, home consumption or marketed, marketing, current and past values, member of grower or marketing cooperative), maintainer-perceived value, type, source, country of origin, history of cultivation, crop qualities, local or national maintainer incentives.
- Crop cultivation and management data: area currently sown, history of area sown, sowing date, crop system (arable or mixed farming system), harvesting date, irrigation, fertiliser, fungicide and pesticide types, organic status, crop resistance as noted by maintainer,

propagation method, selection criteria for propagation, variation displayed by the LR with regard to characterization and evaluation traits, major agronomic problems faced by the crop (pest, diseases, drought, etc.), relationship to other landraces.

- Relative uniqueness of LR (i.e. grown on single farm or more widespread, genetic distinction).
- Crop conservation status: whether the crop is stored *ex situ*, method of selection of seed saved method of seed storage, maintainer exchange frequency, whether it is adequately managed *in situ*, threat of genetic erosion (e.g. perverse incentives, lack of sustainability of farming system, lack of market), length of seed saving, etc.
- Threat: according to the proposed LR threat criteria by Almeida et al. (2024), which includes four criteria (LR population range, LR population trend, market farmer characteristics, and LR context), each of which is divided in a total of 24 subcriteria for which a threat assessment score (1 to 5) is assigned. Based on the percentage values of subcriteria that have a Threat Assessment Score a LR threat category can be assigned.
- Characterisation data: e.g. leaf shape, flower colour, plant habit, seed colour, chromosome number, etc.
- Evaluation data: plant height, days to maturity, protein percentage, disease resistance yield, maintainer's comparison with modern varieties, product processing details etc.
- Photographs.

These data should be included in the descriptors for constructing the LR-POP-NI. These descriptors are discussed and a proposal is made in deliverable D2.3. Also, some of this information may have implications for data protection and so may not be included in an on-line version of the database to protect the privacy of the data providers, but it should not be anonymised so that individual collections may be traced if desirable traits are located.

4.4. Update of the current state of National Inventories of LR in European countries

Landraces National Inventories aim to monitor the extent of LR occurrence and diversity in the country and offer the means to identify the most suitable LR and areas for active conservation, and so promote LR diversity maintenance. To evaluate the status and progress in the development of National Inventories for Landraces (LR-NI and LR-POP-NI), a questionnaire was prepared to collate information on these aspects (Annex 4). The questionnaire contained 16 questions and was distributed among the ECPGR On-farm Conservation Working Group members (https://www.ecpgr.org/contacts-in-ecpgr/ecpgr-contacts/onfarm-conservation-and-management), as well as with a relevant contact from Iceland by November 2024 and responses were received from 30 countries within 5 months.

A summary of the results obtained through this questionnaire is presented below, providing an overview of the current status of national inventories for Landraces (LR-NI) and population-level inventories (LR-POP-NI) across Europe. The full compilation of responses received from participating countries can be found in Annex 5. Where appropriate, the results are compared with those obtained from the CWR questionnaire (Section 3.4), offering insights into common trends and contrasting challenges in the development of national inventories for different components of plant genetic resources.

Figure 20 presents the stages reached by countries in the development of their Landrace National Conservation and Use Strategy Plans, following a seven-step framework. The results show that while many countries have begun the process, relatively few have advanced beyond the initial stages. Specifically, 22 countries reported having at least partially developed a national LR checklist (Step 1),

making it the most commonly completed component. This is followed by 15 countries that have undertaken LR prioritization (Step 2), and 16 countries that report having at least partially developed a national LR inventory (LR-NI) (Step 3). From Step 4 onward, the numbers drop more sharply: 11 countries have identified threats to LR diversity, 9 have carried out some form of genetic analysis, 6 have conducted a gap analysis, and only 6 countries report progress in developing a national LR management plan.

When compared to the equivalent data for Crop Wild Relatives (Q1 in Section 3.4), the overall pattern is similar: most countries have made progress on foundational steps such as listing and prioritization, while implementation-oriented steps—particularly gap analysis and management planning—remain less common. However, the number of countries reporting full or partial achievement is slightly lower for landraces at every stage, suggesting that LR conservation strategies are at an earlier stage of development overall.

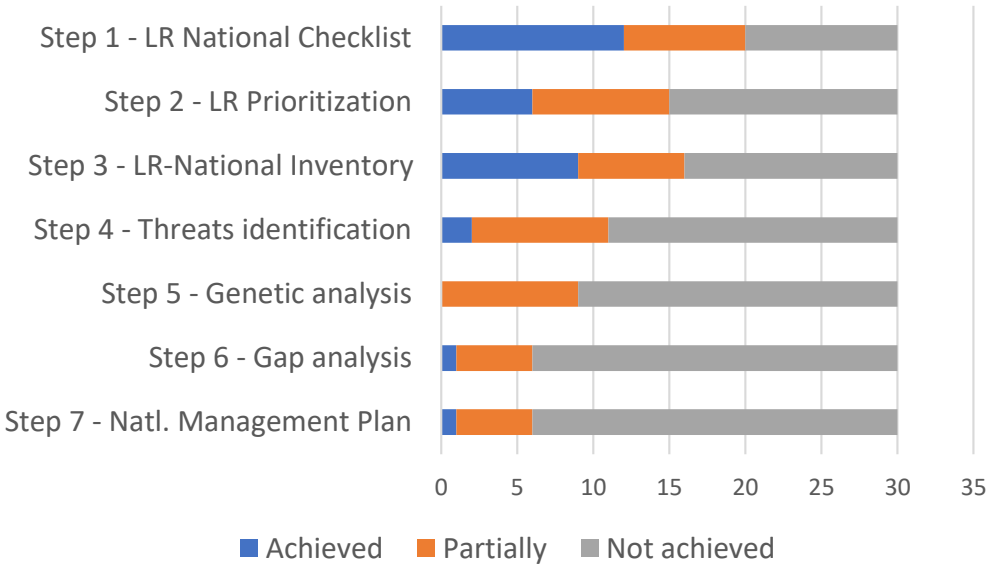


Figure 20. Stages of development of LR National Conservation and Use Strategy Plan reached by the countries that responded to the survey (Q1).

Figure 21 presents the stages of preparation reached by countries in developing their Landrace National Inventories (LR-NI) and Landrace Population National Inventories (LR-POP-NI). As of the time of the survey, 11 countries had not yet started work on their LR-NI, while 10 reported that the inventory was in preparation. Only 2 countries had a first draft prepared, and 5 countries had reached the most advanced stage, with their inventories published and approved. For LR-POP-NI, the figures are lower overall, reflecting a later and more technically demanding stage of development. Specifically, 15 countries reported having not started their LR-POP-NI, while 12 had it in preparation, 1 country had a first draft prepared, and 2 countries reported having a published and approved population-level inventory.

These numbers mirror those observed in the CWR questionnaire. For instance, in the case of CWR-NI (Q2), most countries had already moved into advanced stages, but progress was more modest for the CWR-POP-NI (Q12), with a clear drop in countries reporting published or approved inventories. Similarly, for landraces, a clear divide is visible between taxonomic (LR-NI) and population-level (LR-POP-NI) inventory development: while many countries are actively compiling or finalizing their LR-NI, few have made comparable progress in documenting populations *in situ*. This reinforces the pattern seen with CWRs and highlights the need for greater support and capacity-building to advance

population-level documentation, especially considering the relevance of such data for on-farm conservation planning and the development of national networks of LR conservation sites.

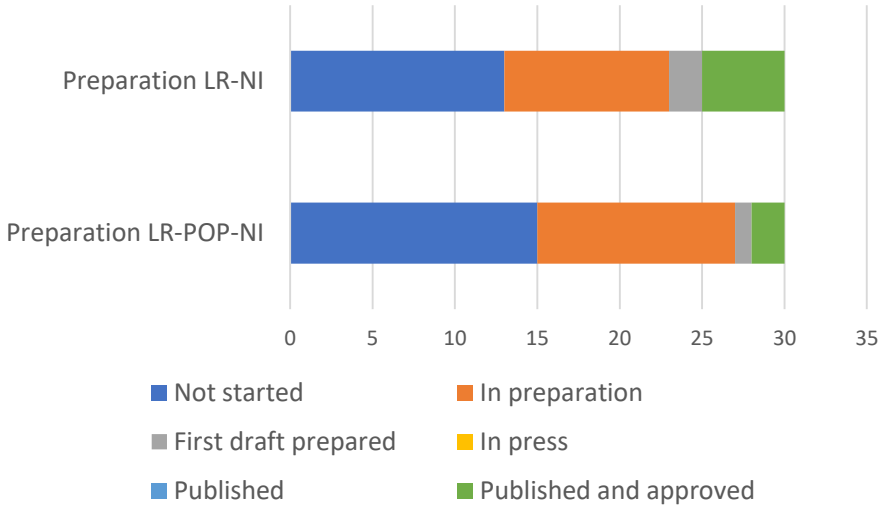


Figure 21. Stages of preparation of the LR-NI and LR-POP-NI reached by the countries that responded to the survey (Q2 & Q3).

Figure 22 shows the range of sources used by countries to compile their Landrace National Inventories (LR-NI) and Landrace Population Inventories (LR-POP-NI). The most commonly cited sources are farmers and maintainers of landraces (15 countries), followed closely by crop experts and national germplasm banks (also 15 countries each). These results highlight the essential role of local knowledge, practitioner expertise, and ex situ collections in building comprehensive landrace inventories. Other widely used sources include scientific and "grey" literature (14 countries), lists of conservation varieties (13), and farming or gardening NGOs (13), all of which underscore the importance of integrating formal and informal knowledge systems. In contrast, more structured or institutional databases were used less frequently. Only 6 countries reported using EURISCO, and just 1 country mentioned using Genesys. Databases of in situ maintained landraces were used by 4 countries, and seed exchange networks by 5, suggesting that digitised and networked systems are still underutilised in the context of landraces, possibly due to fragmented or unpublished datasets.

While partially comparable to the sources reported in CWR Question 13, where biodiversity databases, public herbaria, and field surveys were more prominent, the LR results reflect the on-farm, community-rooted nature of landraces. This reliance on local actors and community knowledge, combined with the lower use of centralised databases, reinforces the need to build bridges between local sources and national data platforms and to improve data flows between actors at different levels. It also points to an opportunity for the GRACE-RI to support the development and integration of in situ and community-based datasets into broader European infrastructures like EURISCO.

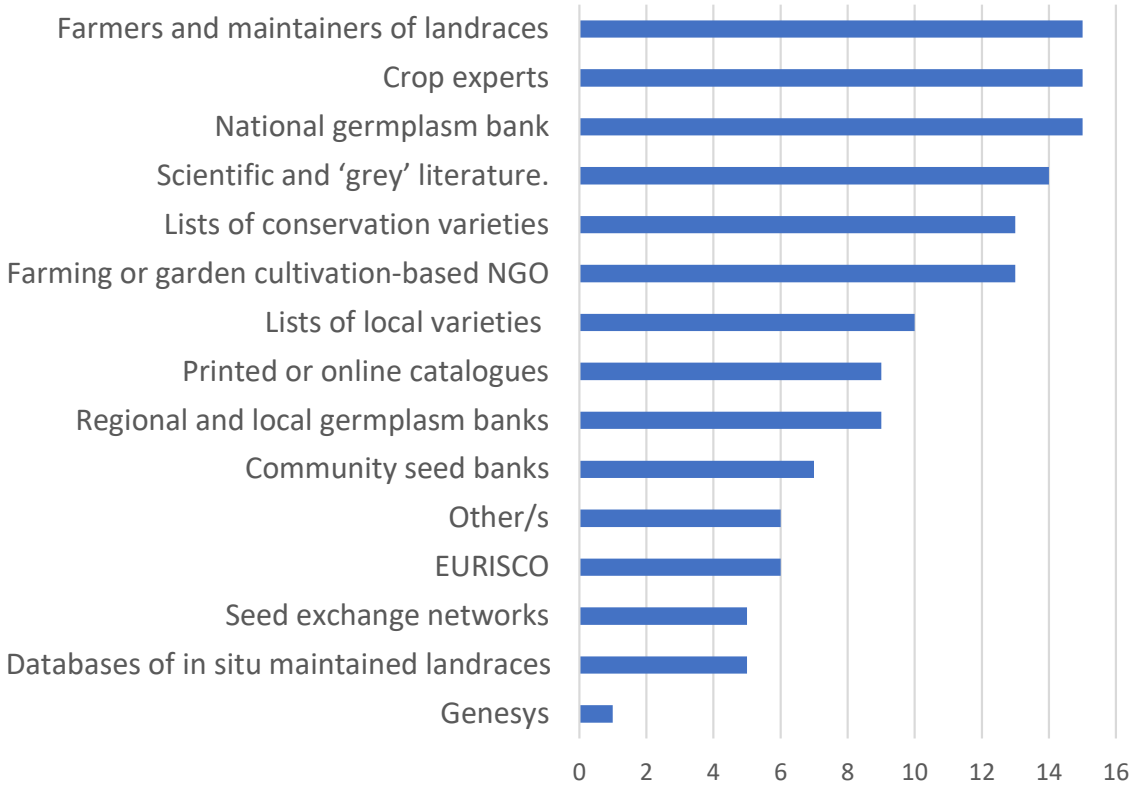


Figure 22. Sources used to create the LR-NI and LR-POP-NI by the countries that responded to the survey (Q4).

Figure 23 summarizes the approaches taken by countries in preparing their Landrace National Inventories (LR-NI) and Landrace Population Inventories (LR-POP-NI), with a focus on adherence to guidelines, methodologies used, crop coverage, and landrace origin criteria. With respect to the use of international guidelines (Q5), only 6 countries reported having followed the recommendations provided by Maxted et al. (2013) or FAO (2015), while 4 applied them partially, and 9 did not apply them at all. While only partially comparable to Q18 and Q19 of the CWR questionnaire, which addressed the use of different tools and principles, this result similarly reflects the limited uptake of existing frameworks—often due to lack of awareness, resources, or alignment with national processes already underway. In terms of methodology (Q6), the majority of countries (11) used an ecogeographic survey approach to develop their inventories, integrating spatial and environmental criteria to document and prioritize landraces. A smaller group (3 countries) applied other approaches, such as national legal mandates or expert-based field assessments. Regarding crop coverage (Q7), countries are split almost evenly: 11 reported including all crops, while 12 focus on a defined subset, typically those of high relevance for local agriculture or cultural heritage. This reflects a pragmatic approach to inventory building, often driven by the availability of data or national conservation priorities. Finally, in terms of occurrence status (Q8), 9 countries reported including all landraces present in the country, while 13 restricted their inventories to autochthonous landraces, i.e., those with a strong local adaptation or historical presence.

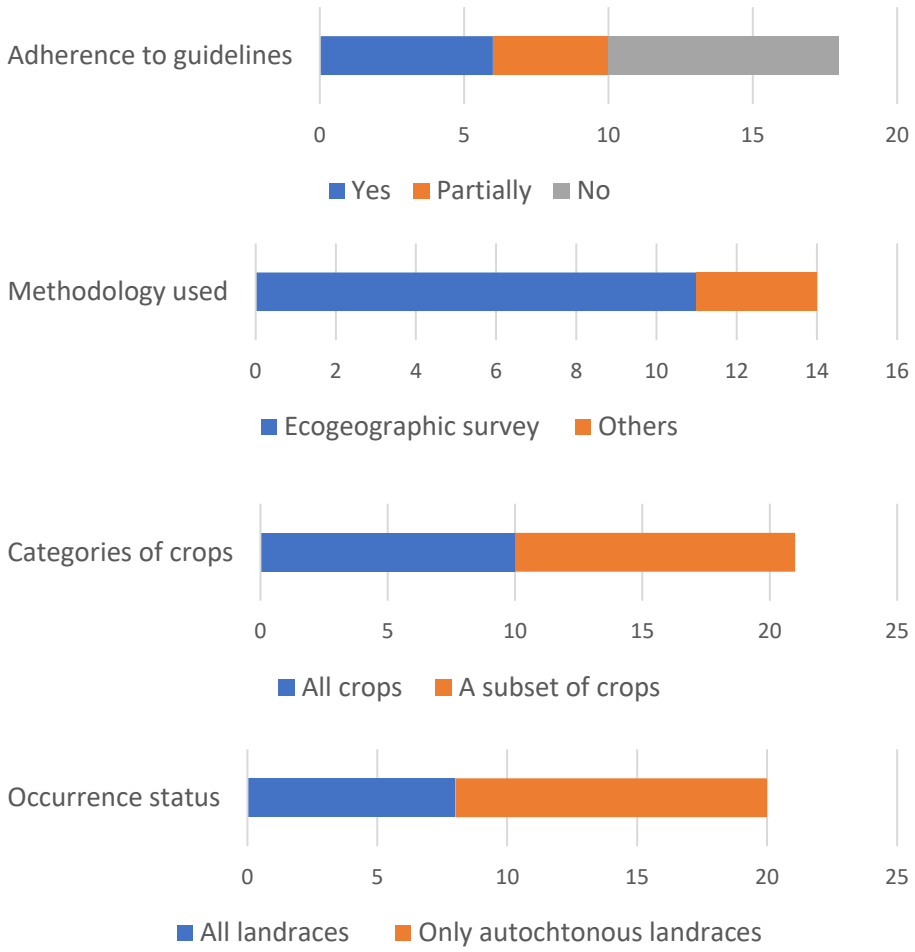


Figure 23. Adherence to the guidelines for preparing the national plans for conserving landraces provided by Maxted et al. (2013) and/or FAO (2015) in preparing the LR-NI and LR-POP-NI (Q5), methodology used for developing the LR-NI and LR-POP-NI (Q6), categories of crops included in the LR-NC and LR-NI (Q7), and occurrence status (autochthony) of the landraces included in the LR-NI (Q8) by the countries that responded to the survey.

Table 3 presents the number of crops and landraces included in the LR-NI and the number of landrace populations recorded in the LR-POP-NI, as reported by the responding countries. The figures vary widely, reflecting significant differences in national approaches, inventory maturity, crop diversity, and levels of data availability. For instance, Portugal reports the most comprehensive dataset, with 123 crops, 7,492 landraces, and 14,814 landrace populations, based on the integration of multiple sources and a long-standing commitment to landrace conservation. Similarly, Italy lists around 100 crops, 2,250 landraces, and approximately 5,400 populations. Not surprisingly, these are the only two countries that have published and approved their LR-POP-NI. Following them is Switzerland, includes 1,949 landraces and 7,814 populations, although the number of crops is not specified. In contrast, other countries report more limited datasets. For example, in some countries where the inventories have not been finished yet the numbers are much smaller, as they generally include only a limited number of crops and/or populations, in this way, Norway includes 25 crops and 70 landraces, while Ukraine reports 12 crops, 24 landraces, and 31 populations. In some cases, such as Lithuania, data is provided at the genus level, suggesting inventories are still under construction.

As with the equivalent CWR tables (Q9 and Q15), these figures should be interpreted with caution. In many cases, the numbers are partial, preliminary, or compiled using different methodologies and inclusion criteria. The data also show that even among countries with well-developed LR-NIs,

population-level documentation (LR-POP-NI) is often incomplete or entirely absent, highlighting a consistent bottleneck observed across both LR and CWR inventory development. Notably, only seven countries reported figures for LR-POP-NI, and only a few of these included detailed records of population-level data verified through field work or cross-referenced with *in situ* conservation actions. The sharp contrasts in reporting scale—from countries listing dozens of crops and landraces to those still limited to small, curated datasets—reiterate the need for harmonised approaches, shared methodological tools, and targeted support for countries in earlier stages of inventory development. The data also confirm that the documentation of landrace populations remains a major gap, requiring additional investment, institutional coordination, and farmer engagement to become an operational reality.

Table 3. Number of crops and landraces included in the LR-NI and number of landrace populations included in the LR-POP-NI by the countries that responded to the survey (Q9).

Country	Number of crops included in the LR-NI	Number of landraces included in the LR-NI	Number of landrace populations included in the LR-POP-NI
Belgium	6	222	117
Finland	45	≈4000	≈300
Germany	≈150	≈2500	
Ireland	72	207	
Israel	50		3200
Italy	≈100	≈2250	≈5400
Lithuania	10 genera		
Montenegro	30	1251	108
Netherlands	63	6637	
Norway	25	70	
Portugal	123	7492	14814
Switzerland		1949	7814
United Kingdom	24	54	48
Ukraine	12	24	31

Figure 24 presents the results of Questions 10 and 11, which address key aspects of data quality and standardization in the development of Landrace National Inventories. Regarding Q10, which asked whether the *ex situ* conservation of landraces included in the LR-NI had been verified, 14 countries responded yes, while 2 reported partial verification, and 2 indicated that no verification had been conducted. These results suggest that a large proportion of countries are actively linking *in situ* and *ex situ* conservation efforts of landraces, ensuring that the landraces listed in their inventories are also preserved in genebanks or equivalent facilities. Nevertheless, the presence of countries with incomplete or absent verification highlights an area requiring further support, particularly for countries still developing their inventories or facing institutional and financial constraints. For Q11, which asked about the use of recommended descriptors for documenting landraces on-farm (e.g., as proposed by Negri et al., 2012, or Weise et al., 2020), responses were more mixed. Six countries reported using these descriptors, 5 applied them partially, while 7 reported not using them at all. The reasons for non-use, as reported in the qualitative data, ranged from lack of awareness and perceived complexity to issues related to data protection or the age of national programs that predated these recommendations. While this question is only partially comparable to Q19 in the CWR section (focused on EURISCO principles), both reflect a broader pattern: standardized documentation tools are not yet

universally adopted, and implementation varies considerably between countries. Promoting wider awareness and simplifying integration into national workflows could significantly improve data quality and interoperability across inventories.

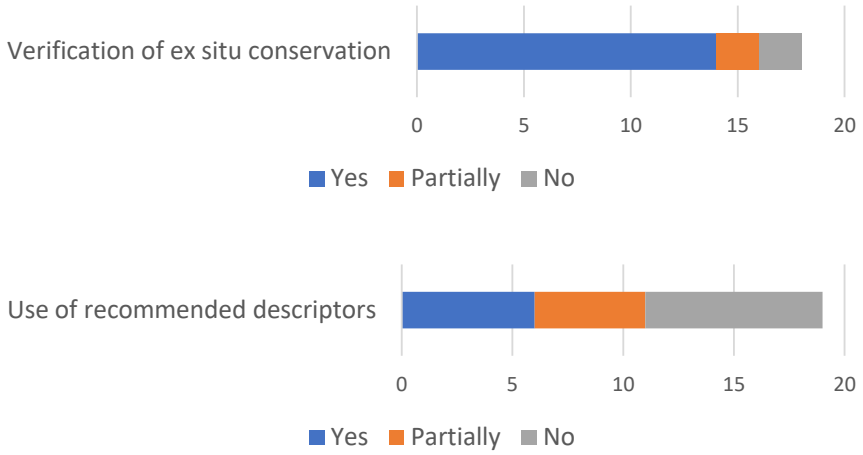


Figure 24. Verification of the *ex situ* conservation of landraces included in the LR-NI (Q10), and use of the descriptors recommended for on-farm landrace data published by Negri et al. (2012) or by Weise et al. (2020) in the preparation of the LR-NI and, if applicable, the LR-POP-NI (Q11), as reported by the countries that responded to the survey.

Figure 25 presents the types of additional data included in Landrace National Inventories (LR-NI) beyond basic taxonomic and occurrence information. The most commonly included descriptors are ex situ and in situ conservation status and vernacular names, each reported by 16 countries, followed closely by cultivation details and synonyms (15 and 14 countries, respectively). These fields reflect the strong focus on practical use and local knowledge in LR documentation. Also widely included are images of different parts of the plant, tolerances to pests and diseases, ethnobotanical data, and type of cultivation, all cited by 10 or more countries, indicating that many inventories aim to capture the traditional and adaptive significance of landraces. Less frequently included, but still relevant, are more specialized descriptors such as tolerances to abiotic stresses, reproductive system, and economic value of the crop (each mentioned by 9–10 countries). Genetic data associated with the landrace was reported by 8 countries, while threat levels, economic value of the landrace, and reference genome availability were cited by fewer (5–7 countries). A small number of countries included added-value initiatives, genetic erosion indicators, or other customized descriptors.

Although only partially comparable to CWR Q10, which focused on associated data types for CWR taxa, the LR results reveal a broader integration of ethnobotanical, socioeconomic, and practical cultivation data, reflecting the on-farm, use-oriented nature of landraces. At the same time, the limited inclusion of genomic and threat-related information underscores the need for improved integration of conservation and breeding-relevant data, particularly for prioritizing and monitoring landraces under threat.

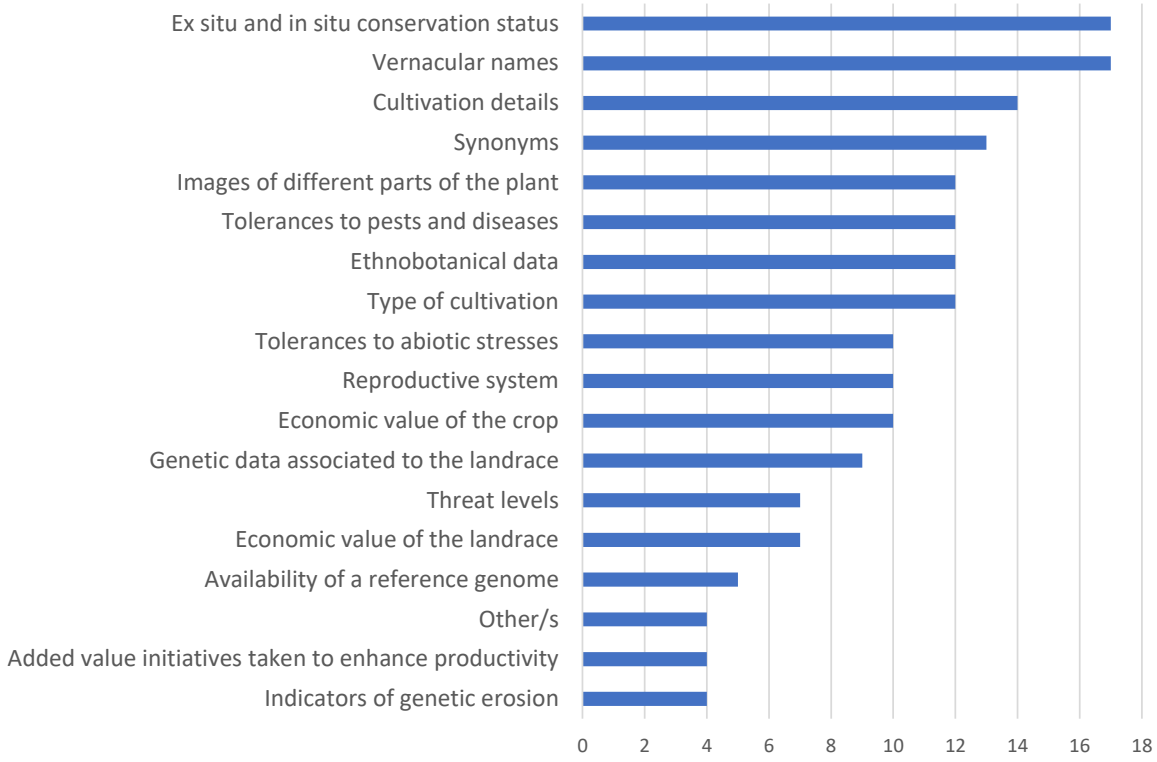


Figure 25. Other types of data are included in the LR-NI by the countries that responded to the survey (Q12).

Figure 26 presents the average impact scores (on a scale from 1 = very low to 5 = very high) for the main limitations encountered by countries in the development of their Landrace National Inventories (LR-NI). The most significant constraint reported was the lack of financial resources, with an average impact score close to 4.5, followed closely by the difficulty in identifying landraces grown on-farm (just above 4.0) and the lack of political interest at the national level (also slightly above 4.0). These were trailed by other systemic and institutional issues such as lack of political interest at the EU level, difficulty in producing the landrace checklist, and the absence of an EU regulation or agency for plant genetic resources, all averaging between 3.5 and 4.0. The lack of expertise received the lowest impact score, just below 3.0, but was still considered a moderate limitation in several countries. When compared to the limitations reported in CWR Q11, the overall trends are consistent: financial, institutional, and political barriers are regarded as the most serious constraints. Notably, the specific challenge of identifying landraces on-farm, which is unique to the LR context, received one of the highest impact scores. This highlights a critical issue for LR conservation: the reliance on informal, locally embedded knowledge and the general lack of systematic documentation of landraces in farmers' fields. These findings reinforce the urgent need for investment in field-based identification, the development of user-friendly documentation tools, and policy-level commitment at both national and European scales. Without these, efforts to build accurate and usable LR inventories will continue to face serious obstacles, particularly in countries where such work is just beginning.

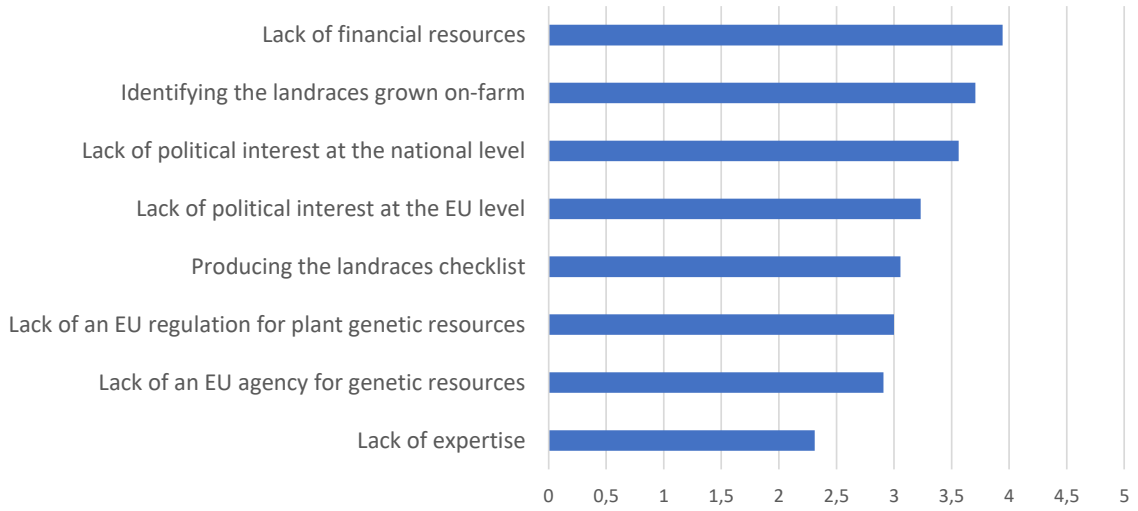


Figure 26. Average impact assessment of limitations encountered in the generation of the LR-NI as assessed by the countries that responded to the survey (1 = very low, …, 3 = medium, …, 5 = very high) (Q13).

Figure 27 highlights the types of actors involved in the development of the Landrace National Inventories (LR-NI) and, where applicable, the LR-POP-NI. The most frequently involved stakeholders are genebanks, cited by 19 countries, confirming their central institutional role in both documenting and conserving landrace diversity. Close behind are national authorities responsible for genetic resources policy and ECPGR On-farm Conservation Working Group representatives, each involved in 17 countries, suggesting a strong policy and technical coordination function in many national processes. Other key contributors include farmers (16 countries) and agronomists or technical staff from cooperatives and seed companies (14 countries), reinforcing the essential role of practitioners in identifying, managing, and documenting landraces *in situ*. Gardeners, often involved through NGOs, networks, or heritage programs, were reported by 13 countries, underscoring the community-based nature of landrace knowledge and conservation. These results are partially comparable to those from the CWR questionnaire (Q20), where similar categories of actors were reported. However, the LR responses show a relatively stronger presence of grassroots actors, such as farmers and gardeners, consistent with the on-farm and culturally embedded nature of landrace management. This suggests that landrace inventory development often relies on a wider and more decentralized base of actors, requiring well-designed participatory approaches and mechanisms for sustained stakeholder engagement.

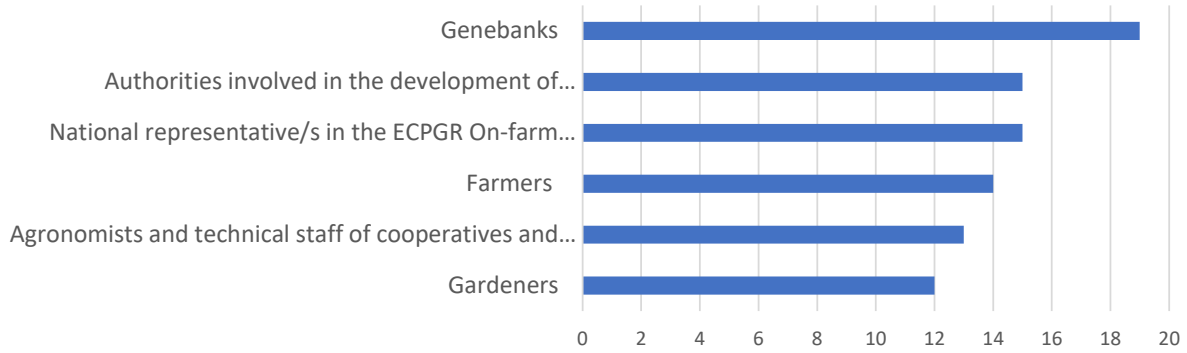


Figure 27. Actors involved in the development of the LR-NI and, if applicable, the LR-POP-NI, as reported by the countries that responded to the survey (Q14).

Figure 28 shows the average impact scores (1 = very low to 5 = very high) assigned by countries to potential contributions of the future Plant Genetic Resources Research Infrastructure (PGR-RI) in supporting the creation and updating of Landrace National Inventories (LR-NI) and Population Inventories (LR-POP-NI). The responses reflect uniformly high expectations across all categories. The highest-rated needs were financial support and organising workshops and seminars for knowledge exchange, both scoring an average of 4.2, followed closely by development of digital tools for data collection and management, promoting stakeholder collaboration, and facilitating data standardization and interoperability, all averaging above 4.0. Slightly lower, but still substantial, were training activities and technical expertise and consultancy (just above 3.9), and facilitating compatibility with EURISCO (3.8).

These findings are directly comparable to those from CWR Q21, which showed a nearly identical pattern. In both cases, countries emphasized the importance of multi-dimensional support, combining funding, training, digital infrastructure, and coordination. The slight differences in emphasis (for instance, the particularly high score for stakeholder engagement and tool development in the LR context) reflect the grassroots and community-based nature of landrace conservation, which often requires closer interaction with non-institutional actors.

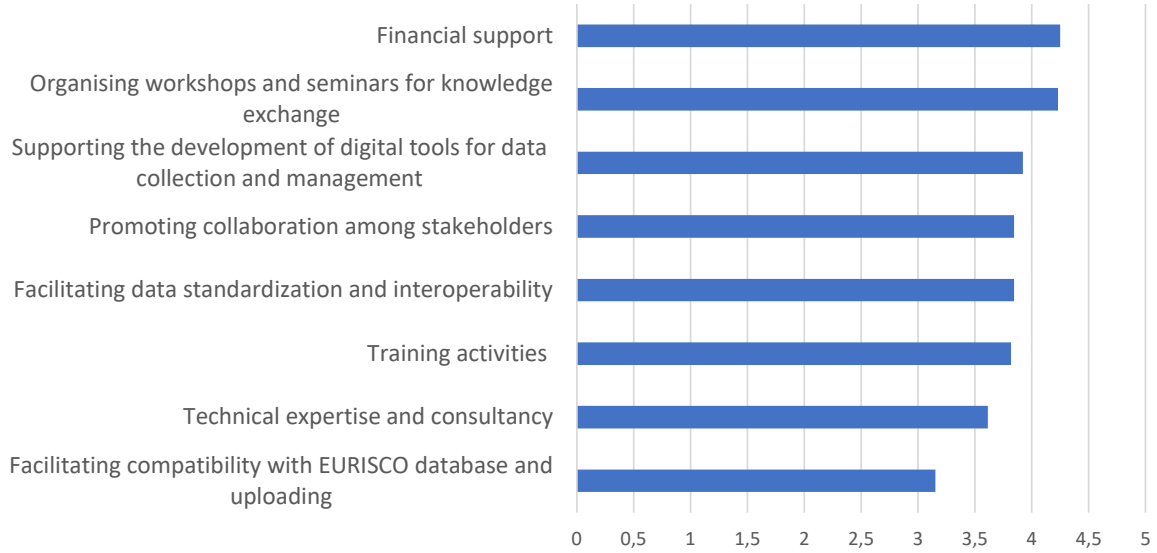


Figure 28. Expected impact of the future Plant Genetic Resources Research Infrastructure on the creation and updating of the CWR-NI and CWR-POP-NI, as assessed by the countries that responded to the survey (1 = very low, …, 3 = medium, …, 5 = very high) (Q15).

Taken together, the results presented above offer a detailed picture of the current state of development of Landrace National Inventories (LR-NI) and Landrace Population Inventories (LR-POP-NI) across Europe. While the data reveal an encouraging level of engagement from many countries, they also highlight substantial heterogeneity in approaches, methodologies, and institutional support. In this way, the analysis of responses from 30 countries shows that progress is being made in documenting landrace diversity at both the landrace and population levels, though this progress remains fragmented and often constrained by limited capacity and resources.

Compared to the situation observed for CWR, the development of landrace inventories appears less advanced and more uneven. Many countries have taken initial steps such as compiling regional or crop-specific lists, but comprehensive national checklists and prioritization strategies are less consistently in place. Only a few countries have published or approved LR-NIs, and even fewer have operational LR-POP-NIs. A distinctive challenge for landraces is the difficulty of identifying and documenting cultivated

diversity on-farm, which was rated as one of the highest-impact limitations in the survey. This reflects the inherently local, dynamic, and often undocumented nature of landrace cultivation, which relies heavily on farmer knowledge, informal seed systems, and cultural practices. The diversity of sources used to compile inventories, ranging from national genebanks and expert input to regional initiatives and farmer surveys, emphasizes this reality. Yet it also reveals the lack of harmonized documentation systems, the limited use of standardized descriptors, and the scarce integration with digital platforms such as EURISCO.

Methodological diversity is another hallmark of landrace inventory development. Only a subset of countries report using international guidelines or descriptor sets, and several noted in open comments that their inventories are still emerging from pilot studies or regional projects. Population-level inventories, where they exist, are often preliminary and rely on estimates or partial data, rather than systematic *in situ* documentation. Despite these challenges, the results demonstrate a high level of expectation placed on the future Plant Genetic Resources Research Infrastructure (GRACE-RI). Countries recognize the value of a coordinated European platform to provide financial support, training, data tools, and stakeholder facilitation. These needs are broadly similar to those identified for CWR, though the reliance on farmer and community knowledge in the case of landraces suggests a greater need for participatory frameworks and support for bottom-up inventory development.
In summary, while notable progress is being made in the development of LR-NIs and LR-POP-NIs, the process remains at an earlier and more diverse stage than for CWR. To bridge this gap, there is a pressing need for flexible, inclusive, and well-resourced strategies that can accommodate the decentralized nature of landrace cultivation while building toward nationally coherent and internationally compatible inventories. Strengthening linkages between farmer communities, technical institutions, and policy frameworks will be key to ensuring that landraces are not only documented, but actively conserved and used in the years to come.

4.5. Final considerations

The establishment and maintenance of LR National Inventories (LR-NI) and LR Populations National Inventories (LR-NI) are critical for the conservation and sustainable use of plant genetic resources. The LR-NI are essential for conservation of genetic resources, as they include the landraces from a country that are worth of conserving, irrespective of the number of farmers growing them, their distribution and cultivated acreage, and one major use of these national checklists is providing information on the e*x situ* safeguarding of these landraces. On the other side, the LR-POP-NI should be more dynamic, given the nature of the potentially rapid changes in cultivation of the landraces and therefore should be regularly updated to reflect changes in the on-farm conservation of landraces, changes in cultivation practices, land changes, abandonment of the farming activity by farmers conserving landraces, and the ongoing threats posed by environmental changes and socio-economic pressures. The LR-NI and LR-POP-NI must contain a minimum set of information compatible with EURISCO, so that agreed elements of the information of the LR-POP-NI is available to users (see Deliverable D2.3).

While National LR-NI of landraces are a first step to ensure the conservation of landraces that have not been collected so far for conservation *ex situ*, LR-POP-NIs are not merely static lists of landraces conserved on-farm but should be active tools that support genetic resources conservation strategies, facilitate research, and promote awareness among stakeholders. It is essential that these inventories remain flexible to incorporate new research findings, technological advancements, and emerging priorities in the realm of agrobiodiversity and genetic resources.

For effective conservation, LR-NI and LR-POP-NI should serve as foundational elements for developing comprehensive national strategies aimed at the long-term preservation of the genetic diversity of

landraces, including the *ex situ* back-up of those at higher risk of extinction. These strategies must ensure sustainable use and management of landraces, involving awareness-raising among landowners and managers, securing commitment and funding, and establishing robust monitoring systems for vulnerable varieties.

In addition to conservation, LR-POP-NI should act as catalysts for research and knowledge dissemination. They should support the development of publications, educational materials, and accessible online platforms that enhance public and scientific understanding of the importance of LR. The inventories should aim to be valuable resources for scientists, policymakers, and breeders, aiding in the utilization and conservation of genetic diversity.

Moreover, LR-POP-NI should help identify priority LR populations for active conservation efforts on-farm. This includes recognizing and addressing threats to the genetic diversity of landraces cultivated on-farm, promoting on-farm conservation practices, and integrating *ex situ* and *in situ* conservation approaches. Further, the on-farm maintenance of LR diversity can be significantly enhanced by applying various methods of adding value to the LR products, so raising the market and farmer value of LR compared to more 'commercial' varieties. By doing so, the LR-NI contribute significantly to food security, sustainable agriculture, and the preservation of cultural heritage associated with traditional farming systems.

Given the changing nature of on-farm cultivation of landraces, LR-POP-NI should undergo regular reviews and updates to ensure their effectiveness. This process involves periodic data collection from biodiversity databases, field surveys, and contributions from local farmers and other stakeholders. Recent availability of more targeted LR preservation schemes, such as the direct provision of financial support for LR maintainers in the UK (Raggi et al., 2020) will, as well as directly promoting LR maintenance, but will also facilitate data collation on LR cultivation to ensure the LR-NI remains current.

A collaborative approach is essential for maintaining the relevance and accuracy of the inventories. In this respect, the success in having useful and relevant National Inventories of Landraces depends on sustained commitment, coordination, and collaboration among various stakeholders, including governments, research institutions, non-governmental organizations, and local communities. By fostering such partnerships and continuously improving the inventories, we can ensure the conservation and sustainable use of landraces for future generations.

The results of the questionnaire underscore the urgent need to treat LR-NI and LR-POP-NI as living tools, requiring regular verification, stakeholder engagement, and structured updating procedures. Although some countries reported large and diverse datasets—including thousands of landraces and populations—these often stem from a mix of sources: historical compilations, project-driven efforts, or regional initiatives that have not been fully harmonized or formally validated. In many cases, the inventories do not yet reflect the current cultivation status or location of landraces on-farm, nor do they capture ongoing dynamics, such as genetic erosion, the reintroduction of landraces through added-value markets, or the disappearance of local varieties due to demographic or economic changes. Population-level inventories are particularly underdeveloped: only a minority of countries have carried out systematic field-based verification or maintain a centralized system to track active populations. In others, LR-POP-NI data is estimated or inferred from secondary sources, with limited consistency or reliability. The idea of developing a "core list" of currently cultivated and actively managed landraces, as proposed earlier in this section, is thus especially important to differentiate between legacy data and entries of clear conservation relevance. Such a list would enable targeted support, prioritization for in situ actions, and better integration with on-farm conservation networks.

Compared to the situation for CWR, the LR context is shaped by a higher degree of informality, decentralization, and cultural specificity, which introduces both strengths and vulnerabilities. On the one hand, inventories can draw on rich local knowledge, community seed systems, and traditional practices that preserve landrace diversity through everyday agricultural use. On the other hand, this very decentralization means that data collection is often inconsistent, non-standardized, and reliant on time-limited projects or personal networks, rather than embedded in institutional frameworks. Many countries reported that their inventories are still under development or assembled from fragmented sources, and that existing records are often not linked to stable conservation or monitoring mechanisms. The absence of coordinated systems for verifying on-farm cultivation status, integrating local descriptors, or enabling participatory updating creates a gap between national inventory goals and what is currently operational. As highlighted in responses to Q15, there is strong consensus that the future GRACE-RI could play a key role in addressing these challenges—particularly by offering long-term financial support, promoting the development of tailored digital tools for decentralized data collection, and facilitating the coordination of multi-actor processes that connect farmers, researchers, NGOs, and policymakers. A well-resourced and inclusive GRACE-RI would be instrumental in ensuring that landrace inventories are not only complete and up to date, but also embedded in the living landscapes and practices that sustain agricultural biodiversity.

4.6. Recommendations for the GRACE-RI

Considering the work described in the previous sections, the recommendations for the GRACE-RI regarding National Inventories of Landraces (LR-NI and LR-POP-NI) are the following:

General recommendations:

- Provide technical assistance, training, and funding mechanisms specifically tailored to the needs of LR inventory development, with a focus on identifying landraces on-farm, one of the highest-rated limitations across countries.
- Establish an expert advisory group through the ECPGR On-farm Conservation Working Group to coordinate methodological guidance, share case studies, and facilitate peer learning.
- Develop long-term strategies for the regular updating and verification of LR-NI and LR-POP-NI, ensuring inventories reflect actual cultivation status, especially for landraces still actively maintained by farmers.
- Promote the integration of LR-NI and LR-POP-NI data into EURISCO, while supporting adaptations of EURISCO's data structure to accommodate relevant landrace-specific descriptors.
- Encourage the development of decentralized, farmer-informed data systems, including user-friendly mobile or community-based tools for participatory inventory contributions.
- Facilitate the harmonization of data formats and descriptors, particularly when inventories are compiled from diverse sources such as NGOs, local projects, academic studies, or informal seed networks.
- Support the visibility and accessibility of LR inventory data through national or regional portals, helping connect users (e.g. farmers, chefs, educators, breeders) with available landraces and the knowledge systems that sustain them.

Recommendations specific to LR-NI:

- Provide support for the adoption and adaptation of existing guidance frameworks (e.g. FAO, 2015; Maxted et al., 2013) for the preparation of LR-NI, including simplification where appropriate, since many countries reported either partial or no use of these guidelines.
- Encourage the inclusion of underrepresented crop groups (e.g. fruits, herbs, ornamentals) where appropriate, beyond staple crops, to reflect the full range of landrace diversity maintained in each country.
- Promote the use of standard descriptors for landraces, particularly those proposed by Negri et al. (2012) and Weise et al. (2020). Questionnaire responses showed limited use of these tools, suggesting the need for greater dissemination and adaptation to national needs.
- Support countries in creating LR-NI that include both autochthonous and non-local landraces when relevant, providing guidance for defining and documenting different occurrence statuses.
- Facilitate collaboration between national authorities, genebanks, seed networks, and farming communities to compile complete and representative LR checklists, especially in countries where inventories remain fragmented or based on legacy projects.
- Encourage countries to document *in situ* and *ex situ* conservation status, and to link landraces in the inventory to active conservation measures, including seed-saving, cultivation practices, or local promotion initiatives.

Recommendations specific to LR-POP-NI:

- Promote the development of LR-POP-NI as a priority action for national programs, as very few countries currently have structured, verified population inventories in place.
- Support the establishment of a “core list” of cultivated landraces and populations, prioritizing those that are still grown, accessible, and under favorable management conditions—thus helping to distinguish legacy entries from actively conserved diversity.
- Facilitate the creation of national or regional landrace conservation networks that integrate farmers, technical staff, NGOs, and researchers, with a focus on on-farm monitoring, exchange, and documentation.
- Develop population-level descriptors suited to landrace documentation (e.g. cultivation site, community steward, seasonality, local use), and support their integration into compatible databases.
- Provide resources and protocols for field validation of LR-POP-NI data, responding to the broad variation in how population-level entries are defined, filtered, and maintained.
- Promote the inclusion of socioeconomic and ethnobotanical data in LR-POP-NI, to better reflect the human–landrace relationship and identify populations of high cultural, gastronomic, or commercial relevance.
- Support countries in implementing monitoring systems for LR populations, particularly those of high conservation interest, and in linking these to ex situ back-up measures, such as duplication in national genebanks.

5. Conclusions

Deliverable D2.5 presents a comprehensive and adaptable blueprint for the development of national in situ inventories for two essential categories of plant genetic resources: Crop Wild Relatives (CWR), which often include Wild Harvested Plants (WHP), and Landraces (LR). This blueprint offers structured

guidance for the creation of both taxonomic-level inventories (CWR-NI and LR-NI) and population-level inventories (CWR-POP-NI and LR-POP-NI), covering aspects such as inventory scope, inclusion criteria, data sourcing, descriptor sets, and mechanisms for periodic verification and updating.

The framework proposed here builds upon established international methodologies and integrates relevant outputs from earlier PRO-GRACE deliverables, notably D1.3 and D2.3. By distinguishing clearly between taxonomic and population inventories and by adapting to the distinct characteristics of CWR and LR conservation, the blueprint allows for progressive and flexible implementation across countries. It promotes alignment with EURISCO, interoperability at the European level, and practical usability at the national and local levels.

The results of the two dedicated questionnaires, which collected information from 34 countries (CWR/WHP) and 30 countries (LR), have provided critical insights into current national practices, bottlenecks, and resource gaps, and helped ensure that the proposed approach is grounded in the realities and capacities of European countries. While substantial progress has been made in compiling taxonomic inventories for CWR, and to a lesser extent for LR, the development of population-level inventories remains uneven and highlights the need for clearer methodologies, greater technical support, and targeted capacity building.

Rather than serving as a static reporting exercise, the questionnaires underscore how national inventories should be treated as living instruments, evolving over time to reflect updated knowledge, newly identified populations, and shifting conservation priorities. The feedback collected also points to the importance of practical tools, adaptable descriptors, and coordinated stakeholder engagement, elements that are fully integrated into the blueprint provided in this deliverable.

Ultimately, D2.5 lays the groundwork for a more coherent and effective approach to in situ genetic resource conservation in Europe. The implementation of the blueprint will enable countries to move from fragmented, ad hoc inventories to consistent, high-quality systems that are dynamic, transparent, and interconnected. With support from the future GRACE-RI, including technical guidance, financial resources, and stakeholder coordination, this blueprint can serve as a foundational instrument for building a pan-European infrastructure for the conservation and sustainable use of plant genetic resources *in situ*.

6. Deviations

While the objectives of Deliverable D2.5 remain fully aligned with the original description in the Technical Annex, namely, the provision of a blueprint for constructing national inventories of in situ conserved plant genetic resources (PGR), some refinements were introduced during its development to better reflect the diversity of national contexts and stakeholder capacities identified through project activities and questionnaire responses.

The original description emphasized the construction of a blueprint for inventories “maintained by major genebanks” and “containing a minimum set of information to be shared with EURISCO.” While these elements are still central, the blueprint presented here expands the focus beyond major genebanks, particularly in the case of landraces, where inventories are often compiled by decentralized actors, including regional authorities, NGOs, farmers, and community seed networks. As a result, the deliverable emphasizes the need for flexible, inclusive frameworks that accommodate different types of inventory custodians and data flows, without compromising interoperability or the objective of eventual EURISCO integration.

Moreover, the blueprint includes not only the minimum data requirements needed to align with EURISCO but also provides guidance on other descriptors and population-level information, enabling

countries to tailor the depth and structure of their inventories according to available resources, conservation priorities, and user needs. This approach reinforces the original goal of enabling prioritization for *ex situ* back-up, particularly for populations at higher risk of extinction or underrepresented in existing collections, while also addressing the broader objective of facilitating use and access to *in situ* and on-farm conserved resources.

In short, the deliverable does not deviate from the spirit or goals of the original work plan but rather broadens and contextualizes the blueprint to better serve the diversity of European PGR conservation systems. The adaptations made enhance the usability and realism of the blueprint and ensure it is well-positioned to guide national implementation and future integration into the GRACE Research Infrastructure.

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ANNEX 1. List of contributors who responded to the questionnaires on the status of development of CWR and LR National Inventories in Europe 2024

Country	ISO 3166 country code	CWR National Inventory	LR National Inventory
Albania	AL	Ndoc Fasilia	Ndoc Fasilia
Armenia	AM	Alvina Avagyan	Karine Sarikyan
Austria	AT	Sylvia Vogl	Sylvia Vogl
Azerbaijan	AZ	Zeynal Akparov	---
Belgium	BE	---	Françóise van Roozendael
Bosnia and Herzegovina	BA	Gordana Đurić	Gordana Đurić
Czech Republic	CZ	Vojtěch Holubec	---
Denmark	DK	Birgitte Lund	Gert Bundgaard Poulsen
Estonia	EE	Rene Aavola	Külli Annamaa
Finland	FI	Heli Fitzgerald	Maarit Heinonen
France	FR	Magalie Delalande	---
Germany	DE	Imke Thormann	Imke Thormann
Greece	GR	Parthenopi Ralli & Nikos Krigas	Parthenopi Ralli
Hungary	HU	---	Attila Simon
Iceland	IS	Magnus Goransson	---
Ireland	IE	Tom Curtis	Tom Curtis
Israel	IL	Einav Mayzlish Gati	Einav Mayzlish Gati
Italy	IT	Pietro Fusani	Lorenzo Raggi & Valeria Negri
Latvia	LV	Agnese Gailite	Dainis Ruņģis
Lithuania	LT	Juozas Labokas	Juozas Labokas & Valerijus Rašomavičius
Malta	MT	Louis Fresta	Louis Fresta
Montenegro	ME	Danijela Stešević	Zoran Jovović
Netherlands	NL	Rik Lievers	Theo van Hintum
North Macedonia	MK	Sonja Ivanovska	Sonja Ivanovska
Norway	NO	Linn Borgen Nilsen	Linn Borgen Nilsen & Anne Strøm Prestvik
Portugal	PT	Joana Magos Brehm	Joana Magos Brehm
Romania	RO	Marius Dan Şandru	Silvia Strãjeru

Serbia	RS	Milena Savic Ivanov	Milena Savic Ivanov
Slovakia	SK	Pavol Hauptvogel	Iveta Čičová
Slovenia	SI	Jelka Šuštar Vozlič	Jelka Šuštar Vozlič
Spain	ES	José María Iriondo Alegría	Lucía de la Rosa
Sweden	SE	Karolina Åsman	---
Switzerland	CH	Sylvain Aubry	Béla Bartha
Türkiye	TR	Erdinç Oğur	---
Ukraine	UA	Roman L. Boguslavskyi	Roman L. Boguslavskyi
United Kingdom	GB	Nigel Maxted	Nigel Maxted

ANNEX 2. Questionnaire on the status of development of CWR National Inventories in Europe 2024

Questionnaire on status of development of CWR National Inventories in Europe 2024

This questionnaire, directed at ECPGR Crop Wild Relatives (CWR) Working Group Members, aims at getting information on the current status of the development of National Inventories of CWR including wild harvested plants (WHP) in European countries for the project "Promoting a plant genetic resource community in Europe (PRO-GRACE)" (https://www.grace-ri.eu/pro-grace). PRO-GRACE is a European Union's Horizon project (grant agreement No 101094738) for developing the concept for a novel European Research Infrastructure dedicated to cataloguing, describing, safeguarding and enhancing European Plant Genetic Resources.

The questionnaire contains questions at the taxonomic level (CWR National Inventory; CWR-NI) and at the population level (CWR Populations National Inventory; CWR-POP-NI), reflecting the importance of having a list of priority taxa on one side (CWR-NI) and of population data (CWR-POP-NI) on the other, both of which are crucial for setting up conservation programs that ensure the survival of individual populations and of priority CWR taxa for making these resources accessible to plant breeders and other potential users. A Distinction between the two terms (CWR-NI and CWR-POP-NI) is provided in **Box 1**.

Box 1. CWR inventory at the taxonomic (CWR-NI) and population (CWR-POP-NI) levels: a clarification

There are two distinct applications of the term CWR inventory in the plant genetic resources (PGR) literature depending on whether the data included are at the taxonomic or population level, as follows:

1. A list of the priority CWR taxa found in a geographic region, usually applied to a country (CWR-NI).
2. A list of the CWR populations for priority CWR taxa found in a geographic region, usually applied to a country (CWR-POP-NI).

To distinguish the two uses of the term CWR inventory, given the original use of the term was for a list of priority CWR taxa found in a geographic region, CWR inventory or CWR-NI is retained for this usage and CWR population inventory or CWR-POP-NI is used when referring to CWR populations.

Some of the questions were formulated, or are similar, to the ones in the questionnaire sent in November 2015 by Labokas et al. (2018)[1] to the ECPGR Wild Species Conservation in Genetic Reserves Working Group Members.

[1] Labokas J, Maxted N, Kell S, Magos Brehm J, Iriondo JM. 2018. Development of national crop wild relative conservation strategies in European countries. Genetic Resources and Crop Evolution 65: 1385–1403. https://doi.org/10.1007/s10722-018-0621-x

Question	Options	Explanation	Enter Answers, where appropriate, in this column.
			For each step indicate in the answers column if it has been reached or not (Yes/no/do not know). Comments can also be included.
1. At what stage of development is your CWR National Conservation and Use Strategy?	• Step 1 – National CWR Checklist		
	• Step 2 – National CWR prioritization		
	• Step 3 – National CWR inventory (CWR-NI)		
	• Step 4 – National CWR gap analysis		
	• Step 5 – National Strategy & Action Plan		
	• Step 6 – National CWR Action Plan implemented		
	• Step 7a – National CWR *in situ* population network covering genetic diversity implemented		
	• Step 7b – National CWR *in situ* population backup of genetic diversity *ex situ* implemented		
	• Step 8 – National CWR *in situ* genetic diversity characterized and evaluated		
	• Step 9 – National CWR genetic diversity available for user access alongside characterization and evaluation data		

Question	Options	Explanation	Enter Answers, where appropriate, in this column.
			For the selected option indicate Yes/no or an elaborated sentence/s
2. At what stage is your CWR-NI prepared?	• Not yet started	Indicate reason(s): lack of funds, lack of technical expertise, lack of data, other reason.	
	• In preparation	Indicate what is already done: national CWR checklist prepared, priority CWR list prepared, etc.	
	• First draft prepared	Manuscript submitted for publication and/or beta version of the public database developed	
	• In press	Manuscript accepted for publication and/or beta version of the public database validated	
	• Published	Provide reference to the published document or to the public dataset	
	• Published and approved	Published and/or database made public and endorsed at national level. Indicate the entity or agency approving the CWR-NI.	

Question	Options	Explanation	Enter Answers, where appropriate, in this column.
			For the selected option indicate Yes/no or an elaborated sentence/s, particularly if the "Other/s" option is selected.
3. What type of approach has been used for developing the CWR-NI?	• Floristic	Approach that aims to produce an inventory of all the CWR that occur in a country.	
	• Monographic	Restricted to one or several genepools of specific crops.	
	• Other/s	Please detail the approach followed.	
			Tick the appropriate option with a "X". You may elaborate the answer if needed.
4. What type of species does your CWR-NI contain?	• CWR only	Choose this option if only wild relatives of crops have been considered for the national inventory.	
	• CWR and WHP (wild harvested plants)	Choose this option if also wild harvested plants have been included in the national inventory irrespective if they are wild relatives of crops.	

			Tick the appropriate answer/s with an "X". You may elaborate the answer if needed.
5. What is the occurrence status (autochthony) of the priority CWR included in the CWR-NI?	• Only native species included	Also called autochthonous species	
	• Native and archaeophyte species included	Archaeophytes generally are plant species introduced in a given geographical region before 1500 A.D.	
	• Native, archaeophyte and neophyte species included	Neophytes are plant species that were introduced after 1500 A.D. Indicate if using a different date.	
			Tick the appropriate answer/s with an "X". Elaborate answer in case "Other" option is selected. Indicate if appropriate if there are differences between CWR and WHP
6. Which categories of crop use / WHP were selected to prioritize the nation's CWR / WHP for the CWR-NI?	• Human food and beverages		
	• Animal food	Forage and fodder species.	
	• Forestry species	May include short rotation forestry, coppice.	
	• Medicinal and aromatic plants		
	• Industrial crops	Oil, fibre, energy crops, etc.	
	• Cultivated ornamental plants		
	• Other	Specify	

Question	Options	Explanation	Enter Answers, where appropriate, in this column.
			Tick the appropriate answer/s with an "X". Elaborate answer/s if needed and in case "Other criteria" is selected.
7. Which other prioritization criteria were applied for the CWR-NI?	• Economic value of the related crop	Economic value can be assessed using official statistical data, like FAOSTAT, EUROSTAT and national statistics portals.	
	• Utilization potential of the CWR (based on the degree of relatedness to the crop and/or confirmed or potential utilization for conferring useful traits)	Degree of relatedness to the crop is being assessed by employing 'gene pool' and 'taxon group' concepts as described by Harlan and de Wet (1971)[2] and Maxted et al. (2006)[3], respectively.	
	• (Socio)economic value of the WHP	See official statistics data.	
	• Relative level of threat	IUCN, Regional and National Red List assessments where taxon assessed and currently recorded as threatened (CR, EN or VU) or near threatened (NT).	
	• Autocthony of the CWR	If the CWR is autochthonous has a higher degree of prioritization than if it is allochthonous	

[2] Harlan JR and de Wet JMJ. 1971. Toward a Rational Classification of Cultivated Plants. Taxon, 20(4): 509–517. https://doi.org/10.2307/1218252

[3] Maxted N, Ford-Lloyd BV, Jury SL, Kell SP, Scholten MA. 2006. Towards a definition of a crop wild relative. Biodiversity and Conservation 15:2673–2685. https://doi.org/10.1007/s10531-005-5409-6

	• Other criteria:	Such as: stakeholder priorities, CWR of national grown crops only, crops used by local people as food source, traditional use, included in Annex I of the ITPGRFA, species distribution, etc.	

Question	**Options**	**Explanation**	**Enter Answers, where appropriate, in this column.**
			Tick the appropriate answer/s with an "X". Elaborate answer/s if needed and in case "Other criteria" is selected.
8. What method of prioritization was applied for the CWR-NI?	• Serial	Using one criterion, then another, etc.	
	• Parallel	Scoring each criterion then summing the scores.	
	• Other criteria:	Please specify.	
			Indicate the number of species, if available, in each of the two options.
9. How many CWR species are included in the national checklist and in the national priority list (CWR-NI)[4]?	• Number of CWR species in the national checklist	Indicate also the number of subspecies included if available.	
	• Number of CWR species in the national priority inventory list (CWR-NI)	Indicate also the number of subspecies included if available.	

[4] A checklist is all the taxa (species and subtaxa) present in the study area, usually a country, where as an inventory contains only the highest priority taxa (species and subtaxa) present in the study area prioritized for active conservation intervention.

Question	Options	Explanation	Enter Answers, where appropriate, in this column.
			Tick the appropriate answer/s with an "X". Elaborate answer/s if needed and in case "Other/s" is selected.
10. What other type of data does your CWR-NI include?	• Scientific name of the related crop	From databases such as GRIN-Global, The Catalogue of Life, World Flora Online, etc.	
	• Economic value of the related crop	From FAO and national annual statistics.	
	• Crop gene pool level/taxon group level	From sources such as the CWR data in GRIN, he Crop Wild Relatives Project, Inventory from the EURISCO Database, etc.	
	• Confirmed or potential uses of the CWR as a gene donor	From sources such as The Crop Wild Relatives Project, scientific publications, etc.	
	• Synonyms	From sources such as Plants of the World Online (POWO), GRIN-Global, International Plant Names Index, Taxonomic monographies, etc.	
	• Vernacular names	From sources such as ethnobotany databases, publications, etc.	
	• Plant life-form	From sources such as Flora Europaea, National/regional floras, Plants of the World online.	
	• Ecology and habitat	From sources such as European Nature Information System, GBIF, etc.	
	• National invasive category / invasiveness	From sources such as Global Invasive Species Database, EPPO Global Database, national or regional databases on invasive species, scientific publications, etc.	

	• Reproductive system	Outcrossing, Mixed mating, predominant selfing, asexual reproduction. From sources such as technical and scientific publications.	
	• Flowering time	From sources such as Flora Europaea, National/regional floras, phenotypic data in germplasm databases, scientific publications, etc.	
	• Ethnobotanical direct uses (i.e., not as a gene donor)	From sources such as Ethnobotany databases, local ethnobotanical studies, scientific publications, etc.	
	• Global, regional and national distribution	From sources such as GBIF, European Nature Information System, Euro+Med PlantBase, IUCN Red list, etc.	
	• *Ex situ* conservation status	From sources such as EURISCO, Genesys, FAO WIEWS, IUCN Protected Areas Database, National Genebanks, Habitat databases and related information systems, IUCN Red List website, publications, etc..	
	• *In situ* conservation status		
	• Legislation applied	From sources such as EU Legislation Database, CBD, ITPGRFA, CITES, national legistlation, National Biodiversity Strategy and Action Plans, etc.	
	• Images of different parts of the plant	From sources such as Germplasm databases containing images, PlantImage Gallery, Botanical Illustration Databases, etc.	
	• Genetic or genomic data and/or reference genome available	From scientific publications and databases such as NCBI	
	• Other/s	Please specify.	

Question	• Options	Explanation	Enter Answers, where appropriate, in this column.
			For those limitations having an impact, assess them using this scale: 1= very low, …, 3= medium, …, 5= very high; 6= unsure. Elaborate answer/s if needed and in case "Other" is selected. You may also include comments in the last option.
11. What are the limitations found in the generation of the CWR-NI? Please assess their impact (1= very low, …, 3= medium, …, 5= very high; 6= unsure)	• Identifying the crops whose CWR will be considered		
	• Procure a digitised list of the flora of the country		
	• Producing the CWR checklist		
	• Prioritizing the CWR checklist		
	• Lack of financial resources		
	• Lack of expertise		
	• Lack of political interest at the national level		
	• Lack of political interest at the EU level		
	• Lack of an EU regulation for plant genetic resources		
	• Lack of an EU agency for genetic resources		
	• Other/s (please specify)		

	• Comments	Include any comments you may have on the question	

Question	**Options**	**Explanation**	**Enter Answers, where appropriate, in this column.**
			Indicate Yes/no or an elaborated sentence/s for the appropriate answer
12. At what stage is your CWR-POP-NI prepared?	• Not yet started	Indicate reason(s): lack of funds, lack of technical expertise, lack of data, other reason.	
	• In preparation	Indicate what is already done: national CWR checklist prepared, priority CWR population list prepared, etc.	
	• First draft prepared	Manuscript submitted for publication and/or beta version of the public database developed	
	• In press	Manuscript accepted for publication and/or beta version of the public database validated	
	• Published	Provide reference to the published document or to the public dataset	
	• Published and approved	Published and/or database made public and endorsed at national level. Indicate the entity or agency approving the CWR-POP-NI.	

Question	Options	Explanation	Enter Answers, where appropriate, in this column.
			Tick the appropriate answer/s with an "X". Elaborate answer/s if needed and in case "Other/s" is selected.
13. What sources have you been used to create the CWR-POP-NI?	• GBIF, including the Global Database for the Distributions of Crop Wild Relatives		
	• EURISCO database		
	• Genesys database		
	• Other national and international *ex situ* conserved collections databases		
	• Biodiversity databases created by national and subnational public administrations and NGOs	Please specify	
	• Public herbaria, including digitised ones		
	• Chorological bibliographic references		
	• IUCN Red List		
	• Cited in Flora		
	• BGCI-base of botanic garden holdings		
	• National NGO working on botanical diversity and conservation		
	• Field surveys		

	• Citizen science platforms (i.e., i-Naturalist and others).		
	• Other/s	Please specify	

Question	Options	Explanation	Enter Answers, where appropriate, in this column.
			Tick the appropriate answer/s with an "X". Elaborate answer/s if needed and in case "Other/s" is selected.
14. What filters have been applied to create the CWR-POP-NI?	• Elimination of records without coordinates or with inaccurate coordinates		
	• Elimination of records for which coordinates could not be accurately georeferenced		
	• Elimination of records that could be cultivated populations		
	• Elimination of records occurring at headquarters of GBIF, Genesys, EURISCO, or other databases		
	• Elimination of records occurring at country or capital centroids.		
	• Elimination of records from i-Naturalist (or at least with no Research Grade) and other amateur sources		
	• Select records occurring only at the national level		

	• Eliminate records dated before 1950	Please specify if another date other than 1950 has been used.	
	• Removal of duplicates		
	• Removal of occurrences falling in urban areas, water bodies or permanent snow and ice		
	• Deleting populations occurring in a 1 km radius of another one		
	• Other/s		

Question	**Options**	**Explanation**	**Enter Answers, where appropriate, in this column.**
			Indicate the total number of populations and average and/or median (specify) in each of the options
15. How many CWR populations are included in the CWR-POP-NI after the filtering step?	• Number of CWR populations in the CWR-POP-NI		
	• Number of CWR populations per species	Please specify average and/or median.	
			Tick the appropriate answer/s with an "X". Elaborate answer/s if needed, particularly if "Partially" option is chosen.
16. Has the occurrence of the populations in the CWR-POP-NI been verified and is current?	• Yes		
	• No		
	• Partially	Please explain by indicating , e.g., percentage	

Question	Options	Explanation	Enter Answers, where appropriate, in this column.
			For those limitations having an impact, assess them using this scale: 1= very low, …, 3= medium, …, 5= very high; 6= unsure. Elaborate answer/s if needed, particularly if "Comments" option is chosen.
17. What are the limitations found in the generation of the CWR-POP-NI? Please assess their impact (use 1= very low, …, 3= medium, …, 5= very high; 6= unsure)	• Procure a list of the occurrences of CWR populations of the country		
	• Filtering the records of occurrences		
	• Selection criteria for the most appropriate wild populations (MAWPs)		
	• Development of the database		
	• Lack of financial resources		
	• Lack of expertise		
	• Lack of political interest at the national level		
	• Lack of political interest at the EU level		
	• Lack of an EU regulation for plant genetic resources		
	• Lack of an EU agency for genetic resources		
	• Other/s (please specify)		
	• Comments	Include any comments you may have on the question	

Question	Options	Explanation	Enter Answers, where appropriate, in this column.
			Tick the appropriate answer with an "X". Elaborate answer/s if "Partially" or "No" options are chosen.
18. Has the Interactive Toolkit for Crop Wild Relatives Conservation Planning[5] been used in preparing the CWR-NI and, if applicable, the CWR-POP-NI?	• Yes		
	• Partially	Explain the reasons for using it only partially or for not using it (e.g., not available when the National Inventory was created, difficulties in using it, strategy used different from the proposed ones by the Toolkit, etc.).	
	• No		

[5] Interactive Toolkit for Crop Wild Relatives Conservation Planning (http://www.cropwildrelatives.org/conservation-toolkit/).

Question	Options	Explanation	Enter Answers, where appropriate, in this column.
			Tick the appropriate answer with an "X". Elaborate answer/s if "Partially" or "No" options are chosen.
19. Does your CWR-POP-NI follow the "Principles for Inclusion of CWR data in EURISCO"[6]?	• Yes		
	• Partially	Explain the reasons for following them only partially (e.g., not available when the National Inventory was created, lack of resources, difficulties in incorporating them, etc.).	
	• No	Explain the reasons for not following them (e.g., not available when the National Inventory was created, lack of resources, difficulties in incorporating them, etc.).	
	• I do not know		

[6] van Hintum T and Iriondo J. 2022. Principles for the inclusion of CWR data in EURISCO. European Cooperative Programme for Plant Genetic Resources. https://www.ecpgr.org/resources/ecpgr-publications/publication/principles-for-the-inclusion-of-cwr-data-in-eurisco-2022

Question	• Options	Explanation	Enter Answers, where appropriate, in this column.
			Tick the appropriate answer/s with an "X". Elaborate answer/s if needed, particularly if "Comments" option is chosen.
20. Which actors have been involved in the development and implementation of your CWR-NI and, if applicable, CWR-POP-NI?	• Genebanks		
	• Taxonomists		
	• Conservation scientists		
	• National representative/s in the ECPGR Crop Wild Relatives Working Group Members		
	• National authorities/agencies involved in the development of CWR conservation strategy	Examples: Ministry of Agriculture, Ministry of Environment, etc.	
	• National protected area and OECM site management authority	PA manager, Land managers, farmers, local council agents, etc.	
	• Local communities local to genetic reserves to be established		
	• Crop breeders		
	• Other/s (please specify)		
	• Comments	Include any comments you may have on the question	

Question	• Options	Explanation	Enter Answers, where appropriate, in this column.
			For those options that you consider could be helpful, assess them using this scale: 1= very low, …, 3= medium, …, 5= very high; 6= unsure. Tick the appropriate answer/s with an "X". Elaborate answer/s if needed, particularly if "Other/s" option is chosen.
21. How could the future Plant Genetic Resources Research Infrastructure help in the creation and updating on the CWR-NI and CWR-POP-NI? Please assess the impact (use 1= very low, …, 3= medium, …, 5= very high; 6= unsure)	• Financial support		
	• Training activities		
	• Technical expertise and consultancy		
	• Facilitating data standardization and interoperability		
	• Facilitating compatibility with EURISCO database and uploading		
	• Promoting collaboration among stakeholders		
	• Organising workshops and seminars for knowledge exchange		
	• Supporting the development of digital tools for data collection and management		
	• Other/s	Please specify	

Question	Please use the box below to provide additional comments
22. Additional comments	

ANNEX 3. Summary of responses to questionnaire on the status of development of National Inventories of Crop Wild Relatives in Europe 2024

Q1 - Stage of development of CWR National Conservation and Use Strategy reached by the countries that responded to the survey.

Stage of development of CWR strategy	Country codes
Not started	AT, BA, MK, ME
Step 1 – National CWR Checklist	AL[a], AM, AZ, CZ, EE, FI, FR, DE, GR[b], IS[j], IE, IL[p], IT[2], LV, LT, MT, NL, NO, PT, RO[b], RS, SK, SI[η], SE[μ], CH, TR[ρ], UA[ψ], GB
Step 2 – National CWR prioritization	AM, AZ, CZ, EE, FI, FR, DE, GR[b], IS[k], IE, IL[q], IT[2], LV, LT, MT, NL, NO, PT, RO, RS, SK, SI[η], ES, SE[μ], CH[ν], TR[ρ], UA, GB
Step 3 – National CWR inventory (CWR-NI)	AM, AZ, CZ, EE[e], FI[b], FR, DE, GR[b], IS[l], IE, IL, LV[s], LT[t], MT, NL, NO, PT, ES[ι], SE[μ], CH, TR[ρ], UA[ζ], GB
Step 4 – National CWR gap analysis	AZ, CZ, FI, IE, IL[b], LT[u], NL, NO[β], PT, ES, CH[ν], TR[ρ], UA[ζ], GB
Step 5 – National Strategy & Action Plan	AZ, CZ[d], DE, IE, LT[u], MT[x], NL, NO[χ], ES[φ], CH, TR[σ], GB[1]
Step 6 – National CWR Action Plan implemented	AZ, GR[h], IE, MT[b], NL, ES[κ], CH, TR[b], GB[1]
Step 7a – National CWR *in situ* population network covering genetic diversity implemented	AZ[b], DE[f], IE, IL[b], LT[v], MT[b,y], NL[α], NO[δ], ES[λ], CH[π], TR[τ], GB[1]
Step 7b – National CWR *in situ* population backup of genetic diversity *ex situ* implemented	AM[b], AZ[b], FI[b], DE[f], GR, IS[m], IE, IL[r], LT[w], NO[ε], SK[γ], SE[μ], CH[θ], TR[υ], GB[1]
Step 8 – National CWR *in situ* genetic diversity characterized and evaluated	AZ, DE[f], GR[h], IE[b], IS[n], NO[ϕ], TR[ω]
Step 9 – National CWR genetic diversity available for user access alongside characterization and evaluation data	AM[c], AZ[b], FI[b], DE[g], GR[i], IE, IS[o], MT[z], NO, SE[μ], TR[ξ]

[a]In some regions the CWR-NI has been established.
[b]Partially
[c]Many ex sity accessions available for users, but C & E data only available thorugh publications
[d]Taylor N.G., Kell S.P., Holubec V., Parra-Quijano M., Chobot K. & Maxted N. (2017): A systematic conservation strategy for crop wild relatives in the Czech Republic. Diversity Distrib. 23:448-462.
[e]Published on the Estonian PGR webpage https://www.genres.ee/metsikud-sugulasliigid/
[f]For a few taxa (steps 7a and 7b) or populations (step 8)
[g]All CWR accessions (priority and non priority CWR) that are stored in genebanks are available, for some there might be characterization data
[h]Only for few specific cases/pilot species
[i]Through genebanks for accessions that are conserved *ex situ*
[j]In progress, based on the Nordic CWR checklist, but not published
[k]In progress, based on the Nordic CWR priority list, but no national priority list published
[l]Partly, as part of two projects; in Vatnajökull National Park, and in Reykjavik municipality
[m]Partly. Seed collections have been made for selected CWR taxa, stored at regional Nordic genebank, NordGen
[n]Very limited. A few studies on genetic diversity in CWR taxa from Iceland are published, or are *in prep*.
[o]Ex situ stored accessions are available via NordGen, but they lack characterisation and evaluation data.
[p]Israel has a list of defined National CWR within its geographical region. Published and used for both ex and in situ conservation programs

[q]Published (Barazani et al., 2008) and re-evaluated (Barazani et al., 2017, 2024)
[r]95% of Israel's CWR species and genetic diversity is conserved ex-situ in the national gene bank
[s]In progress. Priority list prepared
[t]Needs update
[u]Undergoing
[v]Reached 75% (considering that minimum is 5 populations per species)
[w]Reached 42% of the priority CWR species
[x]The National Biodiversity Strategy and Action Plan 2030 includes Target 4, which addresses conservation of crop wild relatives (CWR). However, in situ management currently takes a general approach within protected areas, without distinguishing between specific CWR populations. Refer to: [https://sustainabledevelopment.gov.mt/wp-content/uploads/2024/10/National-Biodiversity-Strategy-and-Action-Plan-to-2030.pdf]
[y]In situ management currently takes a general approach within protected areas, without distinguishing between specific CWR populations
[z]User access *in situ* is possible. Characterization and evaluation data is not yet available. To be started from 2025 onwards as Malta established its first national genebank in 2024
[α]In progress
[β]Conducted for some species
[χ]Not specifically for CWR, but we have a recent strategy and action plan for genetic resources conservation and use, where CWR is addressed
[δ]Two areas with in situ conservation of CWR established
[ε]There is ex situ backup of selected populations of CWR at the common Nordic genebank in Alnarp, Sweden. Threatened (red listed) species of CWR is also stored at the National seedbank for threatened species in Oslo (UiO)
[ϕ]Selected species from the *in* situ conservation areas have been characterized, such as for instance *Malus sylvestris*
[γ]Some CWR species are conserved ex situ in national gene banks, though not systematically
[η]Initial stage, not yet developed
[ι]There is an official checklist of priority CWR (and also wild food plants - WFP) approved and published by the Ministry of Agriculture. The latest update can be found at: https://www.mapa.gob.es/es/agricultura/temas/medios-de-produccion/20240301_actualizacionlistapsc_psua_catalogo_tcm30-676675.xlsx
[φ]Officially approved and published by the Ministry of Agriculture. Available at: https://www.mapa.gob.es/es/agricultura/temas/medios-de-produccion/mapa_estrategiadeconservacion_04_tcm30-636650.pdf
[κ]In progress since 2023. Funded by the Ministry of Agriculture, several actions included in the National Strategy are being implemented. The Ministry of Agriculture is committed to keep implementing the actions of the National Strategy in the coming years
[λ]In progress. One of the actions of the National Strategy implemented by the Ministry of Agriculture has been the identification of 42 priority sites for establishing a national network of genetic reserves located in protected areas based on complementarity analyses and additional factors. In 2025, the Autonomous Regions will be informed about this proposal and invited to commit themselves to their establishment, since they have the competencies in agriculture and environment
[μ] Some work has been done within the Nordic project on CWR https://www.nordgen.org/projects/crop-wild-relatives/about-cwr-and-the-project/. For the CWR-NI, two small sites in Sweden has been monitored, one in the south and one in the north. The material collected within the Nordic countries through this project will be stored at Nordgen and available upon request for research
[ν]Petitpierre et al., 2023 GECCO
[π]Partially (focus on forage crop. See Kägi et al., 2023 Frontiers in Plant Science)
[θ]*Ex situ* collection of CWR on the way but not seen as a backup
[ρ] Conservation gap analysis of crop wild relatives in Turkey | Plant Genetic Resources | Cambridge Core

[σ]General for PGR, not specific for CWR
[τ]Implemented mainly CWR of cereals (+ rare and endemic species + forest trees)
[υ]Done in the areas where in situ conservation programs implemented
[ω]Partly completed for PGR. CWR need to be separated. Very little of it is complete in the areas where *in situ* conservation programs implemented
[ξ]Not all the collections of CWR have been evaluated yet. The requested CWR seeds are provided with characterization and evaluation data, if any, together with the seeds.
[ψ]In the process of finalizing.
[ζ]In the process of development.
[1]Done for England (Enhancing the Conservation of Crop Wild Relatives in England | PLOS One), but not for the whole UK (Lindley et al., 2024)
[2]Full article: A new list and prioritization of wild plants of socioeconomic interest in Italy: toward a conservation strategy

Q2 - Stage of preparation of the CWR-NI reached by the countries that responded to the survey.

Stage of preparation of CWR-NI	Country codes
Not yet started	AT, MK[l], SE[v]
In preparation	AL[a], AM, FR, GR, IS[e], IT[α], LV[h], NO[m], RO[n,o], RS[p,q], SK[q,r], SI[s,t], UA[y], GB[z]
First draft prepared	FR, PT
In press	
Published	CZ[c], DE[d], LT[i], NL[k], TR[x],
Published and approved	AZ[b], EE[c], FI, IE[f], IL[g], MT[j], ES[u], CH[w], GB[z]

[a]National CWR checklist prepared and CWR-NI prepared for some regions
[b]Əkpərov Z.İ. Azərbaycanın bitki genetik ehtiyatlarlı. Bakı:2021,-496 səh
[c]Published on the Estonian PGR webpage https://www.genres.ee/metsikud-sugulasliigid/ and Taylor N.G., Kell S.P., Holubec V., Parra-Quijano M., Chobot K. & Maxted N. (2017): A systematic conservation strategy for crop wild relatives in the Czech Republic. Diversity Distrib. 23:448-462
[d] https://pgrdeu.genres.de/en/list-of-crop-and-crop-wild-relative-species-in-germany/to-the-list-of-crop-and-crop-wild-relatives-species-in-germany/
[e]Work in progress, but no specific funding. The checklist used is the Nordic CWR checklist, and the aim is to publish an Icelandic CWR priority list 2025
[f]Dept of Agriculture, Food and the Marine, Ireland. Curtis, T and Whelan, P. (2019). The Wild Food Plants of Ireland: The complete guide to their recognition, foraging, cooking, history and conservation. Orla Kelly Publishing
[g]Published (Barazani et al., 2008) and re-evaluated (Barazani et al., 2017, 2024)
[h]National CWR checklist prepared, priority CWR list prepared
[i]https://doi.org/10.3390/agronomy14092126; https://zenodo.org/records/11124923
[j]Endorsed by the Plant Protection Directorate responsible for plant genetic resources for food and agriculture and ex situ conservation. The Environment and Resources Authority responsible for wildlife and habitat management and in situ conservation has been informed but they have not formally incorporated the CWR-NI in their national strategy to date. Refer to: https://link.springer.com/article/10.1007/s10722-022-01407-5
[k]Inventory and prioritization for the conservation of crop wild relatives in The Netherlands under climate change - ScienceDirect
[l]Lack of national support, no technical expertise
[m]The inventory is prepared, but not yet officially published. Checklist is available from here: https://www.nibio.no/tema/mat/plantegenetiske-ressurser/genetiske-ressurser-i-naturen?locationfilter=true
[n]Lack of funds, lack of data
[o]National CWR Checklist; National CWR prioritization (partial)
[p]Lack of funds, lack of technical expertise, lack of data

[q]National cheklist prepared, priority CWR list prepared
[r]Lack of funds, resource limitations
[s]Lack of funds, lack of national support
[t]National CWR Checklist; A pilot study was carried out two years ago, a survey of the National flora was performed but it requires more in-depth work and adequate funding.
[u]Available at: https://www.mapa.gob.es/es/agricultura/temas/medios-de-produccion/20240301_actualizacionlistapsc_psua_catalogo_tcm30-676675.xlsx.
[v]Lack of funds at national level
[w]Petitpierre et al., 2023, published and endorsed by the Federal Office for Agriculture
[x] Conservation gap analysis of crop wild relatives in Turkey | Plant Genetic Resources | Cambridge Core
[y]National CWR Checklist and National CWR prioritization - in the process of finalizing; National CWR inventory (CWR-NI) and National CWR gap analysis - In the process of development
[z]Published and approved for England (Enhancing the Conservation of Crop Wild Relatives in England | PLOS One), but in preparation for the whole UK (Lindley et al., 2024)
[α]A priority CWR list was prepared both in 2014 (DOI: 10.2135/cropsci2013.05.0355) and 2021 (https://doi.org/10.1080/21683565.2021.1917469), as well as a survey concerning CWR priority areas for genetic reserves (https://doi.org/10.1016/j.gecco.2024.e02836)

Q3 - Type of approach used for developing the CWR-NI by the countries that responded to the survey.

Approach used for developing the CWR-NI	Country codes
Floristic	AL, AM, CZ, EE, FI, GR, IS, IE, IL, IT, LV, LT, MT, NL, PT, RO, SK, SI, CH, TR, UA, GB[c]
Monographic	ES
Other/s	FR[a], DE, NO[b]

[a]Agronomic approach
[b]Prepared based on a list of 206 prioritized species
[c]Done for UK and England, Scotland and Wales individually

Q4 - Type of species included in the CWR-NI by the countries that responded to the survey.

Species included in the CWR-NI	Country codes
CWR only	FR, GR[a], IS, MT, NL, PT, RO, GB
CWR and WHP (wild harvested plants)	AL, AM, AZ, CZ, EE, FI, DE, IE, IL, IT, LV, LT, NO, SK, SI, ES, CH, TR, UA

[a]Mostly CWR, at least till now since it is in preparation

Q5 - Occurrence status (autochtony) of the priority CWR included in the CWR-NI by the countries that responded to the survey.

Occurrence status (autochtony)	Country codes
Only native species included	AM, EE, GR[b], IL, PT, SK, ES, CH, GB
Native and archaeophyte species included	DE, LV, SI
Native, archaeophyte and neophyte species included	AL, AZ, CZ, FI[a], FR, IS[a], IE, IT, LT, MT[c], NL[d], NO, RO, TR, UA, GB

[a]Neophytes included only when established over 10 generations
[b]At least till now, since it is in progress
[c]Neophyte only up to “naturalised alien” status. Casual aliens are excluded
[d]All species that were established more than 100 years ago

Q6 - Categories of crop use / WHP selected to prioritze the nation’s CWR / WHP for the CWR-NI by the countries that responded to the survey.

Crop use / WHP category	Country codes
Human food and beverages	AL, AM, AZ, CZ, EE, FI, FR, DE, GR, IS, IE, IL, IT, LV, LT, MT, NL, NO, PT, RO, SK, SI, ES, CH, TR, UA, GB

Animal food	AL, AM, AZ, CZ, EE, FI, FR, DE, GR, IS, IE, IL, IT, LV, MT, NO, PT, RO, SK, SI, ES, CH, TR, UA, GB
Forestry species	AL, GR, IL[c], CH, TR, UA
Medicinal and aromatic plants	AL, AM, AZ, CZ, EE, FR[a], GR, IL, LV, LT[d], NO, RO, SK, SI, ES, CH, TR, UA
Industrial crops	AL, EE, FR[b], DE, GR, IL, IT, NL, RO, SK, SI, ES, CH, TR, UA, GB
Cultivated ornamental plants	AL, AM, EE, GR, IL, NO, ES, TR, UA
Other	

[a]Most important ones
[b]Crops that have to undergo industrial treatment before being used : oil, sugar, fibers, tobacco and biofuel
[c]Partially
[d]Only those used for food and/or beverages production

Q7 - Other prioritization criteria applied for the CWR-NI by the countries that responded to the survey.

Prioritization criteria	Country codes
Economic value of the related crop	CZ, EE, FI, FR, GR, IS, IE[d], MT, NL, NO, RO, SK, SI[o], ES, CH[o], TR[o], UA, GB
Utilization potential of the CWR (based on the degree of relatedness to the crop and/or confirmed or potential utilization for conferring useful traits)	AL, AM, AZ, CZ[b], EE, FI, FR, GR, IS, IE[e], IL, LV, LT, MT, NO, PT[m], RO, SK, SI, ES, CH, TR[o], UA, GB
(Socio)economic value of the WHP	CZ[b], FI, IS, LT, NO, SK, SI[o], ES, CH, GB
Relative level of threat	AM, AZ, CZ, EE, FR, DE, GR, IE, IL, IT, LT, MT[j], NL[k], RO, SK, SI[p], ES, CH, TR[o], UA, GB
Autocthony of the CWR	AM, AZ, EE, FR, DE, GR, IE, IL, LT, PT, RO, SK, SI, ES[r], CH, TR[o]
Other criteria	AM[a], EE[b], DE[c], IE[f], IL[g], IT[t], LT[i], NL[l], RO[n], SI[q], CH[s]

[a]Traditional use
[b]Local food source
[c]Stakeholder priorities, importance for breeding
[d]Not assessed through portals
[e]Not in the widest sense of Maxted et al (2006); restricted to near-related taxa
[f]Used Annex 1 of ITPGRFA to prioritise. Distribution
[g]On the national list of protected plants
[i]Crops used by local people as food source, traditional use, included in Annex I of the ITPGRFA, list of global priority crop wild relative genera (Vincent *et al*. 2013), Lithuanian national plant variety lists
[j]Three criteria were used for this scope: the IUCN Red List Status (Global) (IUCN 2021), and relative abundance (National) and endemic status (National) as documented by Lanfranco (2013 – unpublished data)
[k]FLORON rode lijst
[l]Niche modeling and climate change scenarios were used to predict future impacts
[m]For Madeira and mainland, but not for Azores
[n]Stakeholder priorities, CWR of national grown crops only, crops used by local people as food source, traditional use, included in Annex I of the ITPGRFA, species distribution
[o]Partly
[p]Considered also the threat to the ecosystem
[q]Stakeholder priorities, CWR of national grown crops only, crops used by local people as food source, traditional use, included in Annex I of the ITPGRFA, species distribution
[r]Only native plants are included
[s]Check by expert's group

[t]Corresponding to CWR related to crops listed in Annex 1 of ITPGRFA and/or by Italian Institute of Statistics for cultivated areas and yield

Q8 - Method of prioritization applied for the CWR-NI by the countries that responded to the survey.

Method of prioritization	Country codes
Serial	AL, AZ, CZ, FI, GR, IT, LT[a], MT, PT, RO, ES, TR
Parallel	AM, EE, FR, DE, IS, IE, IL, LV, NL, SK, SI, CH, UA, GB
Other criteria:	NO[b]
Total	

[a]Includes a pragmatic approach, e.g., degree of species invasiveness
[b]Unsure if serial or parallel

Q9 - Number of CWR species in national checklists and CWR-NI by the countries that responded to the survey.

Country	National checklist	CWR-NI
Albania	470	168
Armenia	2518[a]	
Azerbaijan	304[b]	117[c]
Czech Republic	1393[d]	207[e]
Estonia	1761	88
Finland	1935[f]	88[f]
France	855	≈80
Germany	2471	117
Iceland	≈650[f]	≈60[f]
Ireland	162[g]	31
Israel	323	170
Italy	8766[f]	
Latvia	440[h]	94[i]
Lithuania	2630[j]	147[k]
Malta	378[l]	44[m]
Netherlands	214	53
Norway	>3000	206
Portugal	637[n] (Azores) 884[n] (Madeira) 2403[n] (Mainland)	27[n] (Azores) 56[n] (Madeira) 165[n] (Mainland)
Romania	937[o]	272[p]
Slovakia	≈200[q]	50[r]
Slovenia	≈150-300[s]	
Spain	n.a.[t]	521
Switzerland	2200	285
Türkiye	7235[u]	764[u]
Ukraine	894	385
United Kingdom	2109[f]	223[f,v]

[a]119 families, 431 genera (70% of the flora of Armenia)
[b]7 subspecies
[c]6 subspecies
[d]1269 food species and 124 fodder species
[e]97 subspecies
[f]Taxa (i.e., may include subspecies)
[g]181 in 2009 Report; refined to 162 in Curtis & Whelan (op.cit.)
[h]Including 32 subspecies

[i]Including 5 subspecies
[j]Including 113 subspecies
[k]Including 1 subspecies
[l]104 genera
[m]10 genera
[n]Species and subtaxa
[o]Including 394 subspecies
[p]Including 106 subspecies
[q]Including 20 subspecies
[r]Including 5 subspecies
[s]Foreseen. The forecast is 5-10% species from Slovene flora (i.e. 150-300 species)
[t]Spain does not have an official National CWR checklist, as it would account for over 75% of the vascular flora and it is not considered to be useful
[u]Conservation gap analysis of crop wild relatives in Turkey | Plant Genetic Resources | Cambridge Core
[v]192 species

Q10 - Other type of data are included in the CWR-NI by the countries that responded to the survey.

Type of data	Country codes
Scientific name of the related crop	AL, AM, AZ, CZ, EE, FI, FR, GR, IS, IE, IL, LV, LT, NL, NO, PT, RO[l], SK, SI[t], ES, CH, TR, UA, GB
Economic value of the related crop	AZ, FI, FR, IL, PT[k], RO[m], SK, SI, ES, CH, TR, UA, GB
Crop gene pool level/taxon group level	AZ, CZ, FI, FR, IS, IE, IL, LT, MT, NL, NO[i], PT, RO, SK, SI, ES, CH, TR, UA, GB
Confirmed or potential uses of the CWR as a gene donor	EE, FI, IS, IE, MT, PT, RO, SK, SI[u], ES[χ], CH, UA, GB
Synonyms	AZ, CZ, EE, FI, IL, NO, PT, RO[n], SK, SI, ES, CH, TR, UA, GB
Vernacular names	AL, AZ[a], CZ[d], FI, FR, IS, IE, RO, SK, SI[v], TR, UA, GB
Plant life-form	AZ, FI, IE, IL, RO[o], SK, SI[w], ES[χ], TR
Ecology and habitat	AZ, CZ, FI, GR, IE, IL, RO[p], SK, SI[x], ES[χ], TR, UA[γ]
National invasive category / invasiveness	AZ, FI, IS, NO, PT, RO, SI[y], CH, UA[γ]
Reproductive system	FI, GR, RO, SK, SI, ES[χ], TR, UA[γ]
Flowering time	AZ, FI, GR, IE, IL, RO, SK, SI[w], ES[χ], TR, UA[γ]
Ethnobotanical direct uses (i.e., not as a gene donor)	AZ[a], IL[a], NO, RO[q], SK, TR, UA[γ]
Global, regional and national distribution	AM, AZ, CZ, EE, FI, IE, IL, NL, RO[r], SK, SI[z], ES, CH, UA[γ]
Ex situ conservation status	AM, AZ, CZ, FI, GR, IE, IL, NO[a], RO, SK, SI[α], ES, TR, UA, GB
In situ conservation status	AZ, EE[b], FI, FR, IS, IE, IL, NL, NO[a], RO, SK, SI[α], ES[δ], TR, UA[γ], GB
Legislation applied	AZ, FI, IS, IE, IL, LT[f], RO[s], SK, SI[α], ES, TR, UA, GB
Images of different parts of the plant	AZ, FI, IL, NL, RO, SI, TR[ϕ], UA[γ]
Genetic or genomic data and/or reference genome available	AZ[a], RO, SI[b], TR[γ], UA[γ]
Other/s	FR[c], IE[e], MT[g], NL[h], NO[j], ES[ε]

[a]Partially
[b]Only for protected species
[c]Link to https://inpn.mnhn.fr/espece for each species, where complete information is available (taxonomy; status in French territories, assessment, protection an threat status at world, Europe, France and French regions levels; habitats ; Global, regional and National distribution maps; history and archaeology)

[d]Czech names only
[e]Culinary use; history of use; still used in Ireland; still used elsewhere; list of seed and gene banks; maps; category for qualification; protected status
[f]ITPGRFA Annex 1, Global priority CWR genera (Vincent *et al.* 2013), IUCN category & criteria (Raudonoji knyga 2021 WEB.pdf), National plant variety list 2023
[g]Red List Status (IUCN -Global); Relative Abundance (National); Native status; Endemic Status (National)
[h]Predicted impact of climate change on distribution
[i]Partly, not yet for all
[j]Name and type of related crop (e.g. related to forage plants, *Trifolium repens* and *T. pratense*)
[k]Only whether the crop is listed in FAOSTATS and whether it is a major or minor crop according to Groombridge and Jenkins (2002). Groombridge B and Jenkins MD (2002) World Atlas of Biodiversity. Prepared by the UNEP World Conservation Monitoring Centre. University of California Press, Berkeley, California
[l]Data also obtained from: Flora RSR, vol I-XIII (1952-1976); Flora ilustrată a României,Ciocârlan (2000, 2009); Flora Europaea (http://rbg-web2.rbge.org.uk/FE/fe.html)
[m]Also obtained from: Union by the International Union for the Protection of New Varieties of Plants (UPOV); Germplasm Resources Information Network database of the United States Department of Agriculture (GRIN-USDA 2017)
[n]Also obtained from: Flora RSR, vol I-XIII (1952-1976); Ciocârlan V. (2000, 2009). Illustrated Flora of Romania
[o]Also obtained from: Sanda, V., Popescu, A.,Doltu, M, I., Doniţă, N., 1983. Ecological and phytocoenological characterization of spontaneous species from the Romanian flora; Sârbu, I., Ştefan, N., Oprea, A., 2013, Vascular plants of Romania, Illustrated field determinant
[p]Also obtained from: Cristea, V., 1991, Phytocenology and vegetation of Romania, practical work supervisor; Sanda, V., Popescu, A.,Doltu, M, I., Doniţă, N., 1983. Ecological and phytocenological characterization of spontaneous species from the Romanian flora
[q]Also obtained from: Crăciun et al., 1976-1977; Kovács, 1979; Cîrnu, 1980; Pop, 1982; Popescu, 1984; Bărbulescu and Motcă, 1987; Pârvu, 2000, 2002-2005; Vîntu et al., 2004; Muntean et al., 2007; Dihoru and Boruz, 2014; PFAF, 2020; https://www.rhs.org.uk/
[r]Also obtained from: Red List of Higher Plants in Romania (Oltean, Negrean et all. 1994); Red Book of Vascular Plants in Romania (Dihoru, Negrean,2009); Carpathian List of Endangered Species (Krzysztof Kukuła et all. 2003); Carpathian red list of forest habitats and species carpathian list of invasive alien species (Ján Kadlečík, 2014); Vasile Sanda, Kinga Öllerer, Petru Burescu, 2008. Phtocenoses in Romania
[s]Also obtained from: Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (Annexes II and IV); European Red List of Medicinal Plants; European Red List of Vascular Plants; Convention on the conservation of European wildlife and natural habitats (Bern, 1979); Natura 2000
[t]Also obtained from: National flora – Mala flora Slovenije (Martinčič et al., 2007), Plants of the World Online, EURO+MED PlantBase (EDIT – European Distributed Institute of Taxonomy)
[u]National databases of countries that have carried out their CWR studies; scientific publications, CWR project
[v]Also from: Mala Flora Slovenije (Martinčič et al., 2007)
[w]Also from: Mala Flora Slovenije (Martinčič et al., 2007), Pladias database, PADAPT database
[x]Also from: National documents, scientific publications and research reports, FloraVeg.eu
[y]Sources used: Mala flora Slovenije (Martinčič et al., 2007) and NeoBiota project research report (Bačič et al., 2012)
[z]Also from: POWO, BioPortal.si
[α]National legislation (Regulation on protected wild plant species, 2004), National Red List (Regulation on the inclusion of endangered plant and animal species in the Red List, 2002), Habitats Directive (92/43/EEC)

[β]National legislation (Regulation on protected wild plant species, 2004), National Red List (Regulation on the inclusion of endangered plant and animal species in the Red List, 2002), Habitats Directive (92/43/EEC)

[χ]For 100 of them (for confirmed or potential uses of the CWR as a gene donor, reproductive system, and flowering time, when information is available)

[δ]For passive conservation in protected areas

[ε]Environmental range of climate variables obtained from climate data of their corresponding populations

[ϕ]Environmental range of climate variables obtained from climate data of their corresponding populations

[γ]Genetic evaluation studies underway

[η]Planned to be included

Q11 – What are the limitations found in the generation of the CWR-NI? Please assess their impact (1= very low, …, 3= medium, …, 5= very high; 6= unsure). Only numeric values between 1 and 5 are presented.

Limitations	AL	AZ	CZ	EE	FI	FR	GR	IS	IE	IL	LV	LT	MT	NL	NO	PT	RO	RS	SK	SI	ES	CH	TR	UA	GB
Identifying the crops whose CWR will be considered	3	1	3	1		3	1		1	1	1	2	2	3	3	2	1	3	3	3	1	3	5	3	1
Procure a digitised list of the flora of the country	1	1	1	1		1	4			1	3	5	2	3	2	4	5	3	4	4	1	2	1	2	1
Producing the CWR checklist	5	3	3	2		2	3		1	1	1	4	1	1	1	1	3	3	3	5	1	2	5	3	1
Prioritizing the CWR checklist	3	3	3	3		2	2		1	4	3	4	3	1	1	1	2	1	4	5	1	4	3	3	1
Lack of financial resources	5	1		2		3	5	5	1	3	5	1	1	1	4	5	5	5	5	5	1	4	5	5	5
Lack of expertise	3	3	2	2		4	2		1	1	5	2	2	2	4	1	4	3	4	3	1	2	3	2	1
Lack of political interest at the national level	5	3	5	3	3	3	5	5	3	4	5	4	2	1	3	5	5	5	4	3,5	1	2	3	3	3
Lack of political interest at the EU level	3	5	5	1	3		4		3		1	4	1	1		5	5		3	3	1		3		4
Lack of an EU regulation for plant genetic resources	3	5	4	2	3	1	4				3	5	2	1			5		4	1	3		3		5
Lack of an EU agency for genetic resources	3	5	2	1	3	2					3	4	2	1		5	5		5	1	5				5

Q12 - Stage of development of the CWR-POP-NI by the countries that responded to the survey.

Stage of development of CWR-POP-NI	Country codes
Not yet started	AL[a], AM, EE, FI, FR, DE[b], GR[a,c], IS[a,d], LV[a,c,d], MT[a,c,d,h], RS[m], SI, TR[o], UA[p]
In preparation	AZ, CZ, IE[e], IL[f], IT, NO, RO[l], SK[m], CH
First draft prepared	AZ, LT[g], PT[k]
In press	
Published	
Published and approved	NL[h], ES[n], GB

[a]Lack of funds

[b]There will not be a publication about a CWR-POP-NI. For populations that are conserved in genetic reserves data are made available online. https://pgrdeu.genres.de/en/in-situ-vorkommen/occurences-of-priority-crop-wild-relatives/

[c]Lack of technical expertise

[d]Lack of data

[e]Seed has been collected from 224 populations and stored in National Seed and Gene Bank in Ireland and in Svalbard, Norway: One pilot study has been carried out on 22 populations of CWRs in South-East Ireland

[f]Although we did collect CWR in population diversity, we are now evaluating thorough models of distribution and genetic information that the correct population identifications are in place in South-East Ireland

[g]A passport dataset of 1080 priority CWR populations has been prepared and uploaded to EURISCO on January 9th, 2024

[h]Lack of human resources

[i]The data for in situ CWR populations has been uploaded to EURISCO

[j]Partly. Some unique populations have been identified and included in the conservation programme, such as *Malus sylvestris* in the Jomfruland national park

[k]A database already exists but a manuscript has not been prepared yet

[l]A list of the CWR populations for priority CWR taxa found in two protected areas (Slatioara Secular Forest and Rodna Mountains National Park)

[m]Lack of funds, lack of technical expertise, lack of data

[n]Done and endorsed at national level by the Ministry of Agriculture. However, not yet published

[o]A project called collecting wild relatives of cultivated plants and determining their genetic reserves is being carried out within the General Directorate of Agricultural Research and Policies (TAGEM)

[p]Lack of funds, lack of researchers and time

[q]A second edition is in preparation

[r]It was started, in some Italian region/areas, thanks to the project "Extension of EURISCO for Crop Wild Relatives (CWR) in situ data and preparation of pilot countries' data sets", to which Italy joined in 2023 and 2024, contributing with the entering oif the first Italian CWR populations in the EURISCO dedicated database (https://eurisco.ipk-gatersleben.de/apex/eurisco_ws/r/eurisco/accession-list-in-situ-cwr)

Q13 - Sources used to create the CWR-POP-NI by the countries that responded to the survey.

Sources used	Country codes
GBIF, including the Global Database for the Distributions of Crop Wild Relatives	AZ, NO, PT, RO, SK, SI[l], ES, CH
EURISCO database	AZ, LT, PT, RO, SK, ES, CH, UA[n]
Genesys database	AZ, PT, RO, SK, CH, UA[n]
Other national and international *ex situ* conserved collections databases	CZ, NO[e], PT, RO, SI[l], ES, CH, GB[p]
Biodiversity databases created by national and subnational public administrations and NGOs	AZ, CZ, IE, IL[b], LT[c], PT[h], RO[j], SK[k], SI[l], ES[m], CH, UA[n,o], GB[p]

Public herbaria, including digitised ones	AZ, CZ, SK, SI[l], ES, CH, UA[n], GB[p]
Chorological bibliographic references	AZ, PT, RO, SK, SI[l], CH
IUCN Red List	AZ, LT[d], PT, RO, SK, SI[l], ES, UA[n], GB[p]
Cited in Flora	AZ, SK, SI[l], CH, UA[n]
BGCI-base of botanic garden holdings	AZ, CH, UA[n], GB[p]
National NGO working on botanical diversity and conservation	PT[h], SK, SI[l], CH, UA[n], GB[p]
Field surveys	AZ, IE, LT, NO[f], RO, SI[l], UA[n], GB[q]
Citizen science platforms (i.e., i-Naturalist and others).	NL[e], PT[i], SI[l], CH, UA[n]
Other/s	DE[a], NO[g]

[a]As mentioned above we have not used the approach on which this questionnaire is based. We have not done a general prioritization of priority CWR populations, as there is insufficient data to do that. Priority CWR population data is generated in projects, which might focus on one priority CWR species, a group of species, or CWR hotspots. Populations for conservation in genetic reserves are selected in these projects. So far there have been projects focusing on wild celery, wild grapevine, Arnica montana, and CWR hotspots. Main data sources of occurrence data were data made available from regional nature protection agencies and citizen science portals.
[b]BioGis (https://biogis.huji.ac.il/eng/searchspecies.html) The Israel Nature and Parks Authority (INPA) database. Israel Gene Bank database
[c]BIGIS database created and maintained by the Nature Research Centre
[d]Regional
[d]waarneming.nl, NDFF
[e]GeNBIS – Nordic Baltic Genebanks Information System (GeNBIS): https://www.nordic-baltic-genebanks.org/gringlobal/search
[f]In Færder national park and in Jomfruland national parks
[g]Artsdatabanken, a Norwegian, public knowledge database for biodiversity: https://artsdatabanken.no/
[h]FloraOn (https://flora-on.pt/)
[i]Data included in GBIF and in FloraOn
[j]Management plan of the Rodna Mountains National Park (Red List of Wild Plants; Guide of the Wild Plants); Slatioara Secular Forest (Chifu T. et.al. 2006, Flora and vegetation of Moldova (Romania) I and II; Oprea A. and Sârbu C., 2021, The Vascular Flora of Rarău Massif (Eastern Carpathians, Romania). Note I and II)
[k]National biodiversity databases and NGO reports have contributed to data collection
[l]Will be used when the CWR-POP-NI is created
[m]For instance, the biodiversity databases provided by Catalonia and Valencia. However, they are available through GBIF. i-Naturalist data available from GBIF has been dismissed to avoid taxon misidentification problems
[n]Planned to use
[o]Information System "Plant Gene Pool" of the National Plant Gene Bank of Ukraine
[p]Entirely based on national sources of data
[q]Some field survey for sites established as genetic reserves
[r]Data not obtained from citizens but from NGOs (e.g. BSBI)

Q14 - Filters applied to create the CWR-POP-NI by the countries that responded to the survey.

Filter applied	Country codes
Elimination of records without coordinates or with inaccurate coordinates	IT, NL, PT, RO, SK, ES, CH
Elimination of records for which coordinates could not be accurately georeferenced	IT, IL, NL, RO, SK, ES, CH

Elimination of records that could be cultivated populations	IT, IL, NL, PT, RO, SK, SI[l], ES, CH
Elimination of records occurring at headquarters of GBIF, Genesys, EURISCO, or other databases	IT, RO, SK, ES
Elimination of records occurring at country or capital centroids.	NL, SK, ES, CH, GB[o]
Elimination of records from i-Naturalist (or at least with no Research Grade) and other amateur sources	IT, NL[e], RO, SK, ES, CH[n], GB[p]
Select records occurring only at the national level	CZ, IL, SK, ES, GB
Eliminate records dated before 1950	IT, LT[c], NL[f], PT, RO[k], SK, CH
Removal of duplicates	IT, PT, SK, SI[l], CH, GB
Removal of occurrences falling in urban areas, water bodies or permanent snow and ice	CZ, PT, RO, SK, SI[l], ES
Deleting populations occurring in a 1 km radius of another one	NL[g], SK, ES[m]
Other/s	DE[a], IL[b], LT[d], NL[h], NO[i], PT[j]

[a]Filters were mainly the precision of the location data and removal of occurrences in urban areas
[b]Deleting observation with error in identification (by special botanist commission)
[c]Major focus is on the populations recorded during the last 10–12 years
[d]Excluding populations significantly intermixed with those of invasive non-native and/or problematic native species. Excluding populations under severe athropogenic preasure (urban, recreational, etc.)
[e]Used amateur observations but eliminated the observations that were not verified by an expert
[f]2010
[g]Only selected 1 or several populations from each flora district in The Netherlands
[h]Only selected large, and long established populations
[i]Unique populations have been identified through DNA analysis
[j]Removed occurrences outside the geographic boundaries. Used GEOQUAL to evaluate the quality of the records and decided to eliminate from the analysis records with TOTALQUAL100 <55 (most, if not all records with a value of 55 were geographically accurate) (LOCALQUAL metric not used)
[k]2000
[l]Will be applied when the CWR-POP-NI is created
[m]Actually, joining records occurring in a 1 km radius, as we consider that they belong to the same population
[n]Not entirely ruled out
[o]None found
[p]Not included directly but included via BSBI source

Q15 - Number of CWR populations included in the CWR-POP-NI after the filtering step by the countries that responded to the survey.

Country	Number of CWR populations in the CWR-POP-NI	Number (mean and/or median) of CWR populations per species
Italy	97	3.46[a]
Ireland	246	3-4[a]
Lithuania	1080	11.25[a] / 7[b]

Netherlands	1912[c]	9
Norway	1[d]	1
Portugal	24270[e] (Azores) 1914[e] (Madeira) 74980[e] (Mainland)	1011.25[a,e] (Azores) 33.38[a,e] (Madeira) 45.69[a,e] (Mainland)
Romania	20	3[a]
Slovakia	≈1200	24[a] / 18[b]
Spain	624237	1198[a]
United Kingdom	646816[f]	≈3250[a]

[a]Average
[b]Median
[c]Including threatened and common species
[d]Formalized
[e]Records, not populations
[f]Corresponds to 199 species (215 taxa, including subspecies). When considering protected areas, there are 155396 records, corresponding to 196 species (210 taxa). For the top 15 NNRs in England there are 5492 records, corresponding to 117 species (118 taxa). Finally „The Lizard" database includes 1070 records, corresponding to 43 species (43 taxa).

Q16 - Verification and up-to-date status of CWR population occurrences in the CWR-POP-NI, as reported by the countries that responded to the survey.

Verification and up-to-date status of CWR occurrences	Country codes
Yes	DE[a], IE, IT, LT[c], NO,
No	PT, SI, CH, GB
Partially	IL[b], NL[d], RO[e], SK[e], ES[f]

[a]For those populations for which data is available at https://pgrdeu.genres.de/en/in-situ-vorkommen/occurences-of-priority-crop-wild-relatives/ the occurrence has been verified
[b]Some models were verified so far
[c]Seven populations (0.65% of the total list) in one remote site are unverified
[d]Verification ongoing
[e]Partially (60%)
[f]Verification of the populations occurring in 10 of the 42 sites selected for the national network of genetic reserves will be carried out in situ in 2025 and 2026.

Q17 - What are the limitations found in the generation of the CWR-POP-NI? Please assess their impact (use 1= very low, …, 3= medium, …, 5= very high; 6= unsure). Only numeric values between 1 and 5 are presented.

Limitations	CZ	DE	GR	IE	IL	IT	LT	NL	NO	PT	RO	RS	SK	SI	ES	UA	GB
Procure a list of the occurrences of CWR populations of the country	3	5	5	3	2	5	1	2	4	5	3	5	4		5	5	1
Filtering the records of occurrences	5		1	3	5	3	1	2	4	3	5	5	3		1	1	1
Selection criteria for the most appropriate wild populations (MAWPs)	5		2	1	3	3	4	1	4	3	4	5	4		5	1	3
Development of the database	2		5	1	3	1	2	1	5	2	5	5	5		5	1	1
Lack of financial resources	5		5	5	4	5	1	1	5	5	5	5	5	5	1	5	3
Lack of expertise	2		3	1	2	1	3	2	4	1	4	5	4		1	3	1
Lack of political interest at the national level	5		5	3	4	3	4	1	4	5	5	5	4	3	1	3	3
Lack of political interest at the EU level	5		4	3		1	4	1		5			3		1		4
Lack of an EU regulation for plant genetic resources	5		4	5		3	5	1					4		3		5
Lack of an EU agency for genetic resources				5		1	4	1					5		5		5

Q18 - Use of the Interactive Toolkit for Crop Wild Relatives Conservation Planning in the preparation of the CWR-NI and, if applicable, the CWR-POP-NI, as reported by the countries that responded to the survey.

Use of the Interactive Toolkit for Crop Wild Relatives Conservation Planning	Country codes
Yes	FR, PT, ES, GB
Partially	AL, AZ[a], LT[e], MT[f], NO[g], SK[a], SI[h]
No	AM[a], CZ, EE, FI[b], DE, GR, IE[c], IL, IT, LV[d], NL, RO, RS, CH, TR, UA[a]

[a]Not available when the National Inventory was created

[b]Not needed

[c]Definition of CWR too broad in Toolkit and numbers of species increases

[d]The Interactive Toolkit was not used for creation of a national inventory and priority list creation. However, it will be of more use for further steps in developing the final CWR-NI strategy/publication, as well as for the CWR-POP-NI

[e]Instead used Maxted, N.; Magos Brehm, J.; Kell, S. 2013. Resource Book for Preparation of National Conservation Plans for Crop Wild Relatives and Landraces (on which The Interactive Toolkit for Crop Wild Relative Conservation Planning is based); and Thormann, I.; Kell, S.; Magos Brehm, J.; Dulloo, M.E.; Maxted, N. 2017. *CWR Checklist and Inventory Data Template v.1.*; Harvard Dataverse, V4; Harvard University: Cambridge, MA, USA

[f]Information about CWR and their genepool level was either not easily available or accessible in user friendly format for the mass exportation of data for further processing

[g]Have not been used systematically. Regarding CWR-POP-NI: Only one population has so far been identified and formally conserved *in situ*. Not applied on a wider range of species

[h]Difficulties with exporting

Q19 - Adherence of the CWR-POP-NI to the 'Principles for Inclusion of CWR Data in EURISCO,' as reported by the countries that responded to the survey.

Adherence to 'Principles for Inclusion of CWR Data in EURISCO'	Country codes
Yes	CZ, DE[b], IE, IT, LT, NL, PT, SI[d], ES, UA[d], GB[e]
Partially	AZ[a], SK[c],
No	RS, TR
I do not know	IL, NO, CH, RO

[a]Not available when the National Inventory was created

[b]If you consider the three boxes in the document “Principles for Inclusion of CWR data in EURISCO” as the principles then the answer is yes. If otherwise, you consider as “principles” the single steps outlined in the document (and on which this questionnaire is supposedly based) then please see comments above

[c]The principles were not fully followed due to data format incompatibility, challenges in data integration, and limited resources. Efforts are ongoing to align the inventory with EURISCO standards

[d]Will be used for creating the CWR-POP-NI

[e]Includes much more data, but does include the “Principles for Inclusion of CWR data in EURISCO” descriptors as well

Q20 - Actors involved in the development of the CWR-NI and, if applicable, the CWR-POP-NI, as reported by the countries that responded to the survey.

Actors	Country codes
Genebanks	AL, AM, AZ, CZ, EE, FI, FR, DE, GR, IS, IE, IL, IT, LV, NL, PT, RO, SK, SI, ES, CH, TR[f], UA, GB
Taxonomists	AL, AZ, CZ, EE, FI, FR, DE, GR, IS, IE, IL, IT, MT, NO, PT, SK, SI, CH, TR[f], UA, GB

Conservation scientists	AL, AZ, FI, FR, DE, GR, IS, IL, IT, MT, NL, NO, PT, RO, SK, SI, ES, CH, TR[f], UA, GB
National representative/s in the ECPGR Crop Wild Relatives Working Group Members	AL, AM, AZ, CZ, EE, FI, FR, DE, IE, IL, IT, LV, LT, MT, PT, RO, SI, ES, TR[f], UA, GB
National authorities/agencies involved in the development of CWR conservation strategy	AM, AZ, CZ, EE, FI, FI, FR, DE, IS, IE, IL, LT, MT, NL, NO, PT, SK, SI, ES, CH, TR[f], UA, GB
National protected area and OECM site management authority	AM, AZ[a], CZ, FI, FR, DE, GR, IL, NL, NO, PT, RO, SI, CH, TR[f], UA, GB
Local communities local to genetic reserves to be established	GR, IT, CH, TR[f], UA, GB
Crop breeders	AM, AZ[a], EE, FI, DE, IS, LV, LT, ES, TR[f], UA, GB
Other/s (please specify)	FR[b], IL[c], IT[h], LT[d], NL[e], GB[g]

[a]Partially
[b]The stakeholders at the different levels were involved, without being exhaustive in each category
[c]Landscape architects, archaeo-botanists
[d]Botanists
[e]Volunteer amateur botanists
[f]To be involved
[g]National PGR Committee
[h]Local (that is at regional level) authorities/agencies involved with the protection of flora and habitats; please note that they do not know at all about the CWR issue, but they are ready to understand it, and they agree with the importance of it; they just would need some additional resources to work on it actively.

Q21 - How could the future Plant Genetic Resources Research Infrastructure help in the creation and updating on the CWR-NI and CWR-POP-NI? Please assess the impact (use 1= very low, …, 3= medium, …, 5= very high; 6= unsure). Only numeric values between 1 and 5 are presented.

Potential contribuiton	AL	AZ	EE	FR	DE	GR	IS	IE	IL	IT	LV	LT	MT	NL	NO	PT	RO	RS	SK	ES	TR	UA
Financial support	5		4	5	5	5	5	5	5	5	5	4	3	1	5	5	5	5	5	5	5	5
Training activities	5		5	5		5		5	5	5	5	3	2	3	5	5	5	5	4	5	5	3
Technical expertise and consultancy	3	5	4	5		5	3	3	3	5	5	5	2	1	4	5	5	5	5	5	5	3
Facilitating data standardization and interoperability	3		4	5	5	3	3	5	4	5	3	4	5	1	4	5	4	5	5	5	5	3
Facilitating compatibility with EURISCO database and uploading	5		5	5	5	3	3	5	3	5	3	4	5	1		5	4	5	4	3	3	3
Promoting collaboration among stakeholders	5	5	5	5	5	3	5	5	5	5	3	3	4	1	4	5	5	5	5	5	5	5
Organising workshops and seminars for knowledge exchange	3	5	5	5		4	3	5	5	5	3	4	4	1	4	5	5	5	4	5	5	2
Supporting the development of digital tools for data collection and management	5		4	5	3	5	3	5	5	5	5	4	5	1		5	3	5	5	5	5	3

Q22 - Additional comments:

Country	Additional comment/s
Israel	More resources should be allocated to the genomic characterization of different populations of crop wild relatives to distinguish the genetic differences between populations and be able to utilize them.
Lithuania	The major factor affecting the creation of CWR -NI, CWR-POP-NI and CWR conservation strategy with action plan is lack of an EU regulation for plant genetic resources. If this is in place, all the national activies are significantly facilitated.
Malta	Malta established its first national bank in 2024. National CWR *in situ* population backup of genetic diversity *ex situ* implemented and National CWR *in situ* genetic diversity characterized and evaluated to be started from 2025 onwards
Netherlands	Creating a CWR-NI is not difficult, the will to do so determines if it happens - external support of other incentives are not really necessary (but can help reluctant countries)
North Macedonia	MKD does not have CWR National Conservation and Use Strategy. However, professors at the Faculty of Agricultural Sciences and Food in Skopje have some data obtained from collection missions performed by foreign private company.
Norway	NordGen is leading a network and long-term project on CWR conservation in the Nordic countries. This is very valuable and has resulted in important results, including a Nordic priority list for both CWR and WFP. Both lists published on Figshare.
Slovakia	The development of the CWR-POP-NI is in its early stages. There is a significant need for funding, expert contributions, and coordinated efforts to compile the necessary population data for conservation planning. The CWR-POP-NI relies on a combination of publicly available databases, national biodiversity records, and conservation reports. Future efforts should focus on integrating field survey data and expanding citizen science engagement to enhance data coverage and accuracy. Additionally, more engagement with botanical garden databases and ex situ conservation repositories could improve the comprehensiveness of the inventory. The applied filters ensure that only high-quality, well-documented, and relevant CWR population records are included in the CWR-POP-NI. Future enhancements could focus on improving data accuracy through additional field validation and cross-referencing with updated databases.
Spain	Spain does not have an official National CWR checklist, as it would account for over 75% of the vascular flora and it is not considered to be useful. Forestry species are considered separately in the Spanish Strategy for Forestry available at: https://www.miteco.gob.es/content/dam/miteco/es/biodiversidad/temas/politica-forestal/EFE%20Web.pdf
Ukraine	Due to Russia's military - aggression against Ukraine, its occupation and violation of large territories where crop wild relatives grow, it is impossible to conduct surveys and collect samples for ex situ conservation. It is the main limitation.

ANNEX 4. Questionnaire on the status of development of National Inventories of Landraces in Europe 2024

Questionnaire on status of development of National Inventories of Landraces in Europe 2024

This questionnaire, directed at the ECPGR On-farm Conservation and Management Working Group Members, aims at getting information on the current status of the development of National Inventories of Landraces in European countries for the project "Promoting a plant genetic resource community in Europe (PRO-GRACE)" (https://www.grace-ri.eu/pro-grace). PRO-GRACE is a European Union's Horizon project (grant agreement No 101094738) for developing the concept for a novel European Research Infrastructure dedicated to cataloguing, describing, safeguarding and enhancing European Plant Genetic Resources.

The questionnaire contains questions at the landrace level (LR National Inventory; LR-NI) and at the population level (LR Populations National Inventory; LR-POP-NI), reflecting the importance of having a list of priority landraces that exist in a country (LR-NI) and of populations maintained on-farm (LR-POP-NI) on the other, both of which are crucial for setting up conservation programs that ensure the *ex situ* and *in situ* conservation of landraces for making these resources accessible to plant breeders and other potential users. A Distinction between the two terms (LR-NI and LR-POP-NI) is provided in **Box 1**.

Box 1. LR checklist and national inventory: a definition

A definition of the terms LR National inventory (LR-NI) and LR Populations National Inventory (LR-POP-NI) is presented below:

1. A subset of the priority LR drawn from the LR National Checklist from a geographic region, usually applied to a country (LR-NI).
2. A list of the LR populations contained in the LR-NI from a geographic region, usually applied to a country, associated to the sites where LR-NI populations are maintained *in situ* (LR-POP-NI).

In this way, the LR-NI may include a certain number of landraces (LR), but each LR can be cultivated by multiple farmers. Each farmer's LR is considered a distinct LR population, depending on how closely the farms are situated and whether germplasm is routinely exchanged between neighbouring farmers. The different LR populations constitute the LR-POP-NI, with each LR population having unique data associated with its maintenance at a specific site by a particular farmer or maintainer.

Question	**Answer** (choose appropriate)	**Explanation**	**Enter Answers in this column**
			For each step indicate in the answers column if it has been reached or not (Yes/no/do not know). Comments can also be included.
1. At what stage of development is your National LR Conservation and Use Strategy and Action Plan?	Step 1 – National LR Checklist		
	Step 2 – National LR prioritization		
	Step 3 – National LR inventory (LR-NI)		
	Step 4 – Identification of threats to LR diversity and threat assessment		
	Step 5 – Genetic analysis of priority LR		
	Step 6 – Gap analysis		
	Step 7 – Formulation of the National Management Plan		

Question	**Answer** (choose appropriate)	**Explanation**	**Enter Answers in this column**
			For the selected option indicate Yes/no or an elaborated sentence/s
2. At what stage is your Landraces National Inventory (LR-NI) prepared?	• Not yet started	Indicate reason(s): lack of funds, lack of technical expertise, lack of data, other reason.	
	• In preparation	Indicate what is already done	
	• First draft prepared	Manuscript submitted for publication and/or beta version of the public database developed	
	• In press	Manuscript accepted for publication and/or beta version of the public database validated	
	• Published	Provide reference to the published document or to the public dataset	
	• Published and approved	Published and/or database made public and endorsed at national level. Indicate the entity or agency approving the LR-NI.	

Question	• **Answer** (choose appropriate)	**Explanation**	**Enter Answers in this column**
			For the selected option indicate Yes/no or an elaborated sentence/s
3. At what stage is your Landraces Population National Inventory (LR-POP-NI) prepared?	• Not yet started	Indicate reason(s): lack of funds, lack of technical expertise, lack of data, other reason.	
	• In preparation	Indicate what is already done	
	• First draft prepared	Manuscript submitted for publication and/or beta version of the public database developed	
	• In press	Manuscript accepted for publication and/or beta version of the public database validated	
	• Published	Provide reference to the published document or to the public dataset	
	• Published and approved	Published and/or database made public and endorsed at national level. Indicate the entity or agency approving the LR-POP-NI.	

			Tick the appropriate answer/s with an "X". Elaborate answer/s if needed and in case "Other/s" is selected.
4. What sources have you used to create the Landraces National Inventory (LR-NI) and the Landraces Population National Inventory (LR-NI)?	• EURISCO		
	• Genesys		
	• National germplasm bank		
	• Regional and local germplasm banks		
	• Community seed banks		
	• Farming or garden cultivation-based NGO		
	• Printed or online catalogues		
	• Lists of local varieties at the national and/or regional levels		
	• Lists of conservation varieties		
	• Scientific and 'grey' literature.	Crop monographs, recent crop studies, crop databases, gazetteers, scientific papers, soil, vegetation and climate maps, atlases, etc.	
	• Crop experts		
	• Farmers and maintainers of landraces		
	• Databases of *in situ* maintained landraces.	Such as the one developed in the Farmers' Pride project (https://www.ecpgr.org/in-situ-landraces-best-practice-evidence-based-database).	
	• Seed exchange networks		
	• Other/s	Please specify	

			Tick the appropriate answer/s with an "X". Elaborate answer/s if needed, particularly if "Partially" option is chosen.
5. Have the guidelines provided by Maxted et al.[1] and/or FAO[2] been used in preparing the Landraces National Inventory (LR-NI) and the Landraces Population National Inventory (LR-NI)?	• Yes		
	• Partially	Explain the reasons for using it only partially (e.g., not available when the National Inventory was created, difficulties in using it, strategy used different from the proposed ones in these works, etc.).	
	• No	Explain the reasons for not using it (e.g., not available when the National Inventory was created, difficulties in using it, strategy used different from the proposed ones in these works, etc.)..	

[1] Maxted N, Magos Brehm J, Kell S. 2013. Resource Book for the Preparation of National Plans for Conservation of Crop Wild Relatives and Landraces. Commission on Genetic Resources for Food and Agriculture. Food and Agriculture Organization of the United Nations, Rome, Italy. 457 pp.

[2] FAO. 2015. National level conservation and use of landraces. Draft technical guidelines. Commission of Genetic Resources for Food and Agriculture. Rome, Italy.

			For the selected option indicate Yes/no or an elaborated sentence/s, particularly if the "Other/s" option is selected.
6. What methodology was used for developing the Landraces National Inventory (LR-NI) and the Landraces Population National Inventory (LR-NI)?	• Ecogeographic survey[3]	Defined as "an ecological, geographical, taxonomic and genetic information gathering and synthesis process, where the results are predictive and can be used to assist in the formulation of collection and conservation priorities"	
	• Other/s	Please detail the approach followed.	
			For the selected option indicate Yes/no or an elaborated sentence/s, particularly if the "A subset of crops" option is selected.
7. What type of landraces does your National Checklist (LR-NC) and National Inventory of Landraces (LR-NI)?	• All crops		
	• A subset of crops	Specify what categories of crops have been included (e.g. cereals, vegetables, fruit crops, etc.)	

[3] Guarino, L., Maxted, N. and Chiwona, E.A., (2006). A methodological model for ecogeographic surveys of crops. IPGRI Technical Bulletin No. 9. pp. 1-58. IPGRI, Rome. ISBN-10: 92-9043-690-5.

			For the selected option indicate Yes/no or an elaborated sentence/s
8. What is the occurrence status (autochthony) of the Landraces included in the LR-NI?	• All landraces present in the country	All landraces present, even if they have been recently introduced, but that are grown	
	• Only local landraces restricted to a geographic location	Only the landraces that originated in the country and that evolved there for at least 10 years are included	
			Indicate the number of species, landraces, and landrace populations, if available, in each of the three options.
9. How many crops and landraces are included in the National Landraces Inventory (LR-NI) and National Landraces Population Inventory (LR-POP-NI)?	• Number of crops included in the LR-NI	Includes the number of crops considered in the LR-NI	
	• Number of landraces included in the LR-NI	Includes unique names of landraces only for all crops in LR-NI	
	• Number of landrace populations included in the LR-POP-NI	Includes populations of landraces maintained on-farm (a unique landraces can be conserved in different sites)	
			Tick the appropriate answer/s with an "X". Elaborate answer/s if needed, particularly if "Partially" option is chosen.
10. Has it been verified if the landraces included in the National Inventory (LR-NI) are conserved *ex situ*?	• Yes	Indicate the percentage of landraces in the LR-NI that are conserved *ex situ*	
	• Partially	Indicate the percentage of landraces verified in the LR-NI that are conserved *ex situ*	
	• No		

			Tick the appropriate answer with an "X". Elaborate answer/s if "Partially" or "No" options are chosen.
11. Have the descriptors recommended for on-farm landrace data published by Negri *et al.* (2012)[4] or by Weise *et al.* (2020)[5] been used?	• Yes	Specify which descriptors have been used.	
	• Partially	Explain the reasons for following them only partially (e.g., not available when the National Inventory was created, lack of resources, difficulties in incorporating them, etc.).	
	• No	Explain the reasons for not following them (e.g., not available when the National Inventory was created, lack of resources, difficulties in incorporating them, etc.).	

[4] Negri V., Maxted, N, Torricelli R, Heinonen M, Vetelainen M, Dias S. 2012. Descriptors for web-enabled national *in situ* landrace inventories. University of Perugia, Perugia, Italy. https://pgrsecure.bham.ac.uk/sites/default/files/documents/helpdesk/LRDESCRIPTORS_PGRSECURE.pdf

5 Weise S, Kreide S, Maxted, N. 2020. Concept for a possible extension of EURISCO for in situ crop wild relative and on-farm landrace data. https://more.bham.ac.uk/farmerspride/wp-content/uploads/sites/19/2021/09/D2.5_EURISCO_in_situ_extension_concept.pdf

			Tick the appropriate answer/s with an "X". Elaborate answer/s if needed and in case "Other/s" is selected.
12. What other type of data does your National Inventory of Landraces (LR-NI) include?	• Economic value of the crop		
	• Economic value of the landrace		
	• Synonyms		
	• Vernacular names		
	• Type of cultivation		
	• Indicators of genetic erosion		
	• Reproductive system		
	• Genetic data associated to the landrace		
	• Availability of a reference genome		
	• Threat levels[6]		
	• Ethnobotanical data		
	• Tolerances to abiotic stresses		
	• Tolerances to pests and diseases		
	• Cultivation details		
	• *Ex situ* and *in situ* conservation status		

[6] Almeida MJ, Barata AM, De Haan S, Joshi BK, Magos Brehm J, Yazbek M, Maxted, N. 2024. Towards a practical threat assessment methodology for crop landraces. Frontiers in Plant Science, 15:1336876. Doi: 10.3389/fpls.2024.1336876

	• Images of different parts of the plant		
	• Added value initiatives taken to enhance productivity		
	• Other/s		

			For those limitations having an impact, assess them using this scale: 1= very low, …, 3= medium, …, 5= very high; 6= unsure. Elaborate answer/s if needed and in case "Other" is selected.
13. What were the limitations found in the generation of the Landraces National Inventory (LR-NI) and the Landraces Population National Inventory (LR-NI)? Please assess their impact (use 1= very low, …, 3= medium, …, 5= very high; 6= unsure)	• Identifying the landraces grown on-farm		
	• Producing the landraces checklist		
	• Lack of financial resources		
	• Lack of expertise		
	• Lack of political interest at the national level		
	• Lack of political interest at the EU level		
	• Lack of an EU regulation for plant genetic resources		
	• Lack of an EU agency for genetic resources		
	• Other/s		

			Tick the appropriate answer/s with an "X". Elaborate answer/s if needed and in case "Other/s" is selected.
14. Which actors have been involved in the development of your Landraces National Inventory (LR-NI) and the Landraces Population National Inventory (LR-NI)?	• Genebanks		
	• Farmers		
	• Gardeners		
	• Agronomists and technical staff of cooperatives and seed companies		
	• National representative/s in the ECPGR On-farm Conservation and Management Working Group Members		
	• Authorities involved in the development of conservation strategies of genetic resources	Examples: Ministry of Agriculture, Ministry of Environment, etc.	

			For those options that you consider could be helpful, assess them using this scale: 1= very low, …, 3= medium, …, 5= very high; 6= unsure. Tick the appropriate answer/s with an "X". Elaborate answer/s if needed, particularly if "Other/s" option is chosen.
15. How could the future Plant Genetic Resources Research Infrastructure help in the creation and updating the Landraces National Inventory (LR-NI) and the Landraces Population National Inventory (LR-POP-NI)? Please assess the impact (use 1= very low, …, 3= medium, …, 5= very high)	• Financial support	For creating and updating the LR-NI and LR-POP-NI	
	• Training activities	Provide examples	
	• Technical expertise and consultancy		
	• Facilitating data standardization and interoperability		
	• Facilitating compatibility with EURISCO database and uploading		
	• Promoting collaboration among stakeholders		
	• Organising workshops and seminars for knowledge exchange		
	• Supporting the development of digital tools for data collection and management		
	• Other		

	Please use the box below to provide additional comments
16. Please use the box to provide any additional comments	

ANNEX 5. Summary of responses to questionnaire on the status of development of National Inventories of Landraces in Europe 2024

Q1 - Stage of development of LR National Conservation and Use Strategy Plan reached by the countries that responded to the survey.

Stage of development of LR strategy	Country codes
Not started	AL, AM, AT[a], BA, DK[f], EE, MT, MK
Step 1 – National LR Checklist	BE[b,c], FI[b,g], DE[i], GR, HU, IE, IL, IT, LV[b,n], LT[o], ME[p], NL[u], NO, PT[w], RO, RS[z], SI[b,χ], CH[η], GB[o], UA[π]
Step 2 – National LR prioritization	BE[b], FI[b], DE, GR[l], IE, IL[b], LT[o], ME[q], NL[v], NO[b], RO, RS[α], SI[δ], CH[ι], GB[o]
Step 3 – National LR inventory (LR-NI)	BE[b], FI[b], DE[j], GR[b], IE, IL[b], IT, LT[o], ME[r], NO, RO[o], RS[β], SI[b,ε], ES[γ], CH[φ], GB[o]
Step 4 – Identification of threats to LR diversity and threat assessment	BE[b], FI[b], GR[b], IE, IT, ME[s], PT[b,x], SI[b], CH[κ], GB[o], UA[θ]
Step 5 – Genetic analysis of priority LR	BE[b], FI[b], DE[k], IT[m], ME[t], PT[b,y], SI[b,ϕ], CH[λ], GB[o]
Step 6 – Gap analysis	BE[b,d], FI[b], IE, SI[b], CH[μ], GB[o]
Step 7 – Formulation of the National Management Plan	BE[b,e], FI[b,h], IE[b], IL[b], CH[ν], GB[o]
Total	

[a]Landraces are conserved in our genebanks and they are listed in the genebank Inventory (www.genbank.at and EURISCO). However I am not sure if this counts as official national inventory

[b]Partially

[c]The LR checklist has been created at the regional level

[d]On fruit trees

[e]For the Waloon network of orchards for conservation

[f]A list of 100 landraces was collected for the Farmers pride project

[g]Based on existing *ex situ* crop list. Need to supplement. Some crops (*Malus domestica*) national LR list of broader than *ex situ* list

[h]Horticultural crops of *ex situ* accessions partly maintained in official back up sites in public gardens. Conservation varieties have management plans

[i]We only have partial list of historical vegetable varieties, but not a complete checklist of all landraces cultivated in Germany

[j]We consider our red list of endangered landraces covering agricultural and horticultural crops as LR-NI

[k]For a few varieties

[l]Needs update

[m]In some cases

[n]We have previously funded expeditions to collect (mainly fruit and berry) accessions from home gardens and elsewhere. If crop experts receive information about potentially unique accessions growing on-farm, the crop experts assess them and they are collected for placement in the genebank. No systematic information about accessions/varieties cultivated on-farm is available

[o]In preparation

[p]The old one expired a long time ago, and we haven't done the new one yet. Since the state doesn't show much interest in it, we are trying to complete it through some regional initiatives and projects

[q]All LRs have the same status and their on-farm cultivation is supported through the national budget. However, the most prevalent are cereals and fruit species

[r]All LRs are inventoried and the data is stored in the National Gene Bank database. Seeds are stored ex situ in the Gene Bank, and in species that reproduce vegetatively in situ or in field collections

[s]The biggest threats are the depopulation of rural areas and very pronounced climate change (the Balkans are experiencing the fastest warming in Europe)

[t]So far, genetic analysis has been conducted on einkorn, einkorn, durum wheat, potatoes, grapevines, and olives
[u]A list (the 'Oranje Lijst' has been compiled with varieties grown in NL during 1850-1940
[v]CGN selected material they would like to conserve *ex situ*
[w]What has been done was a list of all compiled records [from genebanks, catalogues, 84 bibliographic references, etc] of Portuguese LR (Almeida *et al.* 2022; https://www.iniav.pt/images/Recursos-Geneticos/Portuguese_Inventory_of_Food_and_other_Agricultural_crop_Landraces_for_INIAV_Inventory.pdf); from this, we can extract the national LR checklist
[x]Threats to LR were identified for the LR being maintained in 165 farms across Portugal mainland and the archipelagos of Azores and of Madeira. Threat assessment was done for a few LR of common bean (*Phaseolus vulgaris* L.), using the methodology developed by Almeida (2018); this methodology was then refined and published (Almeida *et al.* 2024) and threat assessment of common bean Portuguese LR is currently being carried out to test it
[y]There are several studies on the genetic diversity analysis of LR of several crops (e.g. Almeida 2018, Martins *et al.* 2004; Oliveira *et al.* 2016). However, these have not been carried out systematically and not necessarily done in priority LR as these have not yet been identified
[z]National LR Check list is part of Draft National PGRFA Conservation Programme
[α]Priority is determined according to potential use in breeding
[β]National LR Inventory is part of National PGRFA Inventory
[χ]We have not yet started with the preparation of the national strategy, nor has a comprehensive national LR checklist been drawn up. But valuable information was obtained from a two-year pilot monitoring on landraces cultivation that was conducted, for apple and pear on the territory of the whole country and for other crops (e.g. cereals, vegetables, fodder crops, grapevine, fruit trees) in three selected regions of Slovenia. A questionnaire was also sent to various stakeholders, and a literature review was prepared (including history of cultivation and use in the territory of Slovenia). The information will form the basis for preparation of National LR conservation and use strategy when funds are available
[δ]Draft LR prioritization prepared for apple and pear, for other crops not yet
[ε]A comprehensive LR-NI not yet prepared; the information that was obtained on apple and pear (and to limited extent for other crops) will be included in the LR-NI, for other crops more information is still needed
[ϕ]Partially (for apple, pear and grapevine)
[γ]The information of LR is the included in the National Inventory fo PGRFA
[η]Yes for most of the species used in agriculture, including fodder plants
[ι]https://www.pgrel.admin.ch/pgrel/#/publications/foag
[φ]Yes – historical database and in situ conservation network of 136 sites (collections holders) including a national database for PGRFA of Switzerland. https://www.pgrel.admin.ch/pgrel/#/list/conservationCollection/list
[κ]No prioritization only when it comes to the decision what has to be conserved/maintained for Switzerland and what not. Decision matrix has been developed
[λ]Yes: Ongoing for fruits and cereals
[μ]NAP-PGRFA is continuously developed, and a CH-commission is deciding about next steps
[ν]Yes. https://www.pgrel.admin.ch/pgrel/#/publications/foag
[ο]We have obtained full funding from UK Department of Environment, Food and Agriculture to achieve all 7 steps by March 2026, so answers assume we have completed the entire process
[π]The National LR Cheklist is in the process of creation
[θ]In the determination stage

Q2 - Stage of preparation of the LR-NI reached by the countries that responded to the survey.

Stage of preparation of LR-NI	Country codes

Not yet started	AL, AM, AT, BA, DK, EE, HU[d], LV[h], MT, ME[j], NL[k], MK, ES[o]
In preparation	BE, GR[c], IL[f], LT[i], NO[l], PT, RO, SK, SI[n], UA
First draft prepared	RS, GB
In press	
Published	
Published and approved	FI[a], DE[b], IE[e], IT[g], CH[p]
Total	

[a]For some crops (cereals, potato, apple): Heinonen M. 2014. Landrace in situ Conservation Strategy for Finland. MTT Report no 163 https://jukuri.luke.fi/handle/10024/484828. Also, supplementary inventory of *Triticum aestivum* inventory done in 2024; targeted inventory of *Allium cepa* Aggregatum group based on gap analysis done in 2024

[b]Federal Office for Agriculture and Food (BLE): https://pgrdeu.genres.de/en/on-farm-management/red-list-crops/

[c]The LR-NI includes many landraces and relevant information but not all

[d]Lack of funds, lack of technical expertise

[e]Curtis T. (2015). The production of a comprehensive inventory of Irish landraces of vegetables, cereals and fruits other than apples and potatoes. Unpubl.Rep.to Dept Agriculture, Food and the Marine, Dublin; Curtis, T. (2014). The production of a National Genetic Conservation Strategy for plants: Crop Wild relatives and Landraces. Unpubl.Rep.to Dept Agriculture, Food and the Marine, Dublin

[f]The list is prepared in IGB's database. Although the list has already been made, the publication is pending because the data system is currently under construction

[g]Ministero dell'agricoltura, della sovranità alimentare e delle foreste (Masaf)

[h]Mainly due to lack of data, as well as personnel (time) resources

[i]List of genera compiled

[j]There is only an internal database at the Biotechnical Faculty, where the National gene bank is located. The website is not functional because the server is broken and there was no money to buy a new one. There is a lack of will and understanding at the state level, lack of funds, lack of human capacity, lack of technical expertise, lack of data on LRS that are still present in farmers' fields

[k]We have our checklist and know what should be conserved ex situ. Priority to go further is not seen

[l]A checklist has been elaborated and prioritized varieties are multiplied and distributed to interested farmers from the Community Seed Bank. Information is collected to elaborate an inventory, but more resources/funding needs to be secured. All varieties that are conserved in the common Nordic genebank at NordGen, are included in the database GeNBIS. Here information about each variety and landrace is also available and an inventory of selected varieties and landraces can be downloaded. The information in the inventory is not complete

[m]As said previously, a list of all known records of Portuguese LR has been compiled but priorities for conservation have not yet been identified; there is no timeline for this. The major constraints are all related to the lack of funding

[n]The information was obtained through a two-year pilot monitoring, for apple and pears on the territory of the whole country, whereas for other crops in three selected regions of the country (e.g. vegetables, cereals, fodder crops, grapevine, fruit trees). Report on two-year pilot monitoring submitted to national authority who co-founded the project; public database not yet available

[o]Lack of data and funds

[p]https://www.pgrel.admin.ch/pgrel/#/list/conservationCollection/list.
https://www.pgrel.admin.ch/pgrel/#/publications/npapgrfa

Q3 - Stage of development of the LR-POP-NI by the countries that responded to the survey.

Stage of development of CWR-POP-NI	Country codes
Not yet started	AL, AM, AT, BA, DK, EE, HU[e], LV[h], LT, MT, ME[i], NL, MK, NO[e], ES[m]
In preparation	BE[a], FI[b], DE[c], GR[d], IE[f], IL[f], RO, RS[e,k], SK, SI[l], CH[n], UA

First draft prepared	GB
In press	
Published	
Published and approved	IT[g], PT[g]
Total	

[a]On spelt

[b]For some crops (cereals, potato and apple) some activities have been performed to identify populations conserved *in situ* (Heinonen M. 2014. Landrace in situ Conservation Strategy for Finland. MTT Report no 163 https://jukuri.luke.fi/handle/10024/484828.)

[c]Data framework established in our NI-database

[d]Partially, for specific landraces' populations and areas but not for all

[e]Lack of funds, lack of technical expertise

[f]Curtis T. (2015). The production of a comprehensive inventory of Irish landraces of vegetables, cereals and fruits other than apples and potatoes. Unpubl.Rep.to Dept Agriculture, Food and the Marine, Dublin; Curtis, T. (2014). The production of a National Genetic Conservation Strategy for plants: Crop Wild relatives and Landraces. Unpubl.Rep.to Dept Agriculture, Food and the Marine, Dublin

[f]The list is prepared in IGB's database. Although the list has already been made, the publication is pending because the data system is currently under construction

[g]http://vnr.unipg.it/PGRSecure/html/national_inventory.html developed by UNIPG; BANCA DATI DELL'ANAGRAFE NAZIONALE (https://rica.crea.gov.it/APP/anb/search.php) developed by Masaf

[h]Mainly due to lack of data, as well as personnel (time) resources

[i]Lack of will and understanding at the state level, lack of funds, lack of human capacity, lack of technical expertise, lack of data on LRS that are still present in farmers' fields

[j]A list of all known records of Portuguese LR (not just for priority LR) has been compiled, made available at the website of the national agency that has the national mandate for conserving genetic resources, i.e. Instituto Nacional de Investigação Agrária e Veterinária, I.P. at: https://www.iniav.pt/images/Recursos-Geneticos/Portuguese_Inventory_of_Food_and_other_Agricultural_crop_Landraces_for_INIAV_Inventory.pdf, and published by Almeida *et al.* (2022)

[k]Data exist but have not yet been systematized

[l]As for landraces, also for LR populations the results from the two-year monitoring, results of the questionnaire and a thorough literature survey will be used to prepare LR-POP-NI. Report on the results of two-year pilot monitoring was submitted to national authority who co-founded the project

[m]Lack of data and funds

[n]In the NAP of Switzerland about 50 different institutions are involved and 136 collections are described that hold different accessions mostly of fruits and cereals and potatoes. Very few maintain populations of vegetables. For fodder plants conserved in the wild about 295 different sites are listed. https://www.pgrel.admin.ch/pgrel/#/list/insitu/list

Q4 - Sources used to create the LR-NI and LR-POP-NI by the countries that responded to the survey.

Sources used	Country codes
EURISCO	AM[a], DE, IE, IL[c], RS, SI
Genesys	RS
National germplasm bank	AM[a], BE, FI, DE, GR, IL[d], NO[j], PT, RO, RS, SK, SI, CH, GB[o], UA
Regional and local germplasm banks	AM[a], BE, FI, GR, IT, RS, SI, CH, GB[p]
Community seed banks	AM[a], DE, IE, NO[k], RS, CH, GB
Farming or garden cultivation-based NGO	AM[a], BE, FI, DE, GR, IE, PT, RO, RS, SI, CH, GB, UA
Printed or online catalogues	AM[a], FI, DE, GR, PT, RS, SI, CH, GB[q]
Lists of local varieties at the national and/or regional levels	AM[a], BE, GR, IE, IT, PT, RS, SI, CH, GB[q]

Lists of conservation varieties	AM[a], BE, FI, DE, GR, IE, IT, NO, PT, RS, SI, CH, GB
Scientific and 'grey' literature	BE, FI, DE, IE, IL[e], IT, LT[f], NL[h], PT, RO, SI, CH, GB, UA
Crop experts	AM[a], BE, FI, DE, IE, IL[c], IT, LT, NO, PT, RS, SI, CH, GB, UA
Farmers and maintainers of landraces	BE, FI, DE, GR, IE, IT, LT, NO, PT[l], RO, RS, SI, CH, GB, UA
Databases of *in situ* maintained landraces	IE, PT, SI, CH, GB
Seed exchange networks	FI, IE, PT, CH, UA
Other/s	FI[b], LT[g], NL[i], SI[m], CH[n], GB[r]

[a]Intended to be used when the LR-NI and LR-POP-NI are developed
[b]Historic data: old newspapers, archives, photos, old catalogues
[c]For wheat and barley
[d]IGB's list of collected landraces. In 1980-1982, IGB initiated an "emergency collection mission for landraces" as farming in the country was rapidly shifting to modern agriculture across all sectors (Jewish and Arabic farmers). This mission forms the basis of the landraces list in Israel
[e]For wheat
[f]Including the Database of National Plant Genetic Resources at the State Forest Service: https://agb.amvmt.lt/angi/
[g]Crop and CWR checklist of Lithuania, published at https://www.mdpi.com/2073-4395/14/9/2126
[h]For the checklist
[i]For the checklist we used old catalogues of seed firms from the library
[j]Common Nordic genebank at NordGen
[k]Norsk bruksgenbank (Norwegian community seed bank)
[l]Field survey carried out in 165 farms
[m]Literature review on cultivation of landraces and their use in the territory of Slovenia
[n]Local seed companies and seed sellers. Samen Vatter (Bern), Haubensack (Basle City), Lecerf (Geneva). Little seed producers (local, regional) Samen Mauser, Schweizer Samen, Sativa Rheinau, Artha Samen, etc.
[o]Multiple UK genebanks
[p]Multiple regional and local genebanks
[q]For UK devolved administrations
[r]Commercial seed companies selling LR materials

Q5 - Adherence to the guidelines for preparing the national plans for conserving landraces provided by Maxted et al. (2013) and/or FAO (2015) in preparing the LR-NI and LR-POP-NI, as reported by the countries that responded to the survey.

Adherence to recommended guidelines for preparing the LR-NI and LR-POP-NI	Country codes
Yes	IE, PT, RO, SI, GB, UA
Partially	FI[b], DE[b], LT[c], RS,
No	BE[a], BE[b], IL, IT, NL[d], NO[e], SK, CH[f]
Total	

[a]The development is in the early stage
[b]Not available when the national inventory of some crops was created
[c]Used only theoretically, because we are at the very beginning of the work
[d]Not necessary
[e]The national inventory has not been completed. We are aiming to use such guidelines when developing the complete inventory
[f]CH we started to inventories our LR-pgr in 1998. This was far before the guidelines existed. We developed our descriptors from the scratch. Passportdata were most important part.

Q6 - Methodology used for developing the LR-NI and LR-POP-NI by the countries that responded to the survey.

Approach used for developing the CWR-NI	Country codes
Ecogeographic survey	FI[b], GR, IE, IL[c], ME, PT[f], RO, SI, CH[g], GB[h], UA
Other/s	BE[a], IT[d], LV[e]
Total	

[a]On farm prospection

[b]Ecogeographic survey added with historical data (origin, growing history and sites) & interview data. Used with selected species: *Malus domestica*, *Allium cepa* aggregatum group. Methodology: Heinonen, M., Bitz, L. How to discover heirloom varieties and shape national germplasm collection: A case of Finnish seed born apples (*Malus x domestica* Borkh.) Sustainability 2019, 11 (24), 7000. Doi: 10.3390/su11247000

[c]The emergency collections in the 1980s (as described above) were prepared as ecogeographic collections. Each area produced a list with the crop's name, variety name, Arabic name, purpose of usage, and GPS coordinates. The list was handwritten during the collection mission, and only a brief summary was printed. In recent years, we have digitized the list according to crops and areas. In addition to the collection we had in the gene bank (as described), two programs were developed with the gene bank to return lost landrace (LR) germplasm to Israel—Wheat and Barley. We searched through databases in gene banks around the world for germplasm previously collected in Israel. The germplasm was imported and examined both phenotypically and genotypically

[d]National LAW 1° dicembre 2015, n. 194, "Disposizioni per la tutela e la valorizzazione della biodiversità di interesse agricolo e alimentare", il Ministero delle Politiche Agricole Alimentari e Forestali (oggi Ministero dell'Agricoltura, della Sovranità Alimentare e delle Foreste) and D.M. n. 1862 del 18/01/2018 Modalità di funzionamento dell'Anagrafe nazionale della biodiversità di interesse agricolo e alimentare

[e]Field study by visiting gardeners and farmers

[f]The list of all LR records was obtained by consulting 84 different bibliographic references, complementing with the information gathered from field work (165 farms), and compiled in a database. No prioritization was carried out

[g]Yes. 1. appeal articles in newspapers in the respective region of Switzerland, 2. letters to private individuals, for mouth to mouth communication, 3. posting of appeals on municipal notice boards and market booths, 4. letters to homes for the elderly, 5. radio and television broadcasts, 6. exhibitions, 7. direct contacts with acquaintances, 8. research in literature. Gathering of LR in introduction-collections, storing, propagation, description, etc.

[h]As described in Maxted, N. & Scholten, M.A. (2007). Methodologies for the creation of National / European inventories. In: Del Greco, A., Negri V. & Maxted, N. (compilers) Report of a Task Force on On-farm Conservation and Management, Second Meeting, 19-20 June 2006, Stegelitz, Germany. Pp. 11-19. Bioversity International, Rome, Italy

Q7 - Categories of crops included in the LR-NC and LR-NI by the countries that responded to the survey.

Crop use / WHP category	Country codes
All crops	AM[a], DE[d], GR, HU, IE[e], IT, ME, NL[h], RO, UA
A subset of crops	BE[b], FI[c], IL[f], LV[g], NO[i], PT[j], RS[k], SK[l], SI[m], CH[n], GB[o]

[a]Intended to be included when the LR-NI and LR-POP-NI are developed

[b]Spelt, apple, pear, plum, cherry, peach

[c]Cereals, potato and apple (Heinonen M. 2014. Landrace in situ Conservation Strategy for Finland. MTT Report no 163 https://jukuri.luke.fi/handle/10024/484828)

[d]The Red List contains 2610 entries of species and varieties of the use categories fruit, vegetables, cereals, oil- and protein-producing plants, sugar, starch, fibre plants, medicinal, aromatic and stimulant plants, forage crops and grassland

[e]All crops and vegetables other than apples and potatoes

[f]Cereals, vegetables, legumes, vine crops, spice and aromatic plants, fodder

[g]Fruit crops

[h]For the checklist

[i]Cereals, legumes and vegetables

[j]All food and agricultural crops cultivated in mainland Portugal and the archipelagos of the Azores and of Madeira
[k]Fruits, Vitis, cereals, maize, vegetables
[l]Pulses
[m]When developed (finalised) it will include: selected vegetables, cereals, apple and pear, cereals, fodder crops, etc.
[n]Aromatic and medicinal, Berries, CWR (wild fruits, allium, sorbus, vaccinium, etc…) , forage plants, fruits, grapevine, major crops (cereals, maize, grain legumes, industrial crops), potatoes, vegetables
[o]Cereals, vegetables, forages

Q8 - Table X. Occurrence status (autochtony) of the landraces included in the LR-NI by the countries that responded to the survey.

Occurrence status (autochtony)	Country codes
All landraces present in the country	AM[a], DE, IE[c], LT, NL, NO[f], RO, GB
Only landraces restricted to a geographic location	BE, FI[b], GR, IL[d], IT[e], ME, PT[g], RS, SK, SI, CH[h], UA
Total	

[a]Intended to be used when the LR-NI and LR-POP-NI are developed
[b]Several decades documented growing history, reintroduced from gene bank back to cultivation to their original location area
[c]207 identified so far
[d]There are some local initiatives in Israel to grow landraces in small private gardens. These initiatives might import landraces from other countries that are not originally from the area. We do not consider these as local landraces, and therefore, they are not included in the country's inventory list. Additionally, these initiatives are not official and are not included in the official programs for landrace (LR) conservation
[e]This applies to most of the listed materials
[f]Only landraces that originated in Norway or were imported from abroad but had an important cultural and/or agricultural position in Norway are included. Preferably landraces/varieties that are imported earlier than 1950
[g]Including LR that evolved in the country but the crop is not native (e.g., maize, beans)
[h]Primary collections focus on these crops. = positive list! For the other landraces, they are not in the national conservation program. But data can be collected and introduced in the national db but they are not considered as a conservation variety of CH

Q9 - Number of crops and landraces included in the LR-NI and number of landrace populations included in the LR-POP-NI by the countries that responded to the survey.

Country	Number of crops included in the LR-NI	Number of landraces included in the LR-NI	Number of landrace populations included in the LR-POP-NI
Belgium	6	222[a]	117[b]
Finland	45[c]	≈4000[d]	≈300[e]
Germany	≈150	≈2500	

Ireland	72	207	
Israel	50		3200
Italy	≈100	≈2250	≈5400
Lithuania	10 genera		
Montenegro	30[f]	1251[g]	108
Netherlands	63[h]	6637[h]	
Norway	25	70	
Portugal	123[i]	7492[j]	14814[k]
Switzerland		1949[l]	7814[m]
United Kingdom	24[n]	54[n]	48[n]
Ukraine	12	24	31

[a]150 for apple and 72 for pear
[b]117 for spelt
[c]45 horticultural crops, including ornamental ones
[d]Around 4000 (not all verified as true landraces, not all unique names) received from heritage plant calls in situ
[e]34 conservation varieties. 300 LR accessions of 45 species (incl ornamental) at public gardens of the back up collections
[f]23 plant species of cereals, vegetables, fodder and medicinal aromatic plants and 7 fruit species
[g]421 accessions stored in seeds and 830 accessions of fruit species stored in field collections
[h]In checklist
[i]Crops in the checklist (not in the LR-NI) (Almeida *et al.* 2022)
[j]Unique LR in the checklist (not in the LR-NI) (Almeida *et al.* 2022)
[k]Records in the inventory of all records of all LR (not in the LR-POP-NI)
[l]LR and varieties
[m]Accessions
[n]So far, but not completed yet

Q10 - Verification of the *ex situ* conservation of landraces included in the LR-NI, as reported by the countries that responded to the survey.

Verification of the ex situ conservation of LR included in the LR-NI	Country codes
Yes	BE, FI[a], DE[b], IE[d], IL[e], GR[c], ME[b], NL[g], NO[h], PT[i], RO[j], CH[i], GB[j], UA[k]
Partially	IT[f], RS,
No	LT, SK
Total	

[a]Among seed propagated ones about 80 %; among clonal propagated ones 20 %
[b]Approximately 90 %
[c]Approximately 55-60 %
[d]Approximately 66 %
[e]Since we started with ex-situ collection and not vice versa
[f]Verified for most of those listed in 'Anagrafe Nazionale' della biodiversità di interesse agricolo'
[g]1537 (=23%)
[h]95%
[i]Yes, but there is no readily available information about this
[h]100%
[i]100% if you consider fruit- and berry collections in conservation orchards as *ex situ*
[j]All recorded are included in LR-NI
[k]75%

Q11 - Use of the descriptors recommended for on-farm landrace data published by Negri et al. (2012) or by Weise et al. (2020) in the preparation of the LR-NI and, if applicable, the LR-POP-NI, as reported by the countries that responded to the survey.

Use of the Interactive Toolkit for Crop Wild Relatives Conservation Planning	Country codes
Yes	FI, IE[e], IT, RO, GB[l], UA[m]
Partially	BE[a], DE[b], HU[d], RS, SI[j]
No	GR[c], IL, ME, NL[f], NO[g], PT[h], SK[i], CH[k]
Total	

[a]Lack of resources
[b]Germany has a strict protection of personal data, so we do not used descriptors that would contain personal data of farmers
[c]Not available when the creation of the National Inventory started
[d]Difficulties in using it
[e]Negri *et al* in EURISCO format
[f]Not necessary
[g]No descriptors have been developed yet
[h]Lack of knowledge that they existed
[i]Our gene bank started the process of conserving landraces with farmers who have expressed interest
[j]Not strictly as such, but individual items were included in the interviews with farmers and are also in the questionnaire we have for inclusion of accessions into genebank
[k]CH we started to inventories our LR-pgr in 1998. This was far before the guidelines existed. We developed our descriptors from the scratch. Passport data were most important part. At the moment we are revising the FAO indicators for the national pgrel-reports. They include sustainable use and social aspects
[l]Yes, both Negri *et al.* (2012); Weise *et al.* (2020) used
[m]Both descriptors will be used

Q12 - Other type of data are included in the LR-NI by the countries that responded to the survey.

Type of data	Country codes
Economic value of the crop	AM[a], FI[c], IE, LT, ME[h], RO, RS, CH[b], GB, UA
Economic value of the landrace	AM[a], FI[c], IE, PT[q], RO, CH, UA
Synonyms	AM[a], BE, FI, DE, IL, NL, NO, PT[r], RO, RS, SI[w], CH, UA
Vernacular names	AM[a], BE, FI, DE, GR, IE, IL, IT, LT, ME, NL, NO, PT, RO, RS, CH, GB
Type of cultivation	AM[a], BE, FI, GR, IE, IL, IT, NO, RS, CH, GB, UA
Indicators of genetic erosion	FI[d], IT, PT[s], UA
Reproductive system	AM[a], BE, FI, GR, ME, RO, RS, SI, CH, UA
Genetic data associated to the landrace	BE[b], FI, IL[i], IT[j], ME[l], RS, SI[w], CH, GB[b]
Availability of a reference genome	FI, ME, CH, GB, UA
Threat levels	BE, FI[e], IT, SI, CH[y], GB[b], UA

Ethnobotanical data	AM[a], BE, FI[c], IE[b], IL[b], IT[j], PT, RS[b], SI[b], CH, GB[b], UA
Tolerances to abiotic stresses	AM[a], BE, FI[c,f], IT[j], ME[f], PT, RO, RS, CH[b,z], UA
Tolerances to pests and diseases	AM[a], BE, FI[c,f], IE[b], IT[j], NO[o], PT, RO, RS[b], SI[b], CH[b,z], UA
Cultivation details	AM[a], BE, FI, GR, IE[b], IL[b], IT, ME, NO, RO, RS, SI[b], CH, UA
Ex situ and *in situ* conservation status	AM[a], BE, FI[c], DE, GR, IE[b], IL[b], IT, ME, NL, PT[t], RO, RS[t], SI, CH, GB[β], UA
Images of different parts of the plant	AM[a], BE, FI[g], GR, IL[b], IT, ME[m], NO, RO, RS[b], SI[x], CH
Added value initiatives taken to enhance productivity	BE, FI[h], IL[b], CH[a]
Other/s	IT[k], NL[n], PT[u], SK[v]

[a]Intended to be used when the LR-NI and LR-POP-NI are developed
[b]Partially
[c]With some crops
[d]If possible (comparison data often incomplete)
[e]Partially with conservation varieties
[f]Mainly based on farmers knowledge
[g]Unpublished data
[h]In rare cases
[i]For what and barley
[j]Sometimes
[k]Cultivation location
[l]If analysis were performed
[m]For the populations that were studied
[n]Pedigree, year of recorded cultivation, suppliers of seed (seed trade and/or genebanks)
[o]Some data available
[p]For some images are available
[q]For that information collected from the farm surveys
[r]Only the synonyms of vernacular names
[s]Only for a few LR
[t]Only *ex situ* conservation status
[u]Accession numbers, Institute Codes, crop groups (cereals, fruit trees, etc), taxonomic information (family, genus, species, authorities, subspecies/varieties)
[v]Passport and descriptor data
[w]In part for apple, pear and grapevine
[x]If available
[y]ProSpecieRara does it but on the national level we don't know
[z]Depends on description projects connected to use
[α]Sometimes, but descriptive
[β]All recorded are included in LR-NI

Q13 - What were the limitations found in the generation of the Landraces National Inventory (LR-NI) and the Landraces Population National Inventory (LR-NI)? Please assess their impact (use 1= very low, …, 3= medium, …, 5= very high; 6= unsure). Only numeric values between 1 and 5 are presented.

Limitations	AM	BE	FI	DE	GR	IE	IT	LV	LT	ME	NL	NO	PT	RO	RS	SI	CH	GB	UA
Identifying the landraces grown on-farm	5	2	5	4	2	4	4	5	5	3		4		5	4	3	3	4	1
Producing the landraces checklist	3	5	4	2	3	1		3	4	5	1	3	4	5	3	3	1	2	3
Lack of financial resources	5	3	5	3	5	1		3	3	4	2	5	5	5	5	5	4	3	5
Lack of expertise		2	3		1	1		3	5	3	1	4	2	3	3	1	3	1	1
Lack of political interest at the national level		5		2	5	3		3	5	4	2	2	5	5	5	3	2	3	3
Lack of political interest at the EU level		4		1	4	4		3	5	2			5	5		3	1	4	1
Lack of an EU regulation for plant genetic resources		4		1	4	5		3	5	3				1		3	1	5	1
Lack of an EU agency for genetic resources		5		1		5		3	4	3				1		3	1	5	1

Q14 - Actors involved in the development of the LR-NI and, if applicable, the LR-POP-NI, as reported by the countries that responded to the survey.

Actors	Country codes
Genebanks	AM[a], BE, FI, DE, GR, IE, IL, IT, ME, NL, NO, PT, RO, RS, SK, SI, CH, GB[d], UA
Farmers	AM[a], BE, FI, GR, IE, IL, IT, ME, NO, PT, RO, SI, CH, GB[e], UA
Gardeners	AM[a], BE, FI, GR, IE, IT, LT, RO, SI, CH, GB[f], UA
Agronomists and technical staff of cooperatives and seed companies	AM[a], BE, FI, GR, IT, NL, NO, PT, RO, SI, CH, GB[g], UA
National representative/s in the ECPGR On-farm Conservation and Management Working Group Members	AM[a], BE, FI, DE, GR, IE, LT, ME, NO, PT, RO, RS, SI, CH, GB[h]
Authorities involved in the development of conservation strategies of genetic resources	AM[a], BE, FI, DE, GR, IE[b], IT, ME[c], PT, RO, RS, SI, CH, GB[i], UA

[a]Intended to be used when the LR-NI and LR-POP-NI are developed

[b]Dept of Agriculture, Food and the Marine, Ireland

[c]Ministry of Agriculture, Forestry and Water Management, Ministry of Ecology and Sustainable Development, University of Montenegro

[d]8 UK genebanks involved

[e]48 so far but not completed yet

[f]300 seed guardians via Garden Organic NGO

[g]3 farmer-based cooperatives

[h]2 members

[i] UK Defra and statutory bodies in Scotland, Wales and Northern Ireland

Q15 - How could the future Plant Genetic Resources Research Infrastructure help in the creation and updating the Landraces National Inventory (LR-NI) and the Landraces Population National Inventory (LR-POP-NI)? Please assess the impact (use 1= very low, …, 3= medium, …, 5= very high; 6= unsure). Only numeric values between 1 and 5 are presented.

Potential contribution	AL	AT	BE	FI	HU	LV	LT	ME	NO	PT	RS	CH	UA
Financial support	5	5	3	5	5	3	4	3	5	5	5	3	
Training activities	3	5	3	5	5	3	3	4	3		3		5
Technical expertise and consultancy	4	5	3	3	3	3	4	5	5	2	3	4	3
Facilitating data standardization and interoperability	3	5	5	3	3	3	4	4	4	4	5	4	3
Facilitating compatibility with EURISCO database and uploading	2	5	5	3	3	3	3	2	3	4	3	4	1
Promoting collaboration among stakeholders	3	5	5	3	3	3	4	4	4	4	4	5	3
Organising workshops and seminars for knowledge exchange	4	5	5	5	5	3	4	4	4	4	4	5	3
Supporting the development of digital tools for data collection and management	4	5	5	4	3	3	2	5	4	5	5	5	1

Q16 - Additional comments.

Country	Additional comment/s
Latvia	There is very little systematic information about what is being grown on farms in Latvia. Family farms were forcibly collectivised after WW2 during the Soviet occupation, which only ended in 1991. Some old varieties and landraces were collected by breeders and maintained at agricultural institutes. These are now in the *ex situ* collection in the genebank. I presume that the material that was not collected at this time, has been lost, particularly cereal accessions. The material collected has been used in breeding programs, even up to the present day. There may be a few exceptions for niche crops such as hemp, field beans and some others (e.g. vegetables), which were maintained on a small scale in home gardens. Where there is information about these breeders and crop experts have collected them, and they are in the Latvian genebank. Some of these accessions have been registered as conservation varieties (e.g. 2 hemp varieties, and 1 field bean). Currently, the registration of some other old varieties as conservation varieties is in process (for 4 wheat and 1 rye accession). The main challenges to developing an on farm LR inventory is the lack of information, as well as a lack of human resources (time). The Latvian genebank is currently in the process of developing the in situ conservation plans, and so this is currently the priority. Given the relatively small agricultural sector in Latvia, both in terms of area and the number of farms, I think that the breeders/crop experts working in the agricultural institutes are mostly aware of old varieties/landraces that are still extant (particularly for field crops). Some vegetable accessions may still be unknown, but expeditions have been periodically organised to look for novel vegetable and fruit accessions. Possibly a public call could identify further accessions, however, this would require a substantial investment of time by the crop experts to assess any potentially novel accessions, and there is little support for this currently from the Ministry of Agriculture.
Lithuania	So far, the work is still at the beginning stage which is partially caused by reducing staff. In general, lack of an EU regulation for plant genetic resources is a major factor affecting the concerted national activities including creation of LR conservation and use strategy and action plan.
Malta	Malta currently lacks a comprehensive checklist and inventory of landraces present on the islands. The latest annotated inventory dates back to the early 1920s, with many landraces now extinct due to discontinued use and limited systematic conservation efforts over the years from that period leading to present day. As a result, we have only minimal information to contribute to the questionnaire at this stage.
Netherlands	A sound technical approach is needed, making sure the LR are securely conserved and made available to users (anywhere in the world). The current local on farm approaches are excellent for promoting and supporting the use of LR, usually it is not effective in conserving and providing access.
Norway	There are farmers and groups of farmers in Norway that are actively growing and maintaining landraces and traditional varieties. Nevertheless, on-farm management is not established as a formal

	conservation strategy, and there is no national monitoring of diversity in farmer's fields. The Norwegian Community Seed Bank was also established in 2018, enabling better access to planting material of landraces and traditional varieties of grain and vegetables. There seem to be an increasing interest in local and traditional produce among consumers. To agree on a strategy for the implementation of on-farm management and to further improve the conditions and opportunities for farmers who wish to grow landraces and traditional cultivars on-farm remain important in the coming period.
Portugal	List of references used in the text: Almeida MJS (2018) *Conservation Strategies for Portuguese Crop Landrace Diversity.* University of Birmingham. PhD. Available at: https://etheses.bham.ac.uk/id/eprint/9502. Almeida MJ, Barata AM, De Haan S, Joshi BK, Magos Brehm J, Yazbek M and Maxted N (2024) Towards a practical threat assessment methodology for crop landraces. *Frontiers in Plant Science* 15:1336876, doi: 10.3389/fpls.2024.1336876. Martins S, Carnide V, Vences F, Sáenz de Miera L and Barroso MR (2004) "Genetic diversity among north Portugal landraces of *Brassica oleracea* subsp. *capitata* analysed with RAPD markers." In: J Vollmann J, Grausgruber H and Ruckenbauer P (eds) *Genetic Variation for Plant Breeding.* EUCARPIA & BOKU - University of Natural Resources and Applied Life Sciences, Vienna. pp. 117–120. Oliveira HR, Tomás D, Silva M, Lopes S, Viegas W and Veloso MM (2016) Genetic diversity and population structure in *Vicia faba* L. landraces and wild related species assessed by nuclear SSRs. PLoS ONE 11(5): e0154801. doi:10.1371/journal. pone.0154801.
Slovakia	Our gene bank is focused on the *ex situ* conservation of plant genetic resources for food and agriculture. On-farm conservation is challenging for us in terms of personnel and financial capacity. We are looking for cooperating farmers for the propagation and conservation of landraces.
Ukraine	Russian aggression has caused great destruction to the entire agrarian sector of Ukraine; its occupation of large areas where landraces were also maintained makes it very difficult to establish LR-NI, identify landraces and collect their planting material for ex situ insurance conservation.