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Farmer's Pride

Networking, partnerships and tools to enhance *in situ* conservation of European plant genetic resources

Supporting actions for *in situ* conservation and sustainable use of plant genetic resources in Europe

Citation

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Contents

1.0 Introduction

In 2017, the Horizon 2020 Framework Programme of the European Union approved the Farmer's Pride project entitled 'Networking, partnerships and tools to enhance *in situ* conservation of European plant genetic resources'. The project sought to build an integrated multi-actor network of stakeholders, sites and populations for the *in situ* conservation of plant genetic resources (PGR), with complementary conservation *ex situ* in genebanks, to enhance the availability of, and accessibility to PGR by the user community—including farmers, plant breeders and researchers—to underpin sustainable agriculture, food, nutrition and economic security in Europe, particularly in the context of climate change (see Box 1 for definitions of key terms).

The other main objectives of the Farmer's Pride project were to:

1. Identify and engage the full range of stakeholders in the conservation and sustainable use of PGR, and establish durable partnerships
2. Increase knowledge of crop wild relative (CWR) and landrace diversity in Europe as a basis for systematic conservation planning
3. Enhance PGR population management by determining best practices and publishing practical guidelines and tools
4. Assess the economic value of PGR, the costs of conserving them, and the public's willingness to pay for conservation services
5. Collect empirical evidence for traits sought by plant breeders and farmers to diversify and sustain agriculture in the region, and identify *in situ* PGR populations containing those traits
6. Improve synergies between actors in *in situ* and *ex situ* PGR conservation and sustainable use to ensure adequate and efficient conservation of genetic diversity, as well as facilitated access to PGR conserved *in situ*
7. Influence policy developments towards improved conservation and sustainable use of PGR to meet Europe's commitments under global legislative and policy instruments

In the context of these objectives, the purpose of this document is to provide a summary of the key supporting actions that underpin the establishment of a European network for *in situ* conservation and sustainable use of plant genetic resources, as developed in the Farmer's Pride project. A clear understanding by policymakers of the fundamental elements of PGR conservation and sustainable use described in this document is vital to support the implementation of cost-effective conservation initiatives and incentive mechanisms, increase engagement with the private sector, and ensure sustainable funding for PGR conservation and sustainable use to underpin resilient and sustainable agriculture in Europe. The establishment of a European network for *in situ* conservation and sustainable use of plant genetic resources is vital to the success of regional and national actions for biodiversity conservation, resilient agriculture, and food, nutrition, economic and livelihood security. Table 1 provides the key messages for actions by policymakers and the benefits that the key stakeholders would derive from the network. For details of the steps taken towards the establishment of a European network for *in situ* conservation and sustainable use of plant genetic resources, see Maxted and Kell (2021)[1].

[1] Maxted, N. and Kell, S. 2021. *European Network for In situ Conservation and Sustainable Use of Plant Genetic Resources*. Farmer's Pride, University of Birmingham, Birmingham, UK. Available at: D4.4_European_in_situ_PGR_conservation_network.pdf

Box 1: Definitions of key terms

Landraces	A landrace of a seed-propagated crop is a variable population, which is identifiable and usually has a local name. It lacks 'formal' crop improvement and is characterized by a specific adaptation to the environmental conditions of the area of cultivation (e.g., tolerant to the biotic and abiotic stresses of that area) and is closely associated with the uses, knowledge, habits, dialects and celebrations of the people who developed the landrace and continue to grow it[2].
Crop wild relatives (CWR)	CWR are wild plant species that are genetically close relatives of cultivated species[3].
***In situ* conservation**	The conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings and, in the case of domesticated or cultivated species, in the surroundings where they have developed their distinctive properties [4]. In the case of landraces, it often goes beyond conservation, and includes continuous development and adaptation of the LR which is referred to as "community agrobiodiversity management" and emphasizes the dynamic aspect of *in situ* conservation.[5]
***Ex situ* conservation**	The conservation of components of biological diversity outside their natural habitats[3].
Plant genetic resources (PGR)	Plant genetic material which is of value as a resource for the present and future generations of people." (IPGRI, 1993)

2.0 Key supporting actions

2.1 Identifying and engaging PGR conservation and sustainable use stakeholders

To gain an understanding of the range of stakeholders involved or with an interest in *in situ* (including on-farm) conservation and sustainable use of PGR, and to help ensure full stakeholder representation in the European network, Farmer's Pride carried out an online stakeholder survey which was available in ten languages from 03 May 2018 until 01 April 2019. The project partners and Farmer's Pride Ambassadors[6] disseminated the survey widely to potentially interested stakeholders, including members of the European Cooperative Programme for Plant Genetic Resources (ECPGR); farmer, gardener and trade associations; seed-saver networks; plant breeding and seed companies; public research and technology institutes; botanic gardens; national parks; agro-NGOs; protected area managers; government ministries and other policymakers; and national PGR coordinators. The target

[2] Vetelainen M., Negri V. and Maxted N. 2009. *European landraces: on farm conservation, management and use*. Bioversity Technical Bulletin No. 15, Bioversity International, Rome, Italy. bioversityinternational.org/e-library/publications/detail/european-landraces-on-farm-conservation-management-and-use/

[3] Maxted N., Ford-Lloyd B.V., Jury S., Kell S. and Scholten M. 2006. Towards a definition of a crop wild relative. *Biodiversity and Conservation* 15(8), 2673–2685.

[4] CBD. 1992. *The Convention on Biological Diversity*. Secretariat of the Convention on Biological Diversity. CBD Secretariat, United Nations Environment Programme, Montreal. cbd.int/convention/text/

[5] FAO. 2011. *Second Report on the State of the World's Plant Genetic Resources for Food and Agriculture*. Food and Agriculture Organization of the United Nations, Rome, Italy. http://www.fao.org/3/i1500e/i1500e00.htm

[6] See farmerspride/who-we-are/

area was geographic Europe, the EU member states, Turkey (represented as a partner in the Farmer's Pride project), the Russian Federation, and the Caucasus.

The results exceeded our expectations in terms of the overall number of responses (1022), the geographic coverage, the breadth of stakeholder organizations represented, and the interests of respondents in the *in situ* conservation and sustainable use of PGR. Fundamentally, more than 56% of respondents are interested in becoming a member of a new European network for *in situ* conservation and sustainable use of PGR. Notably, all countries in the target area were represented in the sample, and critically, representatives of all the anticipated main broadly defined stakeholder groups responded to the survey, including independent farmers, protected area managers, seed companies and policymakers.

The survey respondents have interests in all aspects of *in situ* conservation and sustainable use of PGR—from national policy development, through capacity building, improving access to material, direct utilization for own consumption or commerce, to research into stress resistance traits, new markets for neglected crops, diversification of grain-based products, and general resilience of humans and the environment. They also work with all types of PGR, including: crop landraces; crop wild relatives (CWR) and other wild species; conservation, amateur and obsolete varieties; forage and cereal mixtures; and a range of other types of heterogeneous populations.

The majority of survey respondents expressed a wish to receive further information about the Farmer's Pride project and the establishment of the European network—a clear indication of the interest in *in situ* conservation and sustainable use of PGR and of the establishment of the network. Combined with the fact that most respondents also indicated an interest in becoming a member of the network, and the range of stakeholder groups, activities and interests that the survey revealed, the results provided concrete evidence of the need for resources to not only establish the European network, but to sustain it into the future.

Further, on 16 June 2020, an online survey was launched to gather expressions of interest in joining the European network from farmers, protected area managers, gardeners, seed producers and other land managers—the custodians of crop landraces and CWR populations *in situ*. By 23 July 2021, there were 75 expressions of interest, and these are plotted on an interactive map[7] embedded in a web page dedicated to the European network[8].

2.2 Plant genetic resources in Europe

2.2.1 Landraces

The Farmer's Pride project has documented 19,335 records of landrace populations conserved *in situ*, including forage, cereal, pulse and garden crops, and fruit trees from 17 institutions[9]. Notably, 19.8% of the records are located in Natura 2000 protected areas. Analysis of 100 detailed case studies across 14 European countries to fully understand why and how landraces are conserved and managed in

[7] https://tinyurl.com/d34n3dpp
[8] farmerspride/network/
[9] Raggi L., Barata A.M., Heinonen M., Iriondo Alegría J.M., Kell S., Maxted N., Maierhofer H., Prohens J., Ralli P. and Negri V. 2020. In situ *plant genetic resources in Europe: landraces*. Farmer's Pride: Networking, partnerships and tools to enhance *in situ* conservation of European plant genetic resources. Available at: farmerspride/wp-content/uploads/sites/19/2020/06/D1.2_in_situ_PGR_in_Europe_landraces.pdf (Accessed 02.08.21)

Europe has shown that they are valued for their resistance to biotic and abiotic stresses or good productivity under difficult or harsh climatic conditions, traditional reasons, or organoleptic peculiarities which make them highly valued in local and city markets[4]. There is also an increasing demand for existing and new landrace varieties for organic agriculture, and this demand augurs well to their increased conservation through use. There are also relevant policies put in place by the European Commission and local authorities, such as EU Commission Directives 2008/62/EC[10], 2009/152/EC, 2010/60/EU[11], 2018/848 and EU Commission Implementing decisions C (2014) 1681[12], each of which aims to enhance *in situ* conservation and use of landraces by facilitating access to markets[13,14]—however, these are not effective to support the conservation and sustainable use of a sufficiently wide range of the extensive landrace diversity that is maintained by farmers and growers in the region.

The Farmer's Pride project has also developed guidelines[15] to help landrace propagation management and improve access to landrace seeds, based on the collection and analysis of 105 case studies of European *in situ* maintained landraces and a review of the existing literature. The guidelines provide recommendations on the maintenance of landrace identity and genetic diversity, landrace multiplication for both sexually and asexually propagated crops, and a management plan for landrace diffusion and multiplication both within and outside its original locality. They also provide recommendations for improving access to *in situ* landrace propagation materials for breeding, development and research.

A 'Best practice evidence-based database for *in situ* landraces' was also published to promote landrace maintenance (available at https://www.ecpgr.cgiar.org/in-situ-landraces-best-practice-evidence-based-database). The database provides access to evidence-based information on the benefits, opportunities and practices of landrace cultivation to help in decision-making and to promote *in situ* maintenance as a means of conserving and diversifying PGR for food, nutrition and livelihood security. The tool includes examples of *in situ* management practices and of adding value to landraces—for example, marketing options—for different crops and socio-cultural, environmental and economic contexts.

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[10] EC. 2008. Commission Directive 2008/62/EC of 20 June 2008 providing for certain derogations for acceptance of agricultural landraces and varieties which are naturally adapted to the local and regional conditions and threatened by genetic erosion and for marketing of seed and seed potatoes of those landraces and varieties. eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex:32008L0062

[11] EC. 2009. Commission Directive 2009/145/EC of 26 November 2009 providing for certain derogations, for acceptance of vegetable landraces and varieties which have been traditionally grown in particular localities and regions and are threatened by genetic erosion and of vegetable varieties with no intrinsic value for commercial crop production but developed for growing under particular conditions and for marketing of seed of those landraces and varieties. eur-lex.europa.eu/eli/dir/2009/145

[12] EC. 2014. 2014/150/EU. Commission Implementing Decision of 18 March 2014 on the organization of a temporary experiment providing for certain derogations for the marketing of populations of the plant species wheat, barley, oats and maize pursuant to Council Directive 66/402/EEC (notified under document C(2014) 1681). eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32014D0150

[13] Dulloo M. E. 2019. Enabling the establishment of a European network for *in situ* conservation of PGRFA. *Crop wild relative* 11, 13–16. CWR_Newsletter_Issue_11.pdf

[14] Spataro G. and Negri V. 2013. The European seed legislation on conservation varieties: focus, implementation, present and future impact on landrace on farm conservation. *Genetic Resources and Crop Evolution* 60, 2421–2430 doi:10.1007/s10722-013-0009-x

[15] Caproni L., Raggi L. and Negri V. 2020. In situ *landrace propagation management and access guidelines*. Farmer's Pride, University of Birmingham, Birmingham, UK. Available at: D2.4_In_situ_landrace_propagation_management_guidelines.pdf

In some European countries, community seed banks (CSBs) play a vital role in conserving and providing access to landraces, combining *ex situ* and *in situ* conservation[16]. The Farmer's Pride project analysed the services and functioning of CSBs and their complementarities to genebanks and highlighted the necessity to bring all stakeholders together at national and international levels. The common vision of CSBs is to disseminate a wide range of landraces with diverse agro-climatic conditions to as many farmers and gardeners as possible, to support the adaptation and further development of these diverse crop varieties. In this regard, CSBs have a different approach to *in situ* conservation which they refer to as "dynamic management" in which they consider farmers and gardeners as their main target group, not only as stakeholders conserving PGR, but also adapting, marketing, and using them according to their needs.

The regional inventory of landrace cultivation reported in this project represents a first attempt at documenting on-farm landrace diversity and their occurrences across the European region. However, the study only managed to gather information from 14 out of the 44 European countries[17]. For example, major gaps exist for France, Netherlands, Belgium, Turkey and many countries in eastern Europe, including Russia. It is now recommended to expand the study to cover other countries in the European region so that a more comprehensive picture of the distribution and occurrences of landrace cultivation can develop over time. This will allow for the development of more effective policies and future actions across the whole of Europe and promote the use of landrace diversity in crop improvement programmes.

The study also identified that there are different levels of knowledge about the occurrences of landraces in different countries and there is a need to raise awareness and build capacities among these countries to inventory national landrace diversity. The presence of significant diversity within Natura 2000 sites also calls for promotion of landrace conservation within these sites and the development of collaboration with Natura 2000 site managers to ensure their conservation and to facilitate access and use of the landrace genetic materials.

There is also a need to further recognize and strengthen CSBs as a mechanism to disseminate a wide range of landraces with diverse agro-climatic conditions to as many farmers and gardeners as possible, to support the adaptation and further development of these diverse crop varieties. It is also necessary to stimulate the EU to favour the registration of landraces as conservation varieties and establish product labelling and markets to stimulate their use, as well as to support the establishment of CSB networks throughout Europe.

The vital contribution of landrace conservation and sustainable use to support the implementation of the EU 'Farm to Fork' strategy needs to be recognized, and more support provided via the CAP—particularly in the context of promoting the expansion and sustainability of low input and organic agro-ecological systems.

[16] Bartha B., Fehér J., Platzer E. and Poulsen G. 2021. *Community seedbank management guidelines along four network showcases*. Farmer's Pride, University of Birmingham, Birmingham, UK. Available at: D2.3_Community_seedbank_management_guidelines.pdf

[17] worldometers.info/geography/how-many-countries-in-europe/

2.2.2 Crop wild relatives

A major achievement of the Farmer's Pride project has been to increase our knowledge of the distribution of regionally important CWR species in Europe (Figure 1)[18], which were selected based on the economic importance of the associated crops, the potential use of the CWR for crop improvement, and the threat status of the CWR species. Among these priority CWR, 62% are related to human food crops, 36% to forage and fodder crops, and the remaining 2% to both human food and fodder or forage crops[8]. High quality global population occurrence data for the majority of the target CWR species were collated. This dataset constitutes the largest global database of occurrences for the target CWR generated to date and includes records in 43 countries in Europe and Asiatic Turkey.

Information about active *in situ* conservation of CWR populations was also derived through an online survey carried out in nine European languages. The results indicate that most of these conservation actions (91.9%) are related to a network of *in situ* conservation, such as Natura 2000, national or local protected area networks, research centres or genebank networks. The survey also found that most active *in situ* conservation is focused on more than one species and that the most widespread actions performed for CWR species is 'monitoring and census of the species'. Other common practices include: 'phytosociological monitoring', 'seed collection and storage in a genebank', 'controlled grazing' and 'limited use of the territory'[8].

One of the key messages which came out of the survey and analysis was that land managers of sites containing CWR commonly lacked awareness about the presence of the species and their value to food security. However, once they learnt about them through the survey, the land managers became very keen to engage in the *in situ* conservation of these valuable resources. Many protected area managers are already undertaking *in situ* conservation of CWR species that are threatened, rare or endemic within their territory. However, the passive conservation of many CWR populations within protected area networks is still insufficient because active *in situ* conservation of CWR does not frequently occur and needs to be promoted. In addition, these actions are rather limited in scope as they are more oriented to the conservation of the species rather than to the conservation of their genetic diversity[8].

A more detailed study on the potential of Natura 2000 to conserve CWR shows that the Natura 2000 network contains at least 519 priority CWR taxa within just 31% of its sites[19]. In addition, 84 priority taxa have been identified as characteristic species of 83 priority habitats of the Habitats Directive 92/43, and 17 of them are also listed in Annexes II and IV. These findings support the value of using the existing biodiversity conservation infrastructure in Europe for *in situ* conservation of CWR. With very little additional cost involved, the *in situ* conservation of European priority CWR could provide added value to the Natura 2000 network through their important contribution to the maintenance of food, nutrition and economic security.

[18] Rubio Teso, M.L., Álvarez Muñiz, C., Gaisberger, H., Kell, S., Lara-Romero, C., Magos Brehm, J., Maxted, N. and Iriondo, J.M. 2020a. In situ *plant genetic resources in Europe: crop wild relatives.* Farmer's Pride, University of Birmingham, Birmingham, UK. Available at: D1.2_In_situ_PGR_in_Europe_crop_wild_relatives.pdf

[19] Rubio Teso M.L., Álvarez Muñiz C., Gaisberger H., Kell S., Lara-Romero C., Magos-Brehm J., Maxted N. and Iriondo J. 2020b. *Crop wild relatives in the Natura 2000 network.* Farmer's Pride, University of Birmingham, Birmingham, UK. Available at: MS19_Crop_Wild_Relatives_in_the_Natura_2000_Network.pdf

Figure 1. Distribution of 3,094,231 localities of 616 European priority CWR taxa in the study area based on high quality geographic coordinates.

2.3 Survey of useful adaptive traits among farmers and breeders

In the present context of climate change, identifying which landraces or crop wild relative populations might contain the currently most-demanded traits for crop breeding has become an urgent issue. To determine which crop traits are most needed for satisfying future agricultural and market needs, a questionnaire was prepared using the online tool EUSurvey. The questionnaire was circulated among farmers, breeders and seed companies. The ten crops that have a greater demand for useful adaptive traits are soft wheat, tomato, common bean, apple, potato, durum wheat, brassica complex, barley, faba bean and lentil. For most survey respondents (64), abiotic and biotic stress tolerance/resistance were the most demanded groups of traits, although this differed for each crop. Traits related to good nutritional quality were also highly relevant[20].

Based on the survey results, predictive characterization techniques were used to identify CWR populations with a higher probability of containing the identified desired traits than if randomly selected. Two different approaches were followed—the environmental filtering method and the calibration method. Targeted CWR populations were those native to Europe, with occurrence records and evaluation data, and whose related targeted crops obtained a high number of responses in the survey. An evidence-based approach was also used to identify landraces with the desired traits. This relied on a collection of 105 landrace case studies where information on the most important agronomic traits was retrieved from landrace descriptions given by those who cultivate or have deep knowledge of them[21]. For this approach, landraces of both European native and introduced crops were considered.

Populations predictively containing abiotic stress resistance/tolerance traits (i.e., drought tolerance, salinity tolerance or waterlogging tolerance) were found in CWR of wheat (*Aegilops* spp.), lentil (*Lens* spp.) and lupin (*Lupinus* spp.). Populations predictively containing nutritional value traits (i.e.,

[21] ecpgr.cgiar.org/in-situ-landraces-best-practice-evidence-based-database

acyanogenic) were found in CW of white clover (*Trifolium repens*). Abiotic stress resistance/tolerance, biotic stress resistance, and valuable nutritional traits were reported by those who described the landraces for 19, 9 and 15 landraces of different crops respectively. Both approaches used allowed the identification of PGR that can be targeted in breeding and pre-breeding studies where *ad hoc* trials should be carried out to confirm the presence of useful traits.

Predictive characterization is proving to be a powerful tool to narrow down the choice of germplasm for use in plant breeding programmes and should be extended to a wider range of crops, CWR and landraces with the buy-in of the plant breeding sector and farming community.

2.4 Access to *in situ* conserved plant genetic resources

It is clear that for Europe to be able to benefit from conservation and use of landrace and CWR genetic resources, access to this material is essential. However, such access is currently very restricted in the *in situ* context, except for members of CSBs. To obtain a clear picture of the bottlenecks in access to *in situ* conserved PGR, an analysis was carried out to identify and describe the various limiting factors. The main bottlenecks are:

1. The potentially useful PGR are unknown to the users – they do not know they exist or where they exist.
2. The value of the PGR in terms of useful traits or other possible applications, is generally unknown until they are fully characterized.
3. Access to the PGR is often not organized, particularly with regard to CWR – a potential user lacks information such as the availability of the PGR for utilization, how to get access, where to go to, and who to approach.
4. The access and benefit-sharing conditions under which PGR material can be obtained and used are in many cases unclear to potential user and the manager/owner/custodian.

To explore possible mechanisms that would address these bottlenecks, a number of activities were undertaken in the Farmer's Pride project.

We discovered that farmers who are maintaining landraces on-farm are mostly aware of their potential value and of the importance of making them available to external users. They understand the role of PGR diversity in contributing to finding solutions to the food insecurity in the world and they readily make available their diversity to external users. To address the bottlenecks related to the procedures and conditions for accessing CWR material, discussions were held with stakeholders and it became clear that many managers of nature conservation organizations and even some botanical gardens have little or no awareness of the potential value of the PGR diversity in their care. The reluctance of other nature-based organizations to provide access to their genetic material for economical purposes (e.g., private/commercial plant breeding) is due possibly to their fear of loss of intellectual property rights or simply for ethical reasons.

Another observation was that procedures and conditions for external use (outside their own network) often do not exist. This is illustrated by the experiences in the Netherlands where attempts have been made to establish procedures through a series of conversations with nature conservation organizations. While there is a willingness to make their PGR available, there are no procedures to allow them to do it. One of the nature conservation organizations consulted agreed to give the permission for the national genebank to present the diversity on their website and nominated a

contact person in the organization that can be contacted by the genebank, when a request would arise. Every request will, initially, be taken case by case, and the national genebank can help in reaching an agreement (defining the conditions for use), organizing the sampling of the species in-nature, and the shipment of the sample to the user (including the phytosanitary and legal requirements involved).

To tackle the lack of awareness on PGR, a possible mechanism is to have a central point that would collect data, or provide access to data, about existing *in situ* managed PGR, and make these available to potential users. As *ex situ* genebanks are the places where users go to obtain PGR, genebanks could evolve into PGR centres which could provide access to information about *in situ* material that can be found in their territories. The project tested this mechanism with the Turkish and the Dutch genebanks in compiling information about the *in situ* PGR in their countries and presenting it in a website. This proved difficult, as the information was often lacking, not available for publication on a website and/or only available in the national language. However, CGN created a website[22] to show how access to *in situ* conserved PGR material could be achieved[23] and which can be expanded with information from other countries.

Options for providing access to PGR germplasm conserved *in situ* were further reviewed[24] and four clear alternative options were identified (Figure 2):

1. Option 1 is the standard route through which germplasm enters the genebank, and is managed and disseminated:
    a. Population samples are either collected from the wild or on-farm location; on entering the genebank, the samples are registered and documented; they are cleaned and dried to 15 ±3 % relative humidity (for orthodox-seeded species); the germination rate is tested, and if over 85%, the sample is packaged and banked at 18 ±3°C; upon request, a viable seed sample of 40–50 seeds is made available under standard terms of access and benefit-sharing (ABS).
    b. The sample is tested periodically for the germination level, and if the seed viability is less than 85%, the sample is regenerated to ensure the seed viability is maintained above 85%.
2. Option 2 is similar to the standard *ex situ* 'black box' sample:
    a. As for option 1, the samples are registered and documented, cleaned and dried, the germination tested, then packaged and banked, with the banked sample tested periodically for the germination level.
    b. Unlike option 1, the sample is not made available to users and is only available to the donor—possibly as part of their *in situ* monitoring and population reinforcement management actions.
3. Option 3 involves all the standard germplasm banking steps but here the *in situ* back-up samples are not tested for germination or regenerated. In this option, regeneration is replaced by resampling from the original population(s)—for example, once every 15 generations.
4. Option 4 involves the user identifying the *in situ* population(s) they wish to obtain germplasm from and communicating this to the genebank. The genebank then either collects the sample(s)

[22] projects.cgn.wur.nl/farmerspride/index.html
[23] van Hintum T., Csörgõ S., Veteläinen M., Bartha B. and Heinonen M. 2021. *Improving access to* in situ *plant genetic resources*. Farmer's Pride, University of Birmingham, Birmingham, UK. Available at: D3.4_Improving_access_to_in_situ_plant_genetic_resources.pdf
[24] Maxted, N. 2021. The conservation and use of CWR: the *in situ* perspective. *Crop Wild Relative* 13, 32–35.

following the usual procedures, or the population maintainer (e.g. a farmer, protected area manager, or other land manager) supplies a sample. The material is then processed and suuplied to the user in the same way as in option 1.

Each option has advantages and disadvantages. Option 1 would significantly increase genebank expenditure in processing a large number of additional *in situ* population samples, but would ensure the *in situ* germplasm would be available to the user. Option 2 would reduce the processing costs to the genebank, but would not facilitate user access to the *in situ* germplasm. Option 3 would reduce the genebank management costs (with regular re-sampling of the original population the need for germination testing and regeneration would be removed), it would provide *in situ* sample characterization and evaluation alongside *ex situ* material, and it would provide easy access to the *in situ* conserved germplasm for users. Option 4 would require additional but limited cost to the genebank, and provide easy access to the *in situ* conserved germplasm for users.

The ideal in terms of backing up *in situ* conserved populations *ex situ* and providing access to the germplasm for use would be provided by option 3. The *in situ* population samples would be made accessible alongside the *ex situ* conserved material, with no distinction being visible to potential users. The *in situ* population samples could also be characterized alongside existing *ex situ* material, and the additional cost of *in situ* back-up to the genebank would be moderate. It would also raise the profile of the genebank in relation to the user community by supplying both *ex situ* and *in situ* conserved material—potentially at least double the diversity available to end-users—and ensure the current genetic diversity available best reflects the diversity evolving *in situ*.

In the case of landraces, another possibility would be to strengthen the collaboration between national genebanks and CSBs to make optimal use of the networking function of CSBs, and their well-established links between CSB-based *ex situ* and on-farm *in situ* conservation. Importantly, it is always the legal owner of the conserved material that decides on how the material is made available and used. Therefore, some form of written agreement is required between the provider and requester that sets out the conditions under which the material is made available and can be used.

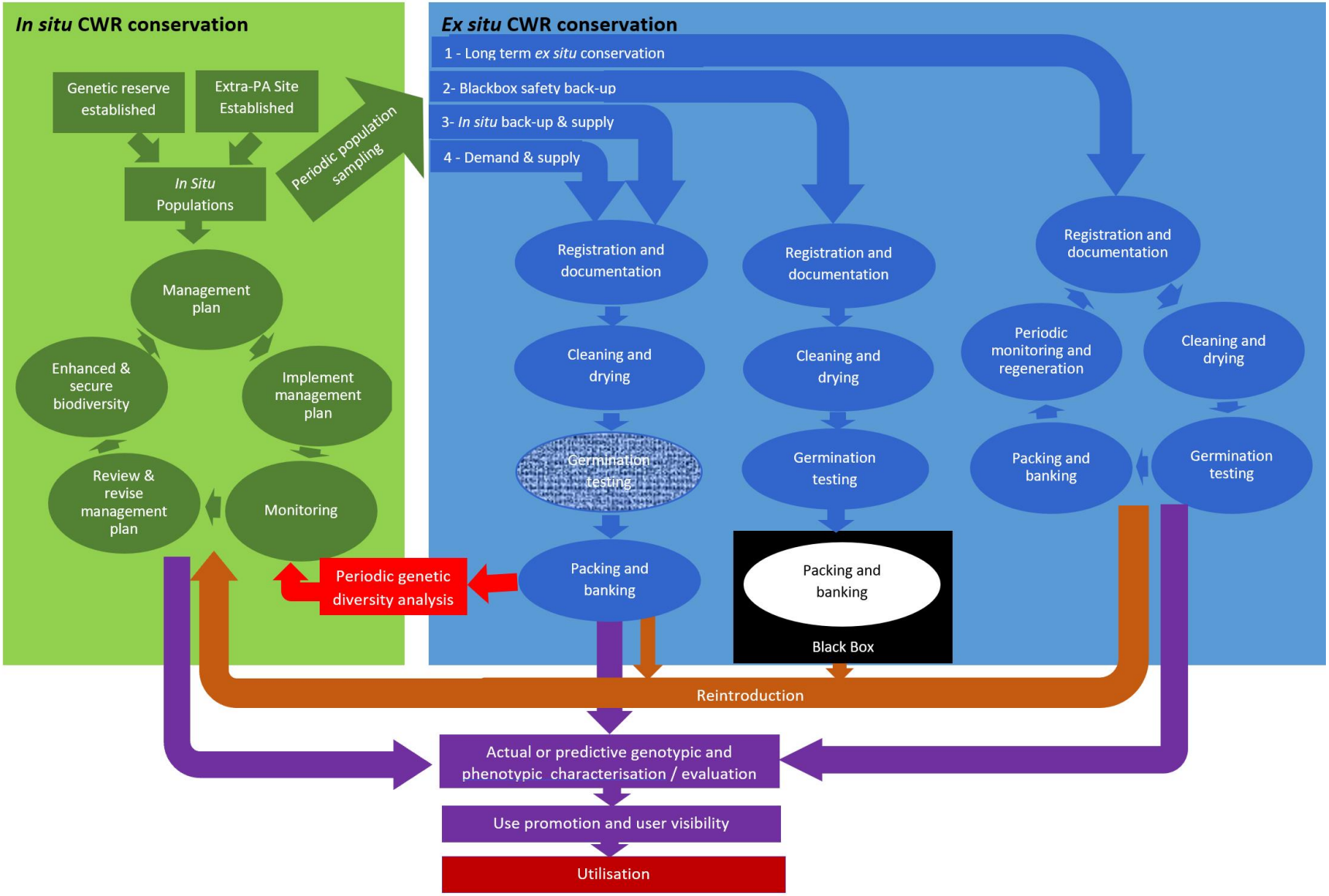

Figure 2. Integration of *in situ* and *ex situ* PGR conservation for utilization – four options. Note PA=protected area.

2.5 Support mechanism for effective conservation and use of landraces

Given that agrobiodiversity is associated with a range of important but poorly quantified public good ecosystem services, its conservation requires public support. For European Union (EU) countries, the Common Agricultural Policy (CAP) is considered to be the critical public policy in terms of both impacts and funds dedicated to the conservation of biodiversity. Its second pillar, through the implementation of Rural Development Plans, contains policy measures that relate to "*environmental, climate and other management commitments*" and comprise a wide range of activities relevant to conservation, sustainable use and development of genetic resources.

Under the post-2013 CAP (which ran until 2020), Farmer's Pride identified a number of institutional arrangements through a desk review/expert consultation. The Alpine countries (Austria and Switzerland) have large formal annual direct support programmes, while relatively less wealthy but higher diversity countries such as Greece have had more modest and temporary ones. By contrast, Hungary and the UK have no direct support programmes at all. Support payments for wheat landraces, where they exist, were in the range of €120–€251/ha; although relatively little of the existing support, even in those countries with large programmes, is focused specifically on wheat landraces (Austria 1.2% and Greece 8.3%). Expert opinion plays a key role in the inclusion of specific landraces on threat lists, in part due to the lack of data for potential indicators (e.g., variety/cultivar areas and farmer numbers); while recognition of differing threat levels plays no role in determining support payments in any of the sample countries.

Estimated conservation costs of €1.8m–€33m p.a. are well within the general public's willingness to pay (€80.2m p.a.), resulting in a high benefit-cost ratio (2.4–44.6) according to the results of a survey[25] designed to determine the general public's willingness-to-pay (WTP) for wheat landrace conservation in Europe (demand side), as well as to assess the willingness of wheat farmers to participate in on-farm conservation of wheat landraces (supply side). Given the public's levels of WTP for wheat landrace conservation, which—even at the relatively low levels found in the Alpine countries and the UK—is sufficient to fund critical conservation interventions, there is potential to better align agrobiodiversity conservation funding with EU citizens' preferences for the conservation of agricultural diversity.

Current support payment levels (€120–€251/ha), where they exist, are on average below that stated by farmers as necessary to cover their opportunity costs (€300–€550/ha). Furthermore, given the high heterogeneity in farmers' WTP compensation for participating in public good conservation activities—including across different landraces—exploration of the potential for improved cost-effectiveness to be achieved through conservation tender mechanisms should be explored. Savings relative to a uniform payments approach could be significant (21–60%).

Such a tender mechanism approach when implemented in conjunction with clear conservation performance targets (such as areas under threatened landrace cultivation, number of farmers involved, spatial configuration, seed access and exchange) as used in PES-based Payments for Agrobiodiversity Conservation Schemes[26] elsewhere, could also contribute to the new CAP post-2020

[25] Covering Austria, Greece, Hungary, Switzerland and the UK.

[26] Drucker A. and Ramirez M. 2020. Payments for agrobiodiversity conservation services: An overview of Latin American experiences, lessons learned and upscaling challenges. *Land Use Policy* 99. doi.org/10.1016/j.landusepol.2020.104810

proposals to shift focus from compliance to performance, while adhering to the public funding for public goods-principle, as well as ensuring a fairer distribution of direct payments.

Given that formal support schemes (€200/livestock unit under the new CAP) exist for animal genetic resources, are at best *ad hoc* for crop landraces, the EU as a whole, as well as national policymakers, urgently need to explore mechanisms through the CAP (and for non-EU countries, their national legal instruments[27]) to systematically support the on-farm conservation of Europe's agricultural heritage of landrace/traditional varieties of wheat and other crops.

[27] Such as the UK Agriculture Act 2020, which states "*The Secretary of State may give financial assistance for or in connection with any one or more of the following purposes:……..(i) conserving plants grown or used in carrying on an agricultural, horticultural or forestry activity, their wild relatives or genetic resources relating to any such plan*" [Chapter 21, Part 1 (Financial Assistance), Chapter 1 (New Financial Assistance Powers), Article 1 (Secretary of State's powers to give financial assistance), Item 1.i]. legislation.gov.uk/ukpga/2020/21/contents/enacted/data.htm

Table 1. Key messages to different stakeholder groups on the establishment of a European *in situ* PGR conservation network

National Policymakers	Plant breeding and seed sectors	Farmers and other landrace maintainers	Environment/nature conservation organizations
The support of national governments is needed to secure EU leadership in the establishment, governance and long-term sustainability of the European *in situ* PGR network. National policymakers are asked to: – Promote the establishment of the network to the European Commission, European Parliament, European Council and other relevant EU bodies – Encourage expressions of interest in joining the network from stakeholders in their countries[28] – Explicitly tackle agrobiodiversity within national biodiversity strategies – Link funding to national long-term conservation and diversity management strategies and actively involve partners from civil society in these programmes – Set objectives and implement effective monitoring of *in situ* PGR	Active *in situ* conservation, management and sustainable use of PGR could more than double the genetic diversity available to plant breeders by providing: – Facilitated access to a much wider gene pool – Increased ability to respond to the rapidly changing environment and changes in EU/government policies – A long-term 'insurance policy' for the plant breeding sector The European network will facilitate collaboration and knowledge exchange between *in situ* PGR custodians and plant breeders, providing: – Direct links with a wide group of *in situ* PGR custodians (e.g., farmers and protected area managers) – Greater opportunities for collaborating with *in situ* PGR custodians in research, testing and reintroduction of PGR to the field	Farmers and other landrace maintainers play a vital role in conserving PGR for food, nutrition, livelihood and economic security. An overall goal of the European network is to empower its stakeholders to maintain and manage their PGR themselves, by: – Providing greater recognition for landrace/heritage varieties and those who grow, document their history and traditional practices, and maintain them – Providing monitoring tools and reporting schemes to manage PGR networks and report their status to the governing body of the European network – Ensuring that threatened *in situ* PGR populations are securely backed up in a national genebank or CSB. Material would be deposited according to terms agreed between the provider and the genebank. – Supporting repatriation of PGR diversity to different agroecosystems and	Raising awareness among nature-based organizations, as the custodians of CWR, on their importance as a contribution to food, nutrition and economic security, is vital to ensure the protection of wild populations of CWR *in situ*. The European network offers many benefits to custodians of CWR, including: – Demonstration of the additional value of their work to society, by contributing to food and economic security, particularly in providing resilience in agriculture in response to climate change – A marketing advantage for landowners, enabling them to attract more tourists and provide opportunities for wider community engagement, leading to greater public awareness of their site and its importance – Opportunities for additional funding for *in situ* conservation work – Technical support and best practice guidelines for CWR management [30]

[28] See farmerspride/network/

[30] Refer to the population management guidelines: Crop_Wild_Relative_Population_Management_Guidelines.pdf

– Implement seed laws to facilitate the registration of heterogeneous varieties that do not meet DUS[29] criteria – Pass plant health laws with the possibility for exemptions for conservation and sustainable use of PGR – Establish and maintain national PGR programmes to implement PGR activities to fulfil their obligations under international legal and policy instruments, such as the FAO Second Global Plan of Action on PGRFA, International Treaty on PGRFA and Convention on Biological Diversity – Promote the integration of CSBs in national conservation programmes, facilitate and implement Farmers' Rights, and subsidize alternative agricultural practices that promote agrobiodiversity – Facilitate exchange of PGR across geographical borders – Explore the use of a cost-effective conservation tender mechanisms to support the on-farm conservation of Europe's agricultural heritage of landrace/traditional varieties of wheat and other crops		the monitoring of their adaptation processes – Increasing opportunities for landrace product marketing through a conservation-related certification scheme – Supporting seed propagation programmes to improve access to seeds and exchange of knowledge between all members of the European network (private and public sector) – Providing technical support, training, evidence-based examples of good management practices and product adding value potential to improve income generation for landrace maintainers – Providing and promoting access to a platform for access to reliable information, knowledge sharing, and collaboration between PGR conservation and sustainable use actors	– Potential for a CWR quality mark and use of the network logo

[29] Distinctness, Uniformity and Stability Testing