Novel characterization of crop wild relative and landrace resources as a basis for improved crop breeding'

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Landraces

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Conserving Europe's plant genetic resources

for use now and in the future

PGR Secure – EU Seventh Framework Programme, THEME KBBE.2010.1.1-03, GA 266394

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Front cover: Young farmer showing his field of " Fagiolina del Lago Trasimeno" landrace in Italy.

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Editorial

Welcome to Issue 3 of Landraces. This newsletter is addressed you by the European Community funded project, "Novel characterization of crop wild relative and landrace resources as a basis for improved crop breeding" (PGR Secure, GA n. 266394) which started on 1st March 2011.

Landraces provides a medium to advertise information about the conservation and use of crop landraces; including updates on the activities of PGR Secure but also more general articles on landraces conservation and use. We intend to anticipate that anyone with an interest in landraces, whether conservationist, breeder, farmer, policy-maker or educator will benefit from this publication, both by spreading news about their own activities and by learning about other initiatives.

This third newsletter is subdivided into two different sections.

In conclusion of the PGR Secure project, the first section provides information about the landrace conservation strategies that were developed for Italy, Finland and Europe.

The second section is addressed to different European experiences of collection, characterization and use of landraces.

Above: A Barley LR (called "Orzo di Ripabottoni") from Molise Region under characterization in the experimental field of the Regione Molise Agency for Rural Development (ARSARP) — Italy (Photo: Michelina Colonna) .

The Italian landrace conservation strategy

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The Italian landrace (LR) conservation strategy was worked out considering the country political context and the PGR Secure achievements which concern the Italian LR inventory and the analysis of constrains and opportunities for LR conservation in the country.

The Italian political context

In Italy the responsibility for Genetic Resource maintenance lies with Regions and Autonomous Provinces, which decide on the matter of agriculture (LR included) while the Ministry of Agriculture (Ministero delle Politiche Agrarie e Forestali, MIPAAF) plays only an orientation and coordination role. All that matters with agriculture is discussed and agreed in a Permanent State-Region Conference.
Italy was the first country in Europe to protect Genetic Resources and LR using specific Regional and national legislations and also to develop specific 'Guidelines for the Conservation of Genetic Resources for Food and Agriculture' (GRFA) ((http:// www.politicheagricole.it/flex/cm/pages/ServeBLOB.php/L/IT IDPagina/305). The national legislation is presently under review.

Regional laws for the Agro-biodiversity conservation

As mentioned above, Regional laws exist that protect agro-biodiversity in Italy (see Negri and Torricelli, 2013).
The main objectives of all Italian Regional legislation are:
- support *in situ* and on-farm conservation of protected genetic resources (plants and animals) within the Region;
- favour the reintroduction or extension of culture of protected genetic resources;
- assign to 'guardian' farmers the multiplication of genetic resources that they themselves have conserved up to present day (Fig, 1);
-control the exchange of the propagation material produced and make it available both to the farmers that apply for it for cultivation, and for scientific purposes such as genetic selection and improvement;
- apply cultivation models, studied on the basis of those adopted by tradition, that should exalt the quality and productivity of the protected genetic resources;
- coordinate the subjects included in the Network in order to promote the economic and cultural enhancement of the genetic resources, protected by law, through the establishment of protection associations, consortia or protected trademarks and its involvement in wine and food fairs.

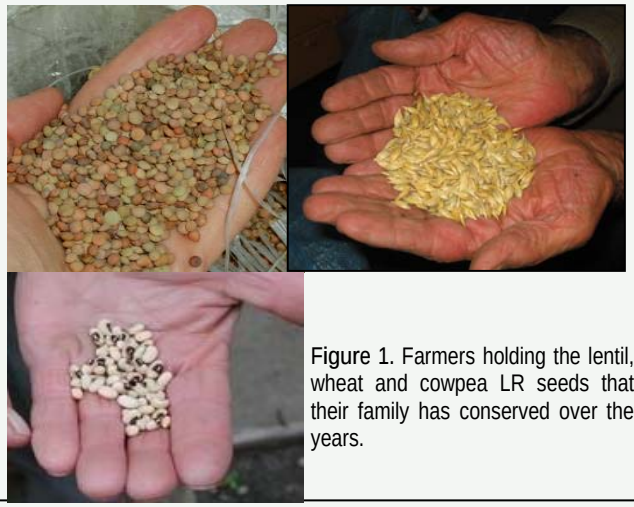

Figure 1. Farmers holding the lentil, wheat and cowpea LR seeds that their family has conserved over the years.

Guidelines for the Conservation for GRFA

According to the contest of the National Plan for Agricultural Biodiversity, a Working Group was established on 2010 and one of his tasks was to define the Guidelines for the Conservation of Genetic Resources for Food and Agriculture. The focus was on *in situ* (on-farm) conservation of *sensu stricto* LR. This was because many Italian typical products are based on the cultivation of LR, which is often profitable for farmers, of the strict link between a *sensu stricto* LR with its territory and people and of the diversity of the landscape that has favoured the maintenance of many LR *in situ*. The main steps in the Italian approach to *in situ* (on-farm) LR conservation are identified by the Guidelines as follows:

a) Collection of information on existing LR (inventory and collection of propagation material for *ex situ* back up and for characterization;
b) Identification of the areas where to carry out *in situ* (on-farm) conservation actions with priority (i.e. the Most Appropriate Areas, MAPAs);
c) Characterization and assessment of the distinctiveness of local varieties;
d) Assessment of population size and genetic structure of local varieties maintained *in situ* (on-farm);
e) Monitoring the effectiveness of *in situ* conservation (periodic assessment of the maintenance of an adequate level of genetic diversity and absence of genetic erosion);
f) Set up and operation of an information system for work related to *in situ* (on-farm) conservation.

These tasks are committed to the Italian Regions and Autonomous Provinces. Some of them have already taken these steps in the frame of their Regional laws, some others have not yet.

PGR Secure achievements

The first Inventory of *in situ* maintained landraces of Italy

As mentioned by the "Italian National Plan for Agro-biodiversity Conservation" and other documents, to compile an inventory, i.e. a solid informative base, is the first step that leads to the development of any conservation strategy. The compilation of an Italian inventory of *in situ* maintained LR was funded by the PGR Secure project .
In order to compile an 'official' inventory, UNIPG has contacted: first, the Ministry of Agriculture, secondly, the Consultative Body of the Regions on the PGR matter providing information on PGR Secure and aims, and thirdly, each single Region officer in charge of Genetic Resources with the request of providing official data on LR maintained *in situ*.
On the basis of information received and using the tools purposely developed in the PGR secure project (i.e. 'Descriptors for web-enabled national *in situ* landrace inventories' and the 'MS database for *in situ* LR data recording', respectively both available from www.pgrsecure.org LR help desk) a 'First Inventory of *In situ* Maintained Landraces of Italy' was prepared (Negri *et al.,* 2013, also available at http://vnr.unipg.it/PGRSecure/). It includes all of the LR that have been recorded by the Italian Regions and Autonomous Provinces through the last two decades and up to January 2013. For each LR, the scientific name of the crop, the local name, the number of recorded accessions, their geographic coordinates and altitude and other information, have been collected. For each Region it is possible to look at the regional database (Fig. 2).

Figure 2.. The first Italian inventory of *in situ* maintained Landraces.

Italian LR inventory results

The inventory located 4806 accessions belonging to 2365 LRs were inventoried across Italy. The highest LR number was recorded in Umbria (378), Calabria (288), Sicily (251), Basilicata (212) and Campania (203); these Italian Regions accounted for more than 50% of total recorded LR (Fig. 3). 329 species are cultivated as LR, among them fruit trees, vegetables, grain legumes, forage crops, cereals, ornamental plants and other species are included. The LRs most frequently found are fruit trees 73% (apples, pears, plums, grapes and olive trees), followed by herbaceous plants 27% (grain legumes, vegetables, cereals and forages).

Constraint and opportunity identification

Steps towards an effective and efficient conservation strategy in Italy should rely on overcoming the constrains and take advantage of opportunities. The analysis of the present situation in Italy identified the main constrains and opportunities as reported below in summary.

Constrains

The information gathered during PGR Secure highlights that there are many LRs at high risk, especially those only grown for family use (mainly horticultural crops). They are estimated to be in much higher number than officially recorded by the Regions and almost never safely backup *ex situ*. Information also shows that better advantage of the present seed legislation for LR seed commercialisation (Spataro and Negri, 2013) should be taken to facilitate on-farm conservation. In addition, activities for PGR conservation are scarcely coordinated among the different Institutions involved (State, Regions and Autonomous Provinces, Universities and research centers) and between them and farmers and farmer communities. In addition, funds for conservation and conservation research are always insufficient.

Opportunities

Enhancing use is a means to sustain *in situ* (on-farm) conservation. Many Italian LRs are presently used produce quality products, many of which also awarded with European quality marks which guarantee them wide and profitable markets. However, there are also typical products from LRs that have a niche, rich market, because of the appreciation of local consumers for typical food deriving from them, and are also offered to tourists in the local restaurants and tourist shops. They are often promoted through the organisations of local fairs, local and national Academies of Cuisine and Slow Food, specific campaign run by farmer organisations and regional funds.

Finally, the request of LR seed or propagation material is icreasing in organic (and more generally 'environmentally friendly') farming and home/community gardening.

The Italian LR Conservation Strategy: Recommendations for Actions in the Next Future

Conservation actions needed

♦ Public Bodies under which lies the responsibility of LR conservation should complete the national inventory and periodically update it.

♦ Public Bodies awareness on the present level of LR loss (especially concerning horticultural crops) should be increased.

♦ Public Bodies should promote safe back up of LRs in public *ex situ* collections, since gathered data shows that almost all of the LR inventoried in Italy are not conserved in the main genebanks.

♦ Public Bodies should increase their coordination in developing and implementing measures for LR conservation and use.

♦ Public Bodies should provide adequate funds for *ex situ* and *in situ* (on-farm) conservation. For *in situ* (on-farm) conservation, initial multiplication of LR accessions stored in Regional, University and Research Center genebanks, followed by distribution among farmers of LR seed should be carried to facilitate use by local farmers/farmer communities as already achieved for some crops in local experiences (Polegri and Negri 2010, Polegri *et al.* 2014). The European Policies already foresee measures for increasing agro-biodiversity than can be used to the purpose.

♦ Last, but not least, public funds are also needed to support research aimed to understand the level of genetic diversity which characterize different LRs, how LR populations evolve on-farm under different climatic constrains and management systems, and to identify genes that underpin evolution and key genetic traits for robustness (e.g. resistance against biotic and abiotic stresses, adaptation to local conditions) and quality. This will facilitate LR broader use in the formal and informal (i.e. farmer guided or participated) crop improvement .

Enhancement of use needed

♦The registration of LR as 'conservation varieties' or other formal designations should be promoted and/or directly carried out by the Public Bodies under which lies the responsibility of LR conservation. This action can facilitate farmer access to LR seed (and in such on-farm conservation), protect LR by strictly linking them to a certain territory, help in developing local seed industries which can usefully complement farmer incomes from LR products.

♦ A perspective for *in situ* (on-farm) conservation appears to be, at least for some of the still existing LR, to promote their use as typical products. Typical products are lucrative on the market because of the added value that the consumers attribute to the superior quality and the link with the history, culture and traditions of the area. By adding value to LR products with quality marks, LR *in situ* (on-farm) conservation is encouraged because of the higher income the farmer gains cultivating the LR rather than cultivating another type of variety of the same crop. Public and private stake holders should better promote the awarding of LR quality marks and local products coming from LR.

♦Strengthening the relationships between the agro-food system and the community based management of plant genetic resources could lead to effective *in situ* (on-farm) conservation. If LR exist and consumers are willing to pay a good price for them, a self-sustainable system could be triggered. In this way the cultivation of LR would become advantageous for local farmers and an effective *in situ* (on-farm) conservation could become a more extensive reality.

♦In this respect, campaigns aimed to promote local economies selling high quality products from nearby farms (like the "Campagna Amica" campaign carried out by one of the main Italian farmer organisation) could greatly promote *in situ* (on-farm) conservation if based on local LRs to a wider extent than at present. The involvement of farmer organisations in plans for for LR enhanced use is to be highly recommended.

♦ Public Bodies under which lies the responsibility of LR conservation and other public (like Municipalities) and private (like citizen associations) stakeholders should promote the use of horticultural crop LRs in community and home gardens. Community gardens already exist in many urban and suburban areas and, after an initial multiplication of LR materials, can easily be spread about. All the same, home gardening should be enhanced promoting the exchange of LR seeds among people in the LR adaptation area. This action appears to be of particular importance for the conservation of the most threatened of all Italian LRs, i.e. those belonging to horticultural crops.

♦ Finally, considering the present need to attain sustainable, high productions with lower inputs than presently applied, the use of LRs in low input farming systems is highly recommended. This is because LRs are heterogeneous populations, highly adapted to specific environments and tolerant to abiotic and biotic stresses that show higher yield stability under different conditions (Torricelli *et al.*, 2014; Raggi *et al*, in prep; and references therein) than uniform varieties mostly used as a productive base. Since they are also able to evolve over time in response to the different human and environmental selection pressures (Rhoné *et al*, 2008, 2010; Pusadeea *et al.,* 2009; Negri and Tiranti, 2010; Tiranti and Negri, 2007), they also constantly provide farmers with a sound base of production.

For the same reasons, the use of LR in plant breeding and participatory plant breeding programs, especially those aimed at creating varieties suitable to environmentally friendly agronomic systems, should also be encouraged.

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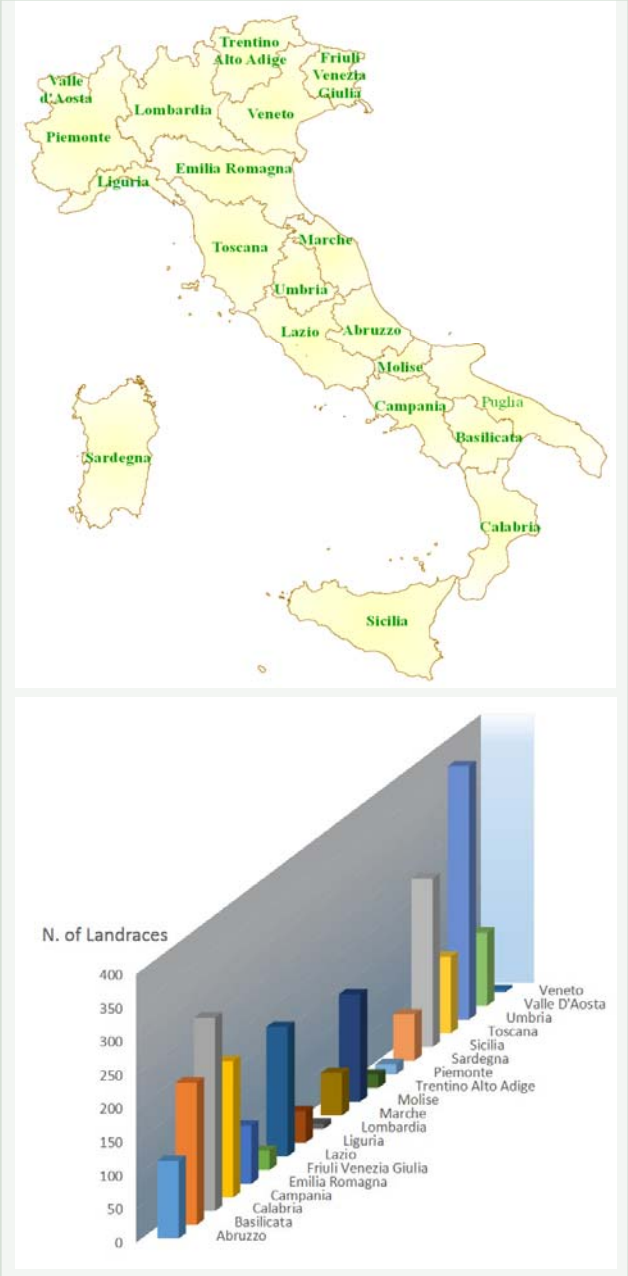

Figure 3 . Official number of landraces that are maintained *in situ* in each one of the Italian Regions.

Finland's landrace *in situ* conservation strategy drawn from cultivation inventories

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The first national landrace *in situ* conservation strategy for Finland was published in 2014 (Heinonen, 2014). The strategy has been compiled as part of the PGR Secure project and activities within the Finnish National Plant Genetic Resources Programme during 2011-2014. The strategy provides the description of the landrace cultivation inventory process applied, landrace *in situ* cultivation and *ex situ* inventory results. The recommendations for the national landrace *in situ* conservation are drawn from the inventory experience.

Methodology used *in situ* cultivation inventories

During 2011-2014 landrace *in situ* cultivation inventories were carried out. The target taxa were apple (*Malus domestica*), potato onion (*Allium cepa* Aggregatum-group) and cereals (winter and spring rye (*Secale cereale*); spring barley (*Hordeum vulgare*); winter and spring wheat (*Triticum aestivum*); oats (*Avena sativa*). The data of conservation varieties and landraces accepted to the National List of Plant Varieties were also collated from the register.

Different inventory methods were developed depending on the target taxa and facilities for variety identification. The shared method with all inventories was to prepare and release public calls or announcements to find farmers and gardeners with potential landraces to obtain the plant material for further evaluation. This was an essential starting point for all target taxa because there is only one and limited register of landrace growers: the register of conservation varieties. Landrace call materials were prepared for both the national wide and the local or territorial search missions. The latter approach of restricted geographical location turned out especially workable because it succeeded to attract the media for spreading calls that saved costs and time.

Call materials consisted of press releases for the media, short articles offered to be published in local print and digital media and trade magazines, and posters offered to public events and websites.

The very important repository for landraces turned out to be the earlier studies on them dating them the early 20th century. In Finland the first collecting missions of landraces were organized by professional plant breeders who collected and studied an extensive amount of landrace samples for breeding material. Especially cereal and apple breeders collected landraces to use them in breeding programs to get winter hardiness and early maturing genetic material. These old literature offered phenotype description, sometimes also with photos or drawings, their origin and cultivation sites. This information was useful both in planning and preparing the calls and in analysing the received samples (the variety verification).

Local history data (especially family, village) printed in newspaper articles or books and old photos were also very useful if available (Fig. 1). Problematic in using the latter source material is that collecting and analyzing is especially time consuming.

During the inventory projects a web-based announcement form for all PGRFA important taxa was designed and released at the public website of the Finnish National PGR Programme (MTT, 2014).

This preliminary data offered by the calls formed the basis for further studies. The most potential landraces were evaluated against the old literature and other knowledge available on that landrace strain and, as the most important, against farmer information about his/her landrace (see the descriptors for *in situ* inventories Negri *et al.,* 2012). After that the potential landrace sample entered to phenotype and DNA analyses. All inventories aimed to identify single landraces and distinguishing them from other landrace strains as well as bred and foreign cultivars. As the final stage the farmer on-farm data was completed of variety verified samples.

Results of landrace *in situ* cultivation inventories

The landrace *in situ* cultivation inventories produced results of 144 landraces, of which 117 were variety verified by the inventory projects (Tab. 1). Some of them especially local apple variety clones and landrace strains of grass plant crops are rather commonly cultivated throughout Finland, in particular in the Central and Eastern part.

Table 1. Number of identified and variety verified landraces in on-farms/in gardens in Finland (Heinonen 2014).

Crop vernacular name	Scientific name	Total no. of *in situ* accessions	Registered as conservation variety	Accepted to the Finnish Plant Variety List
Potato onion	*Allium cepa* Aggregatum Group	41[1]	0	0
Swede	*Brassica rapa* var. *napobrassica*	2	0	1
Turnip (in slash-and-burn cultivation)	*Brassica rapa* subsp. *rapa*	2	2	0
Oat	*Avena sativa*	4	1	0
Red and white clover	*Trifolium* spp.	10	7	3
Barley	*Hordeum vulgare*	3	1	0
Timothy	*Phleum pratense*	2	0	2
Rye	*Secale cereale*	21 [2]	8	1
Apple	*Malus domestica*	57[3]	0	0
Potato	*Solanum tuberosum*	2	0	1[4]

[1]Includes several same clones. In total 22 different clones identified.
[2] Includes some duplicates (i.e. same landrace is cultivated in two or three farms).
[3] Mother trees or old clones; one accession per local variety. In total identified about 100 LR apple varieties. 40-44 samples are still under variety verification (phenotype and DNA-fingerprinting).
[4] Landrace 'Puikula' cultivated and packed in Lappland has been awarded by the EU quality mark 'Protected desination of origin (PDO)' since 1997.
Note: Except of some potato onions and rye *in situ*, all inventoried landraces are extant in their original area and no duplicated accessions are included to the table.

Future challenges and opportunities

For promotion of use and appreciation of landrace value we need more verified and diverse scientific, farmer and consumer knowledge on national landraces found *in situ* and preserved *ex situ*. Furthermore, these goals support the current EU genetic resources policy which is shifting from conservation to sustainable use of agricultural genetic resources (European Commission, 2013).

Currently landraces are grown mainly for home consumption and only few landrace based products are available for consumers, with some few exceptions. Typically landrace products are occasionally sold in local market places, events, small bakeries and agritourism farms as typical or niche products. However, Finns are more and more interested in landrace products. One potato landrace registered under the terms of Protected Designation of Origin (PDO) and the traditional turnip for slash-and-burn cultivation which are retail traded nationwide. One conservation variety of barley has regional markets to its niche products. Although 19 seed propagated landraces are registered as conservation varieties mainly there are cultivated in one single farm. Eight seed propagated landrace varieties are accepted in the National List of Plant Varieties and these have larger cultivating area with many farmers. Twelve old local varieties have gained the trademark FinE© (Finnish Elite) for the horticultural plant varieties as proof that they are also valuable and well-adabted for cultivation in the northern conditions of Finland. In addition, one third of the landrace apple varieties are widely marketed by nurseries. Consequently, they are now common in home gardens in Finland. The total cultivation area of each landrace apple variety ranges from a handful of gardens to hundred or in some cases to thousands of gardens. A handful of horticultural farms have commercial apple production with landrace varieties.

National plant genetic resources are not only the basis of the food security, but they also carry along the information of the biological cultural heritage. Finnish landrace plants have been selected into cultivation due to their culinary, esthetical and cultural properties. Therefore the spectrum of their variation can be wide, and thus they are well suited in displaying diversity in the different times of history.

Figure 1. The old photos are usable sources in landrace cultivation inventories, especially when combined to other historic data. This photo from the 1910s reveals that potato onions (*Allium cepa* Aggregatum group) were grown in the kitchen garden in the south part of Finland. Photo: Anselm Laakso/Achive of the Yläne local heritage association.

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European landrace conservation strategy

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The EC FPVII PGR Secure project (http://www.pgrsecure.org/), recently concluded, aims were to develop conservation strategies for European crop wild relative (CWR) and landrace (LR) diversity and to enhance their use as a mean of underpinning European food security in the face of climate change. Within the PGR Secure project (WP4) UNIPG (University of Perugia, Italy,) MTT Agrifood Research Finland and University of Birmingham UK focused on developing tools and strategies for on-farm LR conservation.

The International Context and actions for LR conservation

During the past 15 years, there have been major policy developments with impact on the conservation, use and exchange of Plant Genetic Resources for Food and Agriculture (PGRFA). Undoubtedly, the International Treaty on PGRFA (ITPGRFA, FAO, 2001) and the 2nd Global Plan of Action (GPA, FAO, 2011) are the most important and reflect a wide consensus among states and have a binding nature for many European states and the European Union (EU).

The ITPGRFA (art. 5) calls each Contracting Party, subject to national legislation, and in cooperation with other Contracting Parties, where appropriate, to promote an integrated approach to the exploration, conservation and sustainable use of plant genetic resources for food and agriculture. Article 6 of the International Treaty also calls each Contracting Party to promote the sustainable use of PGRFA;

The 2nd GPA (FAO, 2011), prepared under the aegis of the Commission on Genetic Resources for Food and Agriculture, updates the Global Plan of Action for the Conservation and Sustainable Use of Plant Genetic Resources for Food and Agriculture, adopted in 1996, at the Fourth International Technical Conference on Plant Genetic Resources. The 2nd GPA responds to the needs and priorities identified in the Second Report on the State of the World's Plant Genetic Resources for Food and Agriculture, a global assessment that FAO published in 2010. It was prepared through a series of regional consultations, with the participation of 131 countries and representatives of the international research community, the private sector and civil society. The Global Plan of Action provides the technical blueprint for the funding decisions of the ITPGRFA and the Global Crop Diversity Trust also established in 2004.

The tenth meeting of the Conference of the Parties to the Convention on Biological Diversity adopted a revised and updated Strategic Plan for Biodiversity for the 2011-2020 period, which the United Nations General Assembly declared the United Nations Decade on Biodiversity, with a view to contributing to the implementation of the Strategic Plan.

As a party to the Convention on Biological Diversity (CBD, 1992), the European Union (EU) agreed that by 2020 the genetic diversity of cultivated plants and farmed and domesticated animals and of wild relatives, including other socio-economically as well as culturally valuable species, is maintained, and strategies have been developed and implemented for minimizing genetic erosion and safeguarding their genetic diversity

The new EU Strategy, 'Our life insurance, our natural capital: an EU biodiversity strategy to 2020' (European Parliament Resolution, 2012) lays down the framework for EU action during this decade, in order to meet the commitments made by EU leaders in March 2010. In addition to the EU Biodiversity Strategy, nearly all EU Member States have also developed their own NBSAPs, further adding to the implementation of the CBD and related international agreements at national level through a wide range of national and sub-national policies and measures.

The resolution of the European Parliament on the EU 2020 Biodiversity Strategy also indicates that the key to the EU 2020 Biodiversity Strategy is the reform of the Common Agricultural Policy (CAP) which is "designed to support farming that ensures food safety (in a context of climate change) and promote sustainable and balanced development across all Europe's rural areas, including those where production conditions are difficult".

The 'European Commission Report to the European Parliament, the Council and the European Economic and Social Committee - Agricultural Genetic Resources - From Conservation to Sustainable Use' (2013) is aimed at "recalling the need to conserve and sustainably use genetic resources and at ensuring that this objective is properly catered for in the ongoing development of relevant policies and programmes, notably:

- the Rural Development Policy, via its agri-environmental measures to target the level of practical farming and via the European Innovation Partnership to bridge practice needs with research activities and foster interaction between relevant actors;
- the Research & Innovation Policy with its Framework Programme Horizon 2020 to build up the knowledge base on genetic diversity in agriculture".

However, Member States have not received inputs from the Commission on how to or where to address exactly measures or programs in favour of agro-biodiversity conservation.

Finally, specifically Regarding LR conservation, the Commission Directives 2008/62/EC 20 June 2008, 2009/145/EC 26 November 2009 and 2010/60/EU 30 August 2010 on seed production and marketing opened a new way for their conservation because the Directives are aimed "to ensure *in situ* conservation and the sustainable use of PGR", as their premise states, although they focus on seed production and marketing instead of genetic resource conservation *per se*. Previous European seed regulation made impossible to commercialise LR seed because the registration to the Common Catalogue required, beside distinctness and stability, uniformity a trait that LRs do not have. However, at present, their application has only partially favoured the registration of LRs maintained on-farm or preserved in *ex situ* collections (Spataro and Negri, 2013).

European LR *in situ* (on-farm) conservation strategy: recommendations

In order to draft a European strategy we took into account the main recommendations from i) the European continental perspective and from ii) the national perspective of the exemplar countries.

As for the former, the recommendations included in the 'The ECPGR concept for *in situ* (on-farm) conservation in Europe' (Negri *et al.*, 2014) were considered. As for the latter, the recommendations from countries that represent very different situations across Europe for pedo-climatic conditions, LR on-farm diversity and socio-economic context (Finland, Italy and UK, Heinonen and collaborators, 2014; Negri and Torricelli, 2014; Maxted *et al*., 2014) were considered.

In spite of the differences that exist among European countries, highlighted common needs and elements for a strategic and cooperative approach to *in situ* (on-farm) conservation do exist.

There are both conservation and enhancement of use actions that are recommended and detailed in Box 1. Many of recommended activities shown in Box 1 can take advantage of the policy and legislative European opportunities for supporting LR cultivation that were mentioned above.

These conservation and promotion of use actions in favour of LRs could be carried out initially concentrating efforts on the most threatened LRs and on MAPAs.

Among the conservation actions mentioned above, the need for European LR inventories has already been stressed by international policies and strategies for a sustainable use of PGRFA for a long time, and more recently by many papers specifically referring to Europe (Maxted *et al.*, 2009; Veteläinen *et al*., 2009a, 2009b, 2012; Negri *et al*., 2014).

Although many activities to increase awareness and capacities have been carried out (see http://www.pgrsecure.org/,LRs helpdesk), lack of funding and models to follow have hampered the compilation of LR inventories across all Europe out up to now.

We note that no action plan for the development of European plans for *in situ* (on-farm) conservation and their implementation can be developed if there is not any informative base (and, of course, the same considerations hold true for the Nation level).

The main restriction nin compiling a European *in situ* (on-farm) conservation strategy of LRs continue to be the lack of information on their existence, location and use.

Box 1

Conservation actions:

- *Compile a European LR inventory and periodically update it;*
- *Educate and raise public awareness of local LR diversity;*
- *Safe back up LRs in ex situ conservation;*
- *Promote LR re-introduction from genebanks back to on-farm;*
- *Increase European coordination in developing and implementing measures for LR conservation;*
- *Make available adequate funds for LR ex situ and in situ (on-farm) conservation actions;*
- *Make available adequate funds for carrying out research into LR diversity in the context of climate change and unpredictability.*

Enhancement of the LR use:

- *Promote the use of home garden LRs in community and home gardens;*
- *Promote the registration of LRs as 'conservation varieties;'*
- *Promote the awarding of quality marks for products coming from LRs;*
- *Promote typical, local products coming from LRs;*
- *Carry out campaigns aimed to promote local economies based on nearby products coming from LRs.*
- *Stimulate the use of LRs in plant breeding and participatory plant breeding programs, especially those aimed at creating varieties suitable to environmentally friendly agronomic systems.*

The compilation of country and European inventories of LRs that are maintained *in situ* (on-farm)

Following the CBD (1992), the 2nd GPA (FAO 2011) policy and strategy for *In Situ* Conservation and Management stresses that ''The surveying and inventorying of PGRFA should be considered as the first step in the process of conservation and reducing the rate of biodiversity loss''.

In addition, the ITPGRFA (FAO 2001), of which many European countries and the EU are contracting parties, recommends that: "Each contracting party should promote or support and appropriate farmers and local communities with efforts to manage and conserve on-farm and their plant genetic resources for food and agriculture'' (article 5c).

To compile Plant Genetic Resource Inventories should also contribute to meet the targets of the EU 2020 Biodiversity Strategy (the European Parliament Resolution, 2012) since, at present; there is no *in situ* (on-farm) systematic conservation of LR in Europe. The figure 1 reports an example of *in situ* conservation of bean LR in central Italy.

Figure 1 – Example of *in situ* conservation of bean LR in Central Italy.

Generic European LR *in situ* (on-farm) conservation strategy: recommendations

The elements considered to draft the main recommendations for a European LR *in situ (*on-farm) conservation strategy show that, in spite of the differences that exist among European countries, common needs and elements for a strategic and cooperative approach to *in situ* (on-farm) conservation do exist.
There are both conservation and enhancement of use actions that are recommended and detailed below.
Conservation actions:

- Educate and raise public awareness of local LR diversity;
- Compile a European LR inventory and continuously update it;
- Safe back up LR in *ex situ* conservation;
- Promote LR re-introduction from genebanks back to on-farm; Increase European coordination in developing and implementing measures for LR conservation;
- Make available adequate funds for LR *ex situ* and *in situ* (on-farm) conservation actions;
- Make available adequate funds for carrying out research into LR diversity in the context of climate change and unpredictability.
- Enhancement of the LR use:
- Promote the use of home garden LR in community and home gardens;
- Promote the registration of LR as 'conservation varieties;'
- Promote the awarding of quality marks for products coming from LR;
- Promote typical, local products coming from LR;
- Carry out campaigns aimed to promote local economies based on nearby products coming from LR (Figs 2 and 3).

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Figure 2 – Young farmer growing and commercializing the " Lenticchia di Capracotta " landrace in Molise Region (Italy).

Figure 3 – Some examples of typical products coming from landraces in Central Italy.

Successful examples of landrace on-farm conservation and use in Italy

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"Nostrano di Storo" maize landrace

The Italian landrace "Nostrano di Storo" is a type of flint maize (*Zea mays* var. *indurata* L.) with very brilliant orange kernels and flint texture, whose production is entirely utilized as flour (Fig. 1). It represents a niche crop with important social and economic significance for local people. This landrace (LR) of maize has originated from an ancient introduction and has been grown in the area since mid 18th century.

"Nostrano di Storo" is actually grown on about 200–250 ha in an alluvial plain, situated in the low Chiese Valley, Province of Trento, North-Eastern Italy, and enclosed within mountain chains. Most farmers (66%) sow maize in fields smaller than 1 ha. The total production of 'Nostrano di Storo' maize has grown from 30 t of 1991 to the current 300 t and its total market value from about 15,000 to more than 500,000 euro (Lucchin *et al.* 2003). Still locally known and fully appreciated as 'polenta' maize, its demand shows a steady increase due to the increased attention of consumers to the locally cultivated crops, usually grown according to low-input agronomic practices. The regional exploitation of the LR has greatly contributed to its on-farm conservation through the continued cultivation and management by farmers in the agro-ecosystem where it has evolved (Lucchin *et al.* 2003). Presently total local income from this LR is estimated at about 1.2 million euro. Maize "Nostrano di Storo" LR was also registered in the European catalogue of 'conservation varieties' which helps in both maintaining the LR on-farm and in linking the LR to its own territory of origin.

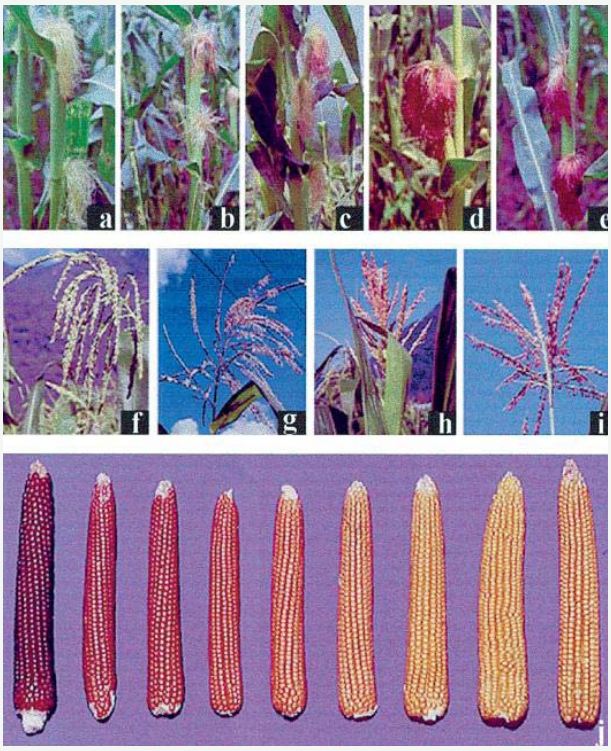

Figure 1. Examples of the phenotypic variability of silks (a–e), tassels (f–i), and ears (j) of the "Nostrano di Storo" maize LR (from Lucchin *et al.* 2003).

Overall it is a nice example of successful on-farm conservation and use of a LR in Italy If a holistic approach to *in situ* conservation is to be used, the inventory data can be used to identify the 'Most Appropriate Areas' (MAA), i.e. the areas that have the highest landrace density, diversity of the territory and that also include protected areas. These areas can be proposed to the National or Regional Authorities as areas where to set up or enhance political and economic actions in favour of priority landraces and agro-biodiversity conservation (Negri *et al.*, 2009). If a conservation approach only focused on single landraces is to be used, the inventory data can be used to implement specific conservation strategies for them.

''Sedano Nero di Trevi'' celery landrace

The ''Sedano Nero di Trevi'' (Black Celery from Trevi) is a LR grown in Umbria, near the small town of Trevi. The term ''black'' refers to the physiological characteristic of petiole that maintains the green colour if not subjected to agronomic whitening treatments. Traditional agronomic practices under a low input system are applied in the area. The ''Black Celery'' is grown on very fertile soils that were reclaimed to agriculture thanks to the canalization and sewage works made during the 18th century and are irrigated with the waters of the Clitunno river. After the Second World War, the introduction of self-blanching commercial varieties caused a crisis in the production of ''Black Celery''. However, the local association Pro Trevi (a non profit organisation established in 1965 and composed of local people who promote different activities in support of the town) has always supported its cultivation by celebrating a yearly ''Sedano Nero'' fair (http://www.protrevi.com/protrevi/sedano12.asp; Fig. 2). During the fair a prize is awarded to the best celery grower, spreading awareness of the peculiarities of the LR and collecting historical documents about it (Castellini 2005). The ''Sedano Nero'' is very appreciated by local consumers, restaurants and gourmet academies for its sensory attributes. It can be considered a representative case of LR on-farm conservation based on the typical, strictly linked to a certain territory, niche, highly valued product obtained (Torricelli *et al.* 2013) and local efforts to sustain cultivation.

Figure 2 – The ''Sedano Nero'' LR fair, http://www.protrevi.com/protrevi/sedano12.asp.

"Solina di Abruzzo" wheat landrace

Abruzzo is a region in central Italy characterized by mountainous and rugged territory overlooking the Adriatic Sea. Within a short distance of 40 km, the altitude ranges from sea level up to almost 3000 m asl. This peculiar orography, the diversity of the lithologic substrates and soils, together with the biogeography of the region, lead to a multitude of environments and microclimates (Manzi 2006). This type of environment has allowed the maintenance of some LR like the "Solina di Abruzzo" wheat. Solina is a winter wheat (*Triticum aestivum* L.), which has to be sown in September or in the first half of October, has a big ear with good protein content. The variety is well adapted to poor soils with an excellent resistance to cold that occurs at high altitudes. In these marginal areas, it has a low but stable yield of about 2 t/ha. The low yield is compensated by the quality of its flour (good taste and aroma). In September 2006 the farmers that grow "Solina" have established a Consortium to conserve and market the ancient wheat. The consortium consists of about 12 famers of the provinces Aquila, Pescara and Chieti. Overall they cultivate 500 ha of wheat. The Consortium uses two small organic mills, one uses traditional milling stones and the other is a more modern roller-mill. The flour is used to prepare bread and fresh home-made pasta in the families. Artisanal bread and pasta from Solina are also directly sold to consumers on the local markets (Silveri and Manzi 2007). "Solina di Abruzzo" LR is a nice example of both family and local market use. The figure 3 shows a field of Solina, pasta, bread, spikes of Solina and logo of the Consortium.

Figure 3 – A) field of "Solina di Abruzzo" LR; B) home made pasta of Solina; C) bread of Solina; D) spikes of Solina; E) logo of the Consortium (Photos: Donato Silveri).

The "Pera Cocomerina" pear landrace

The "Pera Cocomerina" is a LR of pear (*Pyrus comunis* L.) adapted to the high altitudes of the Apennines. The production area is the upper valley of the Tiber, between Romagna, Tuscany, Umbria and Marche Regions. This LR is resistant to pests and its production is constant even in the worst years. The fruits are small and weigh from 20 to 60 g. In normal climatic periods this LR matures at the end of August. There is a late type of LR that matures in the middle of October with a characteristic reddish colour of the flesh (Fig. 4). The colour is due to the presence of anthocyanin, a substance useful in maintaining a good health. This product obtained the Slow Food Presidium status. Since 2003 in Ville di Montecoronaro - Verghereto (Forlì Cesena, Emilia Romagna Region) local people celebrate a ''Pera Cocomerina'' fair in the middle of August (http://www.peracocomerina.it/cocomerina.html). The ''Pera Cocomerina'' is very appreciated by local consumers for its health and sensory characteristics and can be considered a good example of LR on-farm conservation due to the typical, strictly linked to a certain territory characteristics. Both the Slow Food award and the local fair help this LR to be maintained in cultivation.

Figure 4 – Particular of the fruits of "Pera Cocomerina" LR, http://www.turismo.fc.it.

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Common bean (*Phaseolus vulgaris* L.) landraces in Portugal: morphological diversity of the seed

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Introduction

Phaseolus vulgaris (common bean), an important grain legume for human consumption, was introduced in Portugal from the Americas during the XVI century. The good adaptation of this crop to the Portuguese environmental conditions resulted in a remarkable number of landraces which are *ex situ* conserved.
Although the common bean cropping area has been decreasing during the last decades, several landraces are still maintained on-farm, mostly in the northern and central regions of Portugal and mainly for self-consumption or for local market trade.
Concerning the characterization of the Portuguese common bean landraces a few studies have been performed on several subjects as, e.g., analysis of genetic diversity using SSRs (Denis *et al.*, 2013), evaluation of tolerance/susceptibility to rust (*Uromyces appendiculatus*) and to powdery mildew (*Erysiphe diffusa*) (Leitão *et al.*, 2013), evaluation of seed mineral composition (Pinheiro *et al.*, 2010).
In what concerns the morphological characterization, diversity studies have also been performed but only targeted to landraces from restricted country regions (Rodiño *et al.*, 2001; Freitas *et al.*, 2011). In the present work we intend to broaden the information on morphological diversity of the seed of common bean landraces from all the Portuguese geographic regions.

Materials and methods

A total of forty five common bean landraces from the different Portuguese regions and that show representative characteristics of growth habit and seed morphology were selected to be phenotypically evaluated. These accessions were obtained during germplasm collecting missions that took place from 1977 to 2007 and are maintained at the Research Unit of Biotechnology and Genetic Resources, INIAV-Oeiras, Portugal. The landraces were grown during 2013 in a farmer´s field at Cabrela (near Sintra, Portugal) in 3.0 m rows spaced 50 cm (Fig.1). The soil was a haplic luvisol and during the vegetative cycle (May to August/September) the mean T_{min} was 18ºC and T_{max} was 28ºC. The landraces of indeterminate growth, that were 40% of the total, were stacked in order to permit full development of the climbing habit.
Data on seed quantitative traits from 10 plants, randomly selected, were recorded according to the IPGRI Descriptors for *Phaseolus vulgaris* and are presented in Table 1.

A principal component analysis (PCA) (Sneath and Sokal, 1973) of the data was performed and the minimum spanning tree (Rohlf, 1982) was also calculated and superimposed on the projections. The program NTSYS-pc, version 2.1 (Rohlf, 2000) was used in all these statistical multivariate analyses.

Results and discussion

A great diversity in seed size, shape, coat colour and pattern was observed among the landraces studied (Fig.2).
The mean values and standard deviation for the characteristics evaluated are shown in Table 1. A high variability was observed in what concerns the number of seeds and the 100 seed weight.

Table 1. Mean values and standard deviation of the variables used to characterize the 45 common bean landraces.

Variable	Mean	Standard Deviation
Seed Length (mm)	13.15	1.52
Seed thickness (mm)	5.76	0.83
Seed width (mm)	7.39	0.61
100 seed weight (g)	37.80	8.40
Nº seeds	5.73	15.79
Nº locules	6.00	0.90

Table 2 indicates the correlation between the first three principal components and the original variables for the 45 landraces.

Table 2. Values of the eigenvectors on the first three principal components for the 45 common bean landraces.

Variable	I component	II component	III component
Seed Length (mm)	0.03	0.85	0.19
Seed thickness (mm)	-0.82	-0.35	0.03
Seed width (mm)	-0.84	-0.06	0.26
100 seed weight (g)	-0.88	0.24	0.19
Nº seeds	0.46	-0.14	0.85
Nº locules	0.13	-0.67	0.09

The first three principal components explain 77.1% of the total variation for the 45 landraces studied, 39.9%, 22.9% and 14.5% respectively for the I, II and III principal components. The first principal component is controlled by the seed width, the seed thickness and the seed weight, being mainly a component of seed size. The second principal component is controlled by the seed length and the number of locules, being mainly a component of seed shape. The number of seeds controls the third component.
The projection of the 45 landraces onto the plane defined by the I (39.9%) and the II (22.9%) principal components are shown in Fig.3. Five groups can be defined based on the variables used in the characterization. Group A includes five accessions with the highest values of seed thickness, group B includes the six accessions with the highest values for seed weight, group C includes four accessions with the highest seed length and the group D includes three accessions with the highest number of seeds. The remaining 27 landraces showed intermediate values of the characteristics used in the study.

Figure 1. Common bean farmer´s field trial, at Cabrela (Photo: M. M. Veloso).

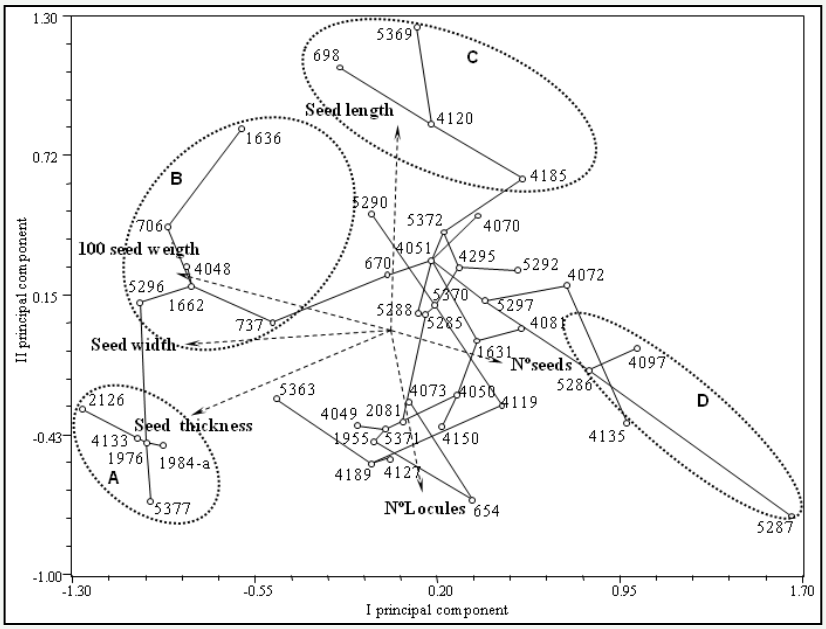

Figure 3. Projections of the 45 common bean landraces onto the plane defined by the Ist (39.9%) and IInd (22.9%) principal components with the minimum spanning tree and the eigenvectors superimposed.

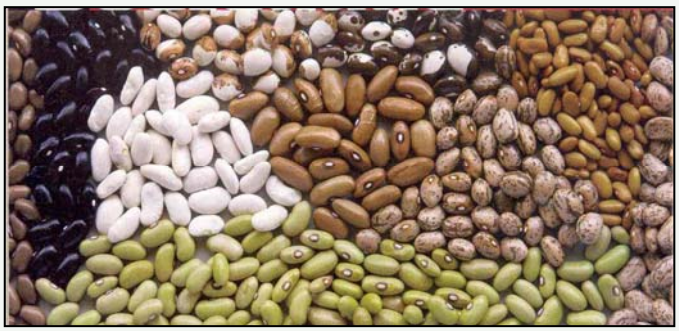

Figure 2. Common bean seeds diversity. Marked differences in size, shape and seed coat colour and pattern are evident (Photo: R. Loureiro).

We notice that in group B are included two landraces (1636 and 1662) which are very appreciated in the Portuguese central littoral region, near Mafra, with important value in the local markets. In addition, the group D includes the landraces 5286 and 5287, which are much used in the Minho region.

Conclusions

In this work we confirmed the great variability in the morphological diversity of the common bean landraces from all the main Portuguese regions. We observed that some of these morphological characteristics are associated with the preference of farmers, what guarantees the on-farm maintenance of landraces. This analysis is being extended to a greater number of landraces. On the other hand, it is intended to integrate the obtained information with other studies, namely on end-users quality and molecular diversity.

The high seed morphological diversity found among these landraces highlights their potential to be included in different food formulations attractive to a wider range of consumers.

As a result of this integrated effort, common bean landraces consumption and market demand will be enhanced, sustaining their on-farm production and conservation.

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On-farm conservation of the olive tree (*Olea europaea*) landraces at Vila Verde de Ficalho (Portugal)

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Olive tree (*Olea europaea*) is an autochthon plant of the Mediterranean basin that plays an important role in the rural economy and in the definition of landscape. Although its presence in the Iberian Peninsula precedes the Romans it was only during the Roman occupation that it gained agricultural importance. The large olive tree genetic patrimony is represented in Portugal by many "old" local cultivars, some of restricted distribution (Moreira *et al.,* 2009). The traditional groves of local cultivars usually have trees older than 100 years and a density of 100 trees per hectare. Biodiversity is high and spread over a great variety of habitats. Often, other fruit trees, namely fig, almond and pear, and wild olive are also present.
The left bank of the Guadiana river in the Baixo Alentejo province is one of the Portuguese regions that most contributes with olive oil of high quality, the Moura/Serpa region standing out in that respect .

Diversity of olive cultivars

A project on traditional olive groves ("Olival Tradicional") was carried out close to Serpa at Vila Verde de Ficalho (latitude of 37°57' N; longitude of 7° 18' W), a region of low annual mean rainfall (400 to 500 mm) with very high temperature in summer and mild winter. It was envisaged to prospect and inventory the local varieties in traditional groves found on Ficalho Hill and on the adjacent plain with in collaboration with the farmers in the region. After olive variety identification by the farmers, fruits and leaves were collected for subsequent morphological and molecular characterization. The dominant cultivars are two local ones, "Cordovil de Serpa" and "Verdeal Alentejana", and "Galega" (of widespread distribution in Portugal). Other local cultivars always present are "Gama", Bico de Corvo", "Mançanilha" and "Carrasquenha". "Gama" was detected in small numbers in all groves, but it was found a 70 hectares grove of this cultivar (Taroais olive grove; Figs. 1 and 2). "Cobrançosa", a cultivar from the northern province of Trás-os-Montes, has been used recently to increase the tree density of the groves. The farmers inquiry further revealed the existence of two other "old" local cultivars, "Judiaga" and "Ocal", but that have no relevance at present (Table 1).

Figure 1. Taroais olive tree grove of Gama landrace at Vila Verde de Ficalho, Portugal (Photo: M. M. Veloso).

Figure 2. Olive fruits from Gama landrace (Photo: M. M. Veloso).

Table 1 – Olive tree landraces identified at Vila Verde de Ficalho groves, data from the inquiries to the farmers.

Landrace	Nº of olive tree	Percentage
Verdeal Alentejana	48 135	48.4%
Cordovil de Serpa	37 674	37.8%
Cobrançosa	7 097	7.1%
Galega	3 668	3.7%
Gama	2 030	2%
Bico de Corvo	732	0.7%
Mançanilha	237	0.2%
Carrasquenha	147	0.1%
Judiaga	2	0.0%
Ocal	2	0.0%
	99 724	100.0%

Contribution of the farmers for traditional grove maintenance and viability

The traditional cultivars (or landraces) have been maintained due to their good agronomical characteristics and high fruit quality for either table consumption or olive oil production. Ficalho's olive oil high quality is well recognized and since 2002 it has been awarded several prizes at both national and international contests. Farmers have had an active role in the maintenance of the best landraces (Figs 3 and 4), as those well known in the Moura/Serpa region ("Cordovil de Serpa" and "Verdeal Alentejana") and those specific to the Ficalho region, for instance the "Gama" landrace. Although "Gama" produces very good oil at high yield it matures very early, out of phase of the dominant "Verdeal Alentejana" and "Cordovil de Serpa".
This was considered inappropriate in terms of the oil-press functioning. However, it was recently recognized that the availability of early maturing cultivars would allow the oil-press to start working one month earlier with a very positive socio-economic impact in the region.
It is known that traditional groves have low economic viability since man power needed for their maintenance is scarce and costly and the revenue from kg of olive fruits hardly covers the expenses. So, many groves are abandoned, particularly if located on hills. Nevertheless, traditional groves have value that surpasses the mere agricultural productivity. They are important repositories of genetic variability of potential importance for olive breeding in what concerns tolerance and adaptation to many biotic and abiotic stresses that might be intensified by the global climatic change. Not less important is the ecological relevance of traditional olive groves, a matter that has been neglected. Indeed, a significant number of the native plants that grow in the groves secure the conditions needed for the winter survival of a diversified fauna.
The project on "Olival Tradicional" showed that Ficalho farmers have played an active role in the identification, selection and conservation of local olive cultivars of great value. By still managing the groves for olive oil production they have been participating in an on-farm genetic resources conservation program that has preserved landraces already existing for hundreds of years.

Figure 3. Farmers at Vila Verde de Ficalho traditional groves.

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Figure 4. Fruit harvest at Vila Verde de Ficalho.

Museum gardens: an opportunity to strengthen the position of local landraces in local societies

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How could genetic resources be cultural heritage?

The complex relationship of cultural heritage with cultural relict plants, landraces and old varieties has become more obvious in recent years. Cultural heritage is a process around values. Even if professionals or representatives of institutions are strongly involved in heritage processes and can even have their own professional heritages that include plant populations they research and protect, we hope for a broader interest. When responsible professionals want something endangered to be preserved in its specific environment they can hardly succeed without supporting local heritage processes.

As Else Marie Karlsson Strese (2010) has put it, one of the problems in the interdisciplinary work with nature and culture is the fuzzy terminology, including heritage. Cultural relict plants are plants once introduced for cultivation, connected to specific cultural places but no longer actively maintained. They can be rare or common but their importance is on a population level. They have been described as living heritage even if the plants did not have any meaning or practical or symbolic value for the local people any more. They are living but they are heritage in a very limited sense, indeed, even if they may have been culturally important once. Some of them are classified as weeds. (Solberg *et al.,* 2013)

In order to live on and become a realized living heritage plants and plant populations should have more immaterial, active and actual value and use in the society. This is especially important for the conservation of endangered populations. As Laura Jane Smith and other scholars have stressed, heritage is not a thing. It is a process of re/constructing cultural and social values and meanings, a negotiation over them (Smith, 2011).

Could living heritage be part of museum processes?

Museums are deeply involved in heritage processes. They are on the way to be more reflective concerning their role in these processes. One of these roles is to enable heritage processes to go on *in situ*ations when some special effort is needed. Museums can, for instance, have a role in the process of keeping old local landraces and cultural relict plants alive, materially and immaterially, in a museum garden and in the minds and activities of local people. Open air museums can be local clone archives that can also spread the plants and help keeping the oral history and nursing and cultivating skills of old plants alive. Actually, these activities started in one of the earliest open air museums in the world Skansen, Stockholm in the 1890s in Sweden. Skansen's creator Arthur Hazelius made no sharp distinction between nature and culture, material and immaterial culture, skills and objects or preservation and revival work. (Rentzhog, 2007)

Professional museums are specialized in collection management and that could be developed and broadened also to the management of living plant collections. Until now, professional museums in Finland have not been widely interested in living heritage plants in their collections development processes (see e.g. Museum 2015 -project and its outcome http://www.luettelointiohje.fi/). Fortunately, there are some exceptions in the field (Heinonen *et al.,* 2014). Even those suffer of a lack of staff taking care of the living collections. A prerequisite for the upkeep of a collection of local landraces is a broad cooperation with local people, volunteers and professionals in the field of genetic resources and their upkeep (Karlsson Strese, 2010).

Local museums are public places run either by museum professionals or by local lay people. Most of the small local museums in Finland, situated in almost every former historical parish, are managed either by local heritage associations or local authorities. The board members of the former tend to be middle-aged 50+ and elderly people, rather active and often educated. Many of these museums are able to activate a remarkable number of volunteers on specific occasions. Developing a museum garden is an opportunity for the museum to get more people interested in museum activities and to attract new kinds of people to visit and support the museum. A precondition for the success of the living collection in the museum garden is that there are enough social and organizational skills to bring interested people with a variety of talents and resources to work together. It seems to be easier for local heritage associations or local museum foundations than for stately or municipally driven museums.

Case Yläne museum garden and garden heritage

In the project "Heritage plants in museum gardens" (Heinonen *et al.,* 2014) one of the tasks was to get a museum garden constructed on a volunteer basis, in cooperation with experts of plant genetic resources, a garden with a collection of local old plants. It proved to be possible and even natural for a local heritage museum to gather local plants with their histories. It was even apparent that a museum garden, constructed and sponsored by local actors and using only historical plant material from local gardens or sites of former local gardens, strengthened local identity and self-esteem. As a result of the project local people's interest in their own gardens focused more than before on the old plant varieties and on the memories and stories connected with them (Figs 1 and 2).

Figure 1. Yläne museum garden plants are desired purchases for both locals and visitors. Photo: Anja Koskela.

Documentation proved not to be a problem in this case. On the contrary, it was made intensively and precisely and partly published on the home pages of the local heritage association (http://www.museoylane.fi) thanks to the engaged volunteers. The old plants became more visible and they became a more apparent part of the real living local heritage. In addition, the activities during the project aroused media's interest as well locally as nationwide: heritage was in process. (Heinonen *et al.,* 2014) A heritage process that includes local landraces in the local gardens and in the common museum garden continues as a part of active local heritage work: maintenance of the museum garden, selling plants of the garden, having garden excursions and heritage plant meetings, gathering knowledge of local garden history, even helping old people in their garden work.

Local interests and resources and cooperation are prerequisites in preserving plant resources

Local heritage associations and other local associations with lay persons are recognized important actors in gathering, maintaining and distributing local landraces and other old plants as well as promoting the awareness of them in the landrace *in situ* conservation in Finland (Heinonen, 2014). Existing interests and activities of local people form a natural basis of developing the local living heritage processes, even if some external professionals or enthusiasts can fuel or even unify the process. Interest in the local history and nature and in the own family history connected with the own garden are probably central causes for active participation in a common process.

Sten Rentzhog (2007) writes in his comprehensive book on open air museums as follows: "Significant results, however, are not possible without broad cooperation. Open air museums may operate as arenas and information centres, hubs of a network of organisations and individuals working on the genetic cultural heritage, centres of competence to which people may turn for help and find like-minded contacts, and, of course, not least, as places for teaching."

The valuable advantage of especially local heritage museums is being located close to lay persons. Hence a museum with local plant heritage collection can connect different people interested on old plants and garden history. As the collection is a public one, it is reachable to every person and serves as public place for education. At the same time it serves as the forum of public knowledge which can be gathered and further utilized locally and for the use of plant genetic resources conservation and utilization needs.

Local heritage associations and museums can serve as nodes of living heritage activities because they are established, familiar and permanent communal actors. In this network interests can be centralized on maintaining and using local landraces as well as recording and dealing with garden history. A sustainable combination of cultural heritage and maintaining genetic resources provides a suitable mix of values in action, enthusiasm, even passion, orderliness and responsibility.

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Figure 2. The old parsonage had glorious and plant rich garden at Yläne municipal. Some of those plantings still exist seen in the 1910s photo. Photo: Anselm Laakso / Yläne Local Heritage archive.

The ARSARP germplasm seed bank: a useful tool for the *ex situ* agrobiodiversity conservation of Molise Region

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Molise, a region in the Centre Italy, is divided into two Provinces: Campobasso and Isernia. It borders on Abruzzo in the north, Puglia in the east, Lazio in the west and Campania in the south. It has a short coastline (Adriatic Sea) in the north-east. The region's western sector is part of the mountainous Apennines; the rest of Molise consists mostly of low mountains and hills (Fig. 1).

A large amount of germplasm of many plant species is still being conserved on-farm in Central Italy and a great number of accessions have been collected and are now conserved in *ex situ* gene banks (Negri, 2003). Also the Molise Region is rich in agricultural genetic resources.

The Regional Agency for Development and Innovation of Molise Agriculture (ARSARP), has worked over the years for the identification and collection of germplasm of wheat landraces still present in the Molise Region and has provided their *ex situ* and *in situ* conservation. Subsequently, within a project funded by the Molise Region, entitled "Enhancement of Molise crops, by the collection and conservation of germplasm of traditional products and through the identification of herbaceous alternative crops", the activity has had a strong impulse with the collection and conservation of other crop species present in the Molise Region and with the establishment of a "germplasm seed bank" (Fig. 2).

The main objective of the seed bank is the collection, propagation and management of germplasm of all plant taxa, endemic, rare, threatened or otherwise of particular agricultural interest of the Molise Region. In particular, the bank aims are: i) collecting Landraces (LRs) still present on the all territory of Molise; ii) promoting their cultivation; iii) studying the level of diversity among and within LRs; iv) conserving biodiversity also with the purpose of improving local culinary traditions and producing new profit opportunities.

Figure 3. Some custodian farmers of Molise Region.

Figure 1. Location of Molise in the map of Italy.

Figure 2. The ARSARP germplasm seed bank.

The salient features of each accession are known (year of harvest, collection site, climatic and environmental characteristics of the collection site, type of material stored, amount of seed, agronomic characteristics, organoleptic characteristics, etc.).

Many accessions stored in the database are multiplied in a network of Molise farmers ("custodian farmers") (Fig. 3) and are subject to constant visits by technicians and researchers, students and tourists.

In recent years 194 accessions belonging to different crop species were stored in the ARSARP germplasm bank .

All the collected accessions were grouped in classes as follows (Table 1):

a. vegetable crops: potato,tomato, melon, broccoli, beet, pepper, stubble turnip, cucumber, celery, prickly lettuce;
b. pulses: chickpea, lentil, grasspea, lupin, common bean, fava bean, broad bean;
c. cereals: emmer, common wheat, durum wheat, barley, oats, rye, corn-maize, sorghum;
d. forages: sainfoin.

Pulses (in particular common bean) and cereals (Fig. 4) are the most frequently found crops, 48 and 36% of the total accessions found, respectively (Fig. 5).

Table 1. Number of the accessions (grouped in classes) of 26 species collected in the territory of Molise region (Italy).

Classes	Common name	Crop	Acces. (n)
Cereals	Emmer	*Triticum dicoccum* Schübler	16
Cereals	Einkorn	*Triticum monococum* L.	2
Cereals	Common Wheat	*Triticum aestivum* L.	8
Cereals	Durum Wheat	*Triticum durum* Desf.	5
Cereals	Barley	*Hordeum vulgare* L.	1
Cereals	Oats	*Avena sativa* L.	1
Cereals	Segale	*Secale cereale* L.	1
Cereals	Corn-Maize	*Zea mays* L.	35
Cereals	Sorghum	*Sorghum vulgare* Pers.	1
Pulses	Chickpea	*Cicer arietinum* L.	18
Pulses	Lentil	*Lens culinaris* Medik	4
Pulses	Grass pea	*Lathirus sativus* L.	10
Pulses	Lupin	*Lupinus* sp. pl.	1
Pulses	Common bean	*Phaseolus vulgaris* L.	57
Pulses	Fava bean	*Vicia faba* L.	2
Pulses	Broad Bean	*Vicia faba* L.	1
Vegetable Crops	Potato	*Solanum tuberosum* L.	1
Vegetable Crops	Tomato	*Lycopersicon esculentum* Mill.	12
Vegetable Crops	Melon	*Cucumis melo* L.	4
Vegetable Crops	Broccoli	*Brassica oleracea* L.	1
Vegetable Crops	Beet	*Beta vulgaris* L.	1
Vegetable Crops	Pepper	*Capsicum annum* L.	3
Vegetable Crops	Stubble turnip	*Brassica rapa* L.	1
Vegetable Crops	Cucumber	*Cucumis sativus* L.	2
Vegetable Crops	Celery	*Apium graveolens* L.	1
Vegetable Crops	Prickly lettuce	*Lactuca scariola* L.	1
Forages	Sainfoin	*Onobrychis vicifolia* Scop.	4
		Total	194

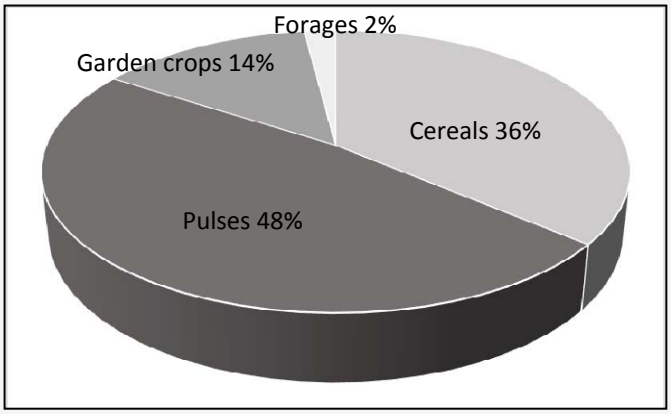

Figure 4. Percentages relative to cereals, forages, garden crops and pulses stored in ARSARP seed bank.

The seed bank is located in the ARSARP headquarters in Campobasso, from where it is possible to get seeds for basic research, for the activities of breeding and reintroduction of species and populations in cropping systems. Each accession is identified by an alphanumeric code which corresponds, in a data store, to a set of information that allows to use better what has been conserved. Each collected accession was subjected to standard conservation procedures: seeds were cleaned and stored in a cold room at +4°C.

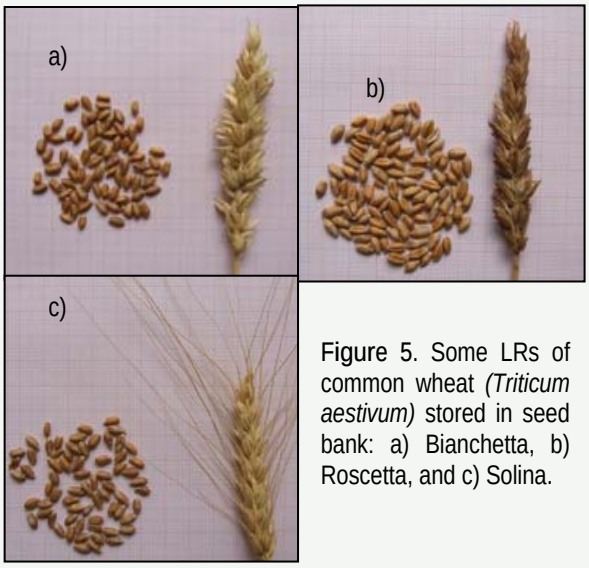

Figure 5. Some LRs of common wheat *(Triticum aestivum)* stored in seed bank: a) Bianchetta, b) Roscetta, and c) Solina.

In conclusion the present paper revealed the strong presence on the territory of Molise Region of pulses and cereal landraces some found in very limited quantities and therefore saved from extinction. In particular one hundred ninety-four landraces belonging to different plant species were found on-farm in Molise Region during exploration and collecting missions carried out since 1990.

The majority of the collected landraces were grown for private use or consumption. The main reasons why these landraces have been maintained on-farm are:

i) their resistance under difficult or harsh climatic conditions;

ii) traditional reasons or organoleptic peculiarities, which make them highly valued and expensive on the local and city markets;

iii) because they are appreciated by the families.

Furthermore the landraces are mostly grown by elderly farmers, in small farms or home gardens and using traditional farming systems or in organic and low input management. The production of certified products, or the incentive to still cultivate, could ensure comparable or greater income as compared to modern varieties, and could encourage younger farmers to continue cultivating these landraces (Montesano *et al.*, 2012).

The experience of other Regions (i.e. Tuscany, Lazio, Marche, Emilia Romagna, Friuli Venezia Giulia and Umbria), demonstrates that a regional law is a good instrument to preserve agricultural biodiversity and to promote the use of landraces. Therefore it is desirable that the Molise Region implements a regional law protect agro-biodiversity.

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Promoting human well-being by caring the local biodiversity in Enabling Gardens

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Introduction

It has been widely recognized as the problem of conservation of biodiversity and the human well-being are closely linked to each other. For this reason, international conventions and policies, such as the Convention of Biological Diversity (CBD) of the World Conservation Union (IUCN), highlighted as conservation programs represent a human need, constituting the basis for the sustainable development and for ensuring freedom and equity for all (Glowka *et al*., 1994). Botanic Gardens Conservation International (BGCI) represents the world's largest network for plant conservation including over 800 botanic gardens, promotes the involvement of specialized gardens in initiatives that use plants for human well-being (Waylen, 2006). Both tangible (material) and intangible (not-material) resources of botanic gardens are equally valuable for the sustainable development, linking biodiversity with public education, secure environment, nutrition, healthcare, poverty alleviation and socio-ecological and economical benefits for communities (Kuzevanov and Sizyck, 2006). Among the not-material benefits, these gardens have also played a key role in developing and hosting the techniques of Horticultural Therapy for people with special needs (Frazel, 1991). Indeed, Horticultural Therapy and gardening activities represent widely accepted techniques for social adaptation and correction of the social behavior of children and young adults affected by neuropsychiatric disorders (Söderback *et al*., 2004; van der Riet *et al*., 2014).
For this aim, during 2013 an Enabling Garden was set up at the center "Il Girasole" located at Morrano di Orvieto (TR, Italy), a specialized rehabilitation and educational center for children and young adults with disabilities (Fig. 1). This garden was designed with the specific aim to develop therapeutic and educational programs for disabled people using multiple sensory stimuli associated with the Horticultural Therapy. In 2015 we have proposed a further development of this activity, through the pilot project "*BiodiversifiCare*".

BiodiversifiCare: objectives and preliminary results

The "*BiodiversifiCare*" project has the specific purpose of using biodiversity as a tool to promote social well-being and to spread the "value of diversity" as a valuable resource for the local community, linking the need of conservation of important landraces with the improvement of life quality of disabled people and of local population.
During the preparatory phase of the project, we constituted a team of health professionals, rehabilitation care practitioners and researchers, expert respectively in neuropsychiatric diseases and in genetic and biodiversity conservation, ecophysiology and plant biochemistry. The team proceeded to the selection of disabled people participating to the Horticultural Therapy programs, on the basis of their cognitive and physical disabilities, for the constitution of an experimental group of "Custodians of Biodiversity", with the specific aim to preserve and propagate the landraces within the local community (Fig. 2).

Figure 1. The Enabling Garden at "Il Girasole" in Morrano di Orvieto (TR).

Figure 2. Some members of the "Custodians of Biodiversity" at "Il Girasole".

The first task of the group was to identify and select the landraces to be introduced within the Enabling Garden and to collect historical information and traditional knowledge on them. For this purpose, specific interviews were addressed to elderly farmers, using the descriptor list developed by Negri *et al.* (2012), with the aim to facilitate the development of National Inventories of landraces that are still maintained *in situ* (i.e. on-farm or in garden). On the basis of this preliminary investigation, the group has selected and started to work with two landraces of *Lactuca sativa* and *Cucumis melo*. These landraces have been introduced within the Enabling Garden and are currently conserved and propagated by the group of custodians at "Il Girasole" (Fig. 3).

Figure 3. Seeds and seedlings of some landraces propagated at "Il Girasole" .

The selected landraces propagated by the group of custodians will be used for different aims:

- the development of specific therapeutic and educational programs;
- their diffusion and propagation in kitchen gardens and orchards of families belonging to the local community;
- their inclusion in the seed banks and National Inventories of plant diversity (Negri *et al.* 2013);
- the characterization of their morpho-physiological and biochemical traits and genetic profile by using molecular markers;
- the evaluation of their resistance to abiotic and biotic stresses;
- the determination of some important nutraceutical compounds in order to promote the healthcare characteristics of the selected landraces.

Moreover, the therapeutic objectives will be monitored by the medical specialized team throughout the phases of the project, in order to evaluate their impact on the self-esteem, the social inclusion and the improvement of physical and cognitive abilities in the disabled people participating at the activities.

Conclusions

This specialized Enabling Garden can represent an interface between nature and people, promoting a rationale and sustainable use of local plant resources with the introduction of economically valuable landraces for the local community (for edible, medicinal, ornamental and other uses) and responding at crucial social issues, such as the social inclusion of disabled children and adults and the promotion of traditional knowledge on the local landraces and their transfer to the future generations. Furthermore, this Center can represent a suitable protected environment to develop therapeutic programs, learning activities and projects for the valorization of human and plant diversity.

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LR Resources

On this page you will find a number of resources to aid and inform the national LR conservation strategy planning process. For one-to-one guidance on any aspect of national LR conservation strategy planning, please contact Valeria Negri: vnegri@unipg.it.

LR conservation planning aids
A list of data sources that can be consulted to aid the development of a LR *in situ* conservation strategy
A Training Guide for *In Situ* Conservation On-Farm (2000) Technical skills and tools to build institutional capacity and partnerships to implement an on-farm conservation programme
Law and Policy of Relevance to the Management of Plant Genetic Resources (2005) Introduction to international legal and policy instruments relevant to professionals who manage, conserve and use plant genetic resources for food and agriculture and/or have policy-making responsibilities.
The International Treaty on Plant Genetic Resources for Food and Agriculture: Implementing the Multilateral System - Learning Module **(2010)** A module for professionals who work in plant genetic resources to understand the impact and working of the multilateral system of access and benefit-sharing of the International Treaty and to use its standard material transfer agreement (SMTA) to enhance transfer of plant genetic resources.
Draft PGRFA Conservation Toolkit: 'Conservation and Sustainable Use of PGRFA: a Toolkit for National Strategy Development' aims to help nations to systematically formulate national strategies for the conservation of LR and LR by leading the user through the various steps of the process and providing supporting reference material. Please note that this publication is currently undergoing review and major modification and will be formally published by FAO later in 2012.
NEW: Italian guidelines to conserve and characterize biodiversity which is useful for agriculture _ summary [IN ENGLISH]

LR data
Resources with a specific focus on *in situ* LR data.
http://www.arsial.it/portalearsial/RegistroVolontarioRegionale/Default.htm
http://germoplasma.arsia.toscana.it/Germo/
For a guide to searching for LR *ex situ* conservation data that can be used for searching landraces *in situ* as well as for carrying out a gap analysis, please consult the
http://eurisco.ecpgr.org/
The EURISCO web catalogue receives data from the National inventories, and provides access to all *ex situ* PGR information in Europe

LR information management
in situ LR descriptors: http://www.pgrsecure.bham.ac.uk/sites/default/files/documents/helpdesk/LRDESCRIPTORS_PGRSECURE.pdf

NEW: to easily record the information on *in situ* LR and build up an inventory, the PGR Secure project team also prepared a Database for recording national *in situ* LR inventory data (PGR_Secure_LR_data_recording_tool.mdb) that can be downloaded along with the manual (LR_data_recording_tool_MANUAL.pdf). Click here to download the tool (MS Access database and user manual zipped, 4.1MB).

LR publications
Agrobiodiversity Conservation: Securing the Diversity of Crop Wild Relatives and Landraces (2012)

LR networks
http://www.ecpgr.cgiar.org/networks/in_situ_and_on_farm/on_farm_wg.html
http://www.bioversityinternational.org/announcements/on_farm_conservation_neglected_and_underutilized_species_and_climate_change_a_new_international_effort.html

LR project websites
From the links below, you will find a number of project websites which are related to a different extent to LR and LR use.
An Integrated European *In Situ* Management Workplan: Implementing Genetic Reserves and On-Farm Concepts (AEGRO)
http://portal.geographie.uni-freiburg.de/forschungsprojekte/indigenoveg/
http://www.diverseeds.eu/
http://www.ensam.inra.fr/gap/resgen88/
www.solibam.eu/
www.urbesproject.org

LR conferences/workshops
From the links below, you will find a number of resources associated with future and past conferences/workshops, such as Powerpoint presentations, posters, reports and other related publications.
Towards the establishment of genetic reserves for crop wild relatives and landraces in Europe, Funchal, Madeira, 13–16 September 2010
Conservation strategies for European crop wild relative and landrace diversity, Palanga, Lithuania, 9–11 September 2011

Other useful links
http://www.bioversityinternational.org/
http://www.cgiar.org/
http://www.fao.org/

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