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# Farmer's Pride

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

## Guidelines for integrated *in situ* and *ex situ* PGR conservation

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## Contents

## Key messages

Since any type of PGR conservation has its risks, assuring safety back-up should have the highest priority. In case of an accidental loss of the material, the material can be recovered from the back-up location. In *ex situ* conservation this is a standard operating procedure, in *in situ* conservation less so, if at all.

Safety back up of *in situ* material is lagging behind because of the following four reasons: (1) managers of the protected areas or farmers growing the landraces are not sufficiently aware of the value of the material they manage, (2) proper methodology for sampling and storing material is lacking, (3) there is no capacity available to sample and store the back-upped material, and (4) lack of priority, lack of trust and legal matters make backing up too difficult or undesirable.

To make a start of overcoming these issues, a dialogue with managers in The Netherlands and Spain has started, and templates of Material Transfer Agreements for black-box safety backup in an *ex situ* genebank have been compiled.

## Introduction

***Context***

The H2020 project Farmers Pride aims to "establish a network of stakeholders and conservation sites that effectively coordinates conservation actions to safeguard the wealth of Europe's *in situ* plant genetic resources (PGR) and integrates the user community to maximize their sustainable use."

Work Package 2 of this project aims to provide "the foundation for individual crop wild relatives (CWR) and landrace (LR) population/site management, how these *in situ* conserved populations might be better integrated with *ex situ* conservation and meet farmers and breeders' demands, as well as assessing the existing policy/enabling environment and making recommendations". In this WP, Task 2.6 "Integrated *in situ* and *ex situ* conservation" was included to explore the possibilities of using the expertise and possibly the infrastructure available from *ex situ* actors for making *in situ* conservation more secure. To quote the Grant Agreement: "The aim is to integrate *ex situ* and *in situ* conservation efforts more effectively, create synergies and reduce vulnerabilities by: (a) Workshop discussion between *in situ* (both CWR and on–farm) and *ex situ* conservation stakeholders of the reasons for the current lack of collaboration will be analyzed, a SWOT analysis will be conducted and solutions will be proposed. Further the policy implications and extra resources/technology required will be discussed and recommendations outlined. (b) Legal instruments in the form of Material Transfer Agreements will be created that will facilitate duplication of *in situ* conserved resources in national *ex situ* facilities. (c) Workshop discussion of protocols for closer integration of *in/ex situ* conservation, including how *in situ* actors should collect and document the biological material for back–up in *ex situ* facilities, how often this sampling process should be repeated, facilitate reintroduction of material to *in situ* sites, when appropriate and how genetic monitoring might be

integrated into the management and monitoring procedures of the protected site. (d) Analysis of required *in/ex situ* human resources and facilities, and costs/benefit implications of back–up strategy. (e) Test back–up strategy of *in situ* activities in two diverse countries, The Netherlands and Spain, to showcases the beneficial synergistic effects of collaboration, collaboration between *in situ* and *ex situ* stakeholders is good in The Netherlands and less so in Spain."

This need for clearer guidelines and tools for facilitating duplication of *in situ* conserved resources in national *ex situ* facilities were derived from earlier discussions between and within the communities involved and can be derived from publications such as the ECPGR Concept for *in situ* conservation of crop wild relatives in Europe and the ECPGR Concept for on-farm conservation and management of plant genetic resources for food and agriculture.

***Analysis and other outputs***

A simple approach for improving the reliability of *in situ* conservation is to use the existing infrastructure of *ex situ* genebanks. The *in situ* occurring diversity can be sampled and stored in *ex situ* facilities. If, due to whatever reason, the diversity *in situ* would be lost, it can easily be restored by retrieving the diversity from the *ex situ* back-up, and reintroducing it in the original setting.

But it appears not to be as simple as that, since this back-up option is rarely used by *in situ* actors. To find the reasons for this, an analysis was made of the bottlenecks for safety backup and the results were discussed with actors via correspondence and during various workshops. The following four major factors were identified hindering optimal use of the back-up option: (1) The managers of the protected areas where the crop wild relatives occur, or the farmers growing the landraces, might not be aware of the value of the material they manage; (2) It is not always clear how to sample or store the material: 'how is the genetic variation subdivided among and within populations of crop wild relatives?' or 'how to back up fruit trees?'; (3) The capacity to actually do it can be lacking for the labour intensive sampling as well as for the *ex situ* storage: 'who should do it, who pays for it?'; (4) Lack of priority, lack of trust, confusion between the safety back-up and the use of the material, and legal matters might be a prohibiting factor: 'does the *in situ* sector see the importance of backing up and does it trust the *ex situ* sector with its material?'

These four factors were further analysed and possibilities to overcome them were identified. The results of the analysis is shown in **Appendix 1** '*In situ* diversity backed up'. One of the elements needed to overcome the final obstacle, identified in the analysis described above, is clarity regarding the formal agreements at the basis of collaboration between the *in situ* actor and the *ex situ* facility. Therefore, **Appendix 2 '**Templates of Material Transfer Agreements for black-box safety backup in an ex situ genebank' was compiled. Finally, activities were developed in Spain and The Netherlands to test the assumptions and to develop actual protocols and other tools to support interaction of *in situ* and *ex situ* conservation efforts. Reports of these activities can be found in **Appendices 3 and 4**.

Based on the analysis and the experiences gained from the national activities in Spain and the Netherlands, a list of guidelines could be compiled, that will be elaborated below.

## Guidelines for safety back-up of *in situ* managed PGR

These guidelines are aimed at the two actor groups involved: the *ex situ* genebank, who intends to support *in situ* actors in preventing their PGR from getting lost, and the *in situ* actor, who searches for ways to avoid accidental loss. Guidelines for genebanks are given below.

The guidelines are not intended to improve access to the PGR managed *in situ*; they are solely intended to improve the reliability of the conservation of PGR by safely backing up the material in an *ex situ* genebank. It should be noted that some of the steps are already standard practice in some genebanks.

*Steps to take by an ex situ genebank to support in situ actors in backing up their valuable plant genetic resources.*

1. Make an inventory of *in situ* actors managing PGR and assess the importance of their material and the risk of accidental loss.
    a. The best way of doing this will vary among countries and the approach should be adapted to fit the circumstances and stakeholders. Actors to consider include protected areas managers working for the public administration, on-farm actors and nature conservation organizations. For the crop wild relatives (CWR) national CWR inventories, national floras, or other inventories can be used. For on-farm initiatives the publications on their websites can be valuable sources.
2. Approach these actors, bilaterally or during conventions or other meetings, with the message that their PGR are important.
    a. Most on-farm actors will know already that their material is important, but having an external organization stressing that this is also known elsewhere can help them realize the importance of proper conservation. Many nature conservation stakeholders are not aware of the concept of CWR or the importance of wild species for agriculture.
    b. The value of the PGR can be their contribution to solving problems in global food supply (Landraces and CWR related to food and forage/fodder crops), but also as contribution to global health (for medicinal plants), for commercial products and the economy (for ornamentals and other species), or (in general) as bio-cultural heritage.
3. Gain trust from the *in situ* actors.
    a. Stress from the beginning that the actor can keep full control over their PGR; if they wish, no one else can access the material but them.
    b. The motivation for proposing a collaboration is just the desire to prevent accidental loss of the material.
    c. Indicate that there are simple contracts to assure that the actor is the only one who can access the *ex situ* backed-up material.
4. Discuss the procedure for *ex situ* back up. Elements to consider are:
    a. Selection of material to back up

- This will obviously be the decision of the *in situ* actor, but the genebank might support this decision by inventorying the uniqueness of the material or, in the case of CWR, the utility (gene pool) or level of threat of erosion.

b. Sampling of target material
   - This is a difficult and expensive step if it involves harvesting seeds from CWR. It might require more than one year to obtain permissions, plan the ideal moment, etc. However, it can also be linked to other CWR research activities. Sampling intensity should not compromise the viability of the natural populations. It should be carried out if possible using a random sampling approach covering the whole occupancy area. Several sampling events may be considered to cover the range of genetic diversity associated to variation in phenological traits.
   - In the case of landraces or traditional varieties it usually is simple.

c. Evaluation of the quality of the sampled material
   - At least, an evaluation by an experienced seed technician/scientist to evaluate if the seed is mature and free from diseases, preferably also including a germination test.

d. Preparation and storage of sampled material
   - For most species this involves threshing, cleaning, drying, packing and freezing the material.
   - The genebank will generally have the expertise and equipment to do so, in case the *in situ* actor has not.

e. Curation of the material
   - The period of storage, possible seed viability analyses, etc.
   - For safety back-up generally the period of storage is indefinite, but the collaboration is reviewed every 5 or 10 years.
   - There should always be the possibility to replace the material with new, fresh material. For each species, a time for resampling (or multiplication) should be determined based on knowledge of seed longevity of the target species in optimal storage conditions.

5. If needed, discuss financial arrangements

   a. Often these transactions can be concluded without any transfer of funds since it will often serve the missions of both parties involved: the *in situ* actor in making its conservation more secure, the genebank in supporting *in situ* activities.
   b. In case financial support is needed, possibilities for external funding should be sought both at the national and international levels.

6. Draft a simple Memorandum of Understanding or a formal Contract to record the agreed points

   a. Keep it as simple as possible and as detailed as necessary; the matter is simple and making heavy contracts can scare off the *in situ* actor, or the authorities involved.
   b. Suggestions on aspects to consider and modes for this contract are listed in **Appendix 2**.

Appendix 1

# *In situ* diversity backed up–An analysis of factors influencing the level of *in situ* diversity (including in-nature and on-farm) backed up *ex situ*

## Introduction

To conserve the world's precious plant genetic resources (PGR), all possible approaches need to be used in a complementary manner. Some approaches are efficient for conserving and making PGR accessible to users, other approaches allow the PGR to evolve and adapt, or allow the PGR to be seen, used and appreciated by the general public. Often these objectives and strengths vary per species of PGR, per actor involved and per geographic region.

To achieve complementarity, the strengths and weaknesses of the different approaches need to be acknowledged and actors should get access to services from other communities with other approaches, to allow them to use these services to strengthen their own activities. Examples can be *ex situ* genebanks having their material regenerated and incorporated in programmes of on-farm actors to improve the access to the general public, or nature conservation stakeholders having their material presented to potential users via the *ex situ* channels for communicating with these users. But the most obvious example is on-farm and nature conservation actors using *ex situ* facilities for backing up their material. However, this currently hardly ever occurs; there are very few examples where *in situ* conservation actors use *ex situ* facilities for safety backup of their material.

In this short analysis we will explore how the *in situ* community (including in-nature and on-farm) can benefit from the experience of the *ex situ* community, how the *in situ* community could make use of the existing infrastructure of the *ex situ* community to improve the security of the diversity conserved *in situ* and what obstacles exist for doing so.

## The *ex situ* conservation ideal

Although the *ex situ* approaches to conservation are varied and include field genebanks, *in vitro* and *cryo* collections, the major share consists of orthodox seed collections, dried and frozen at -18 or -20°C. It is generally accepted in the *ex situ* community (and recorded in the 'FAO Genebank Standards') that the storage facilities should be secure: the infrastructure should guarantee the preservation of seeds under the stipulated standard conditions of temperature and humidity, backup generators with sufficient fuel should be available, fire alarm and fire-fighting equipment should be present, unauthorised access to the genebank should be prevented. As a result, it is the best place to store germplasm with the purpose of prolonging the time between regenerations – assuming that it concerns orthodox seeded crops or CWR.

In addition to securing the storage facility and its operation, *ex situ* genebanks also consider it standard operating procedure to send seeds of each accession in their collection after each

regeneration to a somewhat geographically distant genebank/institution with which they collaborate and possibly even to the Global Seed Vault in Svalbard for safe keeping. This duplication or triplication is done under the clear understanding that the seed remains property of the genebank sending it; contracts are signed stipulating that.

Obviously not all *ex situ* genebanks are organised that way, actually many of them are not. However, many of the larger genebanks such as those in the international network of the CGIAR, and some important national genebanks are well-organised. As a result, one might consider the seed storage in well organised *ex situ* genebanks to be as reliable as reasonably possible.

## The status of *in situ* conservation

Crop genetic diversity has a history in which it evolved and landraces emerged and were used *in situ*. It is only since the rapid changes in agriculture halfway through the previous century that it became clear that if humans would not conserve actively, precious PGR would disappear. Farmers replacing their local diverse landraces with uniform high yielding (and high input) varieties resulted in the loss of genetic diversity. Changes in land-use and other human activities cause wild species, especially those associated to agriculture, to disappear. Recently, climate change has aggravated the situation, the rate of loss of landraces and wild species related to our crop species can be expected to increase alarmingly, if it hasn't already done so. As a result of these changes, a large part of the *in situ* diversity is under threat, although the level of this threat will depend on many factors. A fairly recent study found that, out of 571 priority CWR in Europe, 66 (16%) were threatened and only 19 (3%) were Critically Endangered, compared to the average of all plant species of 20% threatened (Kell et al., 2012). Apparently CWR taxa are less threatened than other wild taxa. However, this might change due to the climate crisis.

Discussing *in situ* conservation is referring to a very wide spectrum of approaches, material and actors. The concern of genetic erosion aggravating due to the rapid societal and climate changes is a common factor in this spectrum. Preventing genetic erosion will require an equally wide spectrum of measures often specific to the approaches, material and actors. However, irrespective of the wide variation in approaches, it is always a good idea to back up the current *in situ* diversity in a secure way. It creates option value for the case the diversity would get lost *in situ*, allowing the reintroduction of the material in the original or another environment. Furthermore, *ex situ* availability of *in situ* populations could, if the owner of the material approves, provide a routine means of user access for *in situ* conserved material. But if it is a good idea, why isn't it a common practice – why aren't all on-farm cultivated varieties and the most representative populations of crop wild relatives backed up in *ex situ* storage? This is caused by a number of factors:

- First of all, the managers of the protected areas, where the crop wild relatives occur, or the farmers growing the landraces might not be aware of the value of the material they manage,
- secondly, it is not always clear how to sample or store the material: 'how is the genetic variation subdivided among and within populations of crop wild relatives?' or 'how to back up fruit trees?',

- thirdly, the capacity to actually do it can be lacking for the labour intensive sampling as well as for the *ex situ* storage: 'who should do it, who pays for it?',
- and finally, lack of priority, lack of trust and legal matters might be a prohibiting factor: 'does the *in situ* sector see the importance of backing up and does it trust the *ex situ* sector with its material?'

These four elements will be discussed below.

*Awareness of the value of PGR*

In the case of crop wild relatives passively conserved in protected areas, protected area managers are unaware of what crop wild relatives are and why they have value to humankind. A similar comparable situation can occur in some countries where the *in situ* cultivation of landraces is operated by aged farmers that live somewhat isolated from society, seed savers networks that operate through volunteering without enough resources, and public administration. Frequently, they have no knowledge of the existence of *ex situ* conservation institutions that they could relate to.

*Sampling and storage methodology*

If *ex situ* backing up is considered, it has to be decided how to do it: how to sample the diversity and how to store it in the backup facility. For on-farm managed orthodox seeded crops this is easy. A sample of the seeds used to sow next year's crop can be dried, packed and frozen by an *ex situ* genebank. Fortunately, this is the vast majority of the diversity of agricultural and horticultural crops managed on-farm. However, it doesn't answer the question for the clonally propagated and tree crops. *Ex situ* approaches to these categories involve either very expensive *in vitro* techniques in which the clones are grown in tubes under slow-growth conditions (e.g., potato), or 'field genebanks' in which the plants are simply grown every year in the field or greenhouse (e.g., garlic or apples). These approaches are not optimal for backing up, both because they are expensive *(in vitro*) but also because they are possibly as vulnerable as in their original *in situ* condition. Further development of *cryo* approaches, in which the material is stored in liquid nitrogen, might provide the solution. Fortunately, it only concerns a very small fraction of the diversity occurring on-farm.

For the crop wild relatives, occurring in-nature, the methodology is less straight forward. We can sample wild populations, but what is enough? How many populations and how much material do we need to sample a crop wild relative species in-nature? Also, the actual sampling is problematic as the populations are not always very accessible (located in remote or private areas, species may be protected, populations may be very small), not all plants will have ripe seeds at the same moment, and many wild species tend to shatter or disperse their seeds otherwise when the seeds are ripe. Regarding the storage of the sampled material, the same holds true as for the on-farm managed diversity: for the orthodox seeded species it is easy, for other material it is not. Fortunately, in Europe, the seeds of most crop wild relatives are expected to behave as orthodox seeds.

Luckily, in recent years, significant advances have been made in both active conservation of CWR populations *in situ* and LR populations maintained on-farm (see Box 1). This forms a good basis for further protocol development.

*Sampling and storage capacity*

In some cases, capacity is a real issue, however, for the on-farm managed material of orthodox seeded crops it is not. The sampling and storing of this material is easy and doesn't require much storage space. However, if many accessions are to be processed and stored at the same time, it can still become a substantial cost. For the crop wild relatives with orthodox seeds, sampling capacity is an issue as it requires a large amount of planning and travelling, but storage is not. As for on-farm material, processing and storing can still be an issue if many accessions are sampled. For the clonally propagated and recalcitrant seeded crops and species also the storage capacity (and associated costs) is a major concern.

It should be noted that many *ex situ* genebanks struggle to keep their own collections properly managed, and staff of these institutions will not always be eager to engage in a collaboration with *in situ* actors purely for reasons of capacity. Thus, the issue of 'who should do it, who pays for it?' becomes very limiting. Stakeholders both from the *in situ* - and the *ex situ* communities operate under very limited funding and, although they may understand the importance and opportunities around the idea of '*in situ* diversity backed up *ex situ*', they may not be able to afford this task.

*Priority, trust and legal matters*

For various reasons the *in situ* and *ex situ* conservation communities evolved in isolation from each other, which in part resulted in one community not appreciating or trusting the other, along with their methods. Furthermore, in some countries, *in situ* conservation of crop wild relatives takes place in institutions (natural parks and other protected areas) that depend on the Ministry/Department of Environment whereas *ex situ* conservation is carried out in institutions that depend on the Ministry of Agriculture. This separation in different sections of the public administration generates many obstacles due to lack of communication and coordination, and associated rivalry and misunderstandings. Fortunately, some positive changes did happen in recent years as apart from a growing appreciation of each other's activities, the urgency to better organise and create synergies has become apparent. As a result, it is expected that the desire to back-up *in situ* material *in ex situ* facilities has and will continue to grow. However, trust is not complete yet. 'How can we know they do not give our material to a big multinational agro-chemical breeding company?' 'Is this a competence of the Ministry of Agriculture or of the Ministry of Environment?' are some questions that still can be heard. To overcome this lack of trust, and to establish a firm basis for collaborations, contracts can be signed defining how the backed-up material can be used. It is common practice in the *ex situ* community to sign a contract stipulating that 'safety back-ups', sent by one genebank to the other for safekeeping, remain the property of the sending genebank and can only be requested and send back to that party. All other use is excluded. This type of contract could form the basis of any back-up transaction.

An additional potential complication is formed by the legal frameworks relevant to sampling and transporting plant material. Nature protection regulation, protecting endangered species, phytosanitary regulations, avoiding the spread of plant diseases, and access and benefit sharing

regulations, such as the Nagoya Protocol, have to be taken into account and can, in some situations, hinder plans for *ex situ* back-up.

## Backing up *in situ* genetic diversity in *ex situ* facilities

The urgency to better secure all genetic resources, both *in* and *ex situ*, is clear to most actors who observe the on-going changes in the environment. Backing up orthodox seeded on-farm managed varieties is easy and does not require much capacity, as the seeds are harvested anyway, and only a small amount needs to be sent to a genebank. This should be given the highest priority and should be promoted by communicating the urgency to all actors involved and creating the channels via which material can easily be deposited in genebanks, with the contractual guarantee that it will not be used for purposes other than those determined by the donor.

For the other categories, in-nature managed material and recalcitrant seeded or clonal crops on-farm, the urgency is just as big, however, more hurdles will need to be taken. For in-nature diversity a prioritisation of crop wild related species will have to be made to determine the most threatened that can then be sampled and backed up *ex situ*. For recalcitrant seeded or clonal crops, methodologies will need to be further developed, such as cryopreservation of fruit trees.

**Box 1. Major recent advances in *in situ* / on-farm conservation.**

The list below provides some entry points into the scientific literature regarding issues related to *in situ* conservation

- Defining CWR and LR (e.g., Zeven, 1998; Camacho Villa *et al.*, 2005; Maxted *et al.*, 2006; Negri *et al*. 2009);
- Creation of CWR / LR checklists and inventories (Zeven and Zhukovsky, 1975; Heywood and Zohary, 1995; Maxted et al., 2007; Kell et al. 2005, 2008, 2016; Idohou *et al.*, 2013; Vincent *et al.,* 2013; Hammer *et al.*,1990, 1999; Hammer, 2001; Negri, 2003; Labokas et al., 2018);
- CWR / LR prioritization (Maxted *et al.*, 1997, 2009; Kell *et al.*, 2017);
- CWR threat assessment (Bilz *et al.* 2011; Kell *et al.*, 2012);
- Locating CWR and LR diversity (Maxted *et al.*, 1997; Negri *et al.*, 2013; Magos Brehm *et al.*, 2017; Pacicco *et al.,* 2018);
- *In situ* and on-farm conservation site selection (Maxted *et al.*, 2008; Vincent *et al.,* 2013; Vincent *et al.,* 2019; Magos Brehm *et al.*, 2017; Pacicco *et al.*, 2018);
- *In situ* and on-farm population management (Tosti and Negri, 2005; Tiranti and Negri, 2007; Iriondo *et al.*, 2008; Polegri and Negri, 2010; Iriondo *et al.*, 2012; Torricelli *et al.*, 2013);
- *In situ* and on-farm *in situ* conservation networks (Maxted and Kell, 2009; FAO, 2013; FAO, 2014; Maxted *et al.*, 2015);
- Multiple aspects of *in situ* conservation (Jain, 1975; Safriel *et al.*, 1997; Zencirci *et al.*, 1998; Meilleur and Hodgkin, 2004; Heywood and Dulloo, 2005**;** Hunter and Heywood, 2011);
- Multiple aspects of on-farm conservation (Brush, 1995; Brush, 2000; Veteläinen *et al.*, 2009; Jarvis *et al.*, 2011; Sthapit *et al.*, 2012; Jarvis *et al.*, 2016);
- Promoting the use of the *in situ* conserved resource (Curtis, 2008; Heywood, 2008; Polegri and Negri 2010; Maxted *et al.*, 2016; Magos Brehm *et al.*, 2017).

Appendix 2

# Templates of Material Transfer Agreements for black-box safety backup in an *ex situ* genebank

## Background

Proper conservation of plant genetic resources (PGR) requires precautions against catastrophes. In the case material is lost at the conservation site, it always makes sense to have the material securely stored at another location. This is called safety back-up.

Many genebanks offer the storage of safety back-ups to colleague genebanks or other actors conserving PGR. This is usually organised in a black-box construction, i.e., the genebank receives a box with properly dried and packed material and only stores it under secure conditions (-18°, secured power supply, etc.). In this black-box construction, the receiving genebank doesn't have the right to use the material. It general, the gene bank doesn't even open the box with seed bags and makes it available only to the one sending it.

This document will help actors considering the safety back-up of PGR to formulate the proper agreements.

## Legal Arrangements

To assure that the receiving genebank only stores the material and not uses it one way or another, a Memorandum of Understanding (MoU) or a more formal MTA can be drafted and signed.

A MoU could be as simple as the one shown in Template 1, to avoid misunderstanding, or more formal as in Template 2, to better define mutual expectations. Obviously, also other issues can be included, such as arrangement regarding the drying and packing of the samples or financial compensation.

As an example of a complete contract for safety backup, the text of the MTA related to deposits of seed material in the Svalbard Global Seed Vault is added in Template 3.

These texts can serve as templates for agreements for anyone wanting to deposit material for *ex situ* safekeeping in a genebank.

## List of templates

TEMPLATE 1 Example of an informal Memorandum of Understanding for Black-Box Safety Back-Up

TEMPLATE 2 Example of a formal Memorandum of Understanding for Black-Box Safety Back-Up

TEMPLATE Text of the MTA related to deposits of seed material in the Svalbard Global Seed Vault

## *TEMPLATE 1 Example of an informal Memorandum of Understanding for Black-Box Safety Back-Up*

MEMORANDUM OF UNDERSTANDING

*<sender complete> and <receiver complete> have agreed that the genetic resources samples sent by <sender> will be stored in the long term storage facility of <receiver short>. The samples will be sent in a box, each sample packed in a sealed laminated aluminium foil bag.*

*<sender> will provide <receiver short> with the number of samples and a list of the material included in the package.*

*<receiver> will take care for an optimal storage of the material under the long term storage conditions. The agreement does not allow utilising the samples included in the safety duplication in any way. Upon request of <sender> the material will be returned.*

*This arrangement starts on <date> and can be denounced at 6 months' notice.*

*<dates, locations, signatures>*

# *TEMPLATE 2 Example of a formal Memorandum of Understanding for Black-Box Safety Back-Up*

MEMORANDUM OF UNDERSTANDING

This Memorandum of Understanding (MOU) is entered into and executed by <receiver complete> and <sender complete>.

**I. Purpose**

The purpose of this MOU is to maintain a Safety Duplicate Collection (hereinafter referred to as SDC) of seed material consisting of <briefly describe the material, e.g., samples of populations of wild species related to crops> from <sender> by <receiver>.

**II. Statement of common interest**

<briefly state why it is important to both parties, e.g. <sender> manages a nature reserve that, amongst others, harbours populations of crop wild relatives. Given the high potential importance of these populations for agriculture and the food supply the <receiver> has agreed to store samples of these populations to assure their availability in case of incidental loss at their original locations>.

**III. Statements of the agreement**

**Of relevance to <receiver>**

§1 <receiver> accepts the responsibility of conserving *ex situ* under appropriate long-term conditions, under a 'black box' arrangement within the storage facilities at <location storage>, a SDC to be provided by <sender>.

§2 The SDC will be stored in accordance with the <receiver> guidelines for storage and handling.

§3 <receiver> will not use or distribute any seed material to a third party from the SDC, and only return it to the provider upon request.

§4 The cost of conserving the SDC will be covered by sources available to <receiver>.

§5 In a situation of emergency all measures will be taken by <receiver> to maintain the safe storage of the deposited material.

§6 In case of accidents or any other event that may inflict upon the viability, germinability, or availability of the deposited seed, <receiver> will not be liable to pay any damages to <sender>. <receiver> will inform (in written form) the other party as soon as possible after the accident or event about the possible damage.

**Of relevance to <sender>**

§7 <sender> is responsible for all seed management activities (threshing, drying, packing [if possible in sealed aluminium foil bags], germination tests, etc.), preceding storage.

§8 <sender> accepts to deliver a <recommended number e.g. 200> of high quality seeds per accession to be included in the SDC. All shipments shall be accompanied with a Phytosanitary Certificate, if appropriate.

§9 <sender> further accepts the responsibility of supplying <receiver> with a safety duplicate of passport and relevant management data, if available in computerised form, pertaining to each stored accession.

§10 Decisions regarding the inclusion or removal of accessions from the SDC's will be taken by <sender> within the scope defined in Section I.

**Of relevance to both**

§11 The material deposited in the SDC at <receiver> falls under the sovereignty of the <country of the sender>

§12 Upon notice, <receiver> has the right to inspect their SDC at any suitable time.

§13 This MOU may be modified or discontinued at the request of either party.

§14 Requests for termination or any change to the MOU shall be submitted to the other party for consideration not less than six (6) months prior to the desired effective date of termination or change.

§15 This MOU has indefinite duration, but shall be reviewed once every five (5) years for relevancy.

<date, locations and signatures>

# *TEMPLATE 3 Text of the MTA related to deposits of seed material in the Svalbard Global Seed Vault*

The text in this annex was copied, for the purpose of illustrating the use of an MTA for safety backup, from https://www.nordgen.org/sgsv/scope/sgsv/files/SGSV_Deposit_Agreement.pdf and slightly edited - the content was not changed. The text was downloaded Sept. 6, 2019, for the most recent original go to the source!

**DEPOSIT AGREEMENT BETWEEN THE DEPOSITOR AND THE ROYAL NORWEGIAN MINISTRY OF AGRICULTURE AND FOOD**

PREAMBLE

WHEREAS

1. The Government of the Kingdom of Norway has established the Svalbard Global Seed Vault (hereinafter referred to as "Seed Vault") to provide a safety net for the international conservation system of plant genetic resources, and to contribute to securing the maximum amount of plant genetic diversity of importance to humanity for the long-term in accordance with the latest scientific knowledge and most appropriate techniques;
2. The Svalbard Global Seed Vault will be under the ownership of the Government of the Kingdom of Norway, and situated in Longyearbyen, Svalbard. The Royal Norwegian Ministry of Agriculture and Food is the national authority liable for the Svalbard Global Seed Vault;
3. The Royal Norwegian Ministry of Agriculture and Food, the Global Crop Diversity Trust and the Nordic Genetic Resource Centre have entered into an agreement providing for the management, operation and the long-term funding of the Svalbard Global Seed Vault. Under the agreement, the Nordic Genetic Resource Centre is required to liaise with depositors with respect to the material to be deposited and the timetable and process for deposition, including guiding the depositors with regard to the packaging and labeling of the material to be deposited consistent with the guidelines and applicable national and international law, and is required, on behalf of the Royal Norwegian Ministry of Agriculture and Food, to enter into and sign the Deposit Agreements with depositors on the basis of the Standard Deposit Agreement (revised 28 January 2013);
4. [**********] (hereinafter referred to as "the Depositor") holds a collection of seeds of distinct plant genetic resources of importance to humanity, and wishes to ensure the longterm safety of its collection by depositing samples of that collection in the Svalbard Global Seed Vault.

**Now therefore, the Royal Norwegian Ministry of Agriculture and Food and the Depositor (hereinafter referred to collectively as "the Parties") hereby agree as follows:**

**1 PARTIES TO THE AGREEMENT**

The present standard agreement is between

(Name of the Depositor) (*The Depositor*)

And

The Norwegian Ministry of Agriculture and Food (*The Ministry*), represented by: The Nordic Genetic Resource Centre

**2. SUBJECT MATTER OF THE AGREEMENT**

1. The Depositor and the Ministry agree that the Deposited Material in the Svalbard Global Seed Vault is deposited in accordance with the terms and conditions set out in this Agreement. The agreement covers all Deposited Material deposited by the Depositor in the Svalbard Global Seed Vault.

**3. RIGHTS, RESPONSIBILITY AND OBLIGATIONS OF THE DEPOSITOR**

**3.1 Requirements to the Deposited Material**

1. Subject to paragraph 2 of this Article, the Depositor shall deposit only samples of plant genetic resources that:
   a. Are, to the best of the Depositor's knowledge,

i. of importance to food security and sustainable agriculture;
ii. samples of plant genetic resources that have not yet been deposited in the Svalbard Global Seed Vault;

b. Have been safety duplicated in a suitable gene bank.
c. Are available to other natural or legal persons in a manner that facilitates access for conservation and sustainable use in compliance with national laws and applicable international treaties.

2. Any or all of the requirements set out in paragraph 1 of this Article may be waived by the Ministry, or by the Nordic Genetic Resource Centre or other institution designated by the Ministry to act on its behalf as manager of the Svalbard Global Seed Vault. Any waiver granted shall be in writing.

**3.2 Shipment**

1. The Depositor shall provide an inventory of each shipment of Deposited Materials under this Agreement in accordance with the standards set out in the Annex.
2. Costs pertaining to the packaging and shipping of the Deposited Materials shall be borne by the Depositor or a third party that has agreed to cover these costs.
3. The Depositor shall ensure that the Deposited Materials in each shipment:
   a. conform fully to the information in the electronic inventory submitted to the Nordic Genetic Resource Centre prior to shipment;
   b. are accompanied by any necessary certificates relating to the plant health of the samples as may be required by the laws of the country of export, the Government of the Kingdom of Norway, and any other country through whose territory the Deposited Materials are to transit, and that other procedures required by those laws in respect of that shipment have been complied with;
   c. are deposited consistent with the FAO Genebank standards or any other applicable international technical standards;
   d. have been packed, sealed and labelled and are accompanied by appropriate documentation in conformity with the standards set out in the Annex to this Agreement, taking into account such guidelines as may be issued from time to time by the Ministry; and
   e. will be dispatched in accordance with the schedule agreed with the Nordic Genetic Resource Centre.

**3.3 Withdrawal of Deposited Materials**

1. The Depositor shall have the right to withdraw all or any of its Deposited Materials at any time on the giving of written notice.
2. Any written notice given under this Article shall identify the individual boxes of Deposited Materials that are to be withdrawn.
3. The Ministry undertakes to return the Deposited Materials within a period of one year from the date of receipt of such written notice.
4. The costs of packaging and shipping in respect of the return of Deposited Materials shall, unless otherwise agreed between the Parties, be borne by the Depositor.
5. The Depositor shall be responsible for complying with all export clearance procedures required by the Government of the Kingdom of Norway on the return of the Deposited Materials and for all import or transit procedures required by the country of import or transit. The Ministry shall use its best efforts to provide such documentation regarding the Deposited Materials and the conditions under which the Deposited Materials were deposited as may be necessary to facilitate such procedures.
6. The Depositor shall notify the Ministry in writing if it no longer wishes the Deposited Materials to be retained in the Svalbard Global Seed Vault but does not wish the Deposited Materials to be returned to it; in such case, the Deposited Materials will be disposed of by the Ministry in accordance with its operating rules and procedures applicable to the Svalbard Global Seed Vault.

**4. RIGHTS AND OBLIGATIONS OF THE NORWEGIAN MINISTRY OF AGRICULTURE AND FOOD**

**4.1 Obligation of the Ministry**

1. The material deposited will be maintained in permafrost conditions supplemented by refrigeration in accordance with internationally accepted standards for long-term seed storage.
2. The Deposited Material shall not be further transferred, except back to the original Depositor or the Depositor's successor in title, or in accordance with the Depositor's instructions.
3. All storage costs pertaining to the Deposited Materials shall, unless otherwise agreed between the Parties, be the responsibility of the Ministry.

4. The Deposited Materials will remain in sealed envelopes packed in sealed boxes, unless otherwise agreed with the Depositor. Where packages or boxes are damaged during transport or storage, or where packages or boxes have been opened for inspection by customs or other authorities, the Ministry shall notify the Depositor. In the event that seeds have been spilled they will be destroyed. In the case of other damage or failure, including packaging not in accordance with the requirements in the Annex, the Ministry will endeavour to repair the damage where possible, or provide for the repackaging or resealing of the Deposited Materials in consultation with, and with the agreement of, the Depositor.
5. The Ministry is not responsible for viability monitoring and regeneration of Deposited Materials. Where additional samples have been provided by the Depositor for the purpose of viability testing of the Deposited Material in agreement with the Ministry, the samples will be returned at the Depositor's request and expense. Testing samples shall be packed in separate boxes.
6. The Ministry shall inform the Depositor of the location of the Deposited Materials in the Svalbard Global Seed Vault.

**4.2 Maintenance of viability and quality**

1. The Ministry does not assume responsibility for viability and quality monitoring of the original accessions represented in the Deposited Materials.
2. The Ministry does not assume responsibility for the periodic monitoring of viability and regeneration of the original accession of the Deposited Materials.

**4.3 The right to refuse samples**

1. The Ministry can refuse to accept samples for deposit.
    a. if the Depositor fails to comply fully with the terms and conditions set out in this Agreement; or
    b. for reasons of force majeure.

2. The Ministry reserves the right to give the highest priority to the safety storage of plant genetic resources for food and agriculture that are available for conservation and sustainable use in accordance with applicable international law.

**4.4 Termination of the Deposit**

1. The Ministry shall have the right to terminate the deposit, or part thereof, if the Depositor fail to comply fully with the terms and conditions set out in this Agreement.
2. The Ministry shall have the right to terminate the deposit, or part thereof, on the giving of one year's written notice, where such termination is required as the result of any change in the policy of the Svalbard Global Seed Vault or the Government of the Kingdom of Norway with respect to the Svalbard Global Seed Vault.
3. Where Deposited Materials are returned as a result of the exercise by the Ministry of its right of termination under this Article, the costs of packaging and shipping in respect of the return of Deposited Materials shall be borne by the Ministry.

**5. GENERAL PROVISIONS**

**5.1 Effect of the Deposit on Property rights**

1. The act of depositing the Deposited Materials in the Svalbard Global Seed Vault shall have no effect whatsoever on the nature and extent of any property rights pertaining to the Deposited Materials.
2. In particular and without prejudice to the generality of the above, the act of deposit shall not act in any way to convey any property rights over the Deposited Materials to the Nordic Genetic Resource Centre or the Ministry.

**5.2 Amendment**

1. This Agreement, including the annex to this Agreement, may be amended by mutual written agreement of the Parties.
2. Any amendment shall enter into force on the date provided for in the amending agreement.

**5.3 Entry into Force**

This Agreement shall come into force on its signature by the authorized representatives of both the Depositor and the Royal Norwegian Ministry of Agriculture and Food.

**5.4 Duration of the Agreement**

1. This Agreement shall remain in force for a period of ten (10) years and shall be renewed automatically for further periods of ten (10) years unless either Party gives notice in writing to the other Party at least six months prior to the expiry of any ten (10) years period that it does not wish this Agreement to be renewed.

2. This Agreement may be terminated by mutual agreement between the Parties to this Agreement.

**6. LIABILITY**

1. The Ministry shall not be liable for any damage caused to the Deposited Materials by any reason whatsoever, unless such damage has been caused as a result of any act of malfeasance or negligence on the part of the Ministry or any employee or agent of the Ministry.
2. In the event of any damage caused by malfeasance or negligence on the part of the Ministry or any employee or agent of the Ministry, the liability of the Ministry shall be limited to the costs of packaging and shipping of new samples, and shall not include costs of regeneration of the plant genetic resources, or similar costs.

**7. DISPUTE SETTLEMENT**

1. Any dispute that cannot be settled by negotiations between the Parties to this Agreement, or through such other procedure as may be agreed between the Parties, shall be finally settled by arbitration in accordance with the Rules or Arbitration of the International Chamber of Commerce by one or more arbitrators appointed in accordance with the said Rules.
2. This Agreement shall be governed by the laws of the Kingdom of Norway. Only the Norwegian court which is locally competent shall have jurisdiction to enforce an award against the Royal Ministry of Agriculture and Food, and only the court which is locally competent for the Depositor shall have jurisdiction to enforce an award against the Depositor.
3. This Agreement does not give rise to rights or obligations under international law.

**8. SIGNATURE**

This Agreement will be signed in three copies.

Signed on behalf of the Depositor:

Signed on behalf of the Royal Norwegian Ministry of Agriculture and Food:

<signatures, names, titles, dates>

<for the annex '**Requirements for the Quality, Quantity, Packing, Inventory and Shipment of Deposit Materials**' see the original document at https://www.nordgen.org/sgsv/scope/sgsv/files/SGSV_Deposit_Agreement.pdf>

# Appendix 3

**Activities performed in Spain for the establishment of successful *in situ* – *ex situ* cooperation.**

a) *Workshop discussion between* in situ *(both CWR and on–farm) and* ex situ *conservation stakeholders about the reasons for the current lack of collaboration. A SWOT analysis was conducted and solutions were proposed. Further, the policy implications and extra resources/technology required were discussed and recommendations outlined.*

In Spain, the different stakeholder groups were firstly surveyed individually. The *in situ* conservation organizations were divided into two different groups (depending on whether they work with landraces or crop wild relatives) in order to analyze their current situation: seed-saver networks and protected areas. Several organizations were surveyed, selected specifically to represent all possible circumstances and opinions.

1. Seed-saver networks (3 local and 1 national): October 6th 2018

All of them have had some cooperation before with Spanish genebanks. Although one local seed network did not keep this relationship with genebanks anymore and does not see it as a priority, the other two local seed networks continue with some cooperation, especially with the CITA genebank (Aragón) and the COMAV genebank (Valencia). With those two genebanks a MTA has been drafted. In some occasions, they have reproduced seeds for the genebanks in exchange for receiving specific landraces seeds.

They all agree with the lack of economic and human resources needed to promote this coordination. All the seed-saver networks have experienced an important increase in information and participation requests in different projects; however, they cannot maintain this pace of free work without recognition of their work (economical or including them as "real" participants of the project). That is the reason why, at first, none of them is willing to participate. The national seed-saver network, Red de Semillas, is open to define a collaboration with Farmer's Pride.

2. Genebanks

| **Genebank** | **IMIDRA** – Information received by mail on November 6th 2018 |
|---|---|
| Collaboration with *in situ* organization | Yes, in the last year, five collaborations.<br>Town halls, research centers, etc., are asked to sign a MTA and to give feedback about how the crop developed or to return regenerated plant material.<br>Farmers: before seeds were given for free, but nowadays the genebank sells them the seedlings.<br>Special collaboration: Agrolab project, as it is run from the centre itself, it is expected that the results (both in plant material and data) will be more useful. |

| | |
|---|---|
| Level of satisfaction and improvements | No one has provided the requested feedback.<br>The small amount of seeds that was returned after multiplication by few people was not included in the genebank collection due to the lack of reliability in this material. |
| Document facilitation | MTA<br>List of seedlings on sale. |
| Interest | Not specially shown.<br>It is not mention if they are interested in getting the results back. |

| **Genebank** | **COMAV** – Information received by mail on November 11th 2018 |
|---|---|
| Collaboration with *in situ* organization | Yes, very numerous, both with farmers and with seed-saver networks (Llavors D'aci).<br>Farmers: usually the genebank conducts a follow-up, requesting data on the behavior, adjustment to the type of landrace, photographs of the crop in different phases, etc. Collaboration to test selected materials: when they receive the seed, they also receive a file to fill about each LR with data and any incidents that the crop could show, as well as consumer acceptance.<br>Seed-saver Networks: in some cases, some agreements on seed regeneration were made with these networks, and then the regenerated seeds were returned to the bank. A document of commitment to cultivate under the agreed conditions is signed by them and, in addition, inspections are made. |
| Level of satisfaction and improvements | Success depends on the genebank's follow-up. If continuous contact is maintained, good results are achieved.<br>Improve continuous monitoring by genebank staff (extra work). |
| Document facilitation | MTA for farmers (simplified MTA)<br>Conditions of the specific COMAV agreement |
| Interest | Yes, they agree to provide data and participate in the process and they are interested in receiving back any related results. |

| **Genebank** | **CRF** – Meeting on November 23rd 2018 |
|---|---|
| | Many collaborations have taken place (both types: transferring seeds and giving advice about how to maintain a seed bank). |

| | |
|---|---|
| | Farmers: No MTA have ever been signed with them. In some occasions, seeds are given to them, but the genebank has never got any seeds back. The genebank has never conducted a follow-up. They highlight that the ideal would be to be able to sell the seeds at price of the cost of production, and this way the genebank would be able to give a decent amount of seeds. However, the Law does not allow selling these type of seeds (LR seeds). |
| Collaboration with *in situ* organization | Nowadays, they are trying to facilitate this process by establishing the role of "associated members" at the New National Collection Plan. This way, the institutional relationships with different related organizations, such as the Spanish Seed-saver Network, are officialised, and the transfer of material is easier.<br>Seed bank (of networked farmers of Madrid): with "Ecosecha" the genebank has tried to establish collaborations of seed multiplication, but they did not rely on the seeds that were returned. There was no follow-up *in situ*, they clarify that there are not enough human resources to carry them out. |
| Level of satisfaction and improvements | Very unhappy with the collaborations of multiplication of seeds. They do not intend to continue with this process. No material that has returned to the genebank has been incorporated into the collection due to lack of trust in it.<br>Different opinions within the staff group: some of them think that if it were carried out correctly it could turn into a very interesting and effective collaboration. Others think that no more energy should be spent to explore this path, it does not work. |
| Document facilitation | They showed us a receipt model that the farmers sign to get the material. |
| Interest | No interest under current conditions. It could be interesting if: seeds could be sold for the cost of multiplication, or exploring the new role of "associate member" to avoid legal obstacles. |

| **Seedbank** | **Seed Bank "Puente del Perdón"-"El Cuadrón"** – Information received by mail on November 29th 2018 |
|---|---|
| Collaboration with *in situ* organization | They have been working in collaboration with a wide variety of collectives and institutions of *in situ* conservation. In recent years, they have developed a stronger relationship with two associations that reproduced their seed. Furthermore, they have been exchanging information on |

| | |
|---|---|
| | landraces. The seed bank has also been collaborating with the Biosphere Reserve "Sierra del Rincón", exchanging landraces for seed multiplication. |
| Level of satisfaction and improvements | They have been working with this type of collaborations since their beginning (2003), increasing collaboration in the last two years, due to its proper functioning. |
| Document facilitation | Report of the seed bank (June, 2018) |
| Interest | - |

| **Genebank** | **CITA** – Information received by mail on December 17th 2018 |
|---|---|
| Collaboration with *in situ* organization | This genebank provides seeds to any organization or person who requests them for their *in situ* reintroduction. They have a special agreement since 2011 with the seed savers network of Aragón. Without official agreement, they also work with the seed savers network of Navarra and of Andalucía. They also work with individual farmers, although the benefit for the genebank about the information they could provide is lower than from the networks.<br>They also work with organizations that are not directly involved in the *in situ* recovery of the varieties, but in the training of people who in the future have in their hands the decision of which crops to use: the centres of agrarian training. |
| Level of satisfaction and improvements | They found the collaboration very interesting; through the networks and farmers, they get information about how the crop behave in the field.<br>The main problem is clear: lack of human resources.<br>In addition, with established agreements, the process would require less time. |
| Document facilitation | Summary of their collaborations |
| Interest | They have shown great interest in streamlining these procedures because each year the number of demands increases, and they believe it is important to keep providing the *in situ* organizations for conservation. |

Protected areas:

Several protected areas, as well as public administrations, were contacted about this subject. As a first response, most of them indicated that they were not actively conserving any CWR. However, conservation of CWR is taking place for those species that are endangered, rare or endemic.

There are examples of *ex situ* and *in situ* conservation occurring in a coordinated way within the same organization, such as the in the Plant Micro-Reserves network of the Valencian Autonomous Community. Some other protected areas are coordinated with the regional gene bank to which they belong.

SWOT Analysis

| | STRENGTHS | WEAKNESSES |
|---|---|---|
| Internal Factors | All groups involved are organized<br>Some good examples of coordination already taking place in Spain<br>General interest in collaboration among all groups | Lack of human and economic resources<br>Differences among groups involved |
| | OPPORTUNITIES | THREATS |
| External Factors | New commission on Plant Genetic Resources Conservation created in the Ministry of Agriculture | No prioritization of this issue in political agendas<br>Lack of general knowledge about CWR |

*b) Assessments of legal instruments in the form of Material Transfer Agreements to facilitate duplication of in situ conserved resources in national ex situ facilities.*

MTAs that are in use with farmers were received from three regional genebanks: COMAV, IMIDRA and CITA. The most important difference found between their MTAs is the type of data and information that it is requested about the plant material given. COMAV and CITA ask for any data related to the given material, while IMIDRA only asks to give back the relevant information about them. Moreover, seed saver's organizations claim that all signed MTA should be available as public information. In addition, they are concerned about third parties using landraces and resulting in varieties under breeder's rights.

*c) Workshop discussion of protocols for closer integration of* in/ex situ *conservation, including how* in situ *actors should collect and document the biological material for back–up in* ex situ *facilities, how often this sampling process should be repeated, facilitate reintroduction of material to* in situ *sites, when appropriate and how genetic monitoring might be integrated into the management and monitoring procedures of the protected site.*

Two different workshops were held for both approaches: landraces and crop wild relatives.

*Towards better coordination and integration of efforts for the conservation of crop wild relatives:*

It was suggested that the following basic requirements must be met to determine a natural CWR population as an *in situ* conservation accession, and to consider its habitat as a "Genetic Reserve" of *in situ* conservation of Crop Wild Relatives (CWR):

1. The target population is in a location which confers it some legal protection (e.g., it is in a protected area or in a location where human activities can be regulated and/or limited).
2. The managers of the protected area are informed about the presence of the target CWR population and have signed a written statement by which they include the conservation of the CWR population among their objectives.
3. The target population is georeferenced and the number of adults (flowering plants) are censused or estimated using a scientific approach.
4. Biotic and abiotic conditions of the site are minimally characterized.
5. The target population is minimally characterized. At least, one herbarium specimen is obtained and deposited in a public Herbarium.
6. The target population and the site are subjected to periodic monitoring (at least once every five years).

To discuss about this integration of efforts, on 22 March 2019 members of genebanks, protected areas and public administration were invited to join in a workshop. Seven participants attended representing: 1. "GANASA" (Biodiversity Area of Environmental Management of the Govern of Navarra), 2. National Park "La Caldera de Taburiente", 3. Menorca Biosphere Reserve, 4. Sierra del Rincón Biosphere Reserve, 5. Botanical Garden of the Canaries "Viera y Clavijo" Gene Bank and 6. the National Centre of Plant-Genetic Resources (CRF).

There was a general interest in this type of cooperation among all the participants, even though some of them were working with CWR without knowing that they were CWR. It was considered that starting collaboration with CWR that are endangered, rare or endemic would facilitate the start of the collaboration process, without the need of extra funds. For the other CWR species, it would be more difficult to implement actions due to the lack of a specific plan for CWR conservation. Whereas legally protected threatened CWR could be managed through the Ministry and Departments of Environment of the public administrations, the Ministry and Departments of Agriculture would be responsible for the rest of them. Previous experiences of coordination between protected areas and gene banks could be the basis for the same type of cooperation for CWR conservation.

In this workshop new possibilities of *in situ* – *ex situ* coordination for CWR conservation arose. From the URJC research group the possibility was offered to compare their lists of flora species with which they work with the prioritized list of CWR in Spain.

*Towards better coordination and integration of efforts for the conservation of landraces:*

On 28 March 2019, a workshop was held with experts of *ex situ* and *in situ* conservation of landraces. Eight participants related to gene banks (regional and national) and to seed savers organizations,

discussed about integrating both approaches of conservation of landraces. They belonged to the regional gene banks of “Instituto de Conservación y Mejora de la Agrodiversidad Valenciana” (COMAV) and “Centro de Investigación y Tecnología Agroalimentaria de Aragón” (CITA), and the national genebank “Centro Nacional de Recursos Fitogenéticos” (CRF). As experts from on-farm conservation of landraces, two members of the national seed-savers organization, as well as of their regional organizations were present.

The interest about this type of cooperation was common to all participants, believing that it could turn into a positive action that would benefit considerably the situation of landraces in Spain. The current situation was analyzed, looking at how it has changed in the last decades: nowadays most landraces are conserved *ex situ* and the current situation should lead to a reintroduction phase for some of them. In this step, different actions should be distinguished: the on-farm replication of the *ex situ* accessions and the evolving material by mixing and selecting *in situ*. In the second case, this material will differ from the *ex situ* one, so the first case has more potential for coordination, through the mutual benefit from providing seeds (gene banks) and receiving characterization data in its original location and some replication of the material (farmers).

To carry on these joint efforts, extra human resources is needed. Collaboration proposals could be discussed in a recently created commission in the Ministry of Agriculture “Comisión Nacional de conservación y utilización de los Recursos Fitogenéticos para la Agricultura y la Alimentación” (National Commission for the conservation and use of PGRFA).

*d) Analysis of required* in/ex situ *human resources and facilities, and costs/ benefit implications of back–up strategy.*

*In situ* analysis:

- Farmers/seed-savers: lack of economic and human resources.
- CWR: estimated costs of seed collection. The Gene Bank of the “Universidad Politécnica de Madrid” has estimated that the costs of collecting seed species in the Biosphere Reserve “Sierra del Rincón” varies from 60€ to 900€ per accession.

*Ex situ* analysis:

Estimated costs of *ex situ* conservation from different sources:

- CIMMYT: 146 USD per accession per year, including regeneration (Philip et al., 1999).
- AVRDC – The World Vegetable Centre: 5-23 USD per accession per year (Schreinemachers, Ebert and Wu, 2014).
- CRF: approximately 50-70€ per accession per year (personal communication)
- Nordgen: around 40-70€ per accession per year (personal communication)

*e) Test back–up strategy of* in situ *activities in Spain.*

A meeting was held on 26 November 2018 to promote, as a pilot study, the collaboration between the “Sierra del Rincón” Biosphere Reserve located in the Madrid Autonomous Region and the Gene Bank of the “Universidad Politécnica de Madrid” (UPM) for the *in situ- ex situ* conservation of CWR. As a result of this, a project proposal was submitted to the Department of Environment of the Madrid Autonomous Region in January 2019.

The project proposal was funded and, as a result, populations of 15 priority species of CWR were prospected and characterized *in situ* in the Biosphere Reserve, as well as collected and conserved in the gene bank. A selection of 15 prioritized CWR existing in the Biosphere Reserve was performed and then prospecting actions were carried out to locate populations in good condition of the selected species. The populations identified and selected were georeferenced and censused. The seeds collected were deposited in the "César Gómez-Campo" Gene Bank of the UPM, thus establishing a start for a collection of CWR of this Biosphere Reserve. The project also included two workshops in the Biosphere Reserve, with an introduction to the conservation of CWR and practical training on *in situ* and *ex situ* conservation. In 2020, a second agreement provided an extension of the project, by which populations of a second set of 15 priority CWR of the Biosphere Reserve were prospected. The selected populations were once again georeferenced and censused and seeds samples were collected and deposited in the UPM genebank.

To carry out this activity, we sought the establishment of a MTA between the “Sierra del Rincón” Biosphere Reserve and the UPM Genebank, following the current state regulation on conservation of plant genetic resources. However, it has not been possible to do it properly. In order to be able to visit the populations of the CWR, obtain herbarium specimens and collect seeds for the genebank, we asked for permission following the channels established by the Department of Environment of the Madrid Autonomous Region. We obtained permission to collect seeds and deposit them in the UPM genebank for the two projects held in 2019 and 2020. The documents simply stated that we were authorized to collect herbarium specimens of the indicated CWR species and to collect seeds and deposit them in the UPM genebank, without any further detail. In 2019 and 2020, we attempted several times, by email and through our contacts in the Department of Environment, to hold a meeting with the service unit in charge of giving the permission to discuss the writing of a proper MTA. However, we never obtained a response from them. It should be noted that while the Spanish legislation concerning the access and use to the genetic resources through the Nagoya Protocol was passed in 2017 and there is a website with information about the procedures to follow (https://www.miteco.gob.es/es/biodiversidad/temas/recursos-geneticos/Normariva_espanola_RG.aspx), the Spanish legislation concerning the access and use to plant genetic resources for food and agriculture was not passed until May 2020, and there is currently no webpage available in the Ministry of Agriculture providing further explanation and providing an e-portal to carry out the procedures.

The results of the implementation of this back-up strategy in the Biosphere Reserve “Sierra del Rincón” have been disseminated in the Bulletin of the MAB program of the Spanish Network of Biosphere Reserves —issues 26 (2019) and 27 (2020). In March 2020, we held a meeting with the

staff that coordinates the Spanish Network of Biosphere Reserves at the Spanish Ministry of Ecological Transition, where we presented this experience. We were then invited to present this initiative to the annual meeting of Directors of Spanish Biosphere Reserves that was going to be held in May. However, this meeting that was going to be held in Madrid was finally suspended as a result of the covid-19 situation.

In parallel, in 2019, we held several meetings with representatives from the Ministry of Agriculture, who are leading the National Commission for the Conservation and Use of PGRFA, where we presented our activities concerning the conservation of crop wild relatives and our interest in participating in the Program for the Conservation and Use of Plant Genetic Resources. As a result of these meetings, we were commissioned to prepare a proposal of a National Strategy for the Conservation and Use of Crop Wild Relatives. During 2020, we completed a draft that was presented for public consultation in October. The draft strategy contains a specific action to promote the compliance of national and international legislation concerning the access and use of CWR and other actions that involve both *in situ* and *ex situ* conservation stakeholders. The national strategy was presented for discussion and approved to the annual meeting of the National Commission for the Conservation and Use of PGRFA held on March 12$^{th}$ 2021.

***References***

Philip, P. et al. (1999) 'Costing the *ex situ* conservation of resources: maize and wheat at CIMMYT', ETPD discussion papers, International Food Policy Research Institute (IFPRI), (52).

Schreinemachers, P., Ebert, A. W. and Wu, M. H. (2014) 'Costing the *ex situ* conservation of plant genetic resources at AVRDC - The World Vegetable Center', Genetic Resources and Crop Evolution, 61(4), pp. 757–773. doi: 10.1007/s10722-013-0070-5.

# Appendix 4

***Activities performed in The Netherlands for the establishment of successful* in situ – ex situ *cooperation.***

The Netherlands is small and relatively simple in terms of organization. The number of *in situ* actors is low, e.g. there is only one genebank, so the inventory of the situation was easy.

It was decided to separately approach the nature conservation organizations and the on-farm actors.

*Nature conservation organizations*

Since in The Netherlands most (>50%) of the area for nature conservation is managed by only two organizations, it was decided to focus on these two organizations: Natuur Monumenten (NM) and Staats Bosbeheer (SBB).

Getting appointments with the right people in these nature protection organizations proved much more difficult than expected. Establishing the initial contacts had been relatively easy, meetings with people working at these organizations were arranged and both organizations were visited to discuss possibilities for collaboration. Both organizations were positive at this level, however there were complications regarding the time input required.

Getting the attention at the top level of these large organizations was another matter.

Regarding Natuur Monumenten it took many phone calls, emails and using personal contacts before an appointment with the Director Nature Management Teo Wams and the Manager Nature and Landscapes Petra Ket was arranged. The visit was prepared by sharing a short note about the potential collaboration "Behoud en toegankelijkheid van Nederlandse wilde verwanten van voedselgewassen" ("Conservation and access of Dutch wild relatives of food crops"[1]) and the meeting took place on January 8th 2020. (Teo Wams tweeted. In Dutch "Had an interesting conversation with @CGN_Wageningen, In NL there are 214 wild plant taxa related to agricultural crops. Treasure-trove of genes for future food. We are going to collaborate. @CropWildRealativ") The conversation resulted in the conclusion that NM is willing to collaborate with regards to the black-box *ex situ* backup, provided CGN will do this in the context of another project that is about to be set up, het Levend Archief (the Living Archive), in which CGN will participate. First collecting was planned later 2020. A report of the meeting is written, shared, and approved by the participants[1].

After the January 8th meeting, it also proved easier to get in contact with Staats Bos Beheer (SBB). An on-line meeting (due to Corona) with the Department Head Management and Planning Jelka Both and Teamleader Seeds and Parks Lammert Kragt took place on July 8th 2020. A report of the meeting

[1] In Dutch, available on request

is written, shared, and approved by the participants[1]. Also SBB agreed with the importance of safety back-up of the CWR in their reserves and allowed coordinated activities to achieve this.

Both organizations expressed their concerns regarding the collecting protocols and the interaction with another initiative aimed at backing up the entire Dutch flora ('Het Levend Archief' – 'The Living Archive'). Luckily CGN is member of the board of the latter initiative and thus no problems were anticipated.

SBB also wanted to encourage use of the platform of the Vereniging van bos- en natuurterreineigenaren (VBNE, Society of forest and nature owners) for raising awareness about the importance of nature as a reserve of CWR, possibly resulting in more nature managers submitting safety backups.

Both organizations made it clear that the actual collecting of samples would not be done by them, CGN would have to take the initiative and cover the costs. Both SBB and NM would be willing to support the initiative by help in the planning, and providing access to the growing populations, etc.

On June 25th and August 20th 2020, in collaboration with the 'Het Levend Archief', CGN went collecting CWR in Dutch nature for the purpose of safety back up. Eleven accessions were collected of the following species: *Vicia tetrasperma subsp. gracilis, Hordeum marinum, Avena fatua, Medicago falcata, Lathyrus tuberosus, Lathyrus sylvestris, Pastinaca sativa* subsp*. sativa, Lactuca serriola, Linum catharticum, Lotus corniculatus* and *Daucus carota.* In doing so, the practical procedures, including the collecting protocol that had been used, could be tested. All went relatively smooth.

It appears that if we want a proper safety back-up of CWR in the Netherlands, the willingness and protocols are largely available. Possibly some awareness raising is needed in the smaller nature conservation organizations and private nature owners, but the general attitude is very positive. The only thing lacking is the capacity to perform the collecting and seed processing, but that could be organized in consecutive projects, either organized by the nature conservation organizations or the genebank CGN.

*On-farm organizations*

Similar to many other countries, the landscape of on-farm organization is very complex. Luckily The Netherlands has one large overarching organization: The Oerakker. This organization coordinates the joint activities of various networks, initiatives and individuals active in the field of on-farm management of PGR. As such it is the ideal platform for approaching this community in the Netherlands. Actually, the Dutch genebank CGN, is actively involved in this organization. As a result, various on-farm NGO's already backup their collections in the CGN facilities.

*In conclusion*

Promoting the *ex situ* backup of *in situ* managed PGR doesn't seem to be a big issue in The Netherlands. The on-farm NGO trust the National Genebank CGN, and are willing to submit material

for safety back-up when alerted to the possibility. After making the nature conservation organisations aware of the value of their plants as PGR, they are also willing to collaborate in backing up their CWR in the *ex situ* genebank. However, the priority of these activities is not such that large scale backing up occurs. A start with backing up CWR has been made, as a pilot, in collaboration with the initiative het Levend Archief.

SWOT Analysis

| | STRENGTHS | WEAKNESSES |
|---|---|---|
| Internal Factors | All groups involved are organized<br>The general attitude is very positive<br>The genebank (CGN) is generally known and trusted amongst on-farm NGO's | Lack of human and economic resources<br>In-nature actors are generally unaware of the CWR in their management |
| | OPPORTUNITIES | THREATS |
| External Factors | Possible collaboration with the initiative 'Het Levend Archief'<br>General interest in biodiversity and global food supply | Many competing issues on the political agenda<br>Climate change is causing rapid loss of CWR<br>Aging of on-farm actors seems to be hindering their activities |